# Discussion Papers In Economics And Business

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## Abstract

The standard argument is that while money creation and credit creation have different channels, they provide the same theoretical size of multipliers. However, there is usually some difference in