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Credit Crunches and Household Welfare:
The Case of the Korean Financial Crisis

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Abstract

The financial crisis in 1997 caused serious deterioration of the Korean economy. We examined the credit crunch in Korea and how it affected household welfare. With household panel data from 1996-1998, we estimated a switching regression model of a consumption Euler equation, which is augmented by endogenous credit constraints. Several empirical findings emerged. First, households coped with the negative shocks by reducing consumption of luxury items while maintaining food, education, and health-related expenditures. Second, the estimated results suggest that the standard consumption Euler equation, i.e., the necessary condition of the life-cycle permanent income hypothesis, does not hold because of binding credit constraints. Especially between 1997 and 1998, the probability of facing credit constraints increased significantly for all households. The expected welfare loss from binding credit constraints increased by 45% during the crisis, suggesting the seriousness of the credit crunch at the household level.

Keywords: Asian financial crisis; credit crunch; consumption Euler equation with endogenous credit constraints

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1. Introduction

The financial crisis in 1997 caused serious deterioration of household welfare in Korea. The poverty head-count ratio in urban Korea jumped from 7.5% in the first quarter of 1997 to 23% in the third quarter of 1998 (World Bank, 2000; Kakwani, 2000; Fallon and Lucas, 2002). This is partly due to the increase in unemployment. The unemployment rate increased from 2.6 percent in 1997 to 8.7 in 1998. In addition, the real GDP and real wage fell by ten and nine percent, respectively, in one year.

The financial crisis in Korea is often referred to as a typical example of a "credit crunch," which can be defined as a situation of significant credit rationing generated either by a sharp decline in the credit supply due to tight monetary policies or by an increase in credit demand (Ding et al., 1998; Agénor et al., 2000). In fact, there is a large body of evidence that corroborates this view. Ding et al. (1998) employed aggregate data and concluded that the sharp increase in the discrepancy between bank lending rates and corporate bond yields served as evidence of a credit crunch. Using bank-level data, Ferri and Kang (1999) showed that banks with lower equity raised lending interest rates while reducing their lending capital rapidly, which consequently generated a credit crunch. Borensztein and Lee (2002) used firm-level data and found that credit had been reallocated particularly from inefficient conglomerate-affiliated firms to more efficient firms. Their results suggest that the credit crunch in the country may have been an outcome of the structural changes in the financial sector rather than that of a general monetary contraction.

However, the existing studies on the credit crunch and the financial crisis exclusively focus on macroeconomic and financial aspects or impacts on firms (Furman and Stiglitz, 1988; Radelet and Sachs, 2000; Kaminsky and Leinhert, 1999; Ding et al., 1998; Borensztein and Lee, 2002; Claessens, et al., 2000). Particularly, in the above-mentioned studies on Korea, there are no clear explanations for how the financial crisis and credit crunch affected the welfare of Korean households. While anecdotal evidence says that, in retrospect, the negative impact of the crisis on Korean household welfare was smaller than was originally expected (World Bank, 2000), aggregate data at the household level indicate the seriousness of the credit crunch on household welfare (Bank of Korea, 2000). For example, the number of individual bankruptcies jumped from 1,435 in 1997 to 2,207 in 1998. In addition, overall retail credit sales decreased by 32 percent from 1997 to 1998, and the overdue rate to credit card companies reached 20.3% in 1998.

Our study tries to fill this gap in the current literature on the credit crunch and the financial crisis by conducting a formal analysis on the social impact of the crisis on individual households. In the theoretical part of this study, we extend the consumption Euler equation by introducing the possibilities of binding credit constraints. We will use this theory as our benchmark model to address to what extent Korean households were affected by the crisis. In our empirical analysis, we employ household-level panel data collected from 1995 to 1998, and we estimate the augmented Euler equation with endogenous credit constraints by using a switching regression model. The methodology allows us to estimate the probability distribution function of binding credit constraints before and during the financial crisis, which make it possible to quantify the seriousness of the credit crunch at the household level. Moreover, with the estimated results, we can calculate the expected value of welfare loss due to the binding credit constraints.

This paper is organized as follows. Section 2 provides the theoretical framework that is the basis of the econometric framework derived in Section 3. Section 4 contains a discussion of the data and empirical results and is followed by the concluding section.

2. The Model Framework

Under the financial crisis, Korean households, especially the poor, were confronted by ex-post shocks in their day-to-day lives (Fallon and Lucas, 2002). These households faced the problem of reconciling income fluctuation with a desirable level of stable consumption. This problem can be theoretically captured as a problem of intertemporal consumption smoothing under a stochastic income process.

Households have developed several ways, such as those involving self-insurance and mutual insurance, to cope with the ex-post risks of negative-income shocks and to protect their levels of consumption (Alderman and Paxson, 1992; Besley, 1995; Morduch, 1995; Rosenzweig, 2001). In this paper, we will focus on the two most important measures that households use to cope in times of crisis, which are consumption reallocation and the use of credit.

