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**Research Report**

## The Impact of Lifting Liquidity Constraints on the Distributions of Consumption, Assets, and Debts

KDI Policy Study, No. 2003-03

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# **The Impact of Lifting Liquidity Constraints on the Distributions of Consumption, Assets, and Debts**

**Seok-Kyun Hur  
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**December 2003**

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## Foreword

The outbreak of the Korean currency crisis in 1997 had an enormous impact on many aspects of Korean economy. In particular, the magnitude of the shock was extremely severe in the financial market. It is notable that there exists a huge interest rate differential between before- and after-crisis.

Such a dramatic switch of interest rate regimes was mainly due to the loosened monetary policy carried out during the recovery period. In addition, Korean economy experienced the collapses of some conglomerates right after the financial crisis. Accordingly, the increased liquidity was directed to consumer finance rather than to business finance. Before the crisis, in the banking sector of Korea, the portion of consumer finance is relatively smaller than that of business loans. However, confronted with the new financial environment, Korean banks opted to expand their shares of consumer finance and lowered the interest rates for consumer finance programs.

Inspired by these observations, Dr. Seok-Kyun Hur and Dr. Taeyoon Sung examine the distribution effects of loosening liquidity constraints on consumption expenditures, asset holdings and debts using the cross-section data sets of 1996 and 2001. The data sets are unique in that they enable economists to evaluate the consequences of the economic regime change following the currency crisis in Korea. They provide some noteworthy results from their analysis. Firstly, the easy monetary regime after the crisis lifted the liquidity constraints as well as lowered various interest rates uniformly. Secondly, the alleviated liquidity constraints contributed to the contraction of consumption inequality. Finally, the reduction of consumption inequality accompanied by the widened income inequality is attributed to easier access to debt financing.

I hope this work can help scholars and policy makers to understand better a microeconomic channel of monetary policy. Finally, Dr. Hur, Dr. Sung, and I share the appreciation toward the researchers and staffs at KDI for their support on this research.

Choong soo Kim  
President  
Korea Development Institute

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## Summary

This paper examines the distributional effect of loosening liquidity constraints on consumption expenditures, asset holdings and debts using two years of cross-section data sets (1996 and 2001). The data sets of our concern are unique in that they enable us to evaluate the consequences of the economic regime change following the currency crisis in Korea. Our findings indicate that (1) the loosened monetary regime after the crisis lifted the liquidity constraints as well as lowered various interest rates uniformly, (2) the less binding liquidity constraints contributed to the contraction of consumption inequality, which accounts for approximately 22.4% of the total reduction, and (3) the reduction of consumption inequality accompanied by the widened income inequality is attributed to easier access to debt financing

## CHAPTER 1

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# Introduction

The recent currency crisis had an enormous impact on almost every aspect of Korean economy. The magnitude of the shock was extremely severe in the financial market.<sup>1</sup> During 1996-2001, the observed nominal interest rate plunge was substantial (refer to [Figure 1]). Reminded that the Korean economy had gone through the currency crisis from the fourth quarter of 1997 till the first quarter of 1999, we notice that there exists a huge interest rate differential between before- and after-crisis. Started from the first quarter of 1991 to the third quarter of 1997, the time series average and standard deviation of the call rate are 13.182 and 2.018 respectively whereas those of the period between the second quarter of 1999 and the fourth quarter of 2002 are 4.686 and 0.437 each.<sup>2</sup>

The movements of real interest rates also show considerable drops after the crisis. [Figure 2] plots the quarterly (quarterlized) real interest rates.<sup>3</sup> We also check the existence of a interest rate differential between before- and after-the crisis. Before the third quarter of 1997, most of the four major interest rates plotted fluctuate between 1% and 3%. After 1998, they show decreasing trends and approach almost zero real interest rate by the end of year 2001.

Such a dramatic switch of interest rate regimes was mainly due to the loosened monetary policy, which was taken during the recovery period. In addition, Korean economy experienced the collapses of various conglomerates right after the financial crisis. Accordingly, the increased liquidity was directed to consumer finance rather than to business finance. Before the crisis, in the banking sector of Korea, the portion of consumer finance is relatively smaller than that of business loans. Confronted with the new financial environment, Korean banks opted to expand their shares of consumer finance and lowered the interest rates for consumer finance programs as well as raised (or weakened) the liquidity or credit constraints they used to apply to individual or household borrowers. [Figure 3] reveals that the proportion of consumer finance in total bank lendings rapidly kept rising from the second quarter of 1999 (28%) till the third quarter of 2002 (48%).

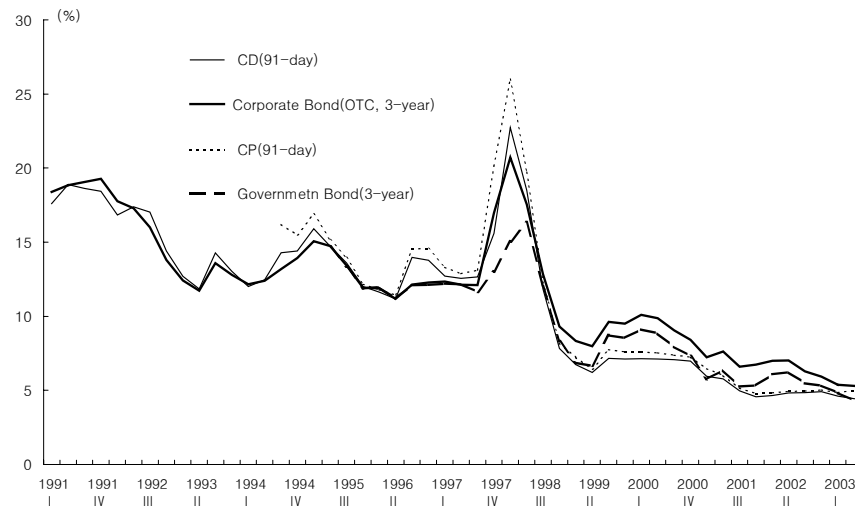
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<sup>1</sup> Shin et al. (2000) provides detailed information on the Korean economy before and after the financial crisis.

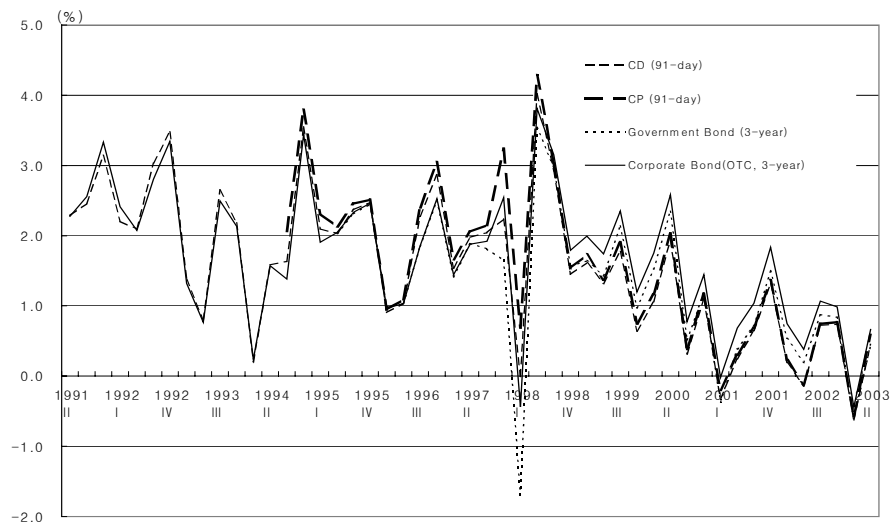
<sup>2</sup> The moving patterns of other major interest rates, such as corporate bonds and T-bills, are similar to that of the call rate.

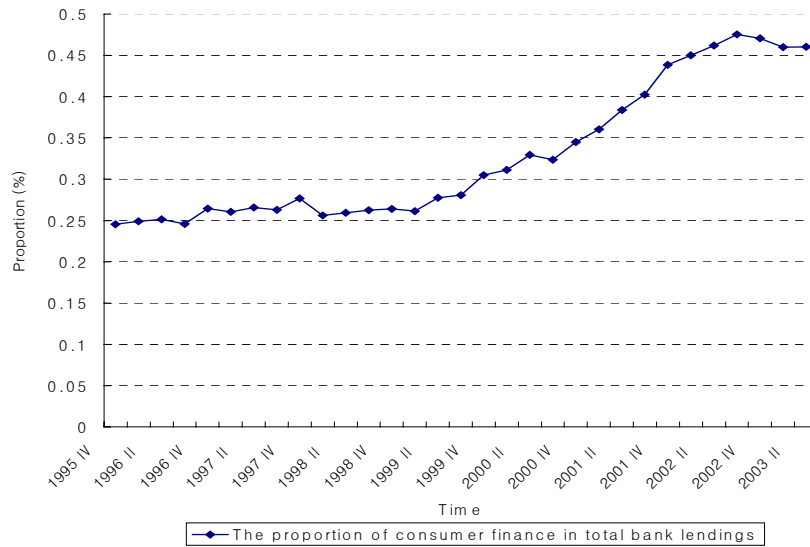
<sup>3</sup> Instead of the anticipated price inflation, we use the realized inflation rate assuming the perfect foresight.

**Figure 1. Movements in Four Major nominal Interest Rates During 1991 Q1-2003 Q3**



**Figure 2. Movements in Four Major real Interest Rates During 1991 Q1-2003 Q3**



**Figure 3. The Proportion of Consumer Finance in Total Bank Lendings**

The purpose of this paper is to explore the effects of the monetary loosening on individual consumption-saving decisions. Unlike most of the literature focusing on tracking individual household's decisions across time and running empirical tests to support or refute the Permanent Income Hypothesis (PIH), our paper investigates the distributional effects of relaxing liquidity or credit constraints in a cross-sectional domain.<sup>4</sup>

<sup>4</sup> PIH is based on a critical assumption that human capital can be priced in the financial market just like physical or financial capital, which does not seem to be realistic. Intertemporal consumption decision of a household with positive physical or financial wealth is likely to be bound by the presence of the liquidity constraint when the wealth held by the household is illiquid. On the other hand, the decision by a household with no other kinds of wealth than human capital is limited by the credit constraint because the household is not able to provide tangible collateral tantamount to the borrowings it may need.

