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Contents

Dearth of Domestic Investment and the Global Saving Glut: An International Panel Data Study[1]

Kazusuke Tsujimura* & Masako Tsujimura**

Abstract

As the U.S. federal budget deficit has increased dramatically since 2001, twin deficits are re-emerging as a much-discussed topic. Nevertheless, the FRB executives argue that people should pay more attention to the current account deficit rather than to twin deficits as a pair. Their contention that the aging population in many advanced economies outside the U.S. is a significant factor underlying the dearth of domestic investment in those countries turned out to be well-founded. However, we failed to find any concrete evidence to support the claim that it is the direct cause of the global saving glut.

Keywords: Saving-investment imbalances; current account deficit; aging population; panel data; seemingly unrelated regressions with linear restrictions

JEL Classification: C33, E20, O16

1. Introduction

One of the recurrent themes that appear in recent speeches by the chairmen of the Federal Reserve Board (FRB) is the U.S. current account deficit[2]. Of course this is not a new subject by any means. At least in the past three decades, the current account deficit was always at the center of U.S. economic concerns, so many practitioners as well as academics argued over it from various perspectives. In the early stage, the concept of twin deficits, a term in reference to a country's government budget deficit and a simultaneous current account deficit, dominated the arguments. Since the notion of the twin deficit merely comes from an identity easily derived from macroeconomic relations[3], the focus among academics was on empirical studies to determine if it was a steady relation. Miller and Russek (1989) as well as Enders and Lee (1990) found no significant relation between the two; while Darrat (1988), Abell (1990), Zietz and Pemberton (1990), Bachman (1992), Rosensweig and Tallman (1993), and Vamvoukas (1999) found evidence to support the existence of twin deficits. Leachman and Francis (2002) suggest that while U.S. fiscal deficits may have contributed to persistent current account deficits in the post-Bretton Woods era, the twin deficit relationship is time-specific and generally rather weak.

As the federal budget deficit has increased dramatically since 2001, twin deficits

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[1] An earlier version of this paper was presented at the 29th General Conference of the International Association for Research in Income and Wealth, Joensuu, Finland, August 20−26, 2006. The authors would like to thank the participants of the conference for their valuable comments and suggestions.

[2] Greenspan (2003, 2004), Bernanke (2005, 2006), Kohn (2006), etc.

[3] See Mann (2002), for example.

are re-emerging as a much-discussed topic relating to the U.S. economy. Why, then, do the executive officers of the Federal Reserve Board believe that people should pay more attention to the current account deficit rather than to twin deficits as a pair? Bernanke (2005) argues that a satisfying explanation of the recent upward climb of the current account deficit requires a global perspective that more fully takes into account events outside the United States. Specifically, he argues that over the past decade a combination of diverse forces has created a significant increase in the global supply of saving—a global saving glut—which helps to explain both the increase in the U.S. current account deficit and the relatively low level of long-term real interest rates in the world today. The prospect of dramatic increases in the ratio of retirees to workers in a number of major industrial economies is one important reason for the high level of global saving. This perspective focuses on international financial flows, and the basic fact that a country's saving and investment need not be equal in each period.

Economic growth requires investment in new capital goods, and the upgrading and replacement of older capital; it is called capital formation. All investment in new capital goods must be financed in some manner. In a closed economy, the funding for capital formation would be provided entirely by the country's national saving. In an open economy however, if a country's saving is less than the amount required to finance domestic investment, the country can close the gap by borrowing from abroad. How the statistical discrepancy might be allocated to consumption and investment affects macroeconomic identities, particularly the savings-investment balance. The two key factors are household savings and the capital formation of non-financial corporations. Bernanke (2005) argues that one source of the saving glut is the strong saving motive of rich countries with aging populations, which must make provision for an impending sharp increase in the number of retirees relative to the number of workers. With slowly growing or declining workforces, as well as high capital-labor ratios, many advanced economies outside the United States also face an apparent dearth of domestic investment opportunities. As a consequence of high desired saving and the low prospective returns to domestic investment, the mature industrial economies as a group seek to run current account surpluses and thus to lend abroad.

The relation between domestic saving and international capital flow has attracted the attention of many scholarly works since the 1980s. Most of the papers in this field are based on the classic work of Feldstein and Horioka (1980). This as well as other studies that followed have typically focused on the premise that free capital flow among industrial countries equalizes the yield to investors. In their study, Feldstein and Horioka, using cross-section data of OECD countries, regressed the ratio of investment to the ratio of saving, and showed that the coefficient was close to unity, which the authors interpreted as evidence against international capital mobility. This result has been reexamined by subsequent studies, among them Murphy (1984), Obstfeld (1986), Wong (1990), and Baxter and Crucini (1993). The results of these additional empirical tests did not necessarily support the conclusions from the original study. For example, Sinn (1992) found that the regression coefficients were lower, and varied considerably from year to year. However, it is apparent that accounting for the aging of the population is beyond the scope of this kind of study. Although Poterba (2001) presented a simple overlapping-generations model, a possibly useful point of departure for understanding why demographic shocks may affect

asset prices and asset returns, Poterba (2005) found only a weak correlation between asset returns on stocks, bonds or bills, and the age structure of the U.S. population over the last seventy years. Thus, it is difficult to find concrete evidence in these works, either to support or to deny the contention of FRB officials that the aging population is to blame for creating a dearth of domestic investment and the global saving glut.

This paper will seek to address this gap by investigating domestic saving-investment imbalances in greater detail. In the first half of this paper, we will compare 21 OECD countries as follows; we will divide an economy into five institutional sectors, and examine the saving-investment imbalances of the sectors to clarify the situation of the country. In addition to the net lending/borrowing of the sectors, which are conventional flow indicators, we will employ financial net worth—a stock statistic—for an overall view. In the latter half of the paper, we will try to determine the fundamental causes that will affect the distribution of saving-investment imbalances among the sectors of a country. A seemingly unrelated regression (SUR) estimation method for panel data with linear restrictions will be used in this regard.

2. Construction of the Data

The fundamental data used in this study were prepared from Volume III of the *National Accounts of OECD Countries*. Volume IIIb (the latter half) of this publication contains information on the financial stocks held by institutional sectors, at the end of the year, in the form of financial balance sheets. The historical tables give a view of the evolution in the holding of stocks of financial instruments by different institutional sectors. Although the availability of data depends on the reporting of particular countries, the data of 21 OECD countries are available between 1998 and 2003. The institutional units, which correspond to economic entities capable of engaging in transactions with other units, are grouped together into four categories, called institutional sectors: non-financial corporations, financial corporations, general government, and households (inclusive of non-profit institutions serving households (NPISH)). A fifth sector, the rest of the world sector, reflects transactions between resident institutional units and non-resident units. Financial assets and liabilities are classified under seven major categories of instruments: monetary gold and special drawing rights (SDRs), currency and deposits, securities other than shares, loans, shares and other equity, insurance technical reserves, and other accounts receivable/payable. The financial balance sheet account also presents a balancing item which corresponds to the financial net worth (financial assets less liabilities).

In addition to the financial balance sheets, Volume IIIa (the first half of the publication) contains information on financial transactions between institutional sectors, by type of instruments. As the title of the publication suggests, the financial statistics presented here are a part of a system of national accounts. Specifically, these statistics directly relate to the 1993 edition of the System of National Accounts (SNA 1993). Table 1 depicts the relationships between main SNA aggregates and the total economy. For example, the financial balance sheets mentioned above correspond to the "balance sheets" in the table; the financial balance sheets exclude non-financial assets, and are classified by institutional sectors. The financial transaction tables, frequently referred to as flow-of-funds accounts,

Table 1 Relationships between Main National Accounts Aggregates and the Total Economy

Current Accounts	Production	1	Value Added = Output − Intermediate Consumption
		2	Gross Domestic Product = Value Added + Taxes less Subsidies on products
	Primary distribution of income	3	Gross Domestic Product = Compensation of Employees + Taxes less Subsidies on products + Gross Operating Surplus/Mixed Income
		4	Gross National Income = Gross Domestic Product + Compensation of Employees (net, from abroad) + Property Income (net, from abroad)
	Secondary distribution of income	5	Gross National Disposable Income = Gross National Income + Current Transfers (net, from abroad)
	Use of income	6	Gross Saving = Gross National Disposable Income − Final Consumption Expenditure
		7	Net Saving = Gross Saving − Consumption of Fixed Capital
Accumulation Accounts	Capital	8	Changes in Net Worth due to Saving and Capital Transfers = Net Saving + Capital Transfers (net, from abroad)
		9	Net Capital Formation = Gross Capital Formation − Consumption of Fixed Capital
		10	Net Lending/Borrowing = Changes in Net Worth − Net Capital Formation − Acquisitions less Disposals of non-produced non financial assets
	Financial	11	Net Lending/Borrowing = Net Acquisition of Financial Assets − Net Incurrence of liabilities
	Revaluation	12	Changes in the Market Value of Net Worth (Revaluation)
	OCVA	13	Other Changes in Volume of Assets and Liabilities (OCVA)
Balance Sheets	Opening balance sheet	14	Opening Net Worth = Opening Non-financial Assets + Opening Financial Assets − Opening Liabilities
	Changes in stock positions	15	Changes in Net Worth = Changes in Net Worth due to Saving and Capital Transfers + Revaluation + OCVA
	Closing balance sheet	16	Closing Net Worth = Closing Non-financial Assets + Closing Financial Assets − Closing Liabilities

Note: This table is prepared from United Nations et al. (1993) and International Monetary Fund (2000).

correspond to the “financial account” of the “accumulation accounts” in Table 1. In SNA 1993, the accumulation account is a connector between the current accounts and the balance sheets. The gross saving, the primary source of the capital accounts, is obtained as the difference between the gross national disposable income (gross national income plus net current transfers from abroad), and the final consumption expenditure. The gross saving minus the consumption of fixed capital is the net saving. Among the accumulation accounts, the capital accounts record the non-financial transactions. A portion of the saving is used for capital formation and for acquisition of non-produced non-financial assets; the remainder comprises net lending (if positive) or net borrowing (if negative). This is the source of the “financial account”, another component of accumulation accounts.

The financial account records the acquisition and disposal of financial assets and liabilities, and shows how net lending or net borrowing, carried over from the capital

account, is reflected in transactions in these financial items. The financial account is the last account in the sequence of accounts recording transactions. The financial transaction tables inherit all the properties from the traditional flow-of-funds accounts, including the one compiled by the U.S. Board of Governors of the Federal Reserve System, since 1950s. The tabulation format of the financial transaction tables is almost identical to that of the financial balance sheets. Each cell of the financial transaction tables corresponds to the same cell of the financial balance sheets; it is supposed to record the increase or decrease of the figures that appear in the financial balance sheets. However, it should be noted that SNA 1993 stipulates that all the items in the balance sheets should be valued at market price. As a result, the differences in the figures between opening and closing balance sheets include not only transactions, but also revaluation that arose from changes in the market value plus other changes in volume in assets and liabilities (OCVA).

3. Distribution Patterns of Saving-Investment Imbalances

One of the advantages of the financial transaction tables is that they provide figures on net lending/borrowing of institutional sectors rather than their aggregate. These indicators give us crucial information on the saving-investment imbalances of a country. However, sometimes the statistics on net lending/borrowing are misleading, because they fluctuate from one year to another. Although financial net worth includes valuation changes as well as OCVA, it could be interpreted as an accumulation of net lending/borrowing of the past. Since financial net worth is considerably more stable than net lending/borrowing, it could be a more reliable indicator of the saving-investment imbalances of a country. For example, households are the primary source of savings so that the financial net worth of the sector in total is positive in any country; it is an indispensable benchmark for an overview. On the other hand, non-financial corporations are the primary investors, so that the financial net worth of the sector in total is negative in the usual case. The financial net worth of the other prominent institutional sectors, including general government and the rest of the world, could be either positive or negative depending on the current situation of the economy. The financial net worth of financial corporations is almost zero, since they are merely financial intermediaries; thus, it lies beyond the scope of this study.

In Figure 1, the net lending/borrowing of institutional sectors is depicted for each country. The data is normalized by the previous year's financial net worth of the households as a benchmark, so that the ratio is free from currency unit or exchange rate[4] fluctuations. The data for both 1998 and 2003 are presented here for comparison. As Ruggles and Ruggles (1992) notes, the patterns of net lending/borrowing are not only different from one country to another, they are different from year to year. In most cases, the households have net lending. However, net borrowing is observed in Australia, Canada (2003 only), Denmark, Finland (2003 only), Hungary (2003 only), the U.K. and in the U.S. (2003 only). The non-financial corporations have net borrowing (i.e. net capital formation) in most cases. The exceptions are Canada (2003 only), Denmark (2003 only), Finland, France

[4] Although in most countries total lending equals total borrowing, there are discrepancies in some cases because of a valuation problem. In such cases, we adjusted the figure to market prices to eliminate the gap; the adjustment is made to each financial instrument rather than to the aggregate.

Fig 1 Net Lending/Borrowing of the Institutional Sectors
(Proportion to the Previous Year's Financial Net Worth of the Household)

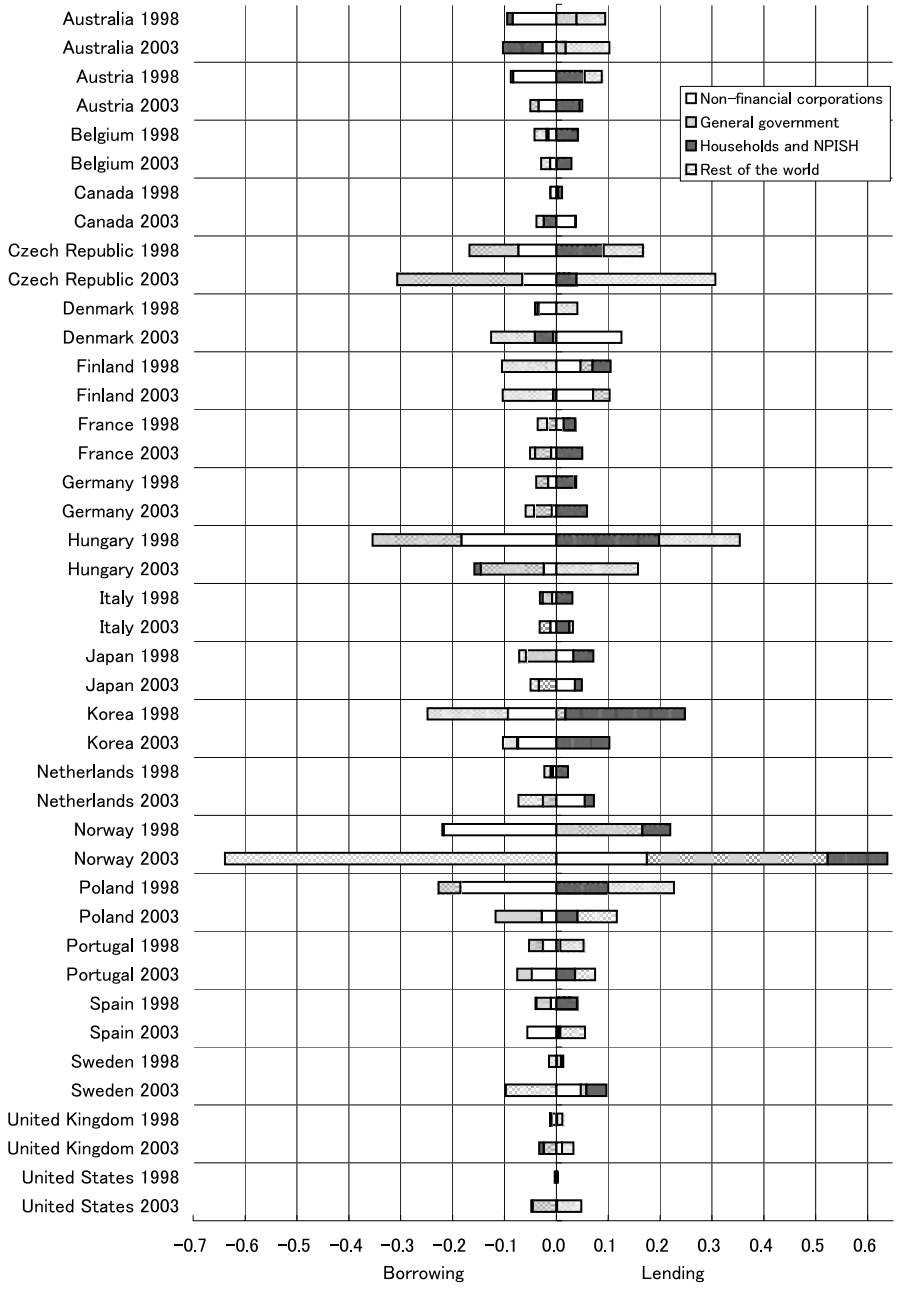


Table 2 Classification of the Distribution Patterns of the Net Lending/ Borrowing among the Institutional Sectors

Category	Non-financial corporations	General government	Households and NPISH	Rest of the world
I	-	-	-	+
II	-	-	+	-
III	-	-	+	+
IV	-	+	-	-
V	-	+	-	+
VI	-	+	+	-
VII	-	+	+	+
VIII	+	-	-	-
IX	+	-	-	+
X	+	-	+	-
XI	+	-	+	+
XII	+	+	-	-
XIII	+	+	-	+
XIV	+	+	+	-

(1998 only), Japan, the Netherlands (2003 only), Norway (2003 only), Sweden, the U.K. (2003 only) and the U.S. (2003 only); the figure implies that, in these countries, the net capital formation could be negative. The signs of general government and the rest of the world are either positive or negative according to the country and to the year. In accordance with the sign of each institutional sector, we can classify the data into 14 categories as shown in Table 2. The results of the classification are found in Table 3. The distribution pattern of the net lending/borrowing of the institutional sectors of a country is changing from time to time. In Australia, Austria, Canada and Denmark, changes of the pattern are observed as much as six times in just a nine year period. In fact, two thirds of the countries experienced a pattern change more than three times between 1996 and 2004.

The financial net worth of each institutional sector[5] normalized by that of the households is depicted in Figure 2. The distribution pattern of the financial net worth looks more stable than that of the net lending/borrowing displayed in Figure 1. Actually, a reverse of the sign between 1998 and 2003 is observed in only four cases: Poland and Sweden in general government, and Korea and the Netherlands in the rest of the world. It is confirmed that the financial net worth of households is positive[6] while that of non-financial corporations is negative in all countries for both years. The sign for general government and the rest of the world are either positive or negative depending on the country. As for 2003, the proportion of the financial net worth of non-financial corporations to that of households is higher (in absolute value) in Norway, Finland, Poland and Hungary; and

[5] Monetary gold and SDRs issued by the IMF are excluded from the data because there are no corresponding financial liabilities. Although in most countries, the sum of financial net worth becomes zero; whenever there are discrepancies, we adjusted the figure to market prices to eliminate the gap.

[6] Financial net worth of the household is positive, without exception, even before normalization.