First, a household can maintain total nutritional intake, while it reduces food purchases and other expenditures. This is accomplished by changing the quality and composition of food expenditures or by reducing non-food expenditures, such as those for luxuries. As revealed in recent studies on the aftermath of the currency crisis in Indonesia and Thailand, consumption reallocation is indeed an important coping strategy (Frankenberg, Thomas, and Beegle, 1999; Townsend, 1999).[1] Interestingly, Olney (1999) showed that cutting consumption was the only viable strategy of American households against a recession in 1930, given the high default cost on their loans. Accordingly, consumer spending collapsed in 1930, turning a minor recession into the Great Depression.

Second, households can use credit to smooth consumption by reallocating future resources to current consumption.[2] The lack of consumption insurance can be compensated for by having access to a credit market (Eswaran and Kotwal, 1989; Morduch, 1994; Besley, 1995; Glewwe and Hall, 1998). However, poor households usually only have limited access to credit markets and are constrained from borrowing for a variety of reasons (Morduch, 1990; Pender, 1996), such as asymmetric information (Stiglitz and Weiss, 1981; Carter, 1988), or policy-induced financial repression (McKinnon, 1973). In any case, the existence of credit constraints has important negative impacts on the risk-coping ability of poor households.

In order to formalize the role of credit availability in consumption smoothing, we construct a model that provides optimal consumer behavior under uncertain income and possible credit constraints, following Zeldes (1989) and Deaton (1991). Suppose a household decision maker has a concave instantaneous utility, $U(\bullet)$, of the household consumption, C_t. The household decision is then to choose C_t that maximizes the

[1] Similarly, Moser (1996) finds the importance of food substitutions and expenditure reductions in four poor urban LDC communities.

conditional expectation of discounted lifetime utility with a subjective discount rate, δ, subject to intertemporal budget constraints:

$$\begin{aligned}
&\underset{\{C_t\}}{Max}\ E_t \sum_{j=0}^{T} \left(\frac{1}{1+\delta}\right)^{t+j} U(C_{t+j}) \\
&s.t.\quad A_{t+1} = (1+r_t)(A_t + y_t - C_t) \\
&\qquad\ A_t + y_t - C_t + z_t \geq 0, \\
&\qquad\ z_t \geq 0 \\
&\qquad\ A_0\ given \\
&\qquad\ A_T \geq 0,
\end{aligned}$$

where A is the household asset at the beginning of the period. The maximum amount of credit possible for this household is represented by z.[3] Note that r and y represent the interest rate and stochastic household income, respectively.

When income is stochastic, analytical solutions to this problem cannot generally be derived (Zeldes, 1989). However, we can derive a set of first-order necessary conditions by forming a value function and Bellman equation to obtain an optimum solution. Let λ represent the Lagrange multiplier associated with credit constraint $A+y-C+z \geq 0$. Combining the envelope condition derived from the first-order conditions, we obtain a consumption Euler equation, which is augmented by the possibility of a binding credit constraint:

$$\begin{aligned}
&U'(C_t) = E_t\left[U'(C_{t+1})\left(\frac{1+r_t}{1+\delta}\right)\right] + \lambda_t, \\
&A_t + y_t - C_t + z_t \geq 0\ \ if\ \lambda_t = 0, \\
&A_t + y_t - C_t + z_t = 0\ \ if\ \lambda_t > 0.
\end{aligned} \qquad (1)$$

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[2] In Korea, there are extensive unorganized money markets from which households may obtain loans. The use of credit for consumption is the basic logic of the LC-PIH interpretation of household-consumption smoothing.

[3] When z is sufficiently large, this household can lend and borrow freely at a rate of interest, r_t. A case of complete borrowing constraint, in which a household cannot borrow at all, can be represented by z=0.

Note that this augmented Euler equation was first derived by Zeldes (1989). As can be seen in Figure 1, we can interpret the Lagrange multiplier, λ, as an indicator of negative welfare effects generated by binding credit constraints.[4] Note that the Lagrange multiplier λ_t is a negative function of the current income, y_t, as can be verified in Figure 1. By using this figure, it is straightforward to show that given other variables, an increase in the current income of a credit-constrained household leads the marginal utility of current consumption to fall, causing the Lagrange multiplier to decline.

3. Econometric Framework

The aim of our econometric framework is to test the implications of the augmented Euler equation (1). Following Zeldes (1989), we assume the rational expectation and the constant relative risk aversion (CRRA) utility, i.e., $U(C_t) = C_t^{1-\gamma}(1-\gamma)^{-1}\exp(\theta_t)$, in which θ represents the household tastes. Then, equation (1) becomes:

$$\hat{C}_{it+1} = \frac{1}{\gamma}\left[(\theta_{it+1} - \theta_{it}) + \log(1+\lambda_{it}') - \log(1+e_{it}) + \log(1+r_{it}) - \log(1+\delta_i)\right], \tag{2}$$

where *i* is the household index and *e* denotes the household mean zero expectation error. The left-hand side variable, $\hat{C}$, indicates the first difference of log consumption or, approximately, consumption growth rate. Note that the Lagrange multiplier is normalized by the future marginal utility of consumption:

$$\lambda_{it}' \equiv \frac{\lambda_{it}}{E_t\left[C_{it+1}^{-\gamma}\exp(\theta_{it+1})\left(\frac{1+r_{it}}{1+\delta_i}\right)\right]}. \tag{3}$$

[4] This term, λ, is equal to the increase in expected lifetime utility that would result if the current constraint were relaxed by one unit. Because the household is constrained from borrowing more, but not from saving more, λ enters with a positive sign. Pender's (1996) result, using the Indian ICRISAT data set, implies that λ>0.