To be precise, we could distinguish the "liquidity constraint" from the "credit or borrowing constraint": The liquidity constraint is defined to be a restriction on the consumption of a household with positive tangible wealth whereas the credit constraint is defined to be a restriction on the consumption of a household with no tangible assets. However, we use these terminologies interchangeably in the paper because of the following reasons. First, the degree of liquidity can substantially vary across different kinds of financial assets. As is known, human capital is less liquid than physical wealth, which in turn is less liquid than financial assets. Thus, whether it is called, the liquidity constraint or the credit constraint, it deals with a trouble a household may cope with when the amount of money it needs exceeds the liquidated value of the wealth it holds. Second, the separation of the liquidity constraint from the credit constraint is not achievable with a data set to be used in the paper. Unavailability of the information on physical wealth makes the distinction meaningless. Some data sets have items concerning real estate, i.e. valuation amount of real estate by type of housing. However, they are still insufficient

A loosened monetary policy influences the distributions of economic resources in an economy through the following channels:<sup>5</sup> First, the monetary loosening lowers the market interest rate, which in turn spurs consumption of the households already included within the reach of the financial sector (interest effect). Second, it alleviates the credit constraints for the households staying outside the financial sector and helps their consumption smoothing. In the paper, we decompose these two effects from available data sets and explain the cross-time variations of the cross sectional consumption-saving pattern in terms of two commonly used inequality index, Coefficient of Variation and Gini coefficients.

The contents of the paper are ordered as follows. Section 2 summarizes and evaluates the relevant literature. Section 3 describes the data sets of our interest, the National Survey of Household Income and Expenditure data sets for 1996 and 2001. Section 4 calculates the Gini coefficients and the Coefficients of Variation with respect to consumption, income, asset holdings, and debts for 1996 and 2001, and explains the cross-time variations of these inequality indices. Section 5 measures the impact of lightening the liquidity constraint on the coefficient of variation of consumption. Despite the unavailability of a tight estimate, a lower bound is obtained. Finally, section 6 concludes.

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to allow the distinction.

<sup>5</sup> Observed at a different angle, the distributional effects can be decomposed into the extensions of internal and external margins in the financial sector.

## CHAPTER 2

### Literature

Most of the literature on this topic are originated from the need to understand the idiosyncracies that cannot be explained under the PIH or Life-cycle consumption models, such as the equity premium puzzle and the existence of the precautionary savings and the bequest motives. To tackle with these issues, a majority response is to introduce the incompleteness of the financial market to a model in a form of the liquidity constraint. Implications deduced from the theoretical discussions are empirically tested using data sets from various sources-panel or cross-sectional ones.

Hall and Mishkin (1982), using panel data, estimate that 20 percent of *U.S.* households are liquidity constrained. Consistently with them, Mariger (1987) estimates that liquidity constrained households constitute 19.4 percent of the population sampled, a group that account for 16.7 percent of consumption in the population sampled. Hayashi (1985) uses a similar methodology with a single cross-sectional data set to infer 16 percent of Japanese families are liquidity constrained.

In addition, several recent analysis of *U.S.* macroeconomic time series data are consistent with the hypothesis that liquidity constraints are important.<sup>6</sup> Constrained agents, who are prevented from trading in asset markets, tend to simply consume up to their labor income each period. Flavin (1981) and Campbell and Mankiw (1990) argue that changes in consumption (or consumption growth rates) are positively related to predictable changes in income, which provides indirect evidence that consumption smoothing is more or less restricted in the presence of limited short-selling or borrowings in the financial market.

As for the case of Korea, there are several relevant papers available. Among them, Yoo (2002) and Yoo and Kim (2002) provide good overviews of Korean economy in the perspective of economic inequality. However, their works focus on the comparison of income distribution changes before and after the financial crisis. Though the consumption distribution is analyzed in the papers, it is intended for the indirect explanation of the income distribution and the presence of liquidity constraints is not discussed explicitly.

On the other hand, Kim (1995) deals with the liquidity constraints and runs cross-country comparisons with Korea, Japan, and the *US* data. Using

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<sup>6</sup> See also Hansen and Singleton (1982) and Mankiw, Rotemberg, and Summers (1985).

the aggregate time series, he shows that consumers are more likely to be constrained by the liquidity constraints in determining durable good consumption than non-durable good consumption. In addition, Kim reveals that there has been a trend of loosening liquidity constraints in Korea since 1980 but the level of liquidity constraints in Korea is still higher than those in Japan and the *US*. In spite of such meaningful conclusions derived, the use of the aggregate time series excludes the possibility of extending the results to the dimension of analyzing the cross-sectional distributions.

The recent occurrence of the currency crisis enables the comparison of drastic changes in the economic environments before and after the crisis, especially in terms of the interest regime switching and the transition from a high interest rate regime to a lowered interest rate one accompanies the alleviation of liquidity constraints. The purpose of our paper does not consist in estimating the proportion of Korean households bound by the liquidity constraints or checking the presence of the liquidity constraints in the economy, but rather it consists in measuring the impact of the alleviated liquidity constraints on the distributions of consumption, assets and debts. In this sense, our paper maintains a distinctively different angle from the existing literature.

## CHAPTER 3

### Data

We use the National Survey of Household Income and Expenditure (NSHIE) data for 1996 and 2001.<sup>7</sup> <sup>8</sup> The time interval of the two data sets gives an exceptional opportunity for us to analyze or compare the interest rate regimes of before-(the high and volatile interest rate regime) and after-crisis (the low and less volatile interest rate regime) respectively.

NSHIE investigates annual income and expenditures, durable goods, savings and liabilities of households in detail from the nation-wide sampled households in order to analyze patterns of income and expenditures of households. The surveyed households are sampled in accordance with administrative zoning and the numbers of population. The sample size is about 30,000 households( 27,000 households in 1996).<sup>9</sup> The information about status of households, annual income, savings, liabilities, and purchase of durable goods are obtained upon interview and recorded on the questionnaires by enumerators. For the detailed information on spendings and incomes, NSHIE refers to family account books, which was distributed prior to the survey so that income source, type of expenditure and their value could be recorded on a daily basis.

Of course, NSHIE is not the only micro data set available depicting the Korean economy. There exist three other micro data sets covering the similar areas of concerns. First, Annual Report on the Household Income and Expenditure Survey (ARHIES) includes annual and quarterly incomes and expenditures of 5,200 urban non-farm households. However, ARHIES does not provide the information on the asset and debt holdings but only identifies the changes in the assets and debts held. Second, Korea Household Panel Study (KHPS) is the first panel data in Korea and holds items regarding various assets and debts held by sampled households. However, the covering period is from 1993 to 1998. To make it worse, in 1998 Korean economy was still in the time of depression. Hence, KHPS is not suitable for

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<sup>7</sup> There were three nation-wide surveys (NSHIE) in 1991, 1996, and 2001. However, the first survey was not consistent with the other two surveys in terms of survey structure and questions. Thus, we focus on the NSHIEs in 1996 and 2001.

<sup>8</sup> NSHIE of 1996 covers the economic activities in 1996. However, NSHIE 2001 covers the economic activities in year 2000, though the survey was conducted in 2001.

<sup>9</sup> The NSHIEs provides a weight for each observation based on the concept of stratified random sampling. However, the weight does not appear to be complete in terms of including farmers and specific regions. Thus, the analysis simply focuses on the sample of all observations, rather than fully utilizes the structure of stratified random sampling.



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comparing the change of an aspect before and after the financial crisis. Third, Korea Labor and Income Panel Study (KLIPS) succeeds KHPS and it also includes asset items. However, KLIPS starts from 1998 and does not cover the period before the crisis.

## Explanation for Changes in Inequality Measures

Using the NSHIE data of 1996 and 2001, we estimate kernel densities of income, consumption, asset and debt. Additionally, we calculate the Gini coefficients of these four variables and draw their Lorenz curves. In Appendix-Tables, we provide several tables to display the patterns of changes in the four variables among various income deciles between the two points of time. Based on these summary statistics, we explain the distributional effects of the recent monetary slackening.

For the convenience of our analysis, we make all the relevant items of the NSHIE data divided by their cross-sectional averages. The rescaling procedure is multi-purposed. First, it sets the distribution of the data points centered at the mean of 1. Second, it enables an scale invariant analysis. For example, the consideration on the change of Consumer Price Index (CPI) would be redundant in this analysis. Third, by construction, the variation of the new centered distribution becomes a coefficient of variation (CV), which measures the degree of dispersion.<sup>10 11</sup> In order to represent CVs and their changes graphically, kernel density functions are estimated as follows.

The kernel density estimate of a series  $X = \{X_i, i = 1, 2, \dots, N\}$  at a point  $x$  is estimated by

$$f(x) = \frac{1}{Nh} \sum_{i=1}^N K\left(\frac{x - X_i}{h}\right)$$

where  $N$  is the number of observations,  $h$  is the bandwidth and  $K$  is a kernel weighting function.  $K$  is given by the Epanechnikov kernel function that is

$$K(u) = \begin{cases} \frac{3}{4} \left(1 - \frac{u^2}{5}\right) / \sqrt{5} & \text{if } \sqrt{u^2} < \sqrt{5} \\ 0, & \text{otherwise} \end{cases}$$

The calculation of bandwidth  $h$  is based on Silverman (1986):

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<sup>10</sup> Since we are interested in showing the patterns of dispersion changes, we do not take a normalization measure like  $\frac{X_i - \bar{X}}{\hat{\sigma}_x}$ .