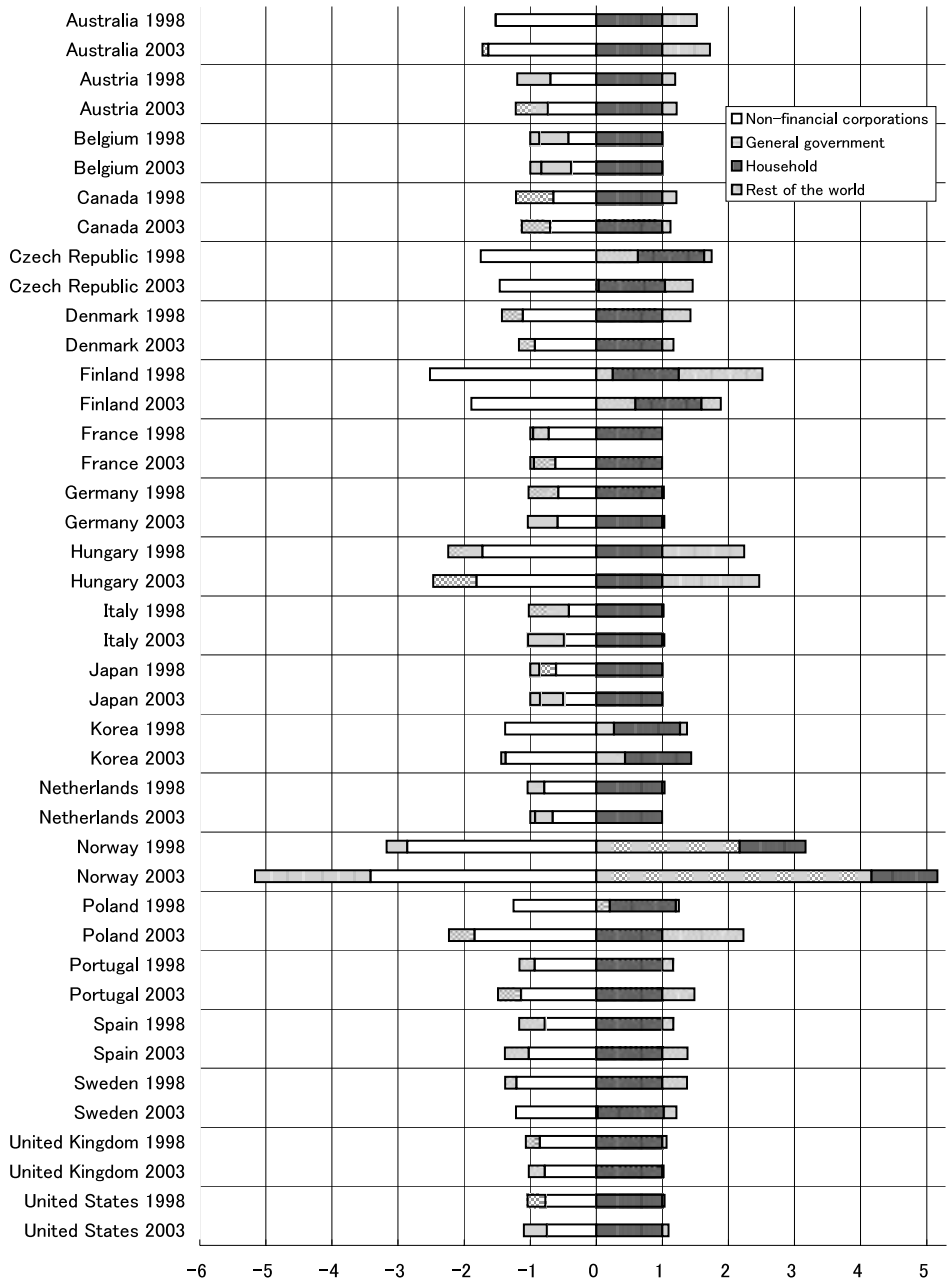
Table 3 Distribution Patterns of the Net Lending/Borrowing of the Institutional Sectors

Country / Year	1996	1997	1998	1999	2000	2001	2002	2003	2004
Australia	III	III	V	I	VII	VII	I	V	I
Austria	III	VI	III	III	III	VII	II	III	II
Belgium	II	II	II	II	II	VI	II	VI	VI
Canada	X	V	VI	IV	IV	XIV	VIII	XII	XII
Czech Republic	III	III	III	III	III	III	III	III	N.A.
Denmark	VIII	N.A.	I	XII	IV	VI	XIV	VIII	IV
Finland	X	X	XIV	XIV	XII	XII	XII	XII	XII
France	II	II	X	X	X	II	II	II	III
Germany	III	III	III	III	VII	II	II	II	X
Hungary	III	III	III	III	III	III	III	I	III
Italy	II	II	II	II	II	III	III	III	III
Japan	II	II	X	X	X	X	X	X	N.A.
Korea	VII	VII	VI	VI	VI	VI	IV	II	VI
Netherlands	X	X	II	XIV	XII	X	X	X	X
Norway	VI	VI	VI	VI	XIV	VI	XIV	XIV	VI
Poland	N.A.	N.A.	N.A.	XI	XI	XI	XI	XI	N.A.
Portugal	XI	III	III	III	III	III	III	III	III
Spain	II	II	II	III	III	III	III	VII	I
Sweden	X	III	XIV	XIV	XIV	VI	VI	XIV	XIV
UK	XI	X	V	V	V	V	IX	IX	IX
US	XI	III	VII	V	V	IX	IX	IX	IX

lower in Belgium, Italy, Japan and Germany. The absolute figures are over unity in 10 countries, implying that the net asset of the household sector is short to finance the net liability of non-financial corporations. The financial net worth of general government is positive in 5 countries including Norway, Finland and Korea, demonstrating that they do not have a public debt at all. Other countries have some public debt; the proportion to the financial net worth of households is relatively higher in Hungary, Italy, Austria, Belgium, and Germany. The sign of financial net worth of the rest of the world is positive in 15 out of 21 countries. In other words, these countries have a net external debt; the proportion to the financial net worth of households is over unity in Hungary and Poland. In contrast, Norway, Belgium, Japan, the Netherlands, Korea and France have a net external asset.

As mentioned above, there are three criteria to classify the pattern of financial net worth of institutional sectors: [a] if the proportion of the financial net worth of non-financial corporations to that of households (I) is above one (in absolute value); [b] if the financial net worth of general government (G) is positive; [c] if the financial net worth of the rest of the world (R) is positive. According to these three criteria, we can sort the patterns into six possible categories. It is far easier to grasp the overall situation by this classification

Fig 2 Financial Net Worth by Institutional Sectors
(Normalized by the Household Sector)



than by net lending/borrowing, which commands as much as 14 categories. For 2003, the countries are grouped into five categories, leaving one remaining category vacant.

[Category I]

$$C_{\mathrm{I}} = \left\{ \left(I < -1 \right) and \left(G < 0 \right) and \left(R \geq 0 \right) \right\}$$

Australia, Hungary, Poland, Portugal, and Spain
Twin debts accumulated by the twin deficits prevail. In these countries, not only non-financial corporations but also general government is active in capital formation. They have no choice but to finance the shortage of supply of funds by external debt.

[Category II]

$$C_{\mathrm{II}} = \left\{ \left(I < -1 \right) and \left(G \geq 0 \right) and \left(R < 0 \right) \right\}$$

Korea and Norway
In these countries, non-financial corporations are active in capital formation. Although the net wealth of households is not enough to cover active investment, the remainder is financed by the affluent net financial asset of general government. Thus these countries maintain a net external asset.

[Category III]

$$C_{\mathrm{III}} = \left\{ \left(I < -1 \right) and \left(G \geq 0 \right) and \left(R \geq 0 \right) \right\}$$

Czech Republic, Finland, and Sweden
Non-financial corporations are very active in capital formation. Although general government manages to maintain a net financial asset, it is not enough to bridge the gap between the net liability of non-financial corporations and the net financial asset of households. The countries belonging to this category offset the shortage in funds by external debt.

[Category IV]

$$C_{\mathrm{IV}} = \left\{ \left(I \geq -1 \right) and \left(G < 0 \right) and \left(R < 0 \right) \right\}$$

Belgium, France, Japan, and the Netherlands
The capital formation of non-financial corporations is so sluggish that the net liability of the sector is less than the net asset of households. Although these countries accumulate external assets by actively investing surplus funds abroad, the government has no choice but to absorb excess funds in the form of public investment, piling up public debt as a consequence.

[Category V]

$$C_{\mathrm{V}} = \left\{ \left(I \geq -1 \right) and \left(G < 0 \right) and \left(R \geq 0 \right) \right\}$$

Austria, Canada, Denmark, Germany, Italy, the U.K., and the U.S.
Twin debts accumulated by the twin deficits prevail. Although the capital formation of

non-financial corporations is not active, the gap between the net liability of non-financial corporations and the net financial asset of households is not large enough to cover the huge debt of the government. The remainder is financed by external debt.

[Category VI]

$$C_{\mathrm{VI}} = \left\{ \left(I \geq -1 \right) and \left(G \geq 0 \right) and \left(R < 0 \right) \right\}$$

No entry for 2003

Capital formation in non-financial corporations is not so active. The difference between the net liability of non-financial corporations and the net financial asset of households plus general government, are held as external assets as a result of active investments abroad.

It is obvious that the last three categories correspond to the notion of dearth of domestic investment. Specifically, the countries belonging to [Category IV] and [Category VI] are contributing to the creation of the global saving glut through capital outflow to the rest of the world. Although both [Category I] and [Category V] exhibit twin debts, the origin is by no means identical; the countries belonging to the latter category are suffering

Table 4 Distribution Patterns of the Financial Net Worth among Institutional Sectors

Country / Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Australia	I	I	I	I	I	I	I	I	I	I
Austria	V	V	V	V	V	V	V	V	V	V
Belgium	IV	IV	IV	IV	IV	IV	IV	IV	IV	IV
Canada	V	V	V	V	V	V	V	V	V	V
Czech Republic	II	III	III	III	III	III	III	III	III	N.A.
Denmark	I	I	I	I	I	I	I	I	V	V
Finland	III	III	III	III	III	III	III	III	III	III
France	IV	IV	IV	IV	IV	IV	IV	IV	IV	IV
Germany	IV	IV	IV	V	IV	IV	IV	IV	V	V
Hungary	I	I	I	I	I	I	I	I	I	I
Italy	V	V	V	V	IV	IV	IV	V	V	V
Japan	IV	IV	IV	IV	IV	IV	IV	IV	IV	N.A.
Korea	III	III	III	III	III	III	III	II	II	II
Netherlands	IV	IV	IV	V	V	V	V	V	IV	IV
Norway	III	III	II	II	II	II	II	II	II	II
Poland	N.A.	N.A.	N.A.	III	I	I	I	I	I	N.A.
Portugal	V	V	V	V	I	I	I	I	I	I
Spain	V	V	V	V	V	V	V	V	I	I
Sweden	I	I	I	I	I	I	III	I	III	III
UK	V	V	V	V	V	V	V	V	V	V
US	V	V	V	V	V	V	V	V	V	V

from lack of investment opportunity, while the countries belonging to the former need to reinforce their infrastructure to cope with the growing capital formation in the private sector. The transition of distribution patterns of financial net worth among institutional sectors are presented in Table 4 for the period between 1995 and 2004. In 10 out of 21 countries, no changes of pattern were observed for the duration. The pattern changed once during the period in 7 countries; in 4 countries the pattern changed twice. However, no country exhibited more than two patterns during the period. Among 204 observations, 48 belong to [Category I], 12 belong to [Category II], 31 belong to [Category III], 44 belong to [Category IV], while the remaining 69 belong to [Category V]. No observation was found belonging to [Category VI].

4. Determinants of Saving-Investment Imbalances

4.1 Fundamental Model

There should be some dominant factors that determine the distribution patterns of net lending/borrowing or financial net worth among institutional sectors. They could be some economic factors or else, some demographic factors as Chairman Bernanke suggests. Since there is not too much a priori information readily available in this regard, we assume a simple linear model. The data is in the form of a cross-sectional time-series, so that panel data analysis techniques will be employed. The fundamental structure of the model could be written in the following manner; we will use the suffixes indicated below:

institutional sector: $i, j = 1, \cdots, \iota$;
country: $k, l = 1, \cdots, \kappa$;
period: $t, s = 1, \cdots, \tau$;
explanatory variable identifier: $h, g = 1, \cdots, \eta$.

$$\mathbf{y}_k = \mathbf{Z}_k \boldsymbol{\beta} + \mathbf{u}_k \quad ; \tag{1}$$

$$\mathbf{y}_k = \begin{pmatrix} \mathbf{y}_{1k} \\ \vdots \\ \mathbf{y}_{ik} \\ \vdots \\ \mathbf{y}_{\iota k} \end{pmatrix}, \qquad \mathbf{y}_{ik} = \begin{pmatrix} y_{ik1} \\ \vdots \\ y_{ikt} \\ \vdots \\ y_{ik\tau} \end{pmatrix} \quad ; \tag{2}$$

$$\mathbf{Z}_k = \mathbf{I}_\iota \otimes \mathbf{Z}_{ik} \quad ; \qquad \mathbf{Z}_{ik} = \begin{pmatrix} \mathbf{z}_{ik1} \\ \vdots \\ \mathbf{z}_{ikt} \\ \vdots \\ \mathbf{z}_{ik\tau} \end{pmatrix} = \begin{pmatrix} z_{ik1}^1 & \cdots & z_{ik1}^h & \cdots & z_{ik1}^\eta \\ \vdots & \ddots & \vdots & \iddots & \vdots \\ z_{ikt}^1 & \cdots & z_{ikt}^h & \cdots & z_{ikt}^\eta \\ \vdots & \iddots & \vdots & \ddots & \vdots \\ z_{ik\tau}^1 & \cdots & z_{ik\tau}^h & \cdots & z_{ik\tau}^\eta \end{pmatrix} \quad ; \tag{3}$$

$$\boldsymbol{\beta} = \begin{pmatrix} \boldsymbol{\beta}_1 \\ \vdots \\ \boldsymbol{\beta}_i \\ \vdots \\ \boldsymbol{\beta}_t \end{pmatrix} \quad ; \qquad \boldsymbol{\beta}_i = \begin{pmatrix} \beta_i^1 \\ \vdots \\ \beta_i^h \\ \vdots \\ \beta_i^\eta \end{pmatrix} \quad ; \tag{4}$$

$$\mathbf{u}_k = \begin{pmatrix} \mu_{1k}\mathbf{i}_\tau \\ \vdots \\ \mu_{ik}\mathbf{i}_\tau \\ \vdots \\ \mu_{tk}\mathbf{i}_\tau \end{pmatrix} + \begin{pmatrix} \boldsymbol{\nu}_{1k} \\ \vdots \\ \boldsymbol{\nu}_{ik} \\ \vdots \\ \boldsymbol{\nu}_{t\kappa} \end{pmatrix} = \boldsymbol{\mu}_k \otimes \mathbf{i}_\tau + \boldsymbol{\nu}_k \quad ; \qquad \boldsymbol{\nu}_{ik} = \begin{pmatrix} \nu_{ik1} \\ \vdots \\ \nu_{ikt} \\ \vdots \\ \nu_{ik\tau} \end{pmatrix} \quad ; \tag{5}$$

$\mathbf{Z}_k$ is a matrix containing explanatory variables; $\mathbf{y}_k, \boldsymbol{\beta}, \boldsymbol{\mu}_k, \boldsymbol{\nu}_k$ are vectors of dependent variables, unknown parameters, country specific random effects components, and remaining stochastic elements, respectively; $\mathbf{I}_t$ is a unit matrix of dimension t; $\mathbf{i}_\tau$ is a vector of ones of dimension τ.

The stochastic assumptions related to the error components are listed below:

$$E\left[\mu_{ik}\right] = 0 \quad ; \tag{6}$$

$$E\left[\mu_{ik}\mu_{jl}\right] = \sigma_{\mu_{ij}}, \quad k = l \quad ; \qquad E\left[\mu_{ik}\mu_{jl}\right] = 0, \quad elsewhere \, ; \tag{7}$$

$$E\left[\nu_{ikt}\right] = 0 \quad ; \tag{8}$$

$$E\left[\nu_{ikt}\nu_{jls}\right] = \sigma_{\nu_{ij}} \, , \quad k = l \quad and \quad t = s \quad ; \qquad E\left[\nu_{ikt}\nu_{iks}\right] = 0 \, , \quad elsewhere \quad ; \tag{9}$$

$$E\left[\mu_{ik}\nu_{jlt}\right] = 0, \quad for \ any \quad i, j, k, l, t \quad ; \tag{10}$$

so that

$$E\left[\mathbf{u}_k\right] = 0 \quad ; \tag{11}$$

and

$$E\left[\mathbf{u}_k\mathbf{u}_k{}'\right] = \boldsymbol{\Psi} = \boldsymbol{\Sigma}_\mu \otimes \mathbf{J}_\tau + \boldsymbol{\Sigma}_\nu \otimes \mathbf{I}_\tau \quad ; \tag{12}$$

$$\boldsymbol{\Sigma}_{\mu} = \begin{pmatrix} \sigma_{\mu_{11}} & \cdots & \sigma_{\mu_{1j}} & \cdots & \sigma_{\mu_{1\iota}} \\ \vdots & \ddots & \vdots & \iddots & \vdots \\ \sigma_{\mu_{i1}} & \cdots & \sigma_{\mu_{ij}} & \cdots & \sigma_{\mu_{i\iota}} \\ \vdots & \iddots & \vdots & \ddots & \vdots \\ \sigma_{\mu_{\iota 1}} & \cdots & \sigma_{\mu_{\iota j}} & \cdots & \sigma_{\mu_{\iota\iota}} \end{pmatrix} \quad ; \tag{13}$$

$$\boldsymbol{\Sigma}_{\nu} = \begin{pmatrix} \sigma_{\nu_{11}} & \cdots & \sigma_{\nu_{1j}} & \cdots & \sigma_{\nu_{1\iota}} \\ \vdots & \ddots & \vdots & \iddots & \vdots \\ \sigma_{\nu_{i1}} & \cdots & \sigma_{\nu_{ij}} & \cdots & \sigma_{\nu_{i\iota}} \\ \vdots & \iddots & \vdots & \ddots & \vdots \\ \sigma_{\nu_{\iota 1}} & \cdots & \sigma_{\nu_{\iota j}} & \cdots & \sigma_{\nu_{\iota\iota}} \end{pmatrix} \quad . \tag{14}$$

Since both net lending/borrowing and financial net worth sum up to zero across institutional sectors before normalization, we must write the restrictions applied to the model explicitly. We will write the linear restrictions on the vector of regression coefficients, after normalization by the financial net worth of households, in the following manner[7]:

$$\mathbf{R}\boldsymbol{\beta} = \mathbf{r} \quad ; \tag{15}$$

in case of zero-sum restrictions[8],

$$\mathbf{R} = \mathbf{i}_{\iota}' \otimes \mathbf{I}_{\eta} \qquad \text{and} \qquad \mathbf{r} = \mathbf{o}_{\eta} \quad ; \tag{16}$$

$\mathbf{o}_{\eta}$ is a vector of zeros of dimension η. Since $\mathbf{R}$ is a $\eta \times (\eta \times \iota)$ matrix of rank $\eta \times \{\eta \times (\iota - 1)\}$, it is possible to express η of the elements of $\boldsymbol{\beta}$ in terms of the remaining $\eta \times (\iota - 1)$ elements, and we can partition $\boldsymbol{\beta}$ as follows:

$$\mathbf{R}_1\boldsymbol{\beta}_{*} + \mathbf{R}_2\boldsymbol{\beta}_{**} = \mathbf{r} \quad ; \tag{17}$$

where

$$\mathbf{R}_1 = \mathbf{i}_{\iota-1}' \otimes \mathbf{I}_{\eta} \qquad \text{and} \qquad \mathbf{R}_2 = \mathbf{I}_{\eta} \quad ; \tag{18}$$

[7] The procedure is based on Howrey and Varian (1984).

[8] Zero-sum restrictions that apply to the net lending/borrowing case appear in the next sub-section. In case of financial net worth, the constant terms sum up to –1 instead.

$$\boldsymbol{\beta}_{*} = \begin{pmatrix} \boldsymbol{\beta}_1 \\ \vdots \\ \boldsymbol{\beta}_t \\ \vdots \\ \boldsymbol{\beta}_{t-1} \end{pmatrix} \quad \text{and} \quad \boldsymbol{\beta}_{**} = \boldsymbol{\beta}_t \quad . \tag{19}$$

Solving equation (17) for $\boldsymbol{\beta}_{**}$ yields

$$\boldsymbol{\beta}_{**} = \mathbf{R}_2^{-1}\mathbf{r} - \mathbf{R}_2^{-1}\mathbf{R}_1\boldsymbol{\beta}_{*} \quad , \tag{20}$$

so that

$$\begin{aligned} \boldsymbol{\beta} &= \begin{pmatrix} \boldsymbol{\beta}_{*} \\ \boldsymbol{\beta}_{**} \end{pmatrix} = \begin{pmatrix} \mathbf{I} \\ -\mathbf{R}_2^{-1}\mathbf{R}_1 \end{pmatrix}\boldsymbol{\beta}_{*} + \begin{pmatrix} \mathbf{O} \\ \mathbf{R}_2^{-1}\mathbf{r} \end{pmatrix} \\ &= \mathbf{R}_{*}\boldsymbol{\beta}_{*} + \mathbf{r}_{*} \quad . \end{aligned} \tag{21}$$

By plugging equation (21) into (1), we obtain the following relations:

$$\begin{aligned} \mathbf{y}_k &= \mathbf{Z}_k\boldsymbol{\beta} + \mathbf{u}_k \\ &= \mathbf{Z}_k\left(\mathbf{R}_{*}\boldsymbol{\beta}_{*} + \mathbf{r}_{*}\right) + \mathbf{u}_k \\ &= \mathbf{Z}_k\mathbf{R}_{*}\boldsymbol{\beta}_{*} + \mathbf{Z}_k\mathbf{r}_{*} + \mathbf{u}_k \quad ; \end{aligned} \tag{22}$$

$$\mathbf{y}_k - \mathbf{Z}_k\mathbf{r}_{*} = \mathbf{Z}_k\mathbf{R}_{*}\boldsymbol{\beta}_{*} + \mathbf{u}_k \quad . \tag{23}$$

We will rewrite the above equation as below:

$$\mathbf{y}_{k^*} = \mathbf{Z}_{k^*}\boldsymbol{\beta}_{*} + \mathbf{u}_k \tag{24}$$

where

$$\mathbf{y}_{k^*} = \mathbf{y}_k - \mathbf{Z}_k\mathbf{r}_{*} \tag{25}$$

and

$$\mathbf{Z}_{k^*} = \mathbf{Z}_k\mathbf{R}_{*} \quad . \tag{26}$$

The log-likelihood function for equation (24)

$$\mathscr{K} = -\kappa\log\left|\boldsymbol{\Psi}\right| - \sum_{k=1}^{\kappa}\left(\mathbf{y}_{k^*} - \mathbf{Z}_{k^*}\boldsymbol{\beta}_{*}\right)'\boldsymbol{\Psi}^{-1}\left(\mathbf{y}_{k^*} - \mathbf{Z}_{k^*}\boldsymbol{\beta}_{*}\right) \quad ; \tag{27}$$

alongside the condition

$$\frac{\partial \mathcal{L}}{\partial \boldsymbol{\beta}_*} = 0 \tag{28}$$

yields the following solution for $\boldsymbol{\beta}_*$:

$$\hat{\boldsymbol{\beta}}_* = \left(\sum_{k=1}^{K} \mathbf{Z}_{k^*}' \boldsymbol{\Psi}^{-1} \mathbf{Z}_{k^*} \right)^{-1} \left(\sum_{k=1}^{K} \mathbf{Z}_{k^*}' \boldsymbol{\Psi}^{-1} \mathbf{y}_{k^*} \right) \quad . \tag{29}$$

It should be noted that the estimator $\hat{\boldsymbol{\beta}}_*$ contains all the information expressed in the original variance-covariance matrix $\boldsymbol{\Psi}$, so that we obtain identical results regardless of the way of partitioning the coefficient vector $\boldsymbol{\beta}$.