Then, the estimable equation becomes:

(4) $$\hat{C}_{it+1} = X_{it}\beta + \frac{1}{\gamma}\left[\log(1+\lambda_{it}')\right] + v_{it},$$

where we suppose that *X* includes the determinants of time preference and interest rate, and v_{it} indicates a stochastic error term including an expectation error.[5] To control for the changes in preferences and household characteristics, such items as household size, age of the head of the household, and age squared were included (Zeldes, 1989).

Now, let *C** represent the optimal consumption in the absence of a current credit constraint. $C^* = C$ if the credit constraint is not binding, while $C^* > C$ if the credit constraint is binding. Then, define the gap between the optimal consumption under the perfect credit accessibility and cash in hand plus a maximum loan, i.e., $H=C^*-(A+y+z)$. Here, two factors are considered to determine whether *H* takes a positive value, i.e., whether the constraint is binding (Jappelli, 1990). First, it depends on the demand for credit, which is represented by the difference between the cash in hand and consumption. The second factor is how many financial intermediaries are willing to supply credit to this individual, which is denoted by *z*. Further, following Hayashi (1985) and Jappelli (1990), we assume that the reduced form of the optimal consumption *C** can be expressed as a linear function of observables, such as current income, wealth, age, and demographic characteristics, as well as the quadratic terms of these variables. The maximum amount of borrowing is also assumed to be a linear function of the same variables. Accordingly, we have a reduced-form equation:

(5) $$H_{it} = W_{it}\beta_W + \varepsilon_{it},$$

[5] Note that taking a second-order Taylor expansion of log(1+*e*) around *e*=0, we obtain $\log(1+e)\approx e-(1/2)e^2$. In this paper, we represent the results by employing the log-linerlized Euler equation without the quadratic term. Yet, recent studies by Carroll (2001), Gourinchas and Parker (2001), and Ludvingson and Paxson (2001) emphasize the importance of higher-order terms in the Euler equation. Following Dyan (1993), we also estimated the augmented Euler equation by assuming that the squared expectation error is captured by various characteristics of households and their heads. The results, which are not reported here and available upon request from the authors, are consistent with the results presented in this paper.

where W includes the assets, income, and determinants of optimal consumption and maximum loan values and ε is an error term which captures unobserved elements and measurement error.

By linearizing equation (4), we can derive the following econometric model of the augmented Euler equation with endogenous credit constraints:

$$(6) \qquad \hat{C}_{it+1} = X_{it}\beta + \lambda_{it}' + v_{it},$$

$$\lambda_{it}' > 0 \;\; if \;\; H_{it} \geq 0,$$
$$\lambda_{it}' = 0 \;\; if \;\; H_{it} < 0,$$

$$H_{it} = W_{it}\beta_W + \varepsilon_{it}.$$

Exogenous Versus Endogenous Credit Constraints

The conventional empirical approach to estimate the system of equations (6) such as Zeldes (1989) and Morduch (1990) ignores the endogeneity of the Lagrange multiplier and splits the sample into those likely to be credit-constrained, i.e., λ_t>0, and those unlikely to be credit-constrained, i.e., λ_t=0, exogenously. Zeldes (1989) splits the sample from the US on the basis of an income-to-wealth ratio. Morduch (1990) utilized information on land ownership as an indicator of credit constraints of households in rural India.

This exogenous split approach, however, has two problems (Garcia, Lusardi, and Ng, 1997, p.158; Hu and Schinantarelli, 1998, pp. 466-467). First, it is unlikely that a single variable, such as an income-to-wealth ratio, would serve as a sufficient statistic of a consumer's ability to borrow. Usually, lenders screen credit applicants with the use of multiple factors. Secondly, if the variables used as a criterion for splitting a sample were correlated with the unobserved factors in consumption growth, this correlation would generate an endogenous sample selection problem. Accordingly, we have to correct the sample selection bias when we estimate the augmented Euler equation.

In order to overcome these two issues, an alternative approach would be to construct a qualitative response model of an endogenous credit constraint by defining an indicator variable of a credit constraint, which would be one if the credit constraint were binding and zero otherwise. Such a qualitative-response model is estimated by Jappelli (1990). Jappelli, Pischeke, and Souleles (1998) combined this model of endogenous credit constraints with a consumption Euler equation.

However, it is not easy to identify credit constraints from data. A direct approach is to utilize information on the household willingness and ability to obtain credit (Feder, Lau, Lin, and Xiaopeng, 1989; Barham, Boucher, and Carter, 1996; Baydes, Meyer, and Aguilera-Alfred, 1994).[6] Generally, such information is not available in standard household survey data (Scott, 2000).

However, even in cases where the indicator variable for credit constraint is not observed, we can apply the estimation method of a switching model with unknown regimes or a version of the Type 5 Tobit model in Amemiya (1985). Dickens and Lang (1985) applied this model to test dual labor-market theory. We follow a study by Garcia, Lusardi, and Ng (1997) and estimate the Euler equation augmented by endogenous credit constraints as a switching regression model.