<sup>11</sup> Note that  $CV(X) \equiv \frac{\sigma_X}{\mu_X}$ .

$$h = \frac{0.9}{N^{1/5}} \min \left[ \hat{\sigma}_x, \frac{IQR_x}{1.349} \right]$$

where  $IQR_x$  and  $\hat{\sigma}_x$  represent the interquartile range and the sample standard deviation of  $X$  respectively. The kernel densities for the variables of our interest (consumption, income, assets, and debts) obtained from the above procedure are drawn in [Figure 4] – [Figure 8].

In addition to CV, we use another measure of inequality, a Gini coefficient (or a Lorenz curve, which is a graphical exposition of the Gini coefficient). Technically speaking, a Lorenz curve is defined on a space of two non-negative stochastic variables, say  $X$  and  $Y$ . Usually in economics the variable  $X$  represents the cumulative portion of households, which are ordered in the magnitude of  $Y$  as they hold. In this case, the value of a Gini coefficient always ranges between 0 and 1. It is because any other distribution cannot be more evenly distributed than a uniform one. That explains why it is commonly (and casually) said that any Lorenz curve should be positioned below the 45 degree line (implying the status of perfect equity).

However, by the definition of a Lorenz curve,  $X$  can be another variable than the population itself. In this case, our common knowledge about a Lorenz curve and a Gini coefficient does not hold any longer. Instead, the Gini coefficient (or the Lorenz curve) of  $Y$  with respect to  $X$  measures how unevenly the variable  $Y$  is distributed compared with the dispersion of  $X$  as well as how  $X$  and  $Y$  are correlated. According to the sign of correlation between  $X$  and  $Y$ , the Lorenz curve can be located above the 45 degree line ( $Corr(X, Y) < 0$ ) or below the 45 degree line ( $Corr(X, Y) > 0$ ). Depending on the relative dispersion of  $Y$  with respect to  $X$ , the Lorenz curve gets more distant from the 45 degree line.

Define such a general (or a bivariate) version of a Lorenz curve as follows.

$$\begin{aligned} L_q(X, Y) &\equiv \frac{\int_0^{y_{\max}} \int_0^{x(q)} y f(x, y) dx dy}{\int_0^{y_{\max}} \int_0^{x_{\max}} y f(x, y) dx dy} \\ &= \frac{E[Y | X \leq x(q)] q}{E(Y)} \end{aligned}$$

where  $x(q) \equiv \{x^* : F(x^*) = q\}$  and  $F(x) \equiv \int_0^{y_{\max}} \int_0^x f(t, y) dt dy$ . To rephrase,  $L_q(X, Y)$  measures the cumulative portion of  $Y$  that the  $q \times 100(\%)$  cumulative portion of households hold when the households are ordered in the magnitudes of  $X$ .

From the above definition, another representation of the bivariate Lorenz curve is deduced as below.

$$\begin{aligned}
L_q(X, Y) &= \frac{E[Y | X \leq x(q)]q}{E(Y)} \\
&= \frac{E[\beta_1 X + \beta_0 + \varepsilon | X \leq x(q)]q}{E(Y)} \\
&= \beta_1 \frac{E[X | X \leq x(q)]q}{E(Y)} + \frac{\beta_0 q}{E(Y)} + \frac{E[\varepsilon | X \leq x(q)]q}{E(Y)} \\
&= \left\{ \text{Corr}(X, Y) \sqrt{\frac{\sigma_y^2}{\sigma_x^2}} \frac{E(X)}{E(Y)} \frac{E[X | X \leq x(q)]}{E(X)} \right. \\
&\quad \left. + \frac{\beta_0}{E(Y)} + \frac{E[\varepsilon | X \leq x(q)]}{E(Y)} \right\} q,
\end{aligned}$$

where  $\beta_1 = \frac{\sigma_{xy}}{\sigma_x^2}$  and  $\text{Corr}(X, Y) = \frac{\sigma_{xy}}{\sigma_x \sigma_y}$ . The term  $\frac{E[\varepsilon | X \leq x(q)]q}{E(Y)}$  catches the non-linear stochastic movement (or the cross-sectional correlation of residuals) with respect to  $X$ .

Setting aside  $\frac{E[\varepsilon | X \leq x(q)]q}{E(Y)}$ , the sign of  $L_q(X, Y)$  is determined by the sign of  $\text{Corr}(X, Y)$  and the absolute magnitude of  $L_q(X, Y)$  is determined by the ratio of standard deviations  $\frac{\sigma_y}{\sigma_x}$ . Accordingly, the aforementioned

intuitive arguments about the properties of the general Gini coefficients are shown to prevail.

Table 1 displays the Gini coefficients of annual income, household expenditures, consumption, asset, debts, and debts to financial institutions for 1996 and 2000. Their Lorenz curves are drawn in [Figure 4]-[Figure 8]. Except annual income, the Gini coefficients and the Lorenz curves of the other variables are bivariate with respect to income. [Figure 9]-[Figure 12] mark the differences of the Lorenz curves between 2001 and 1996 in percentiles. These plots should be interpreted not only in terms of signs but also in terms of the magnitudes of change rates because Lorenz curves are accumulative.

**Table 1. Comparison of Variations in the Gini Coefficients between 1996 and 2001**

	Bivariate Gini coefficients of variables with respect to annual income		
	1996	2001	%Change
Annual income*	0.331482	0.396371	19.57536
Household expenditure	0.244087	0.260368	6.670276
Consumption	0.225275	0.23138	2.7102
Asset	0.359272	0.414842	15.46731
Debt	0.328379	0.256719	-21.8226
Debt-to-financial institution	0.346893	0.279387	-19.4601

\* The Gini coefficients of annual income are ordinary ones unlike the others in Table1

#### 4-1. Income

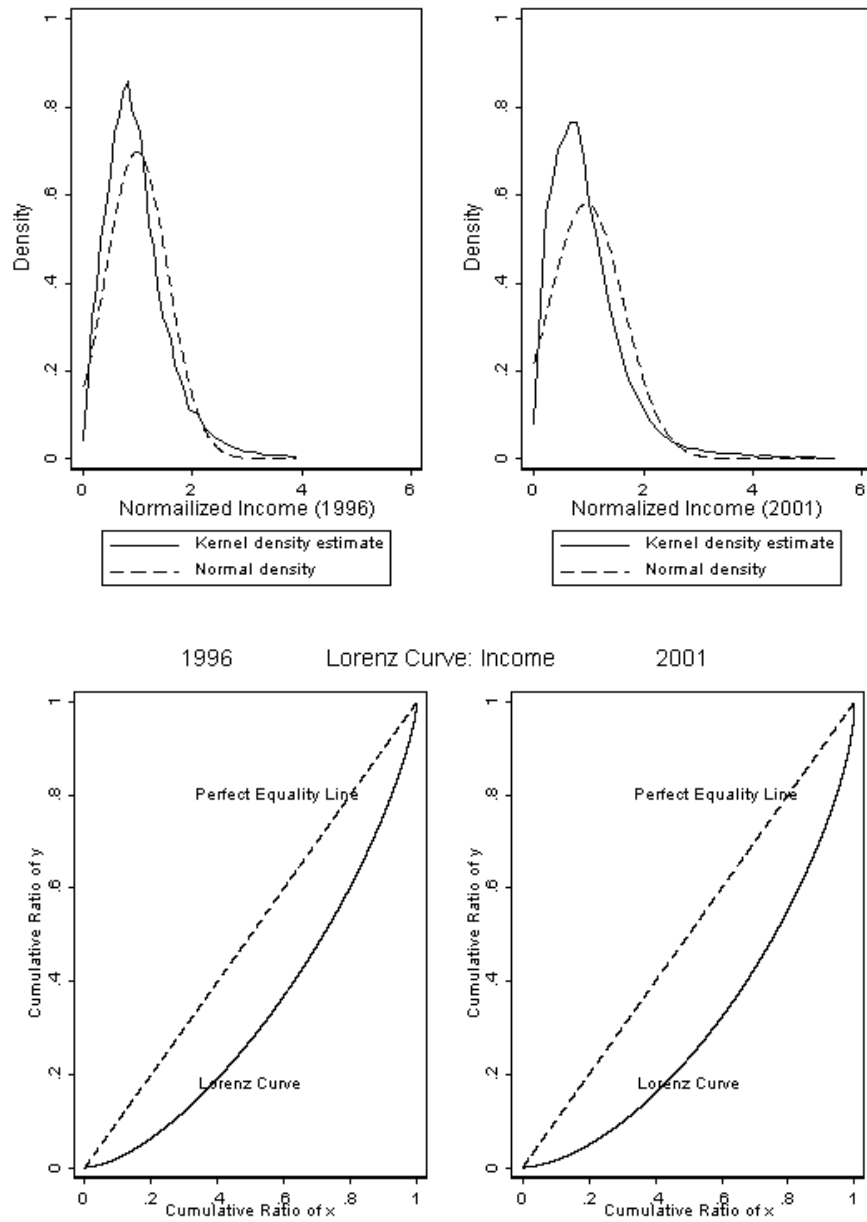
[Figure 4] shows the scaled income kernel densities (solid lines) of year 1996 and 2001 in comparison with the normal distribution densities (dotted lines) with the same means and variances. From [Figure 4], it is easy to check that the variances of scaled income in 2001 is greater than that in 1996 because the peak of a nominal distribution in 1996 is higher than that in