4.2 Estimation Results

Some alternative estimation procedures for SUR with error components like equation (29) have been proposed by Avery (1977), Baltagi (1980), Magnus (1982), Howrey and Varian (1984), and Biørn (2004) among others. The estimation methods are roughly divided into two groups: feasible generalized least squares (FGLS), and maximum likelihood (ML) methods. We opted for FGLS because the estimation results do not depend on the starting values, so that it gives exactly the same estimators throughout the partition of the coefficients vector. In applying FGLS, the variance-covariance matrix $\boldsymbol{\Psi}$ in equation (29) is replaced by $\hat{\boldsymbol{\Psi}}$, which is obtained from the error components of the single-equation random-effects models. The estimation results for net lending/borrowing are given on the left-hand side of Table 5, while the results for financial net worth are listed on the right-hand side of the table. The estimation period is 1998−2003 for financial net worth, and 1999−2003 for net lending/borrowing; both comprise balanced panel data. The dependent variables are normalized by the financial net worth of households as explained previously. Following the suggestions of Bernanke (2005), we included some demographic factors, in addition to the commonly used economic indicators that describe economic development, as explanatory variables: per capita gross domestic product[9] [GDP] and its growth rate [ΔGDP]; the rate of inflation[10] [IFL]; wealth-income ratio[11] [WIR]; the total population [POP] and its growth rate [ΔPOP]; and the ratio of population aged 65 or over to the total population [AGE][12]. At this stage, the AR(1) term $\hat{\nu}_{ikt-1}$ with coefficient ρ is added to take the autocorrelation into consideration[13]. Although ρ is not statistically significant at the 5% level in the case of net lending/borrowing (flow variables), it is found to be highly significant in all the equations

[9] At the price levels and purchasing power parity of 2000.

[10] The growth rate of GDP deflator. The benchmark year is 2000.

[11] The ratio of gross financial assets to GDP at current prices.

[12] All the economic indicators were obtained from Source OECD, provided by Organization for Economic Co-operation and Development, while the demographic data were obtained from WDI Online, published by the World Bank.

[13] As a result, the estimation period reduces to 1999−2003 for financial net worth; 2000−2003 for net lending/borrowing.

Table 5 Parameter Estimates

Net Lending/Borrowing					
Dep. Variable	Exp. Variable	Coef.	Std. Err.	t ratio	p value
EQ1	Constant	-10.8709	3.7603	-2.8910	0.0049
Non-financial	GDP	4.8375	0.9300	5.2018	0.0000
Corporations	ΔGDP	-0.5297	0.2625	-2.0176	0.0468
	IFL	-0.2812	0.1782	-1.5785	0.1182
	WIR	0.2933	0.1737	1.6883	0.0951
	POP	-0.1182	0.0792	-1.4922	0.1394
	ΔPOP	-1.5165	1.2226	-1.2403	0.2183
	AGE	-0.1646	0.2296	-0.7170	0.4754
	ρ	0.1445	0.0913	1.5820	0.1174
EQ2	Constant	-20.0581	9.9346	-2.0190	0.0467
General	GDP	11.9127	2.5490	4.6735	0.0000
Government	ΔGDP	0.7076	0.3108	2.2769	0.0253
	IFL	0.5989	0.2425	2.4699	0.0155
	WIR	-0.2687	0.3822	-0.7029	0.4841
	POP	-0.5608	0.2517	-2.2278	0.0286
	ΔPOP	1.8536	1.6137	1.1486	0.2540
	AGE	-0.5162	0.6270	-0.8233	0.4127
	ρ	0.1568	0.0894	1.7534	0.0832
EQ3	Constant	21.5893	11.3603	1.9004	0.0608
Rest of the	GDP	-14.7815	2.9224	-5.0580	0.0000
World	ΔGDP	0.2952	0.3352	0.8807	0.3810
	IFL	-0.4148	0.2757	-1.5045	0.1362
	WIR	0.1106	0.4331	0.2553	0.7991
	POP	0.7170	0.2891	2.4798	0.0151
	ΔPOP	0.1760	1.7624	0.0999	0.9207
	AGE	0.6789	0.7177	0.9459	0.3469
	ρ	0.1549	0.0885	1.7505	0.0837
EQ4	Constant	9.3397	3.1016	3.0113	0.0034
Households	GDP	-1.9688	0.7897	-2.4931	0.0146
and NPISH	ΔGDP	-0.4731	0.1775	-2.6654	0.0092
	IFL	0.0972	0.1210	0.8029	0.4243
	WIR	-0.1352	0.1418	-0.9533	0.3432
	POP	-0.0379	0.0703	-0.5390	0.5913
	ΔPOP	-0.5132	0.8732	-0.5877	0.5583
	AGE	0.0019	0.1936	0.0099	0.9921
	ρ	0.1535	0.0973	1.5772	0.1185

Financial Net Worth					
Dep. Variable	Exp. Variable	Coef.	Std. Err.	t ratio	p value
EQ1	Constant	-2.9134	0.6703	-4.3464	0.0000
Non-financial	GDP	-0.2163	0.1931	-1.1199	0.2653
Corporations	ΔGDP	-0.0069	0.0149	-0.4654	0.6426
	IFL	0.0218	0.0110	1.9750	0.0509
	WIR	0.0351	0.0228	1.5428	0.1259
	POP	0.0480	0.0222	2.1610	0.0330
	ΔPOP	0.0379	0.0846	0.4481	0.6550
	AGE	0.1155	0.0428	2.6978	0.0081
	ρ	0.6502	0.0828	7.8499	0.0000
EQ2	Constant	0.6004	0.7180	0.8362	0.4050
General	GDP	0.6569	0.2076	3.1637	0.0020
Government	ΔGDP	-0.0014	0.0153	-0.0920	0.9269
	IFL	-0.0258	0.0118	-2.1825	0.0313
	WIR	0.0048	0.0238	0.1995	0.8423
	POP	-0.0523	0.0241	-2.1685	0.0324
	ΔPOP	-0.0479	0.0862	-0.5552	0.5800
	AGE	-0.1338	0.0458	-2.9188	0.0043
	ρ	0.6560	0.0828	7.9192	0.0000
EQ3	Constant	1.3130	0.5130	2.5592	0.0119
Rest of the	GDP	-0.4406	0.1380	-3.1935	0.0019
World	ΔGDP	0.0084	0.0164	0.5102	0.6110
	IFL	0.0040	0.0125	0.3161	0.7526
	WIR	-0.0399	0.0220	-1.8164	0.0722
	POP	0.0043	0.0136	0.3181	0.7510
	ΔPOP	0.0100	0.0936	0.1065	0.9154
	AGE	0.0183	0.0327	0.5599	0.5767
	ρ	0.6530	0.0836	7.8123	0.0000

Note: Shaded figures denote statistically significant at 5% level.

relating to financial net worth (stock variables).

To interpret the estimation results correctly, we should refer to the fundamental relations within the framework of SNA 1993 listed in Table 1. First, let us take a look at the left-hand side of Table 5. For example, for non-financial corporations, per capita GDP (with positive sign) and its growth rate (with negative sign) are statistically significant at the 5% level. The signs on the variables imply that per capita GDP negatively influences the capital formation of the sector, while growth rate affects it positively. By the same token, the opposite sign on both per capita GDP and the total population for government and rest-of-the-world sectors indicate that the former will decrease, and the latter increase, the twin deficits (external and fiscal deficits) simultaneously. Household savings tend to decrease as per capita GDP and its growth rate increase.

Now let us shift our attention to the right-hand side of Table 5. It is noteworthy that both demographic factors, the total population and the proportion of the elderly, have significant effects on net liability (i.e. non-financial assets by implication) in non-financial corporations, reducing it relative to household net financial assets. The results will reinforce the argument of FRB officials that the aging of foreign countries is to blame for the shortfall of domestic investment in relation to the domestic savings of those countries, although aging was not found to be a dominant factor to increase capital outflow from the countries to the rest of the world. It is also observed that increase in per capita GDP tends to reduce the twin debts, corresponding to the twin deficits, in unison.

Finally, simulation test results for evaluation of the predictability of the model are presented in Table 6. We examined whether the model can classify the countries by criteria into the categories mentioned in the previous section: 4 criteria and 14 categories for net lending/borrowing; 3 criteria and 6 categories for financial net worth. The overall category-wise error ratio for net lending/borrowing was 42.9%, while that for financial net worth was 10.5%. As for the criteria attached to each institutional sector, the maximum error ratio for net lending/borrowing was 22.6%, while that for financial net worth was 5.7%.

Table 6 Simulation Test Results

Criteria	Net Lending/Borrowing			Financial Net Worth		
	Number of Errors	Sample Size	The Percentage of Errors	Number of Errors	Sample Size	The percentage of Errors
Non Financial Corporations	9	84	10.7%	2	105	1.9%
General government	19	84	22.6%	3	105	2.9%
Rest of the World	4	84	4.8%	6	105	5.7%
Households and NPISH	8	84	9.5%			
Categorization	36	84	42.9%	11	105	10.5%

5. Concluding Remarks

In this study, we compared the distribution of saving-investment imbalances among institutional sectors in 21 OECD countries. One distinguishing feature of this paper is that we used the financial net worth of institutional sectors as indicators in addition to net

lending/borrowing. We classified the distribution patterns for both variables among the sectors, and attempted to determine the factors that influence distribution. The technical aspects of the paper could be summarized as follows:

(a) Since the financial net worth of the household is positive without exception, we can avoid complications arising from currency conversion, etc., by simply normalizing net lending/borrowing as well as financial net worth of other institutional sectors by it.
(b) The normalization above will allow us to classify the distribution pattern of financial net worth among institutional sectors into six categories. This will help to provide an overall picture for saving-investment imbalances. A similar classification applied to net lending/borrowing will produce 14 categories, which is beyond the scope of full comprehension.
(c) The factors contributing to determine the distribution patterns of financial net worth among institutional sectors could be examined by application of the SUR estimation method involving error components peculiar to panel data. Partitioning of the coefficients vector is a useful technique in cases where linear restrictions apply.

More practical implications of the paper are as follows:

(d) The distribution pattern of net lending/borrowing as well as of financial net worth among institutional sectors is determined by economic as well as demographic factors. However, the contributing factors for the two variables are not identical, most probably because net lending/borrowing changes its sign too frequently. It would be more prudent to focus on financial net worth, which is a more reliable statistic because of greater stability.
(e) The contention that the aging population of the advanced countries is the direct cause of the dearth of domestic investment in those countries is well-founded. However, we failed to find any concrete evidence to support the claim that aging is creating the global saving glut by contributing to increased capital outflow from those countries.
(f) The twin deficits are attributed to two common factors: per capita GDP, and the total population of the country. In that sense, they are destined to be twins; since the two variables are beyond the control of common economic policy, it will prove difficult to find a single miraculous cure.

Ultimately, we must remember that no country is living alone; any country is a member of the international community. Perhaps we should not take the problem of saving-investment imbalances as a domestic one. The external assets of one country finance the external debt of others, which in turn finances the capital formation of the country. However, the real problem is that as time passes, the number of matured countries, with more savings and less investments, will progressively increase through economic growth. We should observe the problem from a global perspective, and endeavor to find a satisfactory solution before it is too late.

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Economic Structure and Growth Performance of Niigata, Toyama, Ishikawa and Fukui Prefectures: A Comparative Econometric Analysis* in the Context of Northeast Asia

Osamu Nakamura**

Abstract

This paper analyzes the economic structure and growth performance of the regional economies, focusing on Niigata, Toyama, Ishikawa and Fukui prefectures. Although these Japanese neighboring prefectures are all located along the Japan Sea coast, their macroeconomic structures are not necessarily similar. Therefore, their economic performance in terms of GDP growth rate has not been similar in the period of the world economic recession. According to the scenario simulation of the world economic recession, Niigata Prefecture is expected to experience the largest negative impacts and Toyama Prefecture is likely to experience the smallest impacts among these prefectures. The outcomes will depend on the structure of the macro economy, especially on extent of regional interactions through intra-national trade.

Keywords: Regional economy, macro econometric model, growth theory, fiscal policy, Keynes multiplier, scenario simulation

JEL Classification: C51, C53

1. Introduction

After the collapse of the bubble economy, the Japanese economy was suffering from a long term economic recession in the 1990s. The regional economies were especially impoverished as a result of the recession and the reform of public finance. Suffering under huge amounts of government debts, government investments have been reduced drastically since the middle of the 1990.

Four prefectures, Niigata, Toyama, Ishikawa, and Fukui, all located in the "back yard of Japan (Ura-Nippon)" along the coast of the Japan Sea, have all experienced similar situations. Although these prefectures are neighbors, their economic performance was not necessarily similar in the past. In terms of annual average growth rate of real per capita income in the period of FY1996−FY2005, Niigata, Toyama, Ishikawa and Fukui prefectures recorded 0.561, 0.546, 0.956, and 0.928 per cent, respectively. In this period, the averaged per capita income growth rate of Japan was 0.65 per cent so that Ishikawa and Fukui prefectures recorded a higher growth, but Niigata and Toyama experienced a lower growth rate.

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This study, therefore, analyzes the regional economic structures and the determinants of economic growth focusing on these four prefectures, utilizing a comparative econometric analysis. The multi-regional macro econometric model of Japan is developed for analyzing the economic structure and growth performance of four regional economies with a regression analysis and scenario simulations.

As for regional econometric modeling, there are many research results of regional models in the world as well as national models and global models. For example, REAL Project, the Illinois State Modeling and Forecasting Project, in the U.S. and the Cambridge Econometrics Regional Econometric Modeling and Local Economy Forecasting Model (LEFM) research programme in the U.K. are well known as large scale regional modeling and forecasting projects.

On the other hand, in Japan, many regional econometric models were developed in the 1960s (Okazaki 1961, Fukuchi 1966a, 1966b, Fukuchi and Nobukuni 1968). In terms of a prefecture basis regional Model, Hokkaido Prefecture Model (Nakamura 1993, 2002), Niigata Prefecture Model (Nakamura 1994, Nakamura and Sato 1994), Fukuoka Prefecture Model (Inada and Fujikawa 1992) were developed in the 1990s.

Assessing and evaluating policy impacts is very important for not only policy makers but also for economists and politicians, so that systematic tools are indispensable for the regional regeneration. This paper is also a study on econometric modeling and forecasting for regional economies as mentioned above.

In the following sections, section 2 studies the recent regional economic performances in Japan and section 3 discusses the structure of multi-regional macro econometric models. Section 4 analyzes the structures of the four prefectural economies based on a regression analysis and section 5 conducts scenario simulations to analyze their economic structures and growth performances. Section 6 concludes this study.

2. Regional Economic Performance of Japan Focusing on Four Prefectures

As mentioned above, the four Prefectures, Niigata, Toyama, Ishikawa and Fukui, are located at the center of the main island of Honshu along the coast of the Japan Sea. These regions belonged to districts known as Echi-zen, Echi-chu and Echi-go (in Japanese) in the past, "Echi" meaning to go "across" the steep mountains from Kyoto and Osaka, which were the center of Japan before the era of the Tokugawa Shogunate. Even today, the geographical terminology Echi-zen, Echi-chu and Echi-go is still employed and is very familiar to us in Japan.

Although these prefectures are neighbors, the characteristics of these regional economies are not necessarily similar because of cultural and historical factors, economic geography, etc., all of which influence economic behavior such as consumption, saving patterns, economic activities and so on.

This section analyzes the recent performance of these regional economies compared to other regional economies of Japan.

2.1 Growth Performance of Regional Economy

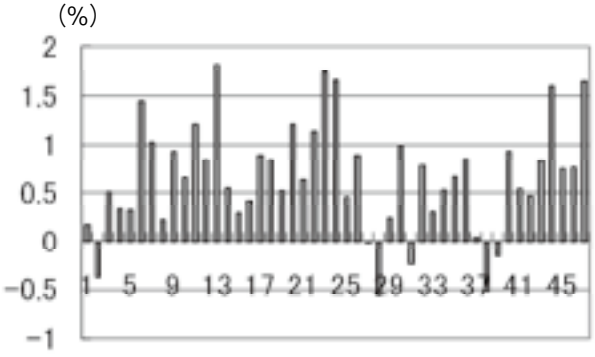
After the high economic growth era of the Japanese economy in the 1950s and 1960s, the situations of the regional economies have improved with the development of the social infrastructures. Especially, the improvements of transportation infrastructures have drastically changed economic and business circumstances in Japan. In Niigata, Toyama, Ishikawa and Fukui prefectures, the social asset improvements played a very important role to strengthen economic and business activities. Especially, high speed transportation infrastructures including major highways and super express trains (shinkansen) have had a dramatic impact on these regional economies. During the period of the bubble economy, many private companies were advancing into these regions, especially into Niigata Prefecture, because of the Kan-etsu highway and the Joetsu Shinkansen.

However, after the burst of the bubble economy, the regional economic situations deteriorated during the 1990s, which has been called the "Lost Decade", in spite of large scale fiscal policies. Even during the longest economic boom from FY2002 to FY2007, the economic growth of many regional economies remained stagnant. Figure 1 shows the annual average growth rates of real GDP of 47 prefectures in the period of FY1996−FY2005. Six prefectures, Aomori, Osaka, Hyogo, Tottori, Ehime and Kochi Prefecture recorded negative growth in this period. The annual average economic growth rate of Japan was 0.845 per cent in this period, so that most of the regional economies were stagnant as well, except for some prefectures, which were able to enjoy an expansion of production and investment for exports.

In addition, most of the regional economies have been suffering from a decrease of government investments, under the program to reform public finance and administration which was implemented by the central government of Japan. The Japanese government investments sharply deceased, as a whole, from 40.6 trillion yen in FY1995 to 34.4 trillion yen in FY2000 and to 21.0 trillion yen in FY2006 in terms of SNA.

In this period, within the four prefectures, Niigata, Toyama, Ishikawa and Fukui, the annual average growth rate of real GDP was also stagnant at 0.295, 0.417, 0.890, and 0.838 per cent, respectively.

Figure 1 Annual Average Real GDP Growth Rates by Prefecture, FY1996−FY2006



(1. Hokkaido, 2. Aomori, 3. Iwate, 4. Miyagi, 5. Akita, 6. Yamagata, 7. Fukushima, 8. Ibaraki, 9. Tochigi, 10. Gunma, 11. Saitama, 12. Chiba, 13. Tokyo, 14. Kanagawa,

15. Niigata, 16. Toyama, 17. Ishikawa, 18. Fukui, 19. Yamanashi, 20. Nagano, 21. Gifu, 22. Shizuoka, 23. Aichi, 24. Mie, 25. Shiga, 26. Kyoto, 27. Osaka, 28. Hyogo, 29. Nara, 30. Wakayama, 31. Totttori, 32. Shimane, 33. Okayama, 34. Hiroshima, 35. Yamaguchi, 36. Tokushima, 37. Kagawa, 38. Ehime, 39. Kochi, 40. Fukuoka, 41. Saga, 42. Nagasaki, 43. Kumamoto, 44. Oita, 45. Miyazaki, 46. Kagoshima, 47. Okinawa)

2.2 Demographic Situation

Japan as a whole is now experiencing lower birthrates and an aging society. Most of the regional economies also face the same problem, especially in the rural areas, where younger people tend to migrate to the urban areas. In the period from FY1996 to FY2005, twenty eight prefectures experienced negative population growth. Four prefectures, Niigata, Toyama, Ishikawa and Fukui, also recorded negative growth at minus 0.2658, 0.1285, 0.0656 and 0.0898 percent per annum, respectively. The negative population growth is mainly the result of fewer children and migration of younger generation, which affects the regional economies negatively through reducing both supply-side and demand-side economy.