Let the Lagrange multiplier, λ', be a linear function of proxy variables, Z, i.e., $\lambda' = Z\psi$ with a coefficient vector ψ. Letting superscripts N and C represent the unconstrained and constrained groups, respectively, the estimable augmented Euler equation (6) can be rewritten as follows:

(7) $$\hat{C}_{it} = X_{it}\beta_N + Z_{it}\psi_N + v_{Nit} \quad if \quad H_{it} < 0,$$

(8) $$\hat{C}_{it} = X_{it}\beta_C + Z_{it}\psi_C + v_{Cit} \quad if \quad H_{it} \geq 0,$$

(9) $$H_{it} = W_{it}\beta_W + \varepsilon_{it},$$

[6] An alternative approach is to estimate the shadow values of capital for producers and compare these with the prevailing market loan rates. Consistent large gaps between the shadow values of capital and prevailing loan rates reflect the presence of credit constraints (Sial and Carter, 1996; Carter and Wiebe, 1990).

where W, following Jappelli (1990) and Garcia, Lusardi, and Ng (1997), is a set of determinants of credit constraints that includes income, income squared, assets, assets squared, age, age squared, gender and marital status of household head, composition of the household, and other control variables. Throughout the estimation, we take the annual growth rate of food expenditures as a dependent variable.

The testable restriction derived from the theoretical result of the augmented Euler equation (1) is that the elements of the coefficient vector, ψ_N, are all zero for the non-constrained group, while the elements of the coefficient vector, ψ_C, are all non-zero.

In order to implement our estimation, we assume that errors follow a joint normal distribution with zero means and the following covariance matrix:

(10)
$$\begin{pmatrix} v_{Nit} \\ v_{Cit} \\ \varepsilon_{it} \end{pmatrix} \sim N\left[\begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_N^2 & \sigma_{NC} & \sigma_{N\varepsilon} \\ \sigma_{CN} & \sigma_C^2 & \sigma_{C\varepsilon} \\ \sigma_{\varepsilon N} & \sigma_{\varepsilon C} & \sigma_\varepsilon^2 \end{pmatrix}\right].$$

For identification, we assume that σ_ε^2=1. We cannot observe H directly, but we can estimate the probability of being credit-constrained jointly with other parameters in Euler equations by maximizing the following log-likelihood function:

(11)
$$l_t(\beta_N, \beta_C, \psi_N, \psi_C, \beta_W, \sigma_N, \sigma_C, \sigma_{N\varepsilon}, \sigma_{C\varepsilon})$$
$$= \sum_{i=1}^{n} \log\left\{ f(v_{Nit} \mid H_{it} < 0)\text{Prob}(H_{it} < 0) + f(v_{Cit} \mid H_{it} \geq 0)\,\text{Pr ob}(H_{it} \geq 0)\right\}$$
$$= \sum_{i=1}^{n} \log\left\{\left[\frac{1}{\sigma_N}\phi\left(\frac{v_{Nit}}{\sigma_N}\right)\right]\Phi\left(\frac{-W_{it}\beta_W - \frac{\sigma_{N\varepsilon}}{\sigma_N^2}v_{Nit}}{\sqrt{1-\frac{\sigma_{N\varepsilon}^2}{\sigma_N^2}}}\right) + \left[\frac{1}{\sigma_C}\phi\left(\frac{v_{Cit}}{\sigma_C}\right)\right]\left[1-\Phi\left(\frac{-W_{it}\beta_W - \frac{\sigma_{C\varepsilon}}{\sigma_C^2}v_{Cit}}{\sqrt{1-\frac{\sigma_{C\varepsilon}^2}{\sigma_C^2}}}\right)\right]\right\},$$

where $\phi(\bullet)$ and $\Phi(\bullet)$ represent the density and cumulative distribution functions, respectively, of standard normal distribution. Note that this likelihood function (11) is the same as the one employed by Dickens and Lang (1985), Garcia, Lusardi, and Ng (1997), and Hu and Schinantarelli (1998).

4. Data and Estimation Results

Data and Descriptive Statistics

We use household-level panel data that was collected through the Korean Household Panel Survey (KHPS) project in all prefectures except Jeju-do (see Appendix for detailed information of the project). Based on a stratified random sampling scheme by street block, this information consists of household- and individual-level data files. For our study, data over three rounds from July 1995 to August 1998 were used where each round covers the period from August to July of the following year. The 1997-98 round is considered to reflect the period of the crisis since it covers the period from August 1997 to July 1998.

Table 1 shows the descriptive statistics. The average age of household heads was 47 in 1996 and 50 in 1998. Household size remained stable at around 3.7. Income and expenditure variables are converted into real value by using provincial consumer price indices. Between the 1995-96 and 1996-97 rounds, total income and wage earnings were fairly stable. Moreover, the major components of expenditures are fairly stable in this period. The value of household assets rose by about five percent, while debt declined by 11 percent during this period.