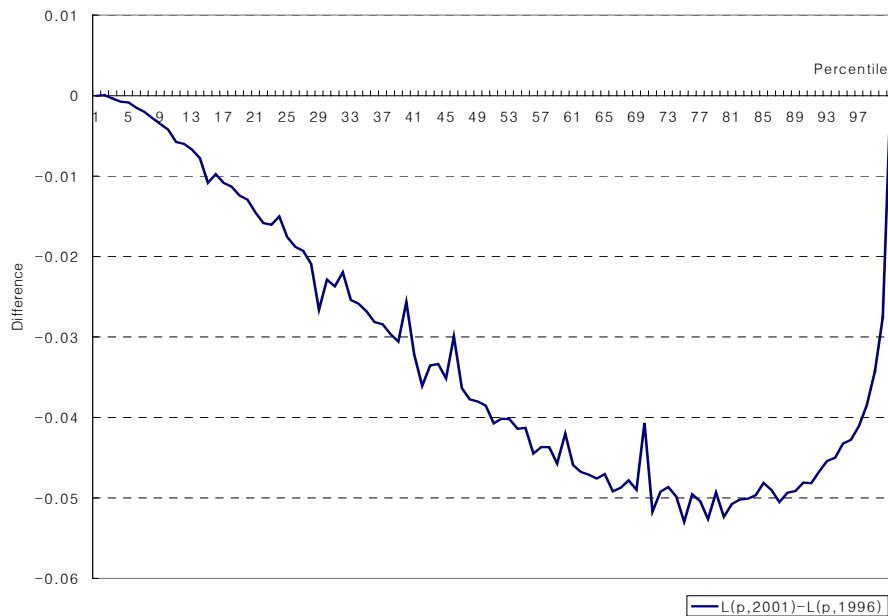
**Table 2. Changes in Scaled total Income between 1996 and 2001 Among Various Income Groups**

Income (from bottom to top)	Income				
	1996		2001		% Change
	AVG	STD	AVG	STD	AVG
1 <sup>st</sup> decile	0.210	0.086	0.156	0.058	-25.55
2 <sup>nd</sup> decile	0.436	0.055	0.334	0.048	-23.31
3 <sup>rd</sup> decile	0.584	0.035	0.481	0.040	-17.64
4 <sup>th</sup> decile	0.706	0.038	0.621	0.041	-12.04
5 <sup>th</sup> decile	0.824	0.034	0.751	0.037	-8.93
6 <sup>th</sup> decile	0.952	0.040	0.887	0.042	-6.86
7 <sup>th</sup> decile	1.086	0.042	1.051	0.056	-3.29
8 <sup>th</sup> decile	1.266	0.057	1.255	0.070	-0.84
9 <sup>th</sup> decile	1.536	0.099	1.561	0.116	1.65

10 <sup>th</sup> decile	2.433	1.401	2.907	2.786	19.47
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**Figure 4. Income: Normalized Kernel Densities and Lorenz Curves**



**Figure 5. Income: Differences of Lorenz Curves between 2001 and 1996**

2001.<sup>12</sup> Precisely, income inequality, in terms of CV, is worsened from 0.752 to 1.159 (increased by 54.3%).

The transition between the two points of time implies that the significant proportion of the (upper) middle income class has moved to the lower income class whereas the inequality within the high income class has been widened. In Table 2, the change rates of average scaled income hold negative signs in most income deciles except the 9th and 10th deciles. Furthermore, the negative change rates have greater absolute magnitudes in lower income deciles. [Figure 5] provide a consistent view with Table 2. The difference of Lorenz curve in income between 2001 and 1996 has negative values in all income percentiles and the magnitudes is increasing to the upper middle percentiles, which reflects that after the financial crisis the substantial portion of the middle class households moves to the lower income groups.

The worsening trend is also detected from another inequality measure, Gini coefficient. The income Gini coefficient is measured with respect to the proportion of households. The rest two pictures in [Figure 4] display the

<sup>12</sup> From the properties of a normal distribution, it is evident that the higher the peak of a normal distribution density, the smaller its variance is.

Lorenz curves of 1996 and 2001 and they also indicate increase of the income Gini coefficient distinctively. Table 1 shows that the Gini coefficient of annual income increases from 0.331 to 0.396 (increased by 19.6%).

## 4-2. Consumption

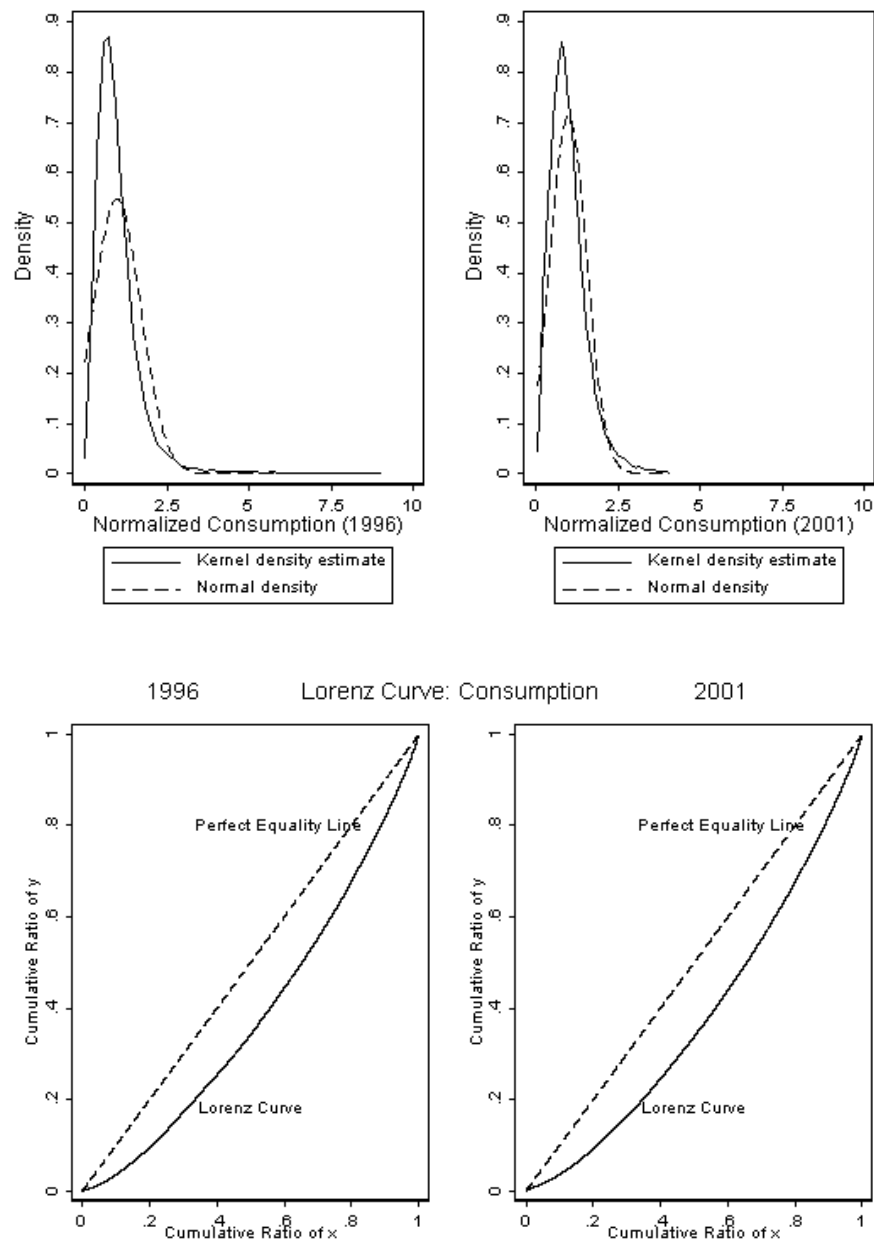
[Figure 6] shows the scaled consumption kernel densities (solid) of year 1996 and 2001 in comparison with the normal densities (dotted) with the same means and variances. From [Figure 6], we check easily that the variances of scaled consumption in 2001 is smaller than that in 1996. Thus, consumption inequality measured by CV, is improved from 1.110 to 0.604 (reduced by 46%). The transition pattern in Table 3 implies that the significant proportions of the low income groups increased their relative consumptions even though the three lowest income groups decrease their relative consumptions. Consistently with Table 3, [Figure 7] shows that the absolute magnitude of the negative value in the difference of Lorenz curves between 2001 and 1996 has peaks around at 29th percentile and the 41st percentiles.

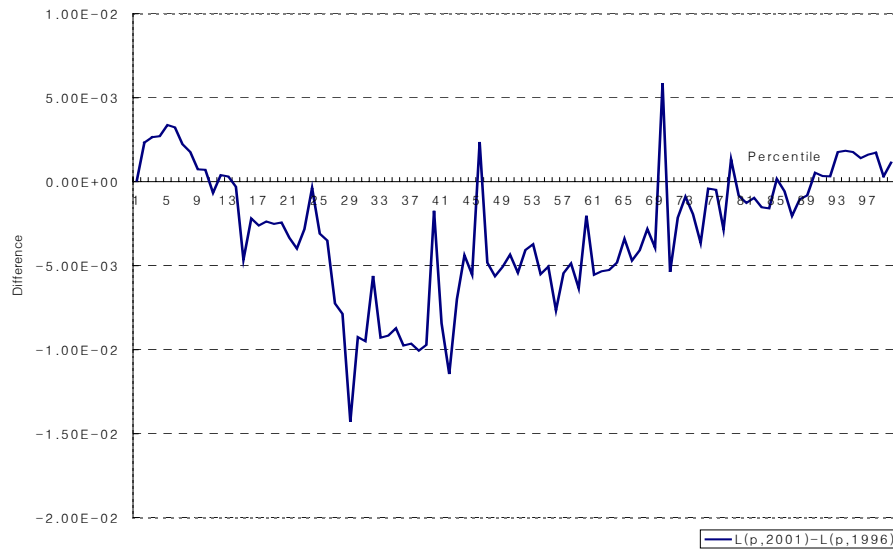
In contrast, the unambiguous trend is not detected in a Gini coefficient. Rather, the Lorenz curves of 1996 and 2001 in [Figure 6] represents a small increase in the bivariate Gini coefficient of consumption with respect to income from 0.2253 to 0.2314 (increased by 2.71%). Where does this