2.3 Per Capital Income Growth in the Regional Economy

Recently, it has been observed that regional income disparity is expanding in Japan because of economic stagnation. This section discusses whether or not per capita income inequality is expanding among the regions using "new" growth theory.

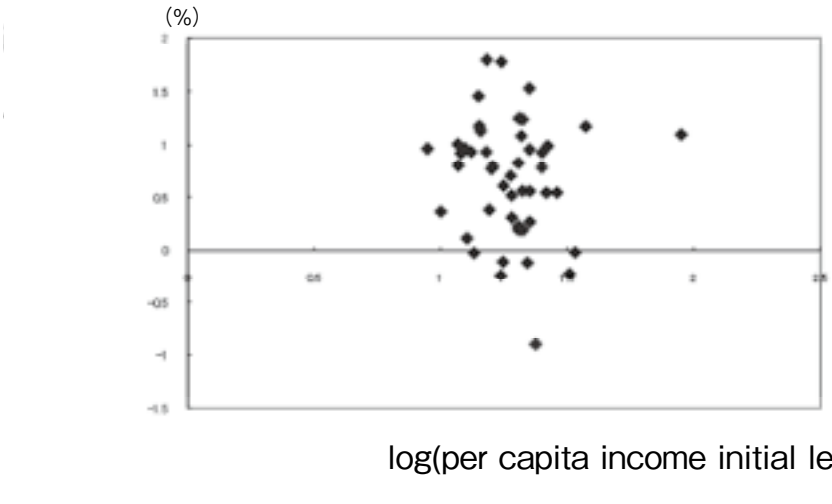
"New" growth theory has been popular since the mid-1980s (Romer 1986, Lucas 1988) and a number of studies have applied this theory to per capita income growth and its determinants. Within the framework of "new" growth theory, convergence of per capita income among nations is one of the highlights and it cannot be observed in many studies. That is why this theory is "new", as opposed to neo-classical growth theory.

Barror and Sala-i-Martin (2004) tested the Japanese regional per capita income convergence using a panel date set from 1930 to 1990 and observed both strong unconditional convergence and conditional convergence with regional dummy variables in this period.

Figure 2 indicates the correlation between real per capita income growth (vertical axis) and the logarithm of the level of initial real per capita income (horizontal axis) with a data set of 47 prefectures in FY1996−FY2005. It seems that there is no strong correlation between both variables. The four prefectures, Niigata, Toyama, Ishikawa, and Fukui are located at the center of the figure, as follows:

Niigata is located at 1.35 in a horizontal and 0.56 in a vertical axis, Toyama 1.46 and 0.55, Ishikawa 1.35 and 0.96, and Fukui 1.40 and 0.93, respectively.

Figure 2 Correlation between Real Per Capita Income Growth and Initial Level of Per Capita Income in Logarithm



Nakamura (2008) analyzes convergence of real per capita income among 47 prefectures based on the "new" growth model framework using the cross-section data set in FY1996−FY2005.

Table 1 explains the results of the regression. According to the results, unconditional convergence is not observed significantly. However, significant conditional convergence can be observed with some control variables. The study suggests that employment ratio to population (LEP) and labor productivity (LPI) explain the growth of per capita income and conditional convergence among prefectures. In addition to that, the study emphasizes the importance of the role of government investment for the growth of per capita income as well as private non-housing investment. However, the annual average rate of convergence of per capita income is very limited at 1.232 percent, although conditional convergence can be observed. This means that per capita income disparity among prefectures is not likely to decrease in the short-term future.

Table 1 Regression Results of Per Capita Income Growth of 47 Prefectures with Non-Linear LS

$(1/T)(\log(GDPPi(t)/GDPPi(t-T)) = \alpha-((1-\exp(-\beta T))/T)\log(GDPPi(t-T))+\gamma IPGi +\delta IGGi-\eta DPOPi+\theta LEPi+\iota LPIi+\lambda IPGi*IGGi$

	Unconditional	*(S.E., t-value)*	*Conditional*	*(S.E., t-value)*
α	0.01088	(0.0062, 1.7416)	-0.15830	(0.0221, -4.78310)
β	0.01680	(0.0483, 0.6669)	0.01232	(0.0150, 7.25667)
γ			0.35626	(0.1425, 2.49961)
δ			0.38955	(0.2137, 2.17820)
η			-0.56983	(0.2469, -2.3183)
θ			0.22972	(0.0306, 6.42490)
ι			0.01352	(0.0021, 7.50081)
λ			-3.45663	(1.7132, -2.01760)
R^2 (R^2ADJ)	0.00978(0.001243)		0.63919 (0.57443)	

GDPP : real per capita income, DPOP: annual average of population growth, IPG: period average of real private investment ratio to real GDP, IGG: period average of real government capital formation ratio to real GDP ratio, LPI: period average of labor productivity (real GDP/number of employment), LEP period average employment ratio to population, i: 1-47 (47 prefectures), T: 9 (FY1996−FY2005), sample: 47
Source: Nakamura, Osamu (2008)

3. Structure of Multi-Regional Macro-Econometric Model

This section explains the structure of a multi regional macro econometric model of Japan formulated on a basis of 47 prefectures, which is a sort of a multi equation structural model system for studying the macro economic structures and policy impacts.

3.1 Model System

The multi regional macro econometric model of Japan in this study is comprised of three sub-models, including (1) regional macro sub-model, (2) central government finance sub-model and (3) Japanese national macro sub-model.

The regional macro sub-model consists of prefecture macro models formulated on the basis of 47 prefectures (Nakamura 2007). This study employs the four prefecture models of Niigata, Toyama, Ishikawa and Fukui, and the rest of Japan model comprising the other forty-three prefectures.

Concerning the central government finance sub-model, the central government finance variables including direct and indirect tax revenues, local allocation tax disbursements, expenditures in the general accounts, etc. are calculated. In the Japanese national macro sub-model, the Japanese macro variables including exchange rates, interest rates, money supply, Japanese macro GDP and its components totaling prefectural GDP, import price, export price, current accounts, etc. are determined.

3.2 Structure of the Regional Macro-Econometric Model

The prefecture basis regional macro-econometric model consists of seven blocks including (1) the real expenditure block, (2) the nominal expenditure block, (3) the production block, (4) the prices and wage rates block, (5) the population and labor force block, (6) the income distribution block, and (7) the local public finance block.

3.2.1 Real expenditure block

In this block, real GDP and its components are determined. The prefecture basis regional model is basically a Keynesian type demand side oriented type model so that real GDP is determined in an identity totaling its components. Real GDP components except government consumption and investment are determined in a behavioral equation, and government consumption and investment are determined in an identity. Each component of real GDP is basically determined by income effects and price effects.

3.2.2 Nominal expenditure block

The nominal expenditure block determines nominal GDP and its components. Nominal government consumption and investment are endogenized in a behavioral equation and other components in an identity. In this block, nominal government investment is determined by not only the local government revenues but also revenues from the central government disbursements, treasury disbursements, local allocation tax revenue, etc. It is one of the key points of this model to consider income reallocation from the central government to local governments (Nakamura 2002).

3.2.3 Production block

In this block, supply side GDP, real private capital stock and depreciation of capital are determined. The production (supply side GDP) is determined with a production function. A conventional Cobb-Douglas type production function is employed in this study. The supply side GDP determined in production function influences prices and wage rates block variables through labor productivity (LPI) changes, and the supply side performance influences real expenditure block variables with price effects, which is also one of the key points of the multi regional model employed in this study.

The regional capital stock data are not available so that this study estimates prefectural real capital stock data for production function (see Appendix A).

3.2.4 Prices and wage rates block

In this block, CPI, export price, import price, GDP deflator, each deflator of GDP components and nominal wage rates are determined. These variables influence real expenditures through price effects. Generally, prices and deflators of each component of GDP are determined by import prices, labor costs (wage rates) and labor productivity (LPI) as mentioned above.

In addition, the variables in this block are very important to link real expenditure block variables to the nominal expenditure block and to link the income distribution block variables to the real expenditure block variables.

3.2.5 Population and labor force block

In this block, the overall population, the number of births and deaths (natural increase/decrease), social increase/decrease, employment and wage and salaried employed are determined. The total population is very important for the regional economy, since the number of population is a key indicator to determine central government disbursements to local governments including subsidies, local allocation tax revenues and so on.

3.2.6 Income distribution block

In this block, prefectural income, wage and salaried income, household disposable income, household property income, private corporation income, etc. are determined. As

real private final consumption depends on real disposal income and real private non-housing investment depends on real private corporation income, this bock plays an important role in linking the variables of income with the expenditure variables in the prefecture based regional sub-model.

3.2.7 Local government finance block

This block plays a very important role in the multi regional macro econometric model of Japan. This is because this block links the Japanese central government sub-model through the taxation system. National taxes including individual income tax, private corporation tax, consumption tax, etc. are calculated in this block and are totaled as national tax revenues of the general accounts in the central government sub-model. At the same time, the national tax revenues are reallocated to the local government bodies, prefectural and municipal governments through the local allocation tax system and through subsidies (Nakamura 2003).

In this block, national taxes mentioned above, local taxes including residential tax, corporation business tax, automobile tax, fixed assets tax, local allocation tax revenue, basic financial demand and revenue, total revenues and expenditures, etc. are determined.

3.3 Intra-National and International Trade

In the model system, the intra-national trade and international trade are independently determined. In the case of intra-national trade, this study employs the prefectural macro trade data, exports and imports of goods and services, subtracting the international trade, exports and imports, based on the fixed ratio of international trade to whole trade derived from Input-Output Table of each prefecture, since the time series data of prefectural external trade are not available in the prefecture data base.

The intra-national exports and imports are calculated in the real expenditure block. On the other hand, international trade including external exports and imports are calculated by reallocating the Japanese macro exports and imports, which are determined in the Japanese national macro sub-model, to the international exports and imports of each prefecture, based on the fixed ratio of each prefecture's international exports and imports to the whole international exports and imports of Japan. This process is very important to evaluate the dynamic multiplier in an open economic system.

In addition, total intra-national exports are equal to total intra-national imports, in which this condition is maintained for solving the model in the model system.

4. Economic Structures of Niigata, Toyama, Ishikawa and Fukui Prefectures with a Regression Analysis

The model system consists of three sub-models, as mentioned above, in which there are five regional models including Niigata, Toyama, Ishikawa, Toyama prefectural models and the rest of Japan regional model. Each regional model has similar model structures as a general model specification in order to compare the behavioral equation coefficients in regression analysis and to make the results consistent among the four prefectures and the

rest of Japan in simulation analysis.

The number of variables in each regional model is 66 with 51 endogenous and 15 exogenous variables. The total number of variables is over 370, including other sub-models, in which there are 335 variables in the regional sub-model, 22 variables in the central government sub-model and 15 variables in the Japanese macro sub-model.

This section analyzes the economic structures of the four prefectures, Niigata, Toyama, Ishikawa and Fukui comparing them to that of rest of Japan with regression results of the major behavioral equations.

4.1 Demand-side Economy : Real Expenditures

The prefecture basis regional model is essentially a demand side oriented type model so that each component of real GDP is determined in a behavioral equation or identity.

Accordingly, this section analyzes the structures of the economy with regression results of the major GDP components such as real private final consumption expenditure (CP), real private non-housing investment (IP), real intra-national exports (EGSD) and real imports (MGSD).

4.1.1 Real private final consumption expenditure

Table 2 shows the regression results of real private final consumption expenditure (CP) of the four prefectures and the rest of Japan. This study employs an absolute income hypothesis for consumption expenditure (Keynesian type consumption function), in which real consumption depends on real household disposable income (YDPR), lending rate (INTLR), and the combined variable ((1+RTXC)*PCP) of both the implicit deflator of CP (PCP) and the consumption tax rate (RTXC), which explains price effects.

Table 2 Real Private Final Consumption Expenditure Regression Results with OLS

<Niigata>
*CP = 4336549 + 0.2855 YDPR - 33921.6 INTLR - 13065.6((1+RTXC)*PCP)*
(5.65) (3.36) (-2.34) (-2.01)
Sample: 1990-2006 R^2ADJ =0.927 SD =31,392.0 D.W.=1.562
<Toyama>
*CP = 2477845 + 0.1575 YDPR - 3254.1 INTLR - 8728.6((1+RTXC)*PCP)*
(5.85) (2.23) (-4.90) (-2.48)
Sample: 1990-2006 R^2ADJ =0.9067 SD =19,471.5 D.W.=1.790
<Ishikawa>
*CP = 1566593 + 0.3391 YDPR - 11486.2 INTLR - 1468.7((1+RTXC)*PCP)*
(5.16) (4.94) (-2.25) (-1.67)
Sample: 1990-2006 R^2ADJ =0.944 SD =13,798.0 D.W.=1.947
<Fukui>
*CP = 2142388 + 0.2516 YDPR - 24291.5 INTLR - 10261.7((1+RTXC)*PCP)*
(7.16) (3.24) (-5.91) (-3.44)
Sample: 1990-2006 R^2ADJ =0.904 SD =15,625.1 D.W.=1.524
<The rest of Japan>
*CP = 306214021 + 0.5640 YDPR - 5573.1 INTLR - 1930.97((1+RTXC)*PCP)*
(9.40) (7.77) (-10.99) (-10.10)
Sample: 1990-2006 R^2ADJ =0.992 SD =1616.3.0 D.W.=1.413

(*t*-value in parenthesis)

As shown in Table 2, the results explain the small marginal propensity to consume in these prefectures (Niigata (0.286), Toyama (0.158), Ishikawa (0.339), Fukui (0.252)) as compared to that of the rest of Japan (0.564), which means that the autonomous consumption is fairly large in considering the average propensity to consume; Niigata (0.76), Toyama (0.69), Ishikawa (0.85), Fukui (0.78) as of FY 2006. In other words, consumption behavior among the households in these prefectures is very conservative to the changes of income, especially in Toyama, as compared to that of the rest of Japan (or overall Japan). This is one of the characteristics of these prefectural economies.

4.1.2 Real private non-housing investment

Non-housing investment plays a very important role for economic activities not only from the demand side but also from the supply side. This is known as the "dual effects of investment", so that non-housing investment is one of the key variables in the model. In this paper we consider some principles including the acceleration principle, the profit principle, the cost principle, and the stock adjustment principle as independent variables to determine investment behaviors.

Table 3 shows the results of regression of real non-housing investment. Real non-housing investment (IP) is explained significantly by real private corporation income (RYC), real rate of interest (INTLR-DOT(PIP)) and implicit deflator of IP (PIP), and one-year lagged real private capital stock (KP(t-1)). However, the acceleration principle cannot explain investment behaviors significantly for these regional economies. In addition, the ratio of real exports of goods and services to GDP (EGS/GDP) is employed to elucidate to what extent the regional economic activities are involved within the Japanese economy as a whole.

Table 3 Real Non-Housing Investment Regression Results with OLS

<Niigata>
IP = 854495 + 0.488 RYC - 44518.5 INTLR - DOT(PIP) - 0.1351 KP(-1) + 35432727 EGS/GDP
(4.14) (3.73) (-3.48) (-6.74) (4.48)
Sample: 1991-2006 R^2ADJ =0.854 S.E.=30,243.2 DW=1.991
<Toyama>
IP = 1200154 + 0.314 RYC - 35322.6 INTLR - DOT(PIP) - 0.0812 KP(-1)
(6.48) (2.91) (-3.18) (-3.64)
Sample: 1991-2006 R^2ADJ =0.619 S.E.=35,767.1 DW=1.893
<Ishikawa>
IP = -184882 + 0.721 RYC - 14744.4 INTLR - DOT(PIP) - 0.0972 KP(-1) + 1650607 EGS/GDP
(-2.09) (2.44) (-2.06) (-2.07) (3.19)
Sample: 1991-2006 R^2ADJ =0.785 S.E.=32,196.1 DW=1.458
<Fukui>
IP = 720244 + 0.417 RYC - 39461.0 INTLR - DOT(PIP) - 0.1707 KP(-1) + 797054 EGS/GDP
(1.85) (2.08) (-3.01) (-6.63) (1.98)
Sample: 1991-2006 R^2ADJ =0.762 S.E.=36,242.8 DW=1.693
<the rest of Japan>
IP = 199781E3 + 0.591 RYC - 5701E3 INTLR - DOT(PIP) - 0.111 KP(-1)
(7.17) (2.25) (-4.57) (-3.12)
Sample: 1991-2006 R^2ADJ =0.826 S.E.=4187E3 DW=1.542

According to the regression results in Table 3, three control variables. Real corporation income, real interest rate (prime rate) and real capital stock with one-year lag for real private non-housing investment are significant in each region. In addition, the ratio of exports to GDP explains real investment to a significant extent in Niigata, Ishikawa and Fukui. However, this ratio is insignificant in Toyama Prefecture as well as the rest of Japan. It is noteworthy that the regional economic interactions through intra-national trade play an important role determining investment behavior even in the rural economies in Japan (Nakamura and Sato 1994), which will be discussed in Section 5 (scenario simulation).

4.1.3 Intra-national exports and imports of goods and services

Intra-national exports and imports of goods and services are major components in GDP, which explain the regional economic performances through regional interactions in Japan. Table 4 shows both the intra-national export (EGSD) and import (MGSD) regression results of the four prefectures.

Table 4 Intra-National Exports and Imports Regression Results with OLS

<Niigata>
ln(EGSD) = - 2.8962 + 1.377992 ln(GDP.roj) - 0.66111 ln(PEGS/PGDP.roj)
(-1.94) (12.16) (-3.30)
Sample:1990-2006 R^2ADJ=0.932 S.E.=0.0245 DW=1.391
ln(MGSD) = - 9.1329 + 1.5128 ln(GDP) - 0.72513 ln(PMGS/PGDP)
(-2.50) (6.55) (-3.60)
Sample: 1990-2006 R^2ADJ =0.870 S.E.=0.02224 DW=1.743
<Toyama>
ln(EGSD) = 3.4995 + 0.86498 ln(GDP.roj)
(1.64) (3.66)
Sample: 1990-2006 R^2ADJ =0.612 S.E.=0.0334 DW=1.973
MGSD/GDPD = 0.252885 - 0.11543 PMGS/PGDP + 0.72512 MGSD(-1)/GDP(-1)
(1.53) (-2.09) (3.43)
Sample:1991-2006 R^2ADJ =0.643 S.E.=0.01702 DW=1.981
<Ishikawa>
ln(EGSD) = - 14.102 + 1.43766 ln(GDP.roj)
(-7.71) (14.65)
Sample: 1990-2006 R^2ADJ =0.9490 S.E.=0.01413 DW=1.742
ln(MGSD) = - 3.9266 + 0.60564 ln(GDP) - 0.4653 ln(PMGS/PGDP) + 0.6335 ln(MGSD(-1))
(-1.51) (2.34) (-2.68) (4.23)
Sample: 1991-2006 R^2ADJ =0.871 S.E.=0.0326 DW=1.984
<Fukui>
ln(EGSD) = - 7.6764 + 1.10915 ln(GDP.roj)
(-1.63) (4.73)
Sample: 1990-2006 R^2ADJ =0.791 S.E.=0.02749 DW=1.515
MGSD/GDPD = 0.38722 - 0.23634 PMGS/PGDP + 0.752465 MGSD(-1)/GDP(-1)
(5.66) (-3.89) (11.70)
Sample: 1991-2006 R^2ADJ =0.894 S.E.=0.01256 DW=2.348

As shown in Table 4, real intra-national exports (EGSD) and imports of goods and services (MGSD) are explained by income effects and price effects. In the exports function, both sides employ logarithm so that each coefficient means an income elasticity as income effects, which is explained by the GDP of the rest of Japan (ln.(GDP.roj)), and price effects, which is the ratio of the export price to the GDP deflator of the rest of Japan, PEGS/PGDP. roj. The prices effects are significant only in Niigata Prefecture.

On the other hand, the four prefectural intra-national imports (MGSD) are significantly explained by income effects (GDP) and relative price effects (ratio of import price to GDP deflator, PMGS/PGDP) in the logarithm imports function for Niigata and Ishikawa, and in the imports ratio function for Toyama and Fukui.

As mentioned above, coefficients explain an income and price elasticity in a logarithm function, which therefore shows the extent of regional interactions between/among regions. In accordance with the regression results in the exports side, Ishikawa Prefecture has the highest coefficient at 1.438, Niigata has the next at 1.378, Fukui at 1.109, and Toyama at 0.865, which means, for example, that each prefecture's intra-national exports increase by 1.438 percent, 1.378 percent, 1.109 percent and 0.865 percent respectively, when the rest of Japan GDP increases by one percent.

4.2 Production (Supply-Side GDP)

To endogenize supply-side economy (GDPS) is very important even in the demand-side oriented model as mentioned above. As shown Table 5, this study employs a productivity function, so that the coefficient of capita-labor (employment) ratio, KP/NLE, explains the coefficient (α) of capital stock (KP) and ($1-\alpha$) means the coefficient of employment (NLE) within a Cobb-Douglas type production function.