On the other hand, with the onset of the crisis, real total income fell by 24 percent between 1997 and 1998. The major income component, wages, dropped by 26 percent and was partially offset by a 28 percent increase in debt during this period.

During the crisis, sales of assets did not increase significantly, and assets declined by a mere 2 percent, implying that such sales did not serve as an important coping device. This may indicate that households were reluctant to sell their assets to cope with the negative shock since land and stock prices declined sharply. This finding contrasts with the findings of Horioka, Murakami, and Kohara (2002) which show that, in the 1990s, Japanese households coped with ex post income fluctuations primarily by drawing down their own savings.

On the other hand, private and public transfers rose by 8 and 11 percent, respectively. However, transfers constituted only 4 percent of total income, and merely 22 percent of total households received transfers. Public transfers consisted predominantly of pensions, which take 82 percent of public transfers on average, since most of the social safety net programs were not yet in place during the initial phase of the crisis, which is the period of our analysis.

With the contraction of the economy, rising unemployment, and falling income, total household expenditures dropped by 29 percent between 1997 and 1998. The largest drop of 63 percent was in the consumption of luxury items, i.e., leisure activities, dining out, and durable goods. On the other hand, food consumption fell by only 15 percent, and expenditures on health and children's education, which included extracurricular activities and additional after-school classes, fell by 20 percent. These three categories — food, health & education, and luxury goods— represented 64 percent of the total expenditure. Although the consumption of food, health services, and children's educational services fell in absolute terms during the crisis, they maintained a higher proportion of the total household budget. The share of food and health and education expenditures increased from 28 percent and 24 percent in 1997 to 31 percent and 25 percent in 1998, respectively, while that of luxury expenditures fell from 12 percent in 1997 to 6 percent in 1998. This suggests that average households were cutting back on the consumption of non-essential items to preserve funds available for food, health, and children's education.[7]

Estimation Results of the Zeldes Type Model

First, we take an exogenous split approach to estimate the augmented Euler equations before and during the financial crisis. For the former period, we investigate consumption growth between the 1995-96 round and the 1996-97 round, while for the

[7] Goh, Kang, and Sawada (2001) examine the consumption reallocation pattern in Korea during the financial crisis.

latter period, we estimate the consumption growth equation between the 1996-97 round and the 1997-98 round. Following Zeldes (1989), we split the sample on the basis of wealth to income ratios. A household is regarded as being credit constrained if the calculated total non-housing wealth was less than two months' worth of the average income.

Note that the Lagrange multiplier λ_t is a negative function of current income, y_t (Figure 1). Hence, it is natural to choose the initial income, y, as an element of proxy variables, Z, in equation (7) and (8). Note that Zeldes (1989) also selected the initial income as the proxy variable. Given the exogenous division of household groups, we can estimate an augmented consumption Euler equation with income as an additional independent variable separately for non-constrained households and constrained households. Then a testable restriction is that the income coefficient is zero for the unconstrained group and is negative for the constrained group.

The estimated coefficients of the Euler equation are reported in Table 2. The coefficients of initial income are negative and statistically significant for the constrained group but not for the non-constrained group. These empirical results are in accordance with our theoretical framework. During the financial crisis, the income coefficient becomes marginally significant even for the non-constrained group. This may be a reflection of the negative and serious effect of the credit crunch even for those households who were not credit-constrained previously.

Estimation Results of the Endogenous Credit Constraint Model

When we assume that credit constraints are endogenously determined, we have to estimate parameters by maximizing the likelihood function (11). Since the likelihood function is not concave in the parameters to be estimated, the nonlinearity of the likelihood function made convergence difficult. However, we can achieve interior solutions by taking the estimated parameters of the Zeldes (1989) type model in Table 2 as the initial values.[8]

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[8] Initially, we set auxiliary parameters, (σ_N, σ_C, $\sigma_{N\varepsilon}$, $\sigma_{C\varepsilon}$), to be (1, 1, 0, 0). Then the estimated auxiliary parameters are employed as the initial values to re-estimate all the parameters.

Table 3 reports the estimation results. First, the coefficients on initial income for the constrained and unconstrained groups are both negative. However, while income coefficients for the unconstrained group are insignificant before the crisis and marginally significant with 9.4% *p*-value during the crisis, the coefficients for the constrained group are statistically significant before and during the crisis at the 9.4% and 6.4% levels of significance, respectively. Hence, the results suggest that the life-cycle permanent income hypothesis (LC-PIH) is not violated for the unconstrained group at least before the crisis but it is violated for the constrained group before and during the financial crisis. These findings are consistent with our hypothesis that the major source of violation of the standard LC-PIH is the credit constraint.

Second, we found the covariance terms of the errors are not significantly different from zero. This finding is in line with Garcia, et al. (1997), and is not surprising. The error terms of the Euler equations are basically expectation errors, which, by nature, should be orthogonal to information available at the initial stage, including sample selection errors. Moreover, this model is not a selection model as is the case in the Lee (1978) model, since households are forced to face a credit constraint, rather than self-selection into the credit constrained regime.