**Table 3. Changes in Scaled Consumption between 1996 and 2001 Among Various Income Groups**

Income (from bottom to top)	Consumption				
	1996		2001		%Change
	AVG	STD	AVG	STD	AVG
1 <sup>st</sup> decile	0.360	0.409	0.360	0.288	-0.001
2 <sup>nd</sup> decile	0.602	0.666	0.561	0.279	-6.811
3 <sup>rd</sup> decile	0.787	2.076	0.708	0.291	-10.129
4 <sup>th</sup> decile	0.817	0.854	0.827	0.320	1.183
5 <sup>th</sup> decile	0.880	0.631	0.923	0.320	4.936
6 <sup>th</sup> decile	1.025	0.842	1.009	0.348	-1.553
7 <sup>th</sup> decile	1.095	0.729	1.120	0.390	2.233
8 <sup>th</sup> decile	1.239	1.014	1.259	0.450	1.686
9 <sup>th</sup> decile	1.411	1.064	1.426	0.612	1.107
10 <sup>th</sup> decile	1.819	1.329	1.809	0.845	-0.537



**Figure 6. Consumption: Normalized Kernel Densities and Lorenz Curves**

**Figure 7. Consumption: Differences of Lorenz Curves between 2001 and 1996**

seemingly irreconcilable difference come from? Reminded that in [Figure 6] the X-axis represents the income distribution of the households (not the households themselves), the worsened inequality in the Gini coefficient may be attributed to either of the following two explanations. One is the relative increase of consumption dispersion with respect to income dispersion. The other is the increase of positive correlation between consumption and income. From the estimation of the kernel density function, we observe the decrease in the consumption inequality in terms of CV. Thus, the first is not an explanation to the puzzle.<sup>13</sup> Only the second can provide more appropriate explanation for the puzzle. The cross-sectional simple OLS result in Table 7 confirms the increase of correlation between consumption and income. Intuitively, the increased correlation between income and consumption implies that less fraction of people are bound with the liquidity constraint or the credit constraint. We know that the banking sector has lowered constraint-type barriers to borrowers as well as interest rates. As a result, more low income class are encouraged to consume up to their affordability. This explanation reconciles the worsened Gini coefficient of consumption (with respect to income) with the improved CV of consumption.

<sup>13</sup> Though CV and Gini coefficient are different measures for inequality, they indicate mostly the same directions of inequality variations (possibly with different magnitudes).

The similar results can be obtained with respect to household expenditures. The definition of household expenditures is broader than consumption and it includes direct taxes (e.g. income and property taxes), public insurances (e.g. medical and employment insurance), and social security in addition to consumption expenditures. The Gini coefficient of household expenditures with respect to income changed from 0.2441 to 0.2604 (increased by 6.67%).

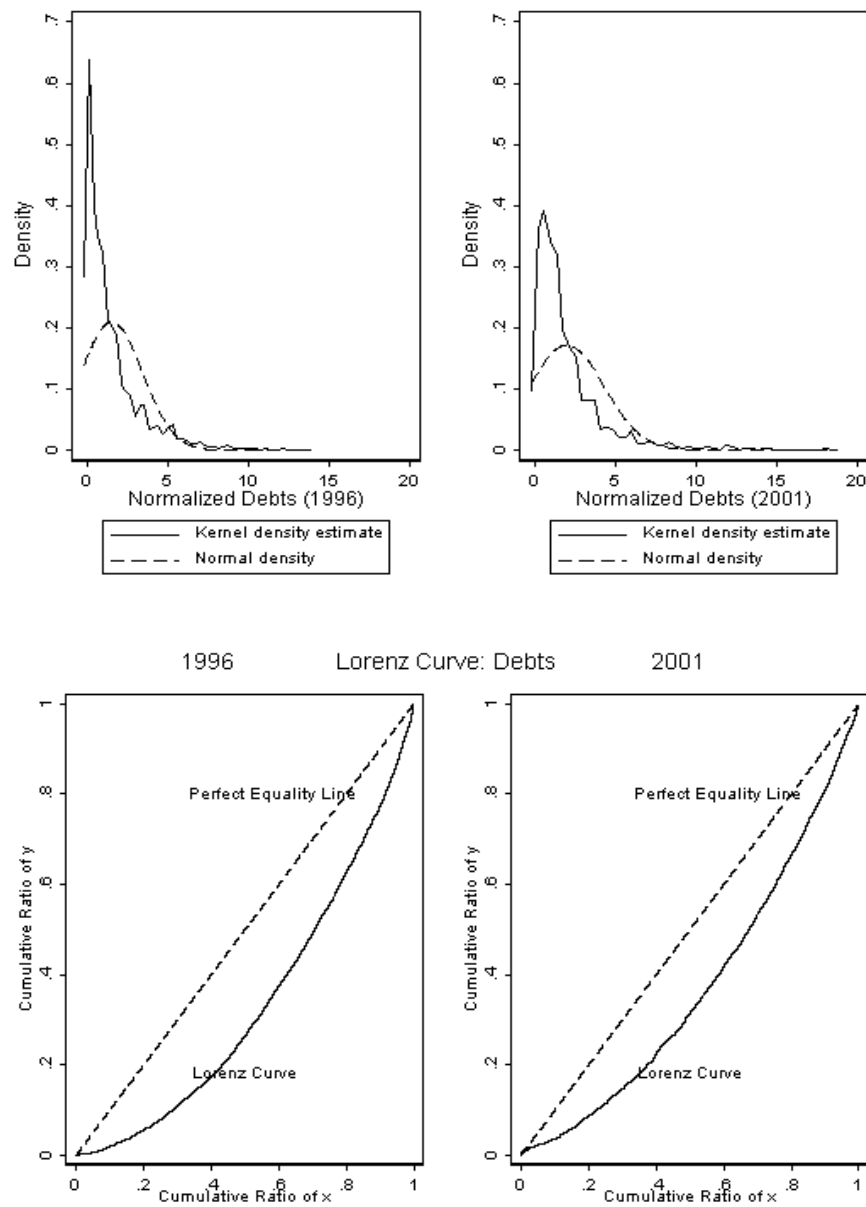
### 4-3. Debt

[Figure 8] displays the scaled debt kernel densities (solid) of year 1996 and 2001 in comparison with the normal densities (dotted) with the same means and variances. From [Figure 8], we check easily that the variances of scaled income in 2001 is greater than that in 1996. Hence, the inequality of debt, in terms of CV, is worsened. The transition pattern implies that the significant proportion of the low debt group has moved to the middle debt group whereas the inequality within the high debt group has been widened. Needless to say, the first effect is dominated by the second effect. [Figure 10] shows a sharp rise in the difference of Lorenz curves in debts from the 1st decile to the 8th deciles, which reflects that the lower income classes got to hold more debts in a relative sense.

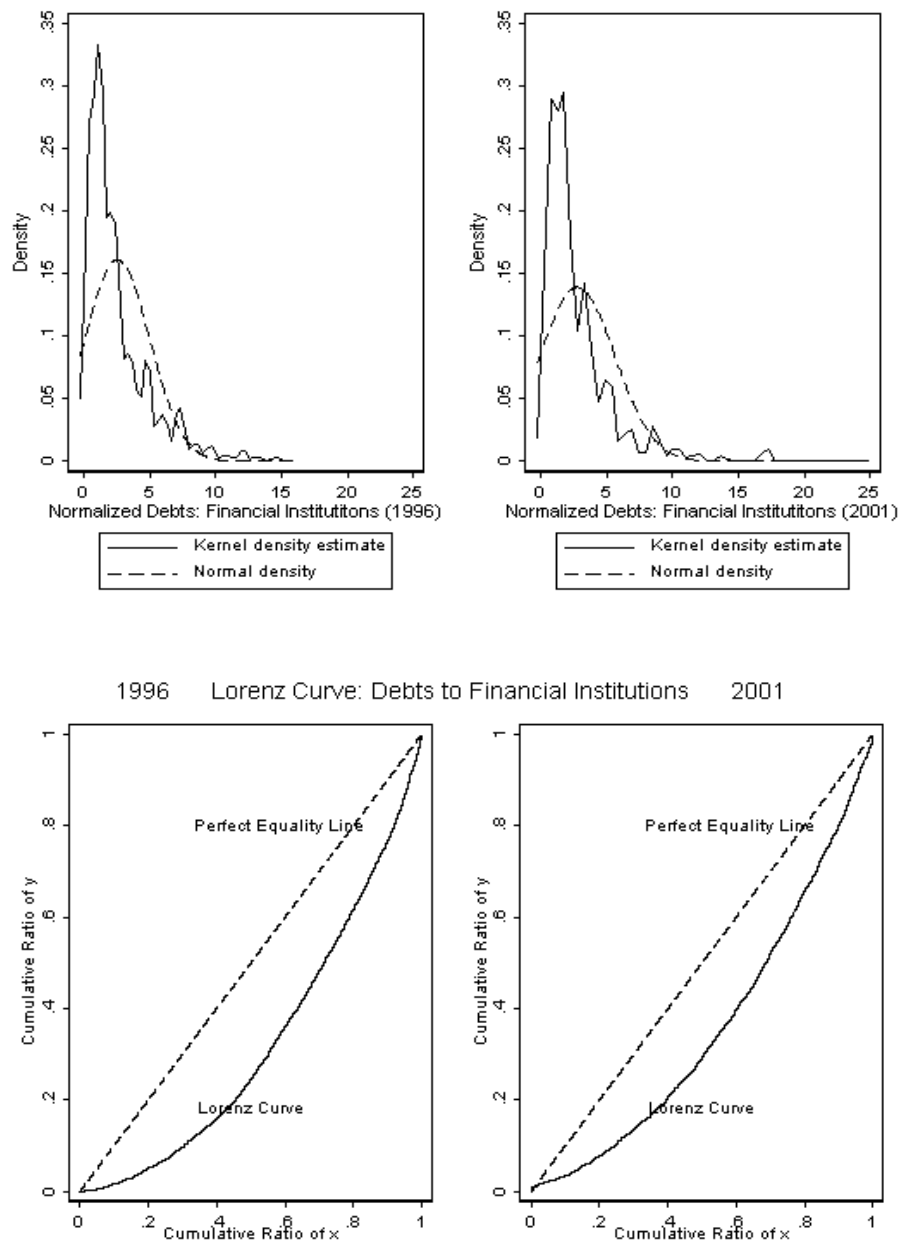
**Table 4. Changes in Scaled Debt-to-Financial Institution between 1996 and 2001**