According to the regression results in Table 5, the capital share (α) of Niigata Prefecture (0.399) is smaller than that of the rest of Japan (0.455) which is nearly similar with that of Japan as a whole (please see the production function of Japan in Table 5). On the other hand, the other prefectures' coefficient of capital is larger than that of the rest of Japan. Generally, the coefficient of capital (capital share) in the production function is dependent on industrial structure, mutuality, technology and so on, so that we can see the differences of the economic structure among these prefectures, which will be analyzed in another study.

Table 5. Production Function Regression Results with OLS

<Niigata>
ln.(GDPS/NLE) = 1.1036 + 0.3989 ln.(KP/NLE)
(25.42) (19.70)
Sample: 1990-2006 R^2ADJ = 0.960 S.E. = 0.1196 DW = 2.038
<Toyama>
ln.(GDPS/NLE) = 0.8555 + 0.5053 ln.(KP/NLE)
(4.41) (6.28)
Sample: 1990-2006 R^2ADJ = 0.899 S.E. = 0.1795 DW = 1.808
<Ishikawa>
ln.(GDPS/NLE) = 0.79654 + 0.54889 ln.(KP/NLE)
(10.47) (15.58)
Sample: 1990-2006 R^2ADJ = 0.942 S.E. = 0.1640 DW=1.192
<Fukui>
ln.(GDPS/NLE) = 0.75466 + 0.5330 ln.(KP/NLE)
(4.21) (7.18)
Sample: 1990-2006 R^2ADJ=0.922 S.E.=0.17401 DW=2.308
<the rest of Japan>
ln.(GDPS/NLE) = 1.99111 + 0.4553 ln.(KP/NLE)
(9.07) (9.86)
Sample: 1990-2006 R^2ADJ = 0.957 S.E. = 0.0120 DW = 1.494
< Japan>
ln.(GDPS/NLE) = 2.23373 + 0.4576 ln.(KP/NLE)
(10.40) (9.94)
Sample: 1990-2006 R^2ADJ = 0.958 S.E. = 0.0110 DW = 1.500

4.3 Dynamic Multiplier Test

Before conducting scenario simulations, this study makes dynamic simulation tests including a dynamic reliability test and a multiplier test. This sub-section discusses the dynamic multiplier test. Concerning the reliability test, the results with MAPE (Mean Absolute Percentage Error) are shown in Appendix B.

As discussed above, this study employs a demand-side oriented model (Keynesian type model) so that the multiplier effects on the economies provide very important information for assessing economic policies, especially fiscal policy. In the dynamic multiplier test, we assume that each prefecture and the rest of Japan continue to increase nominal government investment by one percent of nominal GDP during the tested period. The period covered by the test is ten years.

Table 6 shows the results of the dynamic multiplier test, which explains the impacts of government investment increases on GDP with an indicator of the ratio of real GDP changes to changes in real government investment (ΔGDP/ΔIG). According to the results, the multiplier of Ishikawa Prefecture is the highest on average. Following Ishikawa, Fukui is the second and Niigata is the third. The Toyama Prefecture multiplier is the smallest among these prefectures. Each prefectural multiplier elucidates the macro economic

structure, which depends on marginal propensity to consume, to import, to export, to invest, price effects, and so on. As compared to the rest of Japan, the multiplier of Ishikawa is higher than that of the rest of Japan. On the other hand, the multiplier of Fukui is similar than that of the rest of Japan. Both Niigata and Toyama are lower than that of the rest of Japan.

Four prefectures, nevertheless, the impacts on the exports of goods and services (EGS) are fairly large, especially in Ishikawa and Fukui Prefecture, which results in the higher multiplier in spite of the lower propensity to consume. On the other hand, in the case of the rest of Japan, the ratio of the imports from the rest of the world to total imports is larger so that the multiplier is to be lower in spite of the fairly large propensity to consume.

Table 6 The Results of the Dynamic Multiplier Test (ΔGDP/ΔIG)

Year	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
Niigata	**1.49**	**1.58**	**1.67**	**1.73**	**1.65**	**1.70**	**1.76**	**1.72**	**1.70**	**1.69**
(CP)	0.21	0.22	0.24	0.25	0.24	0.25	0.25	0.25	0.25	0.25
(EGS)	0.96	0.95	0.96	0.98	0.97	0.97	0.99	0.97	0.96	0.96
(MGS)	0.79	0.81	0.82	0.81	0.80	0.81	0.81	0.80	0.79	0.80
(Other)	0.11	0.22	0.29	0.31	0.24	0.29	0.33	0.30	0.28	0.28
Toyama	**1.24**	**1.33**	**1.47**	**1.49**	**1.51**	**1.53**	**1.54**	**1.56**	**1.55**	**1.54**
(CP)	0.04	0.05	0.07	0.08	0.09	0.09	0.10	0.10	0.10	0.10
(EGS)	0.67	0.69	0.69	0.71	0.72	0.72	0.71	0.71	0.71	0.71
(MGS)	0.59	0.59	0.58	0.60	0.61	0.61	0.62	0.61	0.60	0.60
(Other)	0.12	0.18	0.29	0.30	0.32	0.32	0.34	0.36	0.34	0.34
Ishikawa	**1.86**	**1.83**	**2.01**	**1.96**	**1.87**	**1.81**	**1.77**	**1.68**	**1.75**	**1.86**
(CP)	0.31	0.32	0.35	0.34	0.32	0.32	0.32	0.30	0.32	0.32
(EGS)	1.01	1.06	1.09	1.10	1.10	1.09	1.07	1.09	1.08	1.08
(MGS)	0.61	0.71	0.72	0.75	0.76	0.79	0.80	0.80	0.80	0.81
(Other)	0.15	0.16	0.28	0.27	0.21	0.16	0.18	0.11	0.17	0.26
Fukui	**1.46**	**1.54**	**1.77**	**1.85**	**1.86**	**1.83**	**1.80**	**1.67**	**1.87**	**1.89**
(CP)	0.15	0.16	0.19	0.21	0.21	0.21	0.20	0.19	0.21	0.22
(EGS)	0.82	0.83	0.84	0.86	0.86	0.86	0.85	0.84	0.85	0.86
(MGS)	0.58	0.60	0.62	0.64	0.63	0.63	0.62	0.60	0.63	0.64
(Other)	0.07	0.15	0.36	0.42	0.42	0.39	0.37	0.24	0.44	0.45
The R.O.J.	**1.35**	**1.54**	**1.85**	**1.86**	**1.81**	**1.78**	**1.71**	**1.77**	**1.83**	**1.80**
(CP)	0.33	0.41	0.47	0.46	0.45	0.44	0.44	0.45	0.47	0.46
(EGS)	0.71	0.72	0.72	0.73	0.73	0.72	0.71	0.72	0.75	0.74
(MGS)	0.92	0.95	0.97	0.98	0.98	0.97	0.96	0.96	0.97	0.97
(Other)	0.23	0.36	0.63	0.65	0.61	0.59	0.52	0.56	0.58	0.57

(CP:ΔCP/ΔIG, EGS:ΔEGS/ΔIG, MGS:ΔMGS/ΔIG, Other:Δ(CG+IP+IH+JP)/ΔIG)

5. Future Forecasts with Scenario Simulations

This section conducts future forecasts with scenario simulations up to FY2015 and analyzes each prefectural growth performance based on the results of two scenario simulations. As for the scenario, we assume two scenarios such as (1) a most-likely scenario, which is a baseline forecast, and (2) a world economy recession scenario.

5.1 Baseline Forecast with a Most-likely Scenario

The baseline forecast is conducted as a most-likely scenario, in which we assume the world economic environment and the Japanese economic situation including economic policies and major exogenous variables of the Japanese model, do not change drastically in the future. Concerning the exogenous variables set, Appendix D shows the major exogenous variables and values of those variables.

Table 7 shows the results of the baseline forecast with major economic variables from FY2007 to FY2015, for four prefectures and the rest of Japan. In accordance with the baseline forecast, each prefectural economy is expected to be stagnant after the damages of the financial crisis with two-year negative growth in FY2008 and FY2009. At the same time, it is expected that these economies will be in a deflationary economic situation even after the slight recovery since FY2010.

As for the Niigata Prefecture economy, it is expected that real GDP growth rates will probably be -3.7 % and -1.8 % in FY2008 and FY2009, following which real growth rates will revert to positive growth after FY2010. However, the growth performance is expected to be very weak in the first half of the 2010s, so that the level of real GDP in FY2015 will likely be 9,497 billion, which is smaller than that of the level in FY2006.

The major components of real GDP such as real private consumption and real private non-housing investment will show a similar trend. The real private non-housing investment is expected to record a large negative growth at -8.3% in FY2008, following the negative growth of -6.8% in the previous year. Accordingly, real private non-housing investment will probably be in a state of negative growth during three years and the level is expected to shrink sharply to 1,143 billion in FY2009.

As noted, the Japanese recession is mainly dependent on the world financial crisis, so that real exports of goods and services have experienced serious damage, which results in deteriorating regional domestic demand. Therefore the deflationary economy is expected to continue and the GDP deflator will continue to go down during the forecasting period in Niigata Prefecture.

Concerning Toyama Prefecture's economy, the growth performance will be similar to Niigata Prefecture. However, the economy of Toyama is more closed to the rest of Japan as compared to Niigata and Ishikawa Prefectures, and the multiplier of Toyama is smaller than that of other three prefectures, so that the damages of the recession are expected to be limited, as mentioned above. Therefore, it is expected that the growth rates of real GDP will be -1.5%, -1.4% and -0.3% in FY2008, FY2009 and FY2010 and will become positive after FY2011, but limited between 0 to 1 %, up to FY2015.

The components of real GDP display a similar trend in Toyama, since the regional economies in Japan are damaged by the world recession through both intra-national and international trade deterioration. Therefore, real exports of goods and services have sustained serious damages even in Toyama and the rate of increase in real exports is expected to be -4.4%, -3.4% and -0.4% in FY2008, FY2009 and FY2010, which is the cause of the negative rate of changes in real GDP components and of GDP growth. In addition to that, the deflationary economy is expected to continue in the forecasting period up to FY2015 in Toyama Prefecture, as well as other prefectures, as shown in Table 7.

Regarding Ishikawa Prefecture, the local economy is expected to sustain the most

serious damage of all the four under consideration, and the real GDP growth rates will probably be -4.1% and -2.3% in FY2008 and FY2009. Before the recession, Ishikawa Prefecture's economy experienced a strong economic performance in the boom years so that the shock of the recession considevably affected investment behaviors, which is explained by the higher export ratio to GDP at 0.66 as of FY2006, the higher income elasticity at 1.44 in the export equation and the higher multiplier discussed in the previous section. Therefore, real non-housing investment is also expected to decrease sharply at -7.0%, -7.3%, -3.5% and -0.9% during four years in FY2008, FY2009, FY2010 and FY2011.

However, according to the baseline forecast, the economy is expected to recover in FY2011 and the growth rates will probably be 1.2 -1.3% after FY2012. Nevertheless, the deflationary economy will probably be continuing in the future in Ishikawa Prefecture, as well as in the other prefectures, as indicated by GDP deflator forecasted.

With respect to Fukui Prefecture's economy, serious damage was sustained and real GDP growth rate is expected to be -2.2% and -1.8% in FY2008 and FY2009. In the period of the boom after FY2002, the economy was fairly steady, so that the growth is expected to be shrinking with large decreases in investment and exports. The export ratio to GDP in Fukui is the largest among these prefectures at 0.73 as of FY2006, so that the world recession hit the economy through exports decreases.

It is expected that the economy will probably begin recovering after YF2010 and experience 1.3 -1.4% growth rate after FY2012, when the world economy will be expanding under the strong economic growth in some Newly Industrializing Economies. Nevertheless, the deflationary economy will continue in the future.

Table 7 The Results of the Baseline Forecast, FY2007−FY2015 (billions of yen)

	—Actual—	—Estimate—		Forecast						
	FY2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
<Niigata>										
GDP	9,557	9,604	9,252	9,090	9,133	9,139	9,189	9,289	9,388	9,497
(%)	-1.9	0.5	-3.7	-1.8	0.5	0.1	0.5	1.1	1.1	1.2
CP	4,549	4,557	4,484	4,460	4,469	4,458	4,467	4,489	4,502	4,521
(%)	0.8	0.2	-1.6	-0.5	0.2	-0.3	0.2	0.4	0.4	0.4
IP	1,393	1,299	1,191	1,143	1,167	1,180	1,159	1,173	1,189	1,202
(%)	3.4	-6.8	-8.3	-4.0	2.1	1.1	-1.8	1.3	1.3	1.1
EGS	5,212	5,347	4,871	4,666	4,633	4,664	4,733	4,834	4,945	5,061
(%)	-0.2	2.6	-8.9	-4.2	-0.7	0.7	1.5	2.1	2.3	2.3
MGS	4,356	4,317	4,020	3,910	3,917	3,907	3,919	3,950	3,990	4,034
(%)	-2.6	-0.9	-6.9	-2.7	0.2	-0.3	0.3	0.8	1.0	1.1
PGDP	95.0	95.2	96.6	97.0	96.1	95.8	95.3	94.7	94.2	93.5
(%)	0.0	0.2	1.5	0.4	-1.0	-0.2	-0.6	-0.6	-0.6	-0.6
NLE	1,248	1,242	1,230	1,203	1,195	1,187	1,181	1,176	1,170	1,165
(%)	-0.6	-0.4	-1.0	-2.2	-0.7	-0.6	-0.5	-0.5	-0.4	-0.5
<Toyama>										
GDP	4,954	5,029	4,956	4,886	4,872	4,876	4,911	4,955	5,005	5,089
(%)	0.8	1.5	-1.5	-1.4	-0.3	0.1	0.7	0.9	1.0	1.1
CP	2,017	2,027	2,012	2,012	2,012	2,001	2,005	2,008	2,012	2,016
(%)	0.6	0.5	-0.7	0.0	0.0	-0.5	0.2	0.2	0.2	0.2
IP	756	736	733	702	672	657	659	663	668	671
(%)	10.0	-2.7	-0.4	-4.2	-4.3	-2.2	0.4	0.6	0.7	0.60

	Actual	Estimate		Forecast						
	FY2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
EGS	3,447	3,537	3,381	3,278	3,264	3,277	3,308	3,345	3,385	3,425
(%)	-0.7	2.6	-4.4	-3.1	-0.4	0.4	0.9	1.1	1.2	1.2
MGS	2,588	2,581	2,489	2,422	2,393	2,377	2,373	2,371	2,369	2,363
(%)	-1.9	-0.3	-3.5	-2.7	-1.2	-0.7	-0.2	-0.1	-0.1	-0.3
PGDP	92.4	92.1	92.6	93.1	92.9	92.3	91.7	90.9	89.9	88.1
(%)	-1.0	-0.3	0.5	0.5	-0.2	-0.6	-0.7	-0.9	-1.1	-1.3
NLE	573	572	566	554	551	548	546	544	542	540
(%)	-0.5	-0.3	-0.9	-2.1	-0.6	-0.5	-0.4	-0.4	-0.3	-0.4
<Ishikawa>										
GDP	4,879	5,034	4,826	4,715	4,735	4,776	4,838	4,900	4,959	5,013
(%)	0.5	3.2	-4.1	-2.3	0.4	0.9	1.3	1.3	1.2	1.1
CP	2,320	2,351	2,308	2,289	2,294	2,297	2,310	2,322	2,333	2,343
(%)	0.2	1.3	-1.8	-0.8	0.2	0.2	0.5	0.5	0.5	0.4
IP	667	668	617	569	549	545	551	561	571	580
(%)	-1.7	1.1	-7.0	-7.3	-3.5	-0.9	1.1	1.6	1.7	1.5
EGS	3,241	3,354	3,150	3,012	2,997	3,016	3,059	3,109	3,162	3,215
(%)	5.2	3.5	-6.1	-4.4	-0.5	0.6	1.4	1.6	1.7	1.7
MGS	2,720	2,710	2,618	2,526	2,478	2,449	2,447	2,457	2,474	2,493
(%)	-2.3	-0.4	-3.4	-3.6	-1.9	-1.2	-0.1	0.4	0.7	0.8
PGDP	92.6	91.8	93.5	94.1	93.6	93.1	92.3	91.6	91.0	90.4
(%)	-1.0	-0.8	1.8	0.7	-0.5	-0.5	-0.8	-0.8	-0.7	-0.7
NLE	609	605	599	585	580	576	572	569	566	563
(%)	-0.4	-0.5	-1.1	-2.3	-0.8	-0.7	-0.6	-0.6	-0.5	-0.6
<Fukui>										
GDP	3,629	3,724	3,646	3,578	3,578	3,582	3,627	3,677	3,730	3,784
(%)	0.2	2.6	-2.2	-1.8	0.0	0.1	1.3	1.4	1.4	1.4
CP	1,569	1,585	1,566	1,560	1,562	1,554	1,560	1,567	1,575	1,582
(%)	0.3	1.0	-1.2	-0.3	0.1	-0.5	0.4	0.5	0.5	0.5
IP	548	528	492	445	413	402	409	416	423	429
(%)	11.5	-3.7	-6.8	-9.7	-7.1	-2.7	1.7	1.8	1.7	1.2
EGS	2,685	2,766	2,624	2,528	2,516	2,529	2,557	2,592	2,628	2,665
(%)	4.9	3.0	-5.1	-3.1	-0.5	0.5	1.1	1.3	1.4	1.4
MGS	2,033	2,012	1,896	1,811	1,780	1,751	1,745	1,743	1,740	1,735
(%)	-2.7	-1.0	-5.8	-4.5	-1.7	-1.6	-0.3	-0.1	-0.2	-0.3
PGDP	91.5	90.1	91.9	92.8	92.4	92.6	92.0	91.4	90.8	90.3
(%)	-1.3	-0.7	1.3	0.9	-0.4	0.1	-0.6	-0.7	-0.6	-0.6
NLE	427	426	422	413	412	410	409	407	407	406
(%)	-0.2	-0.2	-0.8	-2.0	-0.5	-0.4	-0.3	-0.3	-0.2	-0.3
<The R.O.J.>										
GDP	529,255	539,471	517764	502,504	501,973	504,919	510,240	516,086	522,040	527,751
(%)	2.4	1.9	-4.0	-2.9	-0.1	0.6	1.1	1.1	1.2	1.1
CP	295,123	297,679	292,701	288,257	288,759	287,800	288,830	289,782	290,584	291,111
(%)	1.2	0.9	-1.7	-1.5	0.2	-0.3	0.4	0.3	0.3	0.2
IP	84,458	86,594	76,850	68,538	69,459	71,118	73,142	75,199	77,244	79,193
(%)	5.6	2.5	-11.3	-10.8	1.3	2.4	2.8	2.8	2.7	2.5
EGS	80,123	87,592	78,668	73,403	71,196	70,835	71,574	72,991	74,839	76,971
(%)	8.5	9.3	-10.2	-6.7	-3.0	-0.5	1.0	2.0	2.5	2.8
MGS	58,851	59,900	57,013	53,540	51,878	51,158	51,321	51,902	52,650	53,420
(%)	3.2	1.8	-4.8	-6.1	-3.1	-1.4	0.3	1.1	1.4	1.5
PGDP	92.5	91.7	91.3	92.1	91.6	91.0	90.6	90.2	90.0	89.9
(%)	-0.7	-0.9	-0.4	0.9	-0.5	-0.6	-0.5	-0.4	-0.2	-0.1
NLE	61,033	61,294	60,912	60,070	60,128	60,172	60,253	60,345	60,419	60,456
(%)	0.4	0.4	-0.6	-1.4	0.1	0.1	0.1	0.1	0.2	0.1

(GDP: real GDP, CP: real private consumption, IP: real non-housing investment, EGS: real exports of goods and services, MGS: real imports of goods and services, PGDP: implicit deflator of GDP , NLE: the number in employment (1,000 persons))

5.2 World Economic Recession Scenario

After the financial crisis in the United States the world economy was damaged and world trade also decreased sharply in 2008 and 2009. Nevertheless, owing to various newly industrializing economies' high economic growth and coordinated fiscal policy among major countries, the world economy could avoid a serious crisis and sustain steady growth. However, the situation of the world economy is still unstable, since major countries, especially the U.S., Japan and the U.K. have crucial problems in their domestic economies.

Accordingly, this study also conducts a world recession scenario, in which it is assumed that world trade will continue at lower levels, with zero percent growth up to the year 2015. In the baseline scenario, real world trade will continue with 3% growth per annum from the year 2010 to 2015, so that the scenario simulation is to examine the impacts of a 3 % points decrease of the real world trade growth on the Japanese regional economies.

Table 8 shows the deviation and percentage deviation between the baseline forecast and recession scenario forecast. According to the results of the scenario simulation, we can see that all economies experience similar damage through reduction of exports.