Finally, with respect to the credit constraint equation, while the directions of the estimated coefficients are in line with the preceding studies on credit constraints using the US data sets (Garcia, Lusardi, and Ng, 1997; Jappelli, 1990; Jappelli, Pischeke, and Souleles, 1998), individual coefficients are not statistically significant. Further, we perform a joint test where all the coefficients except the intercept in the credit constraint equation are zero. We conduct Wald tests by using the results of the estimated variance-covariance matrix of the estimators. The test results, which are summarized in Table 4, indicate that we can reject the null hypothesis that the coefficients in the credit constraint equation are jointly zero. We believe that these test results allow us to utilize the estimated parameters of the credit equation to investigate the nature of the credit crunch in Korea.

Hence, we employ these coefficients together in order to further compare credit accessibility before and during the crisis. To do this, we compute the probability of binding credit constraints, $1 - \Phi\left(-W_{it}\hat{\beta}_W\right)$, by using the estimated parameter vector, $\hat{\beta}_W$.

Figure 2 compares the estimated kernel density function of the predicted credit-constrained probability using the switching regression results before and during the crisis. As we expected, the probability density to be credit-constrained increased during the crisis for Korean households.[9] Figure 3 further compares the two distributions by using cumulative density functions of predicted probabilities of binding credit constraints. By looking at Figure 3, we can perform an eye-ball test of the first-order stochastic dominance. It is obvious that the predicted probabilities before the crisis are dominated by the probabilities during the crisis.

Quantifying Welfare Impacts of the Credit Crunch

From the results of our estimation, we calculate the welfare loss from binding credit constraints, which is represented by a triangle shown in Figure 1. Assuming this welfare loss takes the form of a right isosceles triangle, it is computed by $\lambda_t^2/4$. Note that, if the utility function is quadratic, the welfare loss becomes an isosceles triangle. Accordingly, with our estimated parameters, we can derive a consistent estimate of the expected value of this welfare loss by calculating

$$E\left(\frac{\hat{\lambda}_{it}^2}{4}\right) = \frac{\Phi(W_{it}\hat{\beta}_W)\hat{\lambda}_{it}^2}{4}. \tag{10}$$

Recalling equation (3), we can quantify the Lagrange multiplier, $\hat{\lambda}_{it}$, in equation (10) by using the following equation:

$$\hat{\lambda}_{it} = \exp[\gamma(\ln y_{it})\hat{\psi}_N - 1][C_{it+1}^{-\gamma}\exp(\hat{\theta}_{it+1})],$$

where we assume that there is no consumption tilting, i.e., $\delta = r$.[10]

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[9] We used a Gaussian kernel to estimate density. The width of the density is selected so that the mean integrated square error is minimized.

[10] Note that when we compute, θ, we assume that there are no age effects in the augmented Euler equation.

By using equation (10), Table 5 represents the mean and standard deviation of the estimated welfare loss before and during the currency crisis, assuming the coefficient of relative risk aversion is two, i.e., γ=2. The expected welfare loss from binding credit constraints increased by 45% during the crisis, suggesting the seriousness of the credit crunch at the household level (Table 5).

5. Conclusion

In this study we investigate the welfare losses incurred by Korean households that are attributable to the credit crunch. Two important empirical findings emerge. First, households cope with negative shocks by reducing consumption of luxuries, while maintaining expenditures for food, education, and health-related necessities. Second, we observed a significant increase in the predicted probability to be credit-constrained during the crisis. Hence, we conclude that Korean households suffered seriously from inflicted constraints in accessing credit markets during the financial crisis. The results of our calculations indicate that the expected welfare loss from binding credit constraints increased by 45% during the crisis.

When market or non-market opportunities for risk coping and sharing are limited, credit serves as an insurance substitute. Facing negative transitory shocks, households can obtain credit instead of receiving insurance payments so that they can smooth out such shocks. The financial crunch in Korea seems to have disabled this important role of credit as an instrument of self-insurance. Such a mechanism of the credit crunch may have magnified the transmission of negative macroeconomic shocks to the entire Korean economy during the financial crisis in a similar way as in the US during the Great Depression (Olney, 1999).

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Appendix: The data

The Korea Household Panel Survey (KHPS) data has a rectangular form, following the Panel Survey of Income Dynamics (PSID) of the US. There are no replacements of households, but household split-offs due to marriage or other reasons are included. The survey was conducted in all Korean prefectures except Jeju-do through stratified random sampling by street blocks; eight and seven households from each street block are randomly selected in large and small cities, respectively. The data consists of multi-purpose surveys in household and individual modules. Tables A1-A3 present some information on the KHPS. This study excludes data of the first and second waves because definitions of a number of variables and periods covered are not comparable with those in the later waves. Thus, this study examines periods from 1995 to 1998, inclusive of the initial period of the Asian financial crisis.

Table A1. Summary Statistics of Variables

Year identification	Wave	Period Covered
1993	1	Jan. 92 - Dec. 92
1994	2	Apr. 93 - Mar. 94
1995	3	Aug. 94 - Jul. 95
1996	4	Aug. 95 - Jul. 96
1997	5	Aug. 96 - Jul. 97
1998	6	Aug. 97 - Jul. 98

Table A2. Summary Statistics of Variables

	1993	1994	1995	1996	1997	1998
1993	4547	3609	3045	2712	2571	2266
1994		16	13	11	9	7
1995			50	41	39	30
1996				69	55	39
1997					50	46
1998						80
Dropouts		938	564	333	141	305
New Entry (Split-offs)		16	63	121	153	202
Attrition rate		20.6%	15.6%	10.9%	5.2%	11.9%
Total	4547	3625	3108	2833	2724	2468

Table A3. Sample Size

	1994	1995	1996	1997	1998
Household Lacking Consumption Data	0	4	18	20	0
Household Lacking Household Head Education Data	220	61	46	80	70
Total Number of Households in Working Panel	3567	3008	2701	2561	2238

Table 1. Summary Statistics of Variables (In 1995 10,000 Korean Won)

	1995-96	1996-97	1997-98
	Mean (Std. Dev)	Mean (Std. Dev)	Mean (Std. Dev)
Basic Household Characteristics			
Age of household head	47.93	48.71	49.67
	(13.64)	(13.71)	(13.75)
Dummy =1 if the head is female	0.10	0.11	0.12
Dummy=1 if the head is single	0.13	0.13	0.14
Dummy=1 if the head is a salaried worker	0.36	0.34	0.28
Dummy=1 if the head is self-employed or operates a business	0.26	0.26	0.26
Dummy=1 if the head's job is in agriculture or fishing or temporal	0.22	0.22	0.23
Dummy=1 if the head is unemployed, a student, or retired	0.16	0.18	0.23
Household size	3.81	3.72	3.69
	(1.38)	(1.37)	(1.41)
Adult-equivalent household size	3.41	3.35	3.35
	(1.24)	(1.22)	(1.25)
Number of children below 15 years old	1.00	0.94	0.85
	(1.01)	(1.00)	(1.01)
Income, Expenditure, Assets, and Debt			
Non-durable expenditure (food, clothes, education, health, and fuel)	782.78	791.52	647.32
	(571.89)	(530.76)	(463.02)
Food expenditure	352.90	351.54	297.99
	(207.79)	(216.26)	(177.63)
Education & medical expenditure	293.57	304.17	242.21
	(432.09)	(371.30)	(336.21)
Expenditures for luxuries (cultural activities, entertainment, dining out, and durable goods)	179.47	147.25	53.98
	(494.30)	(333.75)	(86.36)
Total income	2954.26	2861.23	2167.79
	(3288.63)	(3029.38)	(2340.89)
Wage income or earnings from work	2094.67	2064.81	1523.41
	(1798.99)	(1734.66)	(1264.16)
Private transfers received	45.60	51.38	54.90
	(152.28)	(214.14)	(209.45)
Public transfers received	18.37	19.18	20.99
	(118.36)	(116.35)	(134.08)
Sales of assets (land, real estate, securities, and withdrawal of time deposits)	252.25	195.01	203.62
	(1485.03)	(1305.44)	(1089.94)
Total assets (savings account, shares, bonds, insurance, loan clubs, current value of house)	7319.85	7681.19	7533.37
	(9439.95)	(9403.04)	(11895.05)
Number of cars owned	0.41	0.44	0.43
	(0.54)	(0.54)	(0.53)
Outstanding debt (formal banks, informal banks, and personal)	945.31	842.02	1074.34
	(2441.61)	(2177.78)	(5252.27)
Number of households	2778	2629	2375

Table 2. The Zeldes (1989) Test:
Estimation Results of the Augmented Euler Equation
Dependent Variable: Growth Rate of Food Expenditure

	Before the Crisis (95/96~96/97)		During the Crisis (96/97~97/98)	
	Non-constrained	**Constrained**	**Non-constrained**	**Constrained**
First difference of adult	0.081	0.157	0.042	0.059
equivalent household size	□0.076□	(0.079)	(0.060)	(0.044)
Age	0.001	-0.007	-0.002	0.003
	□0.002□	(0.003)	(0.003)	(0.002)
Log of initial total income	-0.048	-0.057	-0.075	-0.078
	(0.044)	(0.033)	(0.037)	(0.037)
Constant	0.327	0.798	0.582	0.290
	(0.349)	(0.339)	(0.361)	(0.350)
Number of samples	940	895	900	935

Note) Numbers in parentheses are Huber-White robust standard errors.