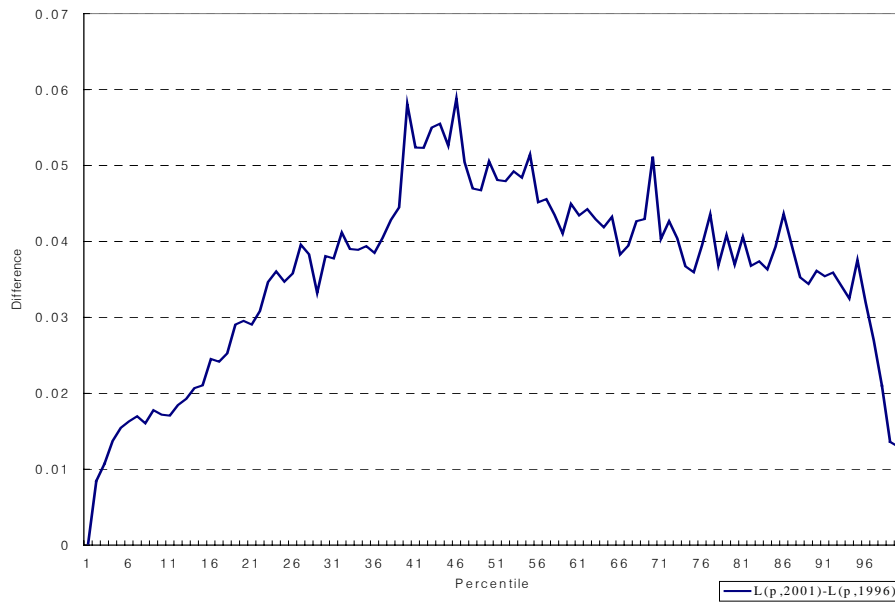
Income (from bottom to top)	Debt-to-Financial Institution				
	1996		2001		%Change
	AVG	STD	AVG	STD	AVG
1 <sup>st</sup> decile	0.173	0.777	0.337	2.509	95.47
2 <sup>nd</sup> decile	0.338	1.231	0.433	1.583	28.01
3 <sup>rd</sup> decile	0.475	1.654	0.580	1.750	22.31
4 <sup>th</sup> decile	0.617	1.428	0.712	2.374	15.47
5 <sup>th</sup> decile	0.866	1.764	0.868	2.056	0.15
6 <sup>th</sup> decile	1.157	2.034	1.042	2.285	-9.94
7 <sup>th</sup> decile	1.217	2.300	1.249	2.659	2.63
8 <sup>th</sup> decile	1.343	2.257	1.350	2.943	0.52
9 <sup>th</sup> decile	1.508	2.563	1.442	3.453	-4.35
10 <sup>th</sup> decile	2.339	5.465	1.989	5.827	-14.95

**Figure 8. Debts: Normalized Kernel Densities and Lorenz Curves**



**Figure 9. Debts to Financial Institutions: Normalized Kernel Densities and Lorenz Curves**



**Figure 10. Debts: Differences of Lorenz Curves between 2001 and 1996**

On the other hand, the trend of increasing inequality is not detected in terms of the Gini coefficient. The Lorenz curves of 1996 and 2001 exhibits a significant decrease of the Gini coefficient in debts with respect to income from 0.3284 to 0.2567 (decreased by -21.82%). Recall the same logic used in explaining the previous consumption part, we can infer that the correlation between income and debt has been decreased. Our intuition proves to be correct from the empirical fact that the correlation of debts with income changes from 0.2648 (1996) to 0.1299 (2001). This provides an indirect evidence that the existing financial constraints levied on each households by banks have been reduced or alleviated. This implies that income, a proxy for the value of human capital, became more critical in the determination of borrowing. To rephrase, this phenomenon is an indicator of a less financially constrained economy.

Table 4 shows that the change rate of the relative debts-to-financial institutions increased from 1996 to 2001 uniformly across all the income deciles and the increasing trends are especially stronger in the lower income deciles (see [Figure 9]). The Gini coefficient of the debts to financial institutions is lowered fast from 0.3469 to 0.2794 (reduced by 19.46%).

#### 4-4. Asset <sup>14</sup>

[Figure 11] displays the scaled asset kernel densities (solid) of year 1996 and 2001 in comparison with the normal densities (dotted) with the same means and variances. From [Figure 11], we check easily that the variances of scaled asset in 2001 is greater than that in 1996. Inequality of asset, in terms of CV, is worsened. The transition pattern in Table 5 implies that the significant proportion of the middle debt group has moved to the high debt group at the same time the inequality within the high debt group has been widened, which is consistent with [Figure 12] depicting the difference of the Lorenz curves in asset holdings between 2001 and 1996.

In addition, the worsening trend is detected in terms of the Gini coefficient. [Figure 11] represents the Lorenz curves of 1996 and 2001 and they indicate increase of the Gini coefficient in asset holdings with respect to income from 0.3593 to 0.4148 (increased by 15.47%).

**Table 5. Changes in Scaled Total Asset Holding between 1996 and 2001 Among Various Income Groups**

Income (from bottom to top)	Total Asset				
	1996		2001		%Change
	AVG	STD	AVG	STD	AVG
1 <sup>st</sup> decile	0.239	0.647	0.224	0.690	-6.50
2 <sup>nd</sup> decile	0.439	0.816	0.327	0.828	-25.58
3 <sup>rd</sup> decile	0.501	0.725	0.418	0.996	-16.57
4 <sup>th</sup> decile	0.661	0.848	0.536	1.174	-18.91
5 <sup>th</sup> decile	0.735	0.847	0.685	1.189	-6.82
6 <sup>th</sup> decile	0.903	1.046	0.859	1.374	-4.85
7 <sup>th</sup> decile	1.013	1.213	0.962	1.277	-5.05
8 <sup>th</sup> decile	1.221	1.220	1.282	1.942	4.96
9 <sup>th</sup> decile	1.616	2.330	1.677	2.160	3.76
10 <sup>th</sup> decile	2.697	3.731	3.035	4.492	12.52

<sup>14</sup> Contributions to public or occupational pensions and medical insurance premium are not included in the amount of asset holdings in NSHIE.

**Table 6. Simple OLS in Pooled Regression (An explanatory Variable: Income)**

Dependent Variables	1996	2001
Consumption (STD)	0.2895 (0.004)	0.1587 (0.0019)
Debts (STD)	0.1859 (0.0031)	0.0876 (0.0043)
Asset (STD)	0.6757 (0.007)	0.5471 (0.0087)

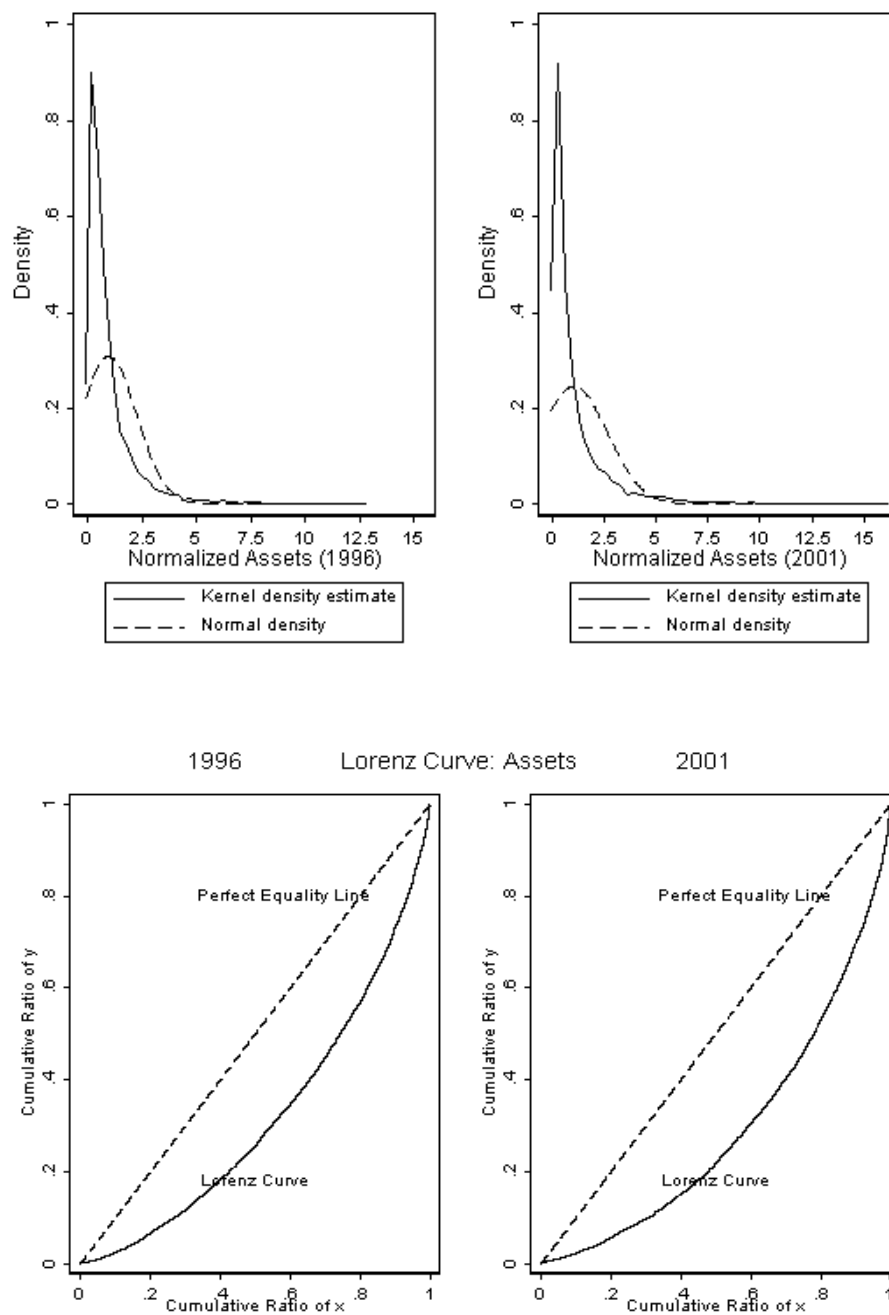
**Table 7. Correlation of Income with Other Variables**