In the case of the rest of Japan, the ratio of external exports to total exports is higher as compared to that of four prefectures, so that the impact of the projected world trade decrease on the total exports is fairly large. Real exports of goods and services could be expected to decrease by -1.1% in FY2010 and by -12.1% in FY2015 as compared to the baseline forecast. Along with the reduction of exports, real private non-housing investment could also be expected to decrease by -0.3% in FY2010 and by -2.7% in FY2015 in comparison with the baseline forecast. As for real GDP, as a result of the decrease of exports and investment, real GDP of the rest of Japan would probably be decreasing by 0.2% in FY2010 and by 17.0% in FY2015.

Regarding the impacts of world trade decreases on the prefectural economies, the four prefectural economies could be expected to sustain similar damages, the extent of which would depend on the ratio of external exports to total exports, the ratio of exports to GDP, and multiplier. Among the four prefectures, the largest impacts in terms of real GDP would be expected by Niigata Prefecture, which would decrease by -2.1% in FY2015, and next by Ishikawa and Fukui, at -1.8%. Toyama at -1.1% in FY2015, compared to the baseline forecast, would experience the smallest impact.

As shown in Table 8, we can easily understand that the regional economic stagnation predicted in the baseline forecast may result from the recession of the world economy when we look into the scenario simulation. Even in the rural areas in Japan, the world economic growth expansion influences the regional economies.

Table 8 The Impacts of the World Economic Recession on the Prefectural Economies

: deviation and % deviation in parenthesis (billions of yen, %)

Fiscal year	FY2010	2011	2012	2013	2014	2015
<Niigata Prefecture>						
GDP	-15.50	-2.38	-78,97	-104.45	-129.45	-188,01
(%)	(-0.2)	(-0.0)	(-0.9)	(-1.1)	(-1.4)	(-2.1)
CP	-2.45	0.34	-12.63	-16.49	-20.24	-29.92
(%)	(-0.1)	(0.0)	(-0.3)	(-0.4)	(-0.4)	(-0.7)
IP	-0.11	-0.81	-2.63	-4.70	-6.27	-7.75
(%)	(-0.0)	(-0.1)	(-0.4)	(-0.7)	(-0.9)	(-1.2)
EGS	-18.73	-61.96	-101.94	-157.70	-213.38	-263.20
(%)	(-0.4)	(-1.3)	(-2.2)	(-3.3)	(-4.3)	(-5.2)
MGS	-13.10	-25.05	-53.23	-70.71	-100.60	-126.75
(%)	(0.3)	(-0.6)	(-1.4)	(-1.8)	(-2.5)	(-3.1)
PGDP	0.106	-0.301	0.203	-0.040	-0.053	0.118
(%)	(0.1)	(-0.3)	(0.2)	(-0.0)	(-0.1)	(0.1)
NLE	-0.513	-1.751	-3.394	-4.821	-6.435	-7.598
(%)	(-0.0)	(-0.2)	(-0.3)	(-0.5)	(-0.6)	(-0.8)
<Toyama Prefecture>						
GDP	-6.20	-8.75	-23.07	-34.23	-36.89	-55.29
(%)	(-0.1)	(-0.2)	(-0.5)	(-0.7)	(-0.9)	(-1.1)
CP	-0.21	0.04	-0.53	-0.800	-0.38	-1.16
(%)	(-0.0)	(0.0)	(-0.0)	(-0.0)	(-0.0)	(-0.1)
IP	-0.11	-0.81	-2.63	-4.70	-6.27	-7.75
(%)	(-0.0)	(-0.1)	(-0.4)	(-0.7)	(-0.9)	(-1.2)
EGS	-8.34	-21.88	-38.39	-56.37	-74.88	-93.41
(%)	(-0.3)	(-0.7)	(-1.2)	(-1.7)	(-2.2)	(-2.7)
MGS	-4.23	-13.17	-17.20	-26.76	-35.17	-46.64
(%)	(-0.2)	(-0.6)	(-0.7)	(-1.1)	(-1.5)	(-2.0)
PGDP	0.061	0.099	0.018	0.019	-0.173	-0.055
(%)	(0.1)	(0.1)	(0.0)	(0.0)	(-0.2)	(-0.1)
NLE	-0.235	-0.734	-1.394	-2.090	-2.735	-3.297
(%)	(-0.0)	(-0.1)	(-0.3)	(-0.4)	(-0.5)	(-0.6)
<Ishikawa Prefecture>						
GDP	-10.90	-23.89	-42.62	-60.48	-75.23	-92.67
(%)	(-0.2)	(-0.5)	(-0.9)	(-1.2)	(-1.5)	(-1.8)
CP	-1.97	-4.25	-7.58	-10.68	-13.15	-16.10
(%)	(-0.1)	(-0.2)	(-0.3)	(-0.5)	(-0.6)	(-0.7)
IP	-2.04	-6.11	-10.51	-15.27	-20.04	-23.76
(%)	(-0.4)	(-1.1)	(-1.9)	(-2.7)	(-3.5)	(-4.1)
EGS	-10.34	-27.07	-47.39	-69.38	-91.77	-113.93
(%)	(-0.3)	(-0.9)	(-1.5)	(-2.2)	(-2.9)	(-3.5)
MGS	-4.41	-8.04	-21.29	-33.44	-44.05	-60.02
(%)	(-0.2)	(-0.3)	(-0.9)	(-1.4)	(-1.8)	(-2.4)
PGDP	0.088	0.017	0.149	0.168	0.053	0.087
(%)	(0.1)	(0.0)	(0.2)	(0.2)	(0.1)	(0.1)
NLE	-0.247	-0.771	-1.894	-2.521	-2.918	-3.098
(%)	(-0.0)	(-0.1)	(-0.3)	(-0.4)	(-0.5)	(-0.5)
<Fukui Prefecture>						
GDP	-6.53	-6.92	-26.73	-40.81	-51.40	-68.35
(%)	(-0.2)	(-0.2)	(-0.7)	(-1.1)	(-1.4)	(-1.8)

Fiscal year	FY2010	2011	2012	2013	2014	2015
CP	-0.70	-0.40	-2.74	-4.23	-5.22	-7.07
(%)	(-0.0)	(-0.0)	(-0.2)	(-0.3)	(-0.3)	(-0.4)
IP	-0.85	-3.98	-6.23	-9.14	-11.94	-13.20
(%)	(-0.2)	(-1.0)	(-1.5)	(-2.2)	(-2.8)	(-3.1)
EGS	-7.47	-1959	-34.35	-50.39	-66.84	-83.64
(%)	(-0.3)	(-0.)	(-1.3)	(-1.9)	(-2.5)	(-3.1)
MGS	-4.02	-4.07	-15.15	-20.89	-22.40	-33.71
(%)	(-0.2)	(-0.2)	(-0.9)	(-1.2)	(-1.3)	(-1.9)
PGDP	0.088	0.017	0.149	0.168	0.053	0.087
(%)	(0.1)	(0.0)	(0.2)	(0.2)	(0.1)	(0.1)
NLE	-0.175	-0.549	-1.094	-1.321	-1.935	-2.398
(%)	(-0.0)	(-0.1)	(-0.2)	(-0.3)	(-0.4)	(-0.5)
<The Rest of Japan>						
GDP	-858.8	-2,306.1	-3,903.3	-5,638.2	-7,331.7	-8,845.3
(%)	(-0.2)	(-0.5)	(-0.8)	(-1.1)	(-1.4)	(-1.7)
CP	-130.5	-310.5	-626.3	-845.6	-1,250.5	-1,591.3
(%)	(-0.1)	(-0.2)	(-0.3)	(-0.4)	(-0.5)	(-0.6)
IP	-174.5	-477.5	-840.1	-1,257.5	-1,694.3	-2,110.8
(%)	(-0.3)	(-0.7)	(-1.3)	(-1.7)	(-2.2)	(-2.7)
EGS	-766.8	-2,017.7	-3,582.9	-5,361.4	-7,294.2	-9,346.9
(%)	(-1.1)	(-2.8)	(-5.0)	(-7.3)	(-9.7)	(-12.1)
MGS	-157.2	-459.9	-862.4	-1,319.8	-1,795.6	-2,264.8
(%)	(-0.3)	(-0.9)	(-1.7)	(-2.5)	(-3.4)	(-4.2)
PGDP	-0.019	-0.078	-0.184	-0.355	-0.585	-0.869
(%)	(0.0)	(-0.1)	(-0.2)	(-0.4)	(-0.7)	(-1.0)
NLE	-25.713	-80.720	-154.201	-232.356	-305.552	-369.925
(%)	(-0.0)	(-0.1)	(-0.3)	(-0.4)	(-0.5)	(-0.6)

6. Concluding Remarks

This paper analyzed the macro economic structure and determinants of growth in the regional economies of Japan, focusing on Niigata, Toyama, Ishikawa and Fukui prefectures. These neighboring prefectures are all located along the coast of the Japan Sea. However, their macro economic structures are very different. The marginal propensity to consume is notably different among the four prefectures, conservative as the consumption behavior is in these prefectures. In addition, the Keynesian multiplier explains the different macro economic structure.

Concerning the growth performance of these prefectural economies, with the world economic recession, these prefectures are expected to experience damage and negative economic growth for a few years from FY2009 to FY2010 and to continue the deflationary economy in the forecasted period. In the case that the world recession will continue in the future, all of the regional economies including Niigata, Toyama, Ishikawa and Fukui prefectures will probably sustain sever damage through decreasing exports demand. Niigata Prefecture will sustain the largest negative impacts, Ishikawa and Fukui will be next and Toyama Prefecture will experience the least damage according to the scenario simulation.

Even in the case of the baseline forecast, the growth performance of the regional economies will be very weak, so that the central government will be requested to implement strong measures to regenerate them, through the process of decentralization and the reform

of public finance and administration.

Due to the lack of data related to bilateral intra-national trade this study cannot link the regional economies between prefectures. Therefore, in future research, we will attempt to estimate bilateral intra-national trade information and develop bilateral linkages between prefectures in the 47-prefecture-based regional model of Japan.

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Appendices

Appendix A: Estimation of capital stock data in four prefectures

Due to the lack of capital stock data of regional economies, we estimate capital stock data using the Japanese capital stock ratio to GDP (λ) by sector, as follows.

$KP_0 = \lambda_1 GDPprimary_0 + \lambda_2 GDPsecondary_0 + \lambda_3 GDPtertiary_0$

$\lambda_1 = KPprimary_0$<Japan>/$GDPprimary_0$<Japan>

$\lambda_2 = KPsecondary_0$<Japan>/$GDPsecondary_0$<Japan>

$\lambda_3 = KPtertiary_0$<Japan>/$GDPtertiary_0$<Japan>

Then, based on benchmark year capital stock, $KP_0(KP_{1990})$, KP from 1991 to 2006 is calculated using the following equation.

KP(t)=KP(t-1)+IP(t)-DP(t)

Appendix B: Dynamic Reliability Test with MAPE by Prefecture, FY1991−FY2006 (%)

	GDP	CP	IP	MGS	EGS	GDPS	PGDP
Niigata	0.94	0.64	8.32	1.99	1.61	1.49	0.46
Toyama	1.47	1.12	4.98	2.49	2.70	2.53	0.78
Ishikawa	1.67	0.80	4.97	2.42	1.71	1.29	0.58
Fukui	1.10	0.81	5.24	1.89	2.21	2.41	0.53
The rest of Japan	1.21	1.76	3.95	2.14	1.24	0.99	1.65

Appendix C: Regression Results of Major Variables in National Macro Sub-Model

INLR = 6.52330 + .905450*(INTOR) - 3.57507 (M2CD/GDPN)
(10.06) (20.74) (-7.29)
sample 1981-2007 R^2ADJ = .989 SE = .269172 DW = 1.528
INTGB = - .971227 + .800017*(INTPR) + .264880 (INTGB.US) - .005143 (EXR)
(-5.01) (18.07) (3.83) (-2.20)
sample 1981-2007 R^2ADJ = .991 SE = .227874 DW = 1.485
M2CD = - 104550.8 + .300974 (GDP) + 60840.1 (MB/MB(-1)) + .847128 (M2CD(-1))
(-2.15) (2.20) (2.21) (14.07)
sample 1981-2007 R^2ADJ = .997 SE = 8,867.45 DW = 1.650
LOG(PEX) = - .532228 + 1.0542 LOG(PX) + .2974 LOG(EXR) - .2452 LOG(GDPC(-1)/L(-1))
(-2.36) (4.04) (6.09) (-2.11)
sample 1982-2007 R^2ADJ = .984 SE = .020279 DW = 1.379
EXR = 48.6830 + 86.7892 (PEXIY(-1)/USPGDP(-1)) - 89.3972 (INTGB/USGB30)
(6.21) (13.65) (-4.25)
sample 1981-2007 R^2ADJ = .906 SE = 14.5829 DW = 1.302
EXG = 10386.6 + 3.00088 (TWM) - 779813.3 (PEX/EXRI/PTW) + .609166 (EXG(-1))
(2.49) (2.49) (-2.39) (3.46)
sample 1981-2007 R^2ADJ = .986 SE = 1,913.93 DW = 2.032
LOG(MG) = - 15.044 + 1.126LOG(GDP) - .5051LOG(PM$*EXRI) + .366LOG(MG(-1))
(-3.10) (4.69) (-2.90) (3.83)
sample1985-2007 R^2ADJ = .973 SE = .073693 DW = 1.538
EGS = 2156.13 + 1.07173 (EXG+EXS)
(2.57) (56.05)
sample 1981-2007) R^2ADJ = .992 SE = 1,592.58 DW = 1.223
MGS = 1084.52 + 1.06956 (MG+MS)
(1.75) (63.10)
sample 1981-2007 R^2ADJ = .994 SE = 1,132.01 DW = 1.438

(INTLR: Prime rate, INTGB: government band yield, EXR: yen rate to US$, M2CD: money supply (M2+CD), MB: monetary base, TWM: real world import, PTW: world trade deflator, EXG: real merchandize exports, MG: real merchandize imports, EGS: real exports of goods and services, MGS: real imports of goods and services)

Appendix D: Major Exogenous Variables for the Baseline Forecast

	2008	2009	2010	2011	2012	2013	2014	2015
INTOR(%)	0.25	0.10	0.10	0.10	0.10	0.10	0.10	0.10
USPGDP(%)	0.25	0.20	0.25	0.25	0.25	0.25	0.25	0.25
USINTGB(%)	4.50	5.00	5.00	5.00	5.00	5.00	5.00	5.00
TWM(%)	-6.50	-5.50	3.00	3.00	3.00	3.00	3.00	3.00
PTW(%)	8.50	5.00	3.50	3.00	2.50	2.50	2.50	2.50
MB(%)	1.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00

(INTOR: policy rate of interest (official discount rate), USPGDP: U.S. implicit deflator of GDP, USINTGB: 30 year government bond yield of the U.S., TWM: real world imports, PTW: deflator of the world imports, MB: monetary base)

Determinants of Per Capita Income Growth of the Japanese Regional Economies on a Basis of 47 Prefectures: An Econometric Analysis in a Framework of "New" Growth Theory

Osamu Nakamura*

Abstract

This paper analyzes the determinants of per capita income growth in the Japanese regional economies utilizing the framework of "new" growth theory. The regression analysis is conducted by using the 47-prefecture cross section data set in FY1996−FY2005. According to the results of this regression analysis, although unconditional convergence cannot be observed, conditional convergence can be observed significantly with some control variables including investment-GDP ratio, population growth, employment-population ratio, and labor productivity. It is worth noting that labor productivity, which explains the differences of industrial structures, technology, culture, etc. among regions, is very significant in explaining per capita income growth. In addition, employment -population ratio, which explains the situation of an aging population structure, labor market and so on, is also significant. However, the rate of convergence is very limited at 1.232 per cent per annum. It seems therefore per capita income disparities among 47 prefectures cannot be reduced in the short-run without strong policies.

KEYWORDS: Per capita income growth, new growth theory, rate of convergence, reform of public finance

1. Introduction

After the bursting of the bubble economy, the Japanese economy experienced a long-run economic stagnation extending over ten years which was called the "lost decade". The economy was revitalized after FY2001, experiencing the longest boom since WWII. However, it seems that this boom did not necessarily contribute to the improvement of household disposable income and employment in spite of the large profits enjoyed by Japanese companies.

Especially, per capita income disparity has been increasing in this period with an unstable employment situation, which is becoming a crucial socio-economic problem. Furthermore, this problem is more serious in the rural economies affected by the reduction of public works expenditures through the process of the reform of public finance and administration implemented by the central government, which results in "income disparity among regions".

This paper, therefore, analyzes the determinants of per capita income growth of the Japanese regional economies utilizing the framework of "new" growth model focusing on the growth performance of 47 prefectural economies.

In broad overview, "new" growth theory began to develop since the mid-1980s and

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very substantial results have come out. Romer (1986) and Lucas (1988) are the pioneering scholars in this field. In this "new" growth model framework, one of the most remarkable points is whether or not convergence can be observed among different countries. Many studies could not identify a convergence of per capita income among countries, which was different from the assumptions of "neo-classical growth model" and gave rise to heated arguments at that time.

On the other hand, some studies did discern convergence of per capita income. Barro and Sala-i-Martin (1992), for example, observed convergence of Japanese regional per capita income by using the 47 Prefecture base data set. In their study, both conditional and unconditional convergence among the 47 prefectures was recognized in the long-term (1930−1990) with initial level of per capita income variables and dummy variables.

2. Regional Growth Performance in Japan

2.1 Macro Economic Growth of Japan

The Japanese economy experienced zero percent economic growth after the bursting of the bubble economy in FY1991, and recorded the longest economic boom after FY2001. However, this long boom was not the results of central government policies such as the reform of public finance and privatization, which were emphasized by the former cabinet, but was dependent on increases of exports and of related industrial investments sustained by strong foreign demand. Furthermore, during this long boom, although some major manufacturing companies could increase their profits, many small and medium size companies could not increase their profits and wage rate increase was therefore stagnant.

In this period, government investments were drastically decreasing under the reform of public finance and administration policy. In terms of SNA, Japanese real government investments decreased from 40.6 trillion yen in FY1995, 34.4 trillion yen in FY2000 to 21.0 trillion yen in FY2006, half the level of FY1995.

In addition, after the financial crisis in the US, the long boom in Japan also came to an end and it is expected that real GDP growth will be negative in FY2008 and FY2009. According to our economic forecasts of the Japanese economy utilizing a macro econometric model (Nakamura 2008), real GDP growth rate is expected to be minus 2.9 % in FY2008 and minus 1.5% in FY2009. Without effective economic policies, the economic situation will deteriorate and a deflationary spiral will accelerate in the near future.

Concerning the unemployment problem, it is expected that percentage of unemployed will increase from 4.2% in FY2008 to 5.0% in FY2009, to 5.5% in FY2010.

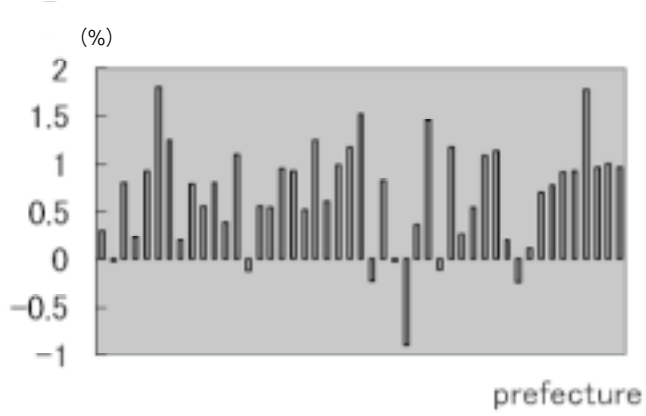
2.2 Regional Economic Performance after the Bursting of the Bubble

After the bursting of the bubble economy, the regional economies were also stagnant during the 1990s. In spite of the large scale fiscal policy and zero percent interest rates policy, the regional economies barely sustained low economic growth in this period. However, with a large decrease of government investment under the reform of public

finance and administration policy, most of the regional economies recorded low economic growth even in the period of the long boom after FY2001.

Figure 1 shows annual average growth rates of real per capita income by prefecture in the period FY1996−FY2006. As shown in Figure 1, with various influences including the bursting of the bubble, the reform of public finance, the world economic boom, etc., regional economic performances were different by prefecture. In this period, although the averaged growth rate of per capita income of Japan, as a whole, was 0.68 per cent per annum, seven prefectures, including Aomori, Kanagawa, Shiga, Osaka, Hyogo, Tottori and Ehime, recorded a negative growth.

Figure 1 Annual Average Growth Rates of Real Per Capita Income by Prefecture, FY1996−FY2006



(From left hand side in Fig.1, 47 prefectures from Hokkaido to Okinawa, which corresponds to the order of prefectures in Appendix Table A)

3. Model

3.1 "New" Growth Model

"New" growth model is a so called "endogenous" growth model. In "neo-classical growth model", economic growth is determined by factors of production including capital, labor, technology, etc. which are determined exogenously and dependent on the assumption of a constant return to scale and diminishing return. In addition, in a steady state, only technical progress can shift economic growth performance (Solow 1956, Swan 1956). In other words, each country has the same production function and its growth rates are converged in the long term.