Table 3. Estimation Results of the Augmented Euler Equation

	Before the Crisis (95/96~96/97)		During the Crisis (96/97~97/98)	
	Non-constrained	**Constrained**	**Non-constrained**	**Constrained**
Euler equation				
First difference of adult equivalent household size	0.137	0.112	-0.319	0.103
	(0.251)	(0.034)	(0.245)	(0.040)
Age of the head	-0.026	-0.002	-0.023	0.001
	(0.028)	(0.001)	(0.031)	(0.001)
Log of initial total income	-0.109	-0.037	-0.396	-0.029
	(0.142)	(0.022)	(0.237)	(0.015)
Constant	3.199	0.374	4.555	0.025
	(2.832)	(0.195)	(4.029)	(0.147)
Probability of Binding Credit Constraints				
Total income	0.585		1.247	
	(0.967)		(1.454)	
Total income squared	-0.545		0.716	
	(0.669)		(2.670)	
Total asset	-0.073		-0.115	
	(0.144)		(0.149)	
Total asset squared	0.014		0.022	
	(0.013)		(0.016)	
Asset×Income	-0.050		-0.799	
	(0.769)		(0.618)	
Age of the head	-0.041		0.024	
	(0.058)		(0.051)	
Age of the head squared	0.000		0.000	
	(0.000)		(0.000)	
Dummy=1 if the head is female	0.081		-0.158	
	(0.221)		(0.222)	
Number of household Members	0.044		-0.117	
	(0.074)		(0.076)	
Number of members under 15 years old	0.210		0.152	
	(0.160)		(0.131)	
Constant	2.126		0.841	
	(1.612)		(1.386)	
Other parameters				
σ_N	2.565		2.610	
	(0.374)		(0.297)	
σ_C	0.504		0.559	
	(0.018)		(0.017)	
$\sigma_{N\varepsilon}$	0.721		0.039	
	(1.043)		(1.218)	
$\sigma_{C\varepsilon}$	0.035		0.058	
	(0.058)		(0.071)	
Number of samples	1835		1835	

Note) Numbers in parentheses are Huber-White robust standard errors.

Table 4.
A Wald Test for the Null Hypothesis:
The Coefficients in the Credit Constraint Equation are Jointly Zero

	Before the Crisis (95/96~96/97)	**During the Crisis (96/97~97/98)**
Wald test statistics	50.54	21.55
[*P*-value]	[0.000]	[0.018]

Note) Numbers in parentheses are Huber-White robust standard errors.

Table 5.
Expected Value of Welfare Loss from Binding Credit Constraints

	Before Crisis	During Crisis
Expected value of welfare loss from binding credit constraints under the assumption of $\gamma=2$ □$\times 10^{-6}$□	0.0099	0.0145

Figure 1
Consumption Smoothing under Binding Credit Constraints

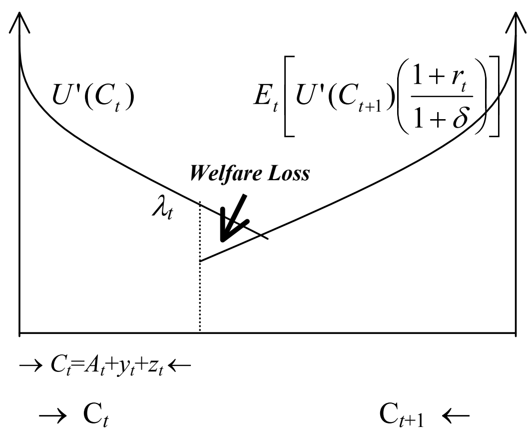

Figure 2
Kernel Density Estimates of Probability to be Credit-Constrained
Before and During the Crisis

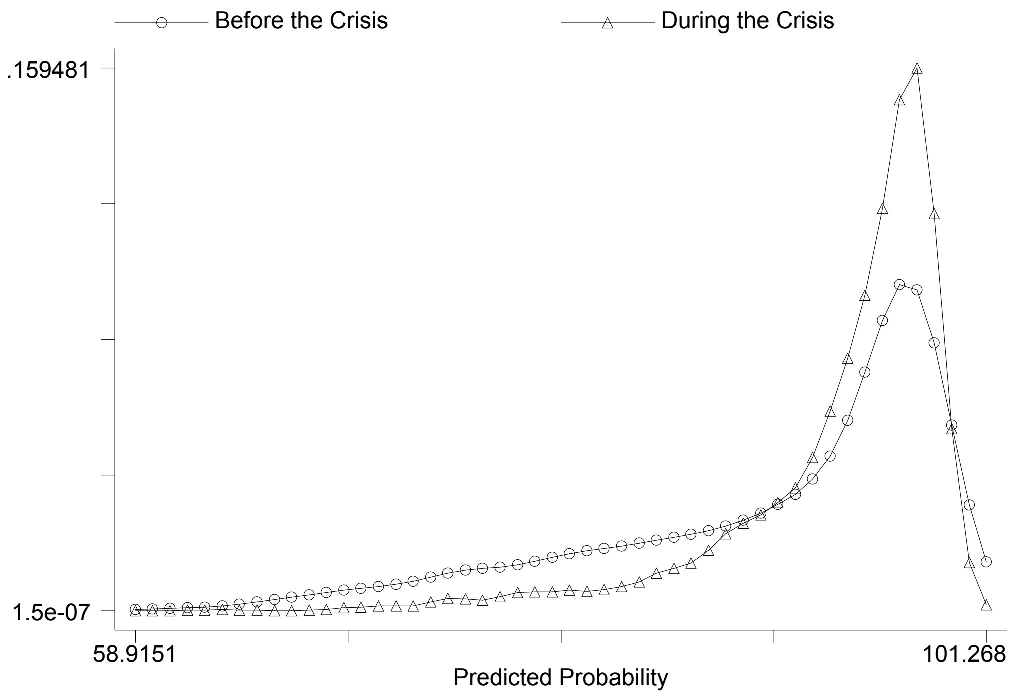

Figure 3
Cumulative Density of Probability to be Credit-Constrained
Before and During the Crisis