Correlation with Income	1996	2001
Consumption	0.3114	0.4725
Assets	0.4035	0.3784
Debts	0.2648	0.1299

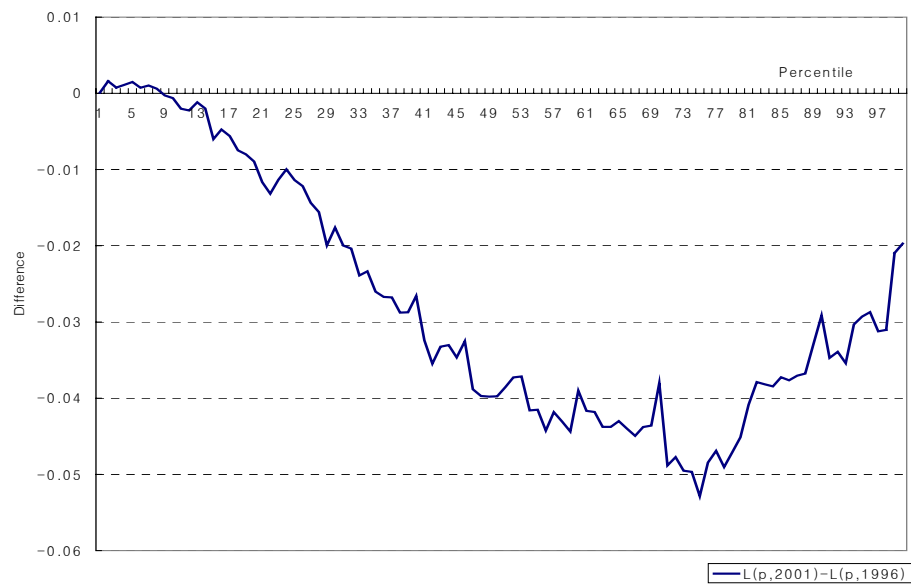
**Table 8. Summary Statistics of Consumption and Income Distributions**

	1996	2001
Sample Mean [C]	14567530	17011691
Sample Mean [Y]	23152723	26397142
Sample Mean [C] / Sample Mean [Y]	0.62919295	0.644452
Mean Sum of Squares [residuals]	2.36E+14	8.21E+13
Sample Standard Deviation [C]	16173676	10282008
Sample Standard Deviation [Y]	17401350	30603268
Coefficient of Variation [C]	1.1102552	0.60440834
Coefficient of Variation [Y]	0.75158978	1.1593402



**Figure 11. Assets: Normalized Kernel Densities and Lorenz Curves**

**Figure 12. Assets: Differences of Lorenz Curves between 2001 and 1996**



## Decomposition of Consumption Inequality

The analysis in the previous section has a limitation in that it is not able to decompose the distributional effects of the recent monetary loosening by sources-interest rate effect, liquidity constraint effect, and income effect. Hence, a new analysis should accommodate the decomposition.

In presence of the liquidity constraint, we assume that liquidity constrained families consume an equal amount to their contemporaneous income, i.e. the relationship between consumption and income is shaped like OAB in [Figure 13]-[Figure 15].<sup>15</sup> This assumption, though having some drawbacks, are adopted by many panel studies, such as Hall and Mishkin (1982) and Hayashi (1985). Deaton (1991) provides a kinked consumption function with respect to "cash-on-hands", which is defined to be the sum of net asset and income. Though it is more general than our assumption on the relationship between consumption and income, we do not adopt the concept of cash-on-hands due to the endogeneity between debt increment and consumption and their possible connections with the slackened liquidity constraints.

The distributional effect of loosening liquidity constraints in proportion of total variations in the consumption CV is obtained from decomposing the cross-time variations in the consumption CV as follows. Denoting  $\frac{C}{E[C]}$  and  $\frac{Y}{E[Y]}$  to be  $C'$  and  $Y'$  respectively, we can represent the CV of consumption in a different way as below.<sup>16</sup>

$$\begin{aligned} CV(C) &\equiv Var\left[\frac{C}{E(C)}\right] = Var[C'] = Var[\beta_1 Y' + \beta_0 + \varepsilon] \\ &= \beta_1^2 Var[Y'] + 2\beta_1 Cov[Y', \varepsilon] + Var(\varepsilon) \\ &= \left[\frac{Cov[C', Y']}{Var[Y']}\right]^2 Var[Y'] + \sigma_\varepsilon^2, \end{aligned}$$

<sup>15</sup> Under the PIH, there is no correlation between consumption and current income

<sup>16</sup> Generally  $Cov[Y, \varepsilon] \neq 0$ , but the construction of simple OLS makes the sample covariance of  $Y$  and  $\varepsilon$  zero. Accordingly, we ignore  $Cov[Y, \varepsilon]$  below.

where the linear representation of  $C' = \beta_1 Y' + \beta_0 + \varepsilon$  always holds true by construction.<sup>17</sup>

The next equation shows that the linear representation of the average-scaled consumption ( $C'$ ) with respect to the average scaled income ( $Y'$ ) guarantees the linear relationship between the full scaled consumption ( $C$ ) and the full scaled income ( $Y$ ) if the true expected values of  $C$  and  $Y$  are already given.

$$\begin{aligned} C &= \alpha_1 Y + \alpha_0 + \eta \\ \Leftrightarrow \frac{C}{E[C]} &= \frac{\alpha_1 E[Y]}{E[C]} \frac{Y}{E[Y]} + \alpha_0 \frac{E[Y]}{E[C]} + \eta \frac{E[Y]}{E[C]} \\ \Leftrightarrow C' &= \beta_1 Y' + \beta_0 + \varepsilon, \end{aligned}$$

where  $\alpha_1 = \beta_1 \frac{E[C]}{E[Y]}$ ,  $\alpha_0 = \beta_0 \frac{E[C]}{E[Y]}$ ,  $\eta = \varepsilon \frac{E[Y]}{E[C]}$ .

The linear representations of consumption with respect to income, such as  $C = \alpha_1 Y + \alpha_0 + \eta$  and  $C' = \beta_1 Y' + \beta_0 + \varepsilon$  do not mean that the unbiased minimum variance estimators of parameters,  $\alpha_1$ ,  $\alpha_0$ ,  $\beta_1$ , and  $\beta_0$ , can be obtained from running linear regression. Those representations are adopted in order to exploit diagnostic symptoms arising from running linear regression for a non-linear relation.

In order to decompose  $Var[C'_{2001}] - Var[C'_{1996}]$ , there are three factors to consider- income distribution change, interest rate change, and loosening (or tightening) liquidity constraints.<sup>18</sup> The next table summarizes the effects of these three factors on  $\frac{E[C]}{E[Y]}$ ,  $\beta_1$ , and  $\sigma_\varepsilon^2$ , which are inferred to influence

the CV of consumption from the above equations. These three factors respectively transmit the effects to  $\frac{E[C]}{E[Y]}$ ,  $\beta_1$ , and  $\sigma_\varepsilon^2$ . Thus, based on the

changes in  $\frac{E[C]}{E[Y]}$ ,  $\beta_1$ , and  $\sigma_\varepsilon^2$ , we infer how much each factor influences

<sup>17</sup> In other words, the representation does not necessarily satisfy the conditions of linear regression., such as  $Cov[Y', \varepsilon] \neq 0$ .

<sup>18</sup> It is impossible to completely explain the variations in the consumption inequality with these three factors of changes. Other variables, such as a demographic structure and an education profile, may claim their contributions to the changes in consumption. However, it is beyond our scope and ability to consider these omitted factors.

the CV of consumption. However, since there is no one-to-one correspondence between the three factors of change and  $(\frac{E[C]}{E[Y]}, \beta_1, \text{ and } \sigma_\varepsilon^2)$ ,<sup>19</sup> careful empirical examination to discern the directions of changes in  $(\frac{E[C]}{E[Y]}, \beta_1, \text{ and } \sigma_\varepsilon^2)$  induced by the factors would be indispensable.

Sources\Indications	$\frac{E[C]}{E[Y]}$	$\beta_1$	$\sigma_\varepsilon^2$
Widened income inequality (CV)	ambiguous	↑	ambiguous
Declining interest rate	↑	↑	↓
Loosening liquidity constraints	↑	↓	↓
Observations	↑	↓	↓

Reminded that the NSHIE data sets of 1996 and 2001 are under consideration, we see in what directions the increased income dispersion between 1996 and 2001 moves  $\frac{E[C]}{E[Y]}, \beta_1$ , and  $\sigma_\varepsilon^2$ . Since the growing income dispersion between the two periods mainly comes from the deteriorations of most income groups except the 9th and the 10th decile groups in Table 2, it leads to a rise in the regression coefficient of  $\beta_1$ . [Figure 13] describes an example in which a median value of a distribution gets smaller. When an OLS regression is applied for the example, the estimated slope parameter  $\hat{\beta}_1$  is a weighted average of 1(=tan45) and the slope of AB. In addition the weight is influenced by the median value of the Y-distribution. Thus, the shrinking median value implies more weight on the 45 degree line in determining the slope estimator  $\hat{\beta}_1$ .