On the other hand, "new" growth model emphasizes the importance of factors of production which are determined endogenously in the economy. In addition to that, this

model asserts that each country has a different production function and each country's rates of growth are not converged to a steady state. Mankiw, Romer and Weil (1992) analyze the importance of human capital using a conventional Cobb-Douglas type production function.

Nevertheless, many studies have failed to prove the explanatory power of these models and have, ironically, strengthened the reliability of neoclassical growth theory. Although there are many problems to be overcome in this growth model, this study analyzes the determinants of per capita income growth of the regional economy of Japan focusing on "convergence" of per capita income.

3.2 Model Structure

Generally, in applying "new" growth theory to country analyses with panel-data or cross-section data set, we employ a model specification, as follows.

$$ln(qi,t)/ln(qi,t\text{-}T)) = \alpha + \beta ln(qi,t\text{-}T) + \delta Wi,t\text{-}T + \eta i + \theta t + ei,t$$
$$qi,t = Qi,t / Ni,t$$

where Q is real national income, N is the number of population, W refers to vector of other control variables, T means the sub-sample period, η indicates country specific effects, θ means common shock of each country in the sub-sample period.

In accordance with past studies related to this growth model approach, control variables included in W in the equation are very important, in which three variables including the investment ratio, population growth, and education expenditures are robust, in general (Levine and Renelt 1992). This is directly related to the issue of "endogeniety" in the model. However, this study focuses on "convergence", not on "enodogeniety" as seen in the term "endogenous growth theory", so that this study employs various type of control variables based on economic theories.

In the equation, coefficient β of initial level of per capita income (ln(qi,t-T)) is a so called "β convergence", which is very important information to determine whether per capita income is converged or not among countries.

On the other hand, when we employ this framework for the Japanese regional per capita income growth, we need to consider other control variables to explain the regional economic performance. Japan is an archipelago extending from Okinawa to Hokkaido, surrounded by sea and containing many mountainous areas. In terms of economic geography, industrial structures, labor market structures, etc. are different among regions. Accordingly, this study considers additional control variables such as labor productivity and employment ratio to population. However, it seems that educational expenditures are not so important to explain the growth disparity among regions in Japan, since the educational system is similar among regions and mobility of labor of high school and university graduates is flexible throughout the nation. In addition, the investment ratio is divided into both the private investment ratio and the government investment ratio to GDP.

In this study, we have tried to analyze the significance of many control variables and their combinations, considering various theories many times. Eventually, it was decided to employ a theoretical model specification[1)], as follows.

$$(1/T)(\ln(qi,t)/\ln(qi,t\text{-}T)) = \alpha\text{-}((1\text{-}\exp(\text{-}\beta T))/T)\ln(qi,t\text{-}T)+\delta_1 IPGi+\delta_2 IGGi+\delta_3 NGRi$$
$$+\delta_4 LENi+\delta_5 LPIi+\delta_6 IPGi*IGGi+ei,t$$

where IPG, IGG, NGR, LEN, LPI are the period average ratio of real private investment to GDP, the period average ratio of real government investment to GDP, the average growth rate of population per annum, the period average ratio of employment to population and averaged labor productivity, respectively.

The model specification is becoming more complicated as compared to the general specification mentioned above, in order to calculate annual rate of convergence, β. In addition, this study does not employ regional specific variables (η) and common shock in the sub-sample period (θ) presented in the general specification, since the study employs regional cross section data.

With respect to expected sign of each coefficient in the theoretical model, it seems that β, δ_1, δ_2, δ_3, δ_4, δ_5, and δ_6 are positive or negative, positive, positive, negative, positive, positive, and negative, respectively. If coefficient β is positive, it means that the per capita income of each regional economy is converged.

4. Analysis of the determinants of per capita income growth

Based on the theoretical model, we conducted two regression analyses with OLS employing a 47-prefecture basis cross section data set in FY1996−FY2005.[2)]

Table 1 shows regression results with non-linear LS for two cases, unconditional and conditional convergence. In the case of unconditional convergence, the result shows that positive as coefficient β is, the initial level of per capita income (ln(qi,t-T)) is not significant. As shown in Figure 2, a correlation between the per capita income growth (vertical) and the initial level of per capita income in logarithm (horizontal) cannot be seen. In other words, unconditional convergence cannot be observed among the 47 prefectural economies in this period.

On the other hand, in the case of conditional convergence, all the control variables are significant. As for β coefficient, β is positive at 0.01232 which means that conditional convergence is observed and per capita income among the regional economies is converged at 1.232 per cent per annum in FY1996−FY2005 with a condition of other control variables.

Table 1 Regression Results of Per Capita Income Growth of 47 Prefectures with Non-Linear LS

$(1/T)(\ln(qi(t)/qi(t-T)) = \alpha-((1-\exp(-\beta T))/T)\ln(qi(t-T))+\delta_1 IPGi+\delta_2 IGG+\delta_3 NGR+\delta_4 LEPi+\delta_5 LPIi+\delta_6 IPGi*IGGi$

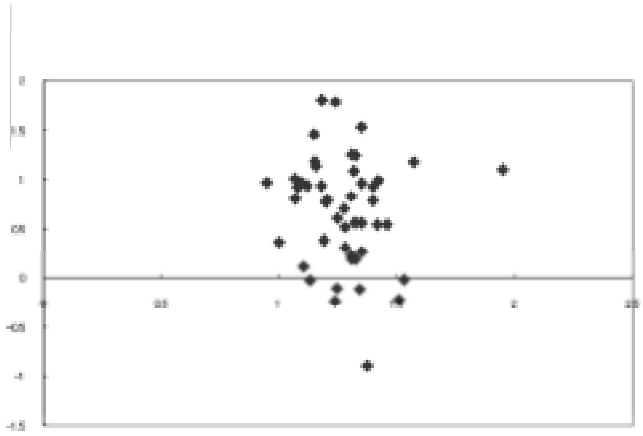
	Unconditional	*(S.E., t-value)*	*Conditional*	*(S.E., t-value)*
α	0.01088	(0.0062, 1.7416)	-0.15830	(0.0221, -4.78310)
β	0.01680	(0.0483, 0.6669)	0.01232	(0.0150, 7.25667)
δ_1			0.35626	(0.1425, 2.49961)
δ_2			0.38955	(0.2137, 2.17820)
δ_3			-0.56983	(0.2469, -2.3183)
δ_4			0.22972	(0.0306, 6.42490)
δ_5			0.01352	(0.0021, 7.50081)
δ_6			-3.45663	(1.7132, -2.01760)
R^2 (^{2}ADJ)	0.00978(0.001243)		0.63919(0.57443)	

As for other control variables, both private and government investments have similar impacts, in which the coefficients, 0.35626 and 0.38955, are fairly steady. This means that a one percentage point increase of each investment ratio results in an increase of per capita income growth rate by 0.35626 percent and 0.38955 percent, respectively. Concerning the population growth, the coefficient of this variable is expected between 0 and -1, theoretically. The estimated coefficient is -0.5698, which is acceptable, theoretically and statistically, since the dependent variable is per capita income growth.

With respect to employment ratio to population, the estimated coefficient is 0.2297. In a neo-classical type production function, this control variable means labor in a sense, so that a one percentage point increase of employment ratio results in an increase in per capita income growth by 0.2297 percent. In addition to that, labor productivity is also significant and its estimated coefficient is 0.01353, which is a sort of technology in a conventional production function. Accordingly, each coefficient and its combination in the regression result may be seen to be plausible.

Regarding overall performance of the result, adjusted R^2 is 0.5744, which is not so high, but acceptable in the regression analysis with a cross section data set.

Figure 2 Correlation between Real Per Capita Income Growth and Initial Level of Per Capita Income in Logarithm



log(per capita income initial level)

5. Concluding Remarks

In accordance with the analysis of the Japanese regional per capita income growth and its determinants by means of "new" growth model utilized in this study, all control variables, including the initial level of per capita income, both private and government investment ratio, employment ratio and labor productivity, can explain per capita income growth significantly. The model structure is becoming similar to "neo-classical growth model", which is explained by factors of production such as capital, labor and technology. In addition to that, convergence of per capita income among the prefectural economies can be observed, which also tends to support neo classical theory. As Thirlwall (2002) commented critically, "Nothing to change…" regarding economic theories in this field.

However, this study has been able to introduce some important implications, as follows.

(1) In this sample period, FY1996−FY2005, dispersion of per capita income among prefectural economies could not be observed, but conditional convergence could be seen. However, the rate of convergence itself is very limited at 1.232 per cent per annum, so that the income and growth disparities as seen in Figure 2 cannot be decreased in the short term without employing strong policies to improve this situation.

(2) Both investment ratios are significant. The private investment ratio is more significant than the government investment ratio. Government investment, however, has larger impacts on growth, which means that reductions of government investment through the reform of public finance and administration deteriorate income and growth disparities.

(3) With fewer children and an aging society, employment ratio to population indicates labor demand to strengthen the supply side economy as a factor of production. Especially in

rural areas, this indicator explains the potentiality for growth so that strong policies to increase the employment rate are indispensable.

(4) Differences of labor productivities among regions are indicating various factors such as economic and industrial structures, companies' technology, comparative advantage structure, culture and history, and so on. Accordingly, it is noteworthy that each regional economy is able to accelerate growth, strengthening their comparative and absolute advantages with strong policies by both private and public sectors, through decentralization and regional autonomy.

For further study in the future, we will employ a panel data set and regional specific variables such as a regional dummy, etc. to improve regression results. At the same time, we will conduct some scenario simulations for planning policies to improve not only the national economy but also regional economies.

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Notes:

1) This study depends on a formal model with theories, not on an informal model.

2) Data sources:

Statistical Year Book by Prefecture

Annual Report on Prefectural Accounts by Economic and Social Research Institute

Appendix Table A. 47 Prefecture Cross Section Data Set, FY1996−FY2005

	ln(qi,t)/ ln(qi,t-T)/T	ln(qi,t-T)	NGR	IPG	IGG	LEN	LPI
Hokkaido	0.31120	1.28090	-0.13670	0.09797	0.11605	0.47376	8.40882
Aomori	-0.02390	1.13112	-0.35336	0.16009	0.10223	0.49679	6.88173
Iwate	0.79350	1.20485	-0.27995	0.11810	0.11383	0.54886	6.92289
Miyagi	0.22890	1.30687	0.10384	0.13249	0.07104	0.49454	8.29152
Akita	0.93382	1.17912	-0.60479	0.12571	0.13494	0.49938	7.35508
Yamagata	1.78628	1.18156	-0.34858	0.13781	0.09770	0.52310	7.40277
Fukushima	1.24586	1.30875	-0.22694	0.14574	0.07332	0.50312	8.40203
Ibaraki	0.19302	1.32488	0.03318	0.14157	0.07004	0.48666	8.67897
Tochigi	0.78528	1.39965	0.14490	0.12997	0.04812	0.51933	8.70036
Gunma	0.56189	1.32277	0.08561	0.13036	0.05627	0.52215	8.14019
Saitama	0.80205	1.06872	0.40186	0.11814	0.04545	0.39219	8.36085
Chiba	0.38568	1.19153	0.44785	0.12221	0.07130	0.39642	9.12889
Tokyo	1.09529	1.95159	0.70028	0.12535	0.02499	0.69818	11.79608
Kanagawa	-0.11646	1.34232	0.66776	0.12745	0.04177	0.42177	9.75752
Niigata	0.56090	1.35109	-0.26575	0.13468	0.09686	0.52653	8.13645
Toyama	0.54568	1.45924	-0.12847	0.13778	0.08054	0.53085	8.92259
Ishikawa	0.95580	1.35057	-0.06555	0.12434	0.09228	0.53267	8.27020
Fukui	0.92802	1.40024	-0.08979	0.13136	0.09280	0.53612	8.54294
Yamanashi	0.51958	1.28022	-0.00103	0.14310	0.10100	0.51443	7.82340
Nagano	1.23666	1.32482	-0.03555	0.13390	0.08671	0.53945	8.00239
Gifu	0.61069	1.24788	0.01605	0.12436	0.08751	0.50200	7.72113
Shizuoka	0.98824	1.42206	0.13855	0.13241	0.04493	0.56289	8.41183
Aichi	1.17061	1.57347	0.56162	0.16073	0.04150	0.56582	9.54039
Mie	1.52215	1.34976	0.12259	0.18745	0.06905	0.49815	8.86967
Shiga	-0.22477	1.50936	0.68158	0.12538	0.06659	0.47734	10.17121
Kyoto	0.82760	1.30620	0.05544	0.11896	0.05946	0.47492	8.80587
Osaka	-0.01811	1.53118	0.01310	0.13080	0.03715	0.53005	9.42132
Hyogo	-0.90115	1.37503	0.34162	0.14794	0.07172	0.42929	9.43323
Nara	0.36741	0.99959	-0.12512	0.11730	0.08253	0.35159	8.48966
Wakayama	1.45030	1.14854	-0.45725	0.12360	0.10954	0.45964	7.86065
Tottori	-0.10761	1.24566	-0.13643	0.12886	0.11222	0.52906	7.24052
Shimane	1.17353	1.15209	-0.40409	0.12616	0.15626	0.51951	7.22914
Okayama	0.26983	1.35120	0.03587	0.12927	0.07244	0.49426	8.52235
Hiroshima	0.54482	1.41778	-0.01835	0.12791	0.06466	0.51055	8.94310
Yamaguchi	1.08157	1.31797	-0.41984	0.14075	0.07053	0.49543	8.60223
Tokushima	1.12921	1.15724	-0.28854	0.14040	0.10247	0.48846	7.64648
Kagawa	0.19628	1.30790	-0.15540	0.14278	0.06021	0.51247	8.04668
Ehime	-0.23946	1.23718	-0.27782	0.13324	0.08845	0.50804	7.34952
Kochi	0.11602	1.10349	-0.27433	0.11796	0.13932	0.49184	6.91692
Fukuoka	0.70574	1.27549	0.21655	0.12863	0.06462	0.47397	8.43798
Saga	0.77081	1.20046	-0.22765	0.13391	0.09318	0.50088	7.47663
Nagasaki	0.92024	1.07931	-0.45388	0.14834	0.10561	0.47029	7.00583
Kumamoto	0.93386	1.11991	-0.11224	0.14387	0.08653	0.49200	7.00428
Oita	1.76797	1.23906	-0.18420	0.15929	0.08309	0.47445	8.74340
Miyazaki	0.96501	1.09501	-0.22473	0.13243	0.11094	0.49536	6.94819
Kagoshima	1.00438	1.06732	-0.25063	0.13618	0.11981	0.47329	7.12582
Okinawa	0.96351	0.94633	0.67168	0.12677	0.12199	0.41286	7.21432

Income Mobility in Korea: 1998−2002

Hae-Ryun Kim*

Abstract

This paper presents an empirical analysis of the extent of income mobility and change of income mobility in Korea from 1998 to 2002 using various measures of mobility. One of the major findings is the mobility of the lowest and highest income classes is quite static, while that of total mobility is high compared to other OECD countries. In addition, a female household head is more likely to move down compared to a male household head, indicating that they could suffer more economic hardship than males for the time period. The result for changes in mobility is also in contrast to that of the extent of overall mobility. Although there was significant income mobility, the extent of mobility has decreased over five years. As a result, inequality after IMF crisis in 1997 still remained at a high level, and moreover it could be aggravated in the future.

Keywords: Inequality, income mobility

1. Introduction

It has generally been accepted that distributions of economic well-being at one point in time could give incorrect information about economic well-being, if considering life-time economic well-being. Measuring inequality is like a snapshot. It does not reflect whether an individual or household moves up or down on their income ladder due to change of opportunities, change of economic policy, or change of business cycles, etc. Moreover, it is considered that inequality at a given point in time is over-estimated compared with life-time inequality, if there is income mobility. Income mobility could be defined as having two aspects: absolute and relative mobility. Absolute mobility shows the change in income level over time, whereas relative mobility measures the change in the relative position of an individual in income distribution over time. However, it is disputed whether inequality would be aggravated in the presence of higher income mobility. Mobility can only offset increased inequality if the changes in the extent of mobility also increase over time (Gottschalk and Danziger, 1997). Korea was thought to be a country reducing its inequality in the path of rapid economic development, indicating there might be higher income mobility. However, this reputation changed after it experienced the IMF financial crisis in 1997. The inequality in Korea is regarded as having been aggravated right after the crisis, and it still remains at a high level even after recovering from the economic recession. Furthermore, it is questionable whether there is still higher income mobility in Korea. Therefore, it is necessary to examine the situation of income mobility in Korea with that of inequality.

This paper examines the extent of income mobility, and whether or not income

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mobility reduced income inequality after the IMF crisis in Korea using several alternative income mobility measures. To examine whether there is different mobility by sex, the mobility rate of households is shown for households where the head is male, and where the head is female. In addition, the trend of change in the extent of mobility is investigated to anticipate the future inequality situation with the equalizing effect of mobility.

The structure of the paper is as follows. In Section II , I discuss how to construct a longitudinal data building procedure using a currently available micro-data set, and explain various kinds of measures for income mobility: correlation coefficients (Pearson and Spearman), transition matrices and Shorrocks' mobility index. Employing elaborated longitudinal micro-data, Section III shows the empirical result for the inequality and income mobility of Korea. Finally, I summarize the findings, and make conclusions.

2. Data and Measurement

2.1 Data

The source of the data is a micro-data set of the Household Income and Expenditure Survey (HIES) from 1998 to 2002. The income and expenditure unit is a household, and surveyed income and expenditure are on a monthly basis. For investigating income mobility, longitudinal data are usually required. Unfortunately HIES is not designed for the purpose of longitudinal survey. However, the same households were surveyed for 5 years before changing the sample according to the population census which is implemented every 5 years. Moreover, each household could be identified by an identification number. Therefore I constructed longitudinal data according to the household identification number.

The data building procedure is as follows: first of all, only employee households were selected, because income for non-employee households[1] was not available due to the policy of the Statistics Korea (KOSTAT). All duplicated households were deleted from the sample.[2] Secondly, monthly income is converted into annual income for all households which had an income for 12 months a year. Annual income is the average monthly income over 12 months. Then, households with income and other attributes for 5 years, i.e., from 1998 to 2002 continuously, were selected. I chose the households where the head of the household was between 20 and 65 years of age with a view to focusing on households which are just entering the labor market, and those which are not retired.

Consequently, there is a considerable amount of data attrition through the data processing procedure (Table 1). In this paper, the number of selected households was finally 606. The concept of income in this paper is regular income for employee households. In HIES, total income consists of regular income and irregular income. The former is classified into salaries and wages, self-employment and subsidiary work income, income from assets,

[1] In HIES, households are classified into two types: employee households and non-employee households. Non-employee households are defined as self-employed, managers and non-working households such as the unemployed, and people without occupation.

[2] In case of households with no response (missing households), households which had a similar income to that of the missing households were used for each month. However, the household identification number was also duplicated until 1999, thus it is difficult to build longitudinal data. Therefore, duplicate households were omitted.

and transfer income. The latter is defined as income such as retirement allowances, money received for congratulations or condolences, etc. Each income is deflated by the consumer price index, of which the base year is 2000, in order to obtain real terms of income.

Table 1 Number of surveyed households and selected longitudinal data in HIES data

Year	No. of surveyed households (Average)		No. of households with full 12 month	No. of selected households[1]
	Employee	Non-employee	Employee	Employee
1998	3,098	2,272	1,531	606
1999	2,931	2,315	1,584	606
2000	2,916	2,304	2,244	606
2001	2,837	2,304	2,158	606
2002	2,762	2,255	2,100	606

Note : 1. Number of employee households whose income is available consecutively for 5 years.
Source of number of surveyed households: KOSTAT (2002), "Annual Report on the Household Income and Expenditure Survey"

2.2 Measurement of Income Mobility

Mobility measure can be categorized into two classes: one-stage mobility measure and two-stage mobility measure. According to Cowell and Schluter (1998), one-stage mobility indices use full information about income distribution over a time period, that is, they are estimated directly from the data, while two-stage mobility indices at first convert income distribution into grouped distribution, and then they are examined. The correlation coefficient, Shorrocks' mobility index, Field's and Ok's measures, and King's measure, are included in one-stage indices. The standard example for two-stage indices is the transition matrix and related indices. Mobility measures implemented in this paper are the Pearson and Spearman correlation, Transition Matrix, and Shorrocks' mobility index. Correlation coefficient is a mobility measurement that is based on the relationship between income at time t and that at time $t+k$ for each individual or household. The Pearson correlation coefficient $\rho_{Pearson}$ presents the relationship for individual or household incomes, as does the Spearman correlation coefficient $\rho_{Spearman}$ for an individual or household's income ranks. Large values of the correlation show a low degree of mobility. For transition matrix from time t to $t+k$, income recipients at each time are grouped into income classes whose incomes are the deciles or quintiles of income distribution. The ij^{th} entry of the matrix is the number of income recipients who have changed from income class i at time t to income class j at time $t+k$. Those who have not changed their income class over time are on the diagonal of the matrix.