Furthermore, the declining interest rate and the loosened liquidity constraint have influence on the consumption-income relationship as in [Figure 14] and [Figure 15]. In the figures, OAB represents a kinked linear relationship before the credit constraint loosening whereas DAB in [Figure 15] (or OAD in [Figure 14]) denotes a new relation between consumption

<sup>19</sup> In other words, the three factors do not command  $(\frac{E[C]}{E[Y]}, \beta_1, \text{ and } \sigma_\varepsilon^2)$  orthogonally.

and disposable income. From the figures, we easily confirm the directions of changes in  $(\frac{E[C]}{E[Y]}, \beta_1, \text{ and } \sigma_\varepsilon^2)$  from the declining interest rate and the loosened liquidity constraint in the above table. The pure effect of the lowered interest rate encourages the consumption of non-liquidity-constrained consumers and their marginal and average dispensities to consumption rises. In contrast, the alleviation of the liquidity constraints induces the consumption of liquidity constrained consumers and their marginal dispensity to consumption is lowered while their average dispensity to consumption rises.

The above table summarizes our discussion so far regarding the directions of variations in  $(\frac{E[C]}{E[Y]}, \beta_1, \text{ and } \sigma_\varepsilon^2)$ , following the changes in income, interest rate, and liquidity constraints. From the table, we see that only a decrease in  $\beta_1$  distinguishes the liquidity effect from the other two factors.

Cross-time variations in the square of the consumption CV is decomposed into the following:<sup>20</sup>

$$\begin{aligned} \text{Var}[C'_{2001}] - \text{Var}[C'_{1996}] &= \beta_{1,2001}^2 \text{Var}[Y'_{2001}] + \sigma_{\varepsilon,2001}^2 - \beta_{1,1996}^2 \text{Var}[Y'_{1996}] - \sigma_{\varepsilon,1996}^2 \\ &= \beta_{1,2001}^2 (\text{Var}[Y'_{2001}] - \text{Var}[Y'_{1996}]) \quad [\text{Income effect}] \\ &\quad + (\beta_{1,2001}^2 - \beta_{1,1996}^2) \text{Var}[Y'_{1996}] \quad [\text{Liquidity effect}] \\ &\quad + (\sigma_{\varepsilon,2001}^2 - \sigma_{\varepsilon,1996}^2) \end{aligned}$$

The distributional effect of loosening liquidity constraints in proportion of total variations in the square of the consumption CV is calculated from

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<sup>20</sup> Another decomposition of the cross-time variation is possible by taking a different reference point of time as below:

$$\begin{aligned} &\text{Var}[C'_{1996}] - \text{Var}[C'_{2001}] \\ &= \beta_{1,1996}^2 (\text{Var}[Y'_{1996}] - \text{Var}[Y'_{2001}]) \quad [\text{Income effect}] \\ &\quad + (\beta_{1,1996}^2 - \beta_{1,2001}^2) \text{Var}[Y'_{2001}] \quad [\text{Liquidity effect}] \\ &\quad + (\sigma_{\varepsilon,1996}^2 - \sigma_{\varepsilon,2001}^2) \end{aligned}$$

The concepts of compensated variation and equivalent variation in consumer theory may differ in magnitudes but they always indicate the same directions. Likewise, whichever decomposition we choose, we will get the same qualitative results. The authors are grateful for an anonymous referee for suggesting the other way of decomposition.

$$\frac{\Delta\beta_1^2 \text{Var}[Y'_{1996}] + \Delta\sigma_\varepsilon^2}{\text{Var}[C'_{2001}] - \text{Var}[C'_{1996}]} \text{ and } \Delta\beta_1^2 \equiv \beta_{1,2001}^2 - \beta_{1,1996}^2$$

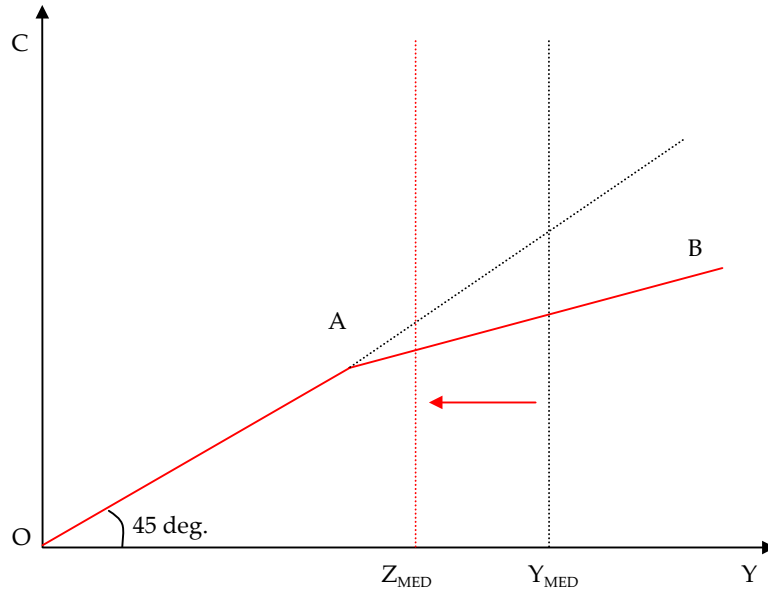
where the symbol  $\Delta$  stands for the variation induced by the liquidity constraint effect only. The distributional effects of loosening liquidity constraints in proportion of total variations in the square of the CVs of other variables (assets and debts) are calculated in the same way. Similarly, the decompositions of other inequality measures by the above three factors are possible, too.

Based on the above formula, we come up with

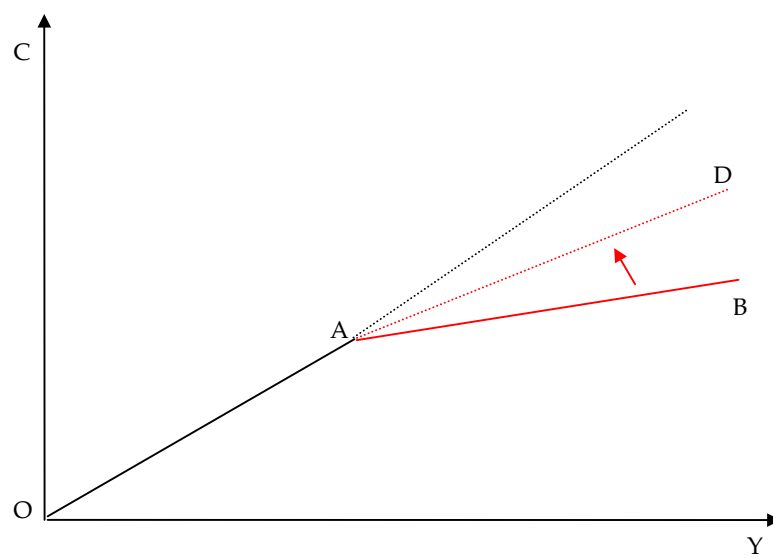
$$\frac{(\beta_{1,2001}^2 - \beta_{1,1996}^2) \text{Var}[Y'_{1996}]}{\text{Var}[C'_{2001}] - \text{Var}[C'_{1996}]} = 0.224.$$

The above calculation doesn't include the variations of  $\Delta\sigma_\varepsilon^2 = \sigma_{\varepsilon,2001}^2 - \sigma_{\varepsilon,1996}^2$  because it may also come from the other two sources than the alleviation of the liquidity constraints. Thus, the figure 22.4% is a lower bound for the distributional effect of the loosened liquidity constraints on the consumption distribution.

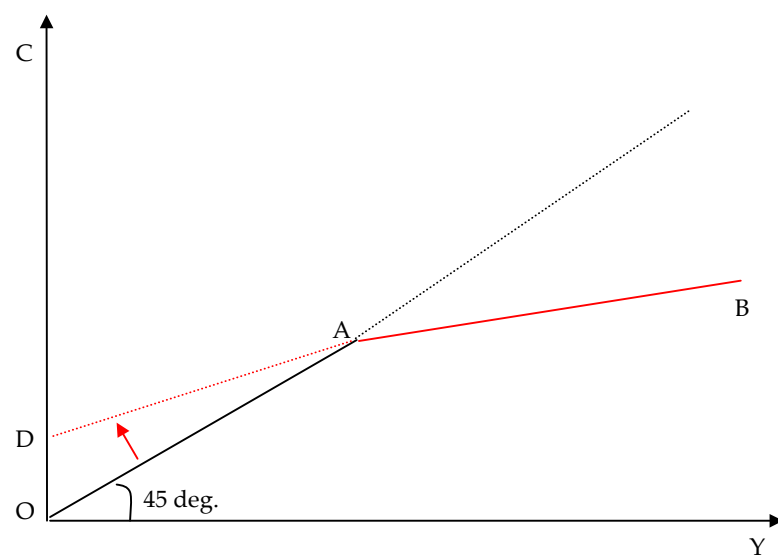
**Figure 13. Income Effect**



**Figure 14. Interest Rate Effect**



**Figure 15. Liquidity Constraint Loosening Effect**





## CHAPTER 6

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### **Conclusion**

Our paper examines the distributional effect of loosening liquidity constraints on consumption expenditures, asset holdings and debts using NSHIE data sets (1996 and 2001). These data sets are unique in that they enable us to evaluate the consequences of the economic regime change following the currency crisis in Korea. The loosened monetary policy combined with the concentration of bank loans on consumer finance lowered and stabilized the yield rates of various bonds ranging from treasury bills to corporate bonds. In addition to the lowered interest rate regime, it contributed to getting the liquidity constraints less binding, which resulted in the contraction of consumption inequality. The reduction of consumption inequality accompanied by the widened income inequality is attributed to easier access to debt financing. Finally, we show that the magnitude of the liquidity constraint loosening effect accounts for approximately 22.4% of the total reduction in the square of the consumption CV.

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