Besides the diagonal, there are number of income recipients who have moved upward or downward over time. The Shorrocks' mobility index measures the degree of equalized effect of income mobility over a time period. Shorrocks (1978) suggests that mobility is estimated by the extent to which the inequality index for incomes averaged over the time period, are lower that of incomes in each period. This compares the inequality index over the time period with the weighted average of the annual index, with weights chosen to be proportional to the mean annual incomes.

Shorrocks' rigidity index is defined as

$$R(y_T) = \frac{I(\bar{y}_T)}{\sum_{t=1}^{T} w_t I(y_t)}$$

where $I(\cdot)$ denotes a certain inequality index, y_T is the $(N \times T)$ matrix of income of N recipients from time 1 to T, $\bar{y}_T$ denotes the $(N \times 1)$ vector of the averaged incomes of N recipients over the time period (i.e., $(\bar{y}_1, \bar{y}_2, \cdots, \bar{y}_N)$, where $\bar{y}_i = \frac{1}{T}\sum_{t=1}^{T} y_{it}$, i=1, ⋯, N), y_t denotes the $(N \times 1)$ vector of household incomes at time t, and $w_t = \frac{\sum_{t=1}^{N} y_{it}}{\sum_{i=1}^{N}\sum_{t=1}^{T} y_{it}}$ is the share of total incomes at time t to total income over the entire time period.

Finally, the mobility index is defined as $M(y_T) = 1 - R(y_T)$, ranging from 0 (complete immobility) to 1 (complete mobility).

3. Empirical Analysis

3. 1 Trend of Inequality

To see the overall situation of inequality in Korea, a longer time period of cross-sectional income inequality indices is estimated.[3] Figure 1 shows the trend of the Gini index and Mean Log Deviation (MLD) of regular income from 1990 to 2002. Before the IMF financial crisis in 1997, the degree of both indices was very stable. However, those indices in 1998 increased sharply after the crisis. The levels of indices were still high even though the economy recovered after 2000.

Using longitudinal data which was built through the data processing presented in section 2.1, longitudinal inequality indices are estimated.

Table 2 and Figure 2 show income inequality in each of 5 different year and 4 different accounting periods, that is, from 1998 to 1999, from 1998 to 2000, from 1998 to 2001, and from 1998 to 2002. Trends of longitudinal inequality indices are similar to cross-sectional inequality, while levels of indices are lower because of data attrition.[4] The Gini index and MLD in 1998 were 0.2637 and 0.1308, respectively.

In 1999, the Gini index increased a little to 0.2653, while it decreased to 0.2495 in 2000 due to economic recovery after experiencing the IMF financial crisis. It started to increase again in 2001 at 0.2575. In 2002, it was 0.2573. MLD showed a similar trend. Income inequality decreased as incomes were averaged over longer periods of time, regardless of different inequality measurement, indicating that there was income mobility.

[3] After mean regular income per employee household using original micro data is calculated, the Gini index and MLD are estimated. Although some households were not surveyed for all 12 months every year, I include them to avoid the data attrition problem. The average number of samples was 3,650 from 1990 to 2002.

[4] The number of households in longitudinal data is 606 per year, while that in cross-sectional data is an average of 3,650 from 1990 to 2002.

Figure 1 Trend of cross-sectional income inequality

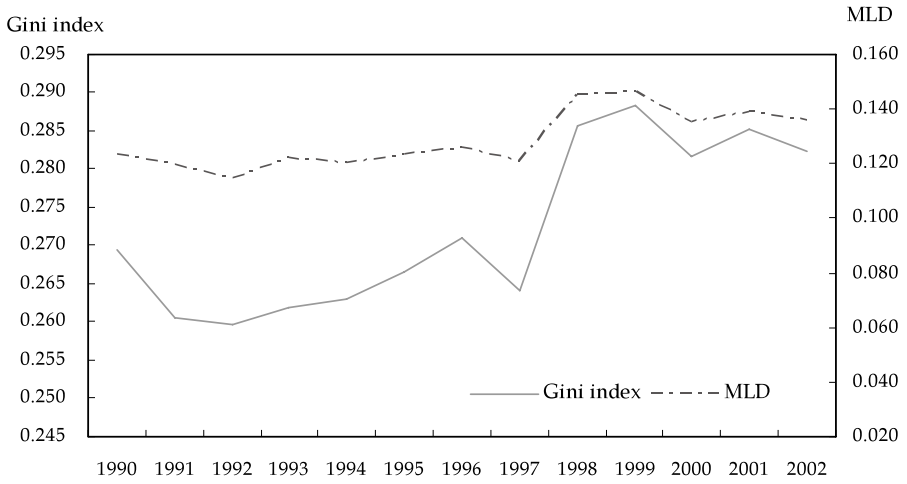
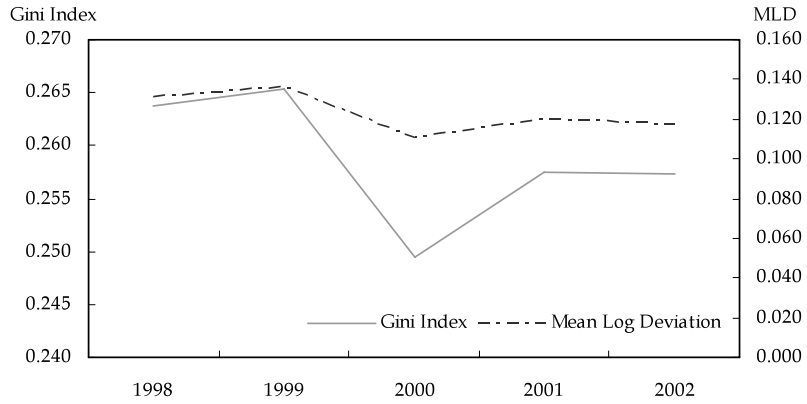


Table 2 Income inequality and average income

Year/Period	Income Inequality		Income (1,000 won)	
	Gini Index	Mean Log Deviation	Average Income	Median Income
1998	0.2637	0.1308	25,614	23,685
1999	0.2653	0.1361	26,946	25,206
2000	0.2495	0.1104	29,533	27,532
2001	0.2575	0.1196	31,305	29,293
2002	0.2573	0.1173	33,289	31,461
Period 1(1998~1999)	0.2563	0.1192	26,280	24,311
Period 2(1998~2000)	0.2465	0.1049	27,364	25,294
Period 3(1998~2001)	0.2436	0.1015	28,349	26,324
Period 4(1998~2002)	0.2409	0.0987	29,337	26,948

Figure 2 Trend of longitudinal income inequality



3.2 Income Mobility

3.2.1 Correlation coefficient

Well-known measures of income mobility are the Pearson and Spearman coefficients of correlation in income per household between the base year and the final year. As the value of the correlation coefficient is close to 1, there is higher immobility, while as it approaches 0, there is higher mobility. The Pearson and Spearman coefficients between 1998 and 2002 were 0.7466 and 0.6894, respectively. The correlation coefficient between 2 adjacent years shows a higher relationship than that over a 5 year time span. Interestingly, the value of the coefficient decreases as the time span increases. This indicates the degree of mobility increases as the length of the accounting period increases.

Table 3 Correlation coefficient result

Year	Pearson correlation coefficient					Spearman correlation coefficient				
	1998	1999	2000	2001	2002	1998	1999	2000	2001	2002
1998	1	0.8816	0.8127	0.7775	0.7466	1	0.8648	0.7744	0.7503	0.6894
1999		1	0.9001	0.8297	0.7927		1	0.8860	0.8318	0.7716
2000			1	0.9061	0.8498			1	0.9058	0.8330
2001				1	0.9125				1	0.9064
2002					1					1

3.2.2 Transition matrix

For transition matrix, first of all, all households are grouped into 5 income classes (quintiles) according to their income level. The rows and columns of the matrix correspond to quintiles of households in the base year and those in the final year, respectively. Each entry shows the number or percentage of households who change or remain in their income classes from the base year to the final year. Households who do not move over time are in the main diagonal, while households who move up or down are in the off-diagonal. The sum of each row is the same as the total number of selected households, i.e., 606 or 100 percent. In this paper, year 1998 and 2002 are compared to estimate mobility rate in the transition matrix. As seen from Table 4, the percentage of all households who remained in the same quintile in 1998 and in 2002 was 43.1 in both years. With regard to direction of income mobility, the upward movement was larger than the downward movement. The upward mobility rate was 30.5, and the downward mobility rate was 26.4. Mobility rates were lower for household in both the lowest and highest quintile. Specifically, 43.8 percent for the bottom quintile and 37.2 percent for the top quintile moved to another income quintile, i.e., the 2nd, 3rd and 4th quintile, whereas the mobility rate for other quintiles was more than 60 percent.

This may reflect the notion that the poor tend to remain poor and the rich tend to

remain rich. When seeing the lowest quintile, 56.2 percent of households in 1998 were still in the same quintile in 2002. Those who moved up to the 2nd, 3rd and 4th quintile were 24.8, 15.7 and 3.3 percent, respectively. No one moved up to top quintile. Although total mobility rate seemed to be high in the bottom quintile at 43.8, half of those in the bottom quintile were still there, and another 28.2 percent stayed in the next quintile (2nd quintile) over 5 years, indicating substantial immobility of the poor.

Table 4 Transition matrix by income quintile

(Units: households, %)

		Income quintile in 2002					Mobility rate		
		1st	2nd	3rd	4th	5th	Stay	Downward	Upward
Income quintile in 1998	1st	56.2 (68)	24.8 (30)	15.7 (19)	3.3 (4)	0.0 (0)	56.2	-	43.8
	2nd	19.0 (23)	37.2 (45)	28.9 (35)	13.2 (16)	1.7 (12)	37.2	19.0	43.8
	3rd	14.8 (18)	20.5 (25)	25.4 (31)	29.5 (36)	9.8 (12)	25.4	35.2	39.3
	4th	7.4 (9)	14.0 (17)	19.0 (23)	33.9 (41)	25.6 (31)	33.9	40.5	25.6
	5th	2.5 (3)	3.3 (4)	11.6 (14)	19.8 (24)	62.8 (76)	62.8	37.2	-
Sum		121	121	122	121	121	43.1	26.4	30.5

Note) Number of households per quintile is in parentheses

Most movement occurs toward the nearest quintile. Mobility rates to one quintile above and below were 21.8 percent and 15.7 percent, respectively. These rates were significantly higher than those to 2 or more quintiles away (Table 5). This suggests that there were no dramatic changes in mobility.

Table 5 Mobility using income quintile

(Units: %)

Change in quintile	Mobility rate
Upward	30.5
1 quintile above	21.8
2 quintile above	7.8
3 quintile above	1.0
4 quintile above	0.0
Downward	26.4
1 quintile below	15.7
2 quintile below	8.1
3 quintile below	2.1
4 quintile below	0.5
Stayed in same quintile	43.1
Total	100.0

To see whether there is different income mobility between households where the head of the household is male and where the head of the household is female, the mobility rate of income quintile by male and female household is shown in Table 6. There is higher mobility for male than for female. The total mobility rate for male is 57.6 percent, and that for female is 46.7 percent. Furthermore, females are less likely to move up than males. The upward mobility rate of female is 24.4 percent, whereas that of male is 32.5 percent. This indicates that the economic situation of a female household could easily suffer economic hardship as compared to a male household.

Table 6 Mobility rate of income quintile by sex of household head

(Units: %)

Income quintile	Male household head			Female household head		
	Stay	Downward	Upward	Stay	Downward	Upward
1	42.9	-	57.1	79.2	-	20.8
2	34.7	18.8	46.5	37.5	25.0	37.5
3	27.9	29.8	42.3	25.0	50.0	25.0
4	38.7	35.8	25.5	0.0	66.7	33.3
5	66.4	33.6	-	33.3	66.7	-
Total	42.4	25.1	32.5	53.3	22.2	24.4

3.2.3 Shorrocks' mobility index

Table 7 shows the degree of equalized effect of income as the time period is extended using different income inequality indices: the Gini index, and MLD. The mobility for four types of accounting period: 1 year (1998−1999), 2 years (1998−2000), 3 years (1998−2001), and 4 years (1998−2002), was estimated. As expected, mobility increases as the accounting period becomes longer.

The choice of inequality index for mobility measure does matter. Two indices showed a different level in mobility. The Gini index indicates a weaker equalizing effect than MLD. The overall equalizing effect between 1998 to 2002 was 10 percent for the Gini index and 19 percent for MLD. Compared to other OECD countries, the mobility rate of Korea was fairly high. The average mobility rate in 6 countries from 1989 to 1991 is 5.1 for the Gini index and 12.1 for MLD[5].

[5] 6 OECD countries are Denmark, France, Germany, Italy, United Kingdom, and the United States. For more detailed mobility figures, see *Employment Outlook* "Earnings Inequality: Taking a longer Run View" (1996) pp. 27−61, published by the OECD.

Table 7 Shorrocks' mobility index

Period	Using Gini index	Using MLD
1998−1999	0.016	0.076
1998−2000	0.064	0.149
1998−2001	0.085	0.182
1998−2002	0.097	0.198

3. 3 Change of Income Mobility

It has been argued that, if there is higher income mobility, concern over increased inequality is unnecessary. According to Gottschalk and Danziger (1997), this is not appropriate because only increases in {*the extent of} mobility can offset increased income inequality. They demonstrate this through the relationship between mobility, single-year inequality, and long-run inequality. Long-run inequality, which is denoted by the variance of income averaged over multiple years, can be decomposed into the average of yearly variances and the average of covariance of income across years as below.

$$\mathrm{var}(\bar{Y}) = \frac{1}{K^2}\sum_{t=1}^{K}\mathrm{var}(Y_t) + \sum_{t=1}^{K}\sum_{s\neq t}\mathrm{cov}(Y_t, Y_s)$$

$$= \frac{\overline{\mathrm{var}}}{K} + \frac{K-1}{K}\overline{\mathrm{cov}}$$

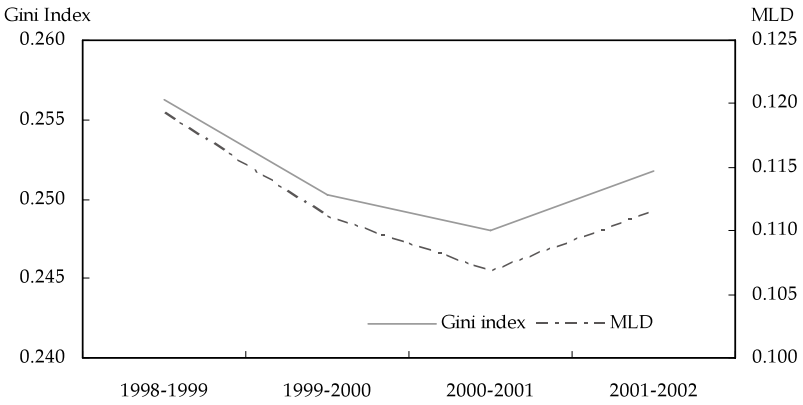
where $\overline{\mathrm{var}} = \frac{1}{K}\sum_{i=1}^{K}\mathrm{var}(Y_t)$ and $\overline{\mathrm{cov}} = \frac{1}{K^2-K}\sum_{t=1}^{K}\sum_{s\neq t}\mathrm{cov}(Y_s, Y_t)$

This can be interpreted as, increased annual inequality captured by the increase in $\overline{\mathrm{var}}$ can be offset by the increase in mobility captured by the decrease in $\overline{\mathrm{cov}}$. Therefore, I analyze the changes in inequality and those in income mobility using Shorrocks' mobility index in adjacent years: 1998−1999, 1999−2000, 2000−2001, and 2001−2002. Due to smoothing, the Gini index and MLD for each year-pair were lower than those for each different single year at about 0.25 and 0.11, respectively (Table 8 and Figure 3). The inequality level of each different single year was about 0.26 for the Gini index and 0.12 for MLD. Average and median incomes also were smoothed. Inequality in the first year-pair (1998−1999) was 0.256. That in the second year-pair (1999−2000) slightly decreased to 0.254, while that in the last year-pair (2000−1999) increased again.

Table 8 Shorrocks' mobility index

per Year/Period pairs	Mobility index	
	Gini index	Mean log deviation
1998−1999	0.0312	0.1074
1999−2000	0.0262	0.0944
2000−2001	0.0221	0.0723
2001−2002	0.0219	0.0586

Figure 3 Trend of longitudinal income inequality per year-pair

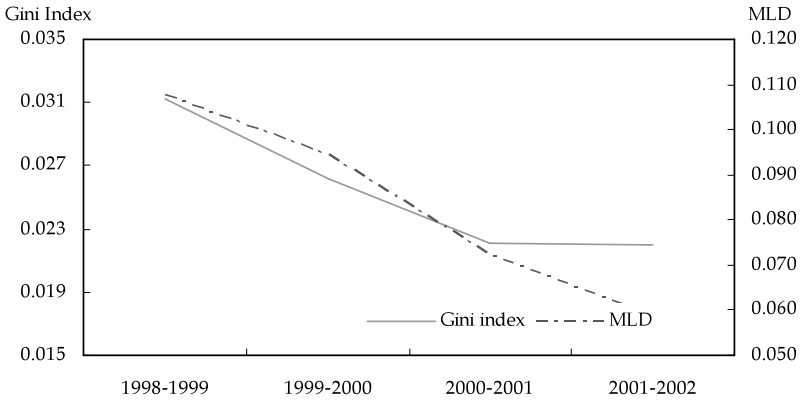


The change in the extent of income mobility decreased over time in both the Gini index and MLD. (Table 9 and Figure 4). The mobility index for the Gini index was 3.1 percent in the first year-pair, whereas it was 2.2 percent in the last year-pair. That for MLD was 10.7 percent in the first year-pair, and 5.9 percent in the last year-pair. The extent of mobility is lower than that for the 5 year accounting period. Therefore, this suggests that recent increased inequality would persist in the future as income mobility decreases.

Table 9 Income inequality and income per year-pair

Year/Period	Income inequality		Income (1,000 won)	
	Gini index	Mean log deviation	Average income	Median income
1998−1999	0.2563	0.1192	26,280	24,311
1999−2000	0.2503	0.1111	28,239	26,165
2000−2001	0.2480	0.1068	30,419	28,508
2001−2002	0.2518	0.1114	32,297	30,202

Figure 4 Trend of income mobility per year-pair



4. Conclusion

In this paper, I discussed the situation of household income mobility and inequality after the IMF financial crisis in 1997 with respect to inequality changes in Korea by various accounting periods: 2 years (1989−1999), 3 years (1998−2000), 4 years (1998−2001), and 5 years (1998−2002). For this purpose, various kinds of mobility measurement were implemented such as correlation coefficients, transition matrix, and Shorrocks' mobility index. In addition, the change of mobility over time was investigated for the purpose of forecasting the future inequality situation of Korea. In order to analyze income mobility, first of all, it is required that the data are longitudinal data. Therefore, I developed micro-data for *Household Income and Expenditure Survey* (HIES) into longitudinal data by household identification number and converted monthly cross-section data into annual longitudinal data, selecting households whose income data is available for a full 12 months and which were surveyed for 5 consecutive years: 1998−2002. Unfortunately, many households in the original survey data were dropped through this procedure. Moreover, income data for non-employee households are not available due to the policy of the Korean National Statistics Office (KNSO). Finally, the number of selected households is 606 out of over 5,000 original samples.

Empirical analysis shows meaningful results regardless of data attrition. Income inequality from 1998 to 2002 remained at a high level, although the economy overcame the recession induced by the IMF financial crisis in 1997. A higher degree of income mobility also was found in Korea between 1998 and 2002, compared to six OECD countries such as United States, Denmark, Germany, etc. This shows that the Korean economy has experienced dynamic changes over this period. However, the mobility by different income quintile presents another aspect. The mobility of the lowest and highest income class is quite static. Most of them stayed in their quintile over time. Moreover, most movement for both quintiles is explained by upward movement to the next quintile. Thus, this suggests that the social phenomenon whereby the poor tend to remain poor and the rich tend to remain rich, occurs in Korea.

Another finding is that there is different mobility by sex of household head. Female household heads are more likely to move down compared to male household heads, indicating that they could suffer more economic hardship than males for a given time period.

The most important finding in this paper is that the result of changes in mobility is also in contrast to that of the extent of overall mobility. Although there was significant income mobility, the extent of mobility has decreased over 5 years. As a result, inequality after the IMF crisis still remained at a high level, and moreover it could be aggravated in the future. Thus, it is necessary to pay more attention to seeing the facts implicit in inequality through income mobility. Yet despite the favorable results of this paper, further research remains to be done. Income for non-employed households which is not available in the *Household Income and Expenditure Survey* (HIES) could be estimated using the inverse regression method. In addition, a more detailed analysis for transition matrix, such as by age group, could be implemented.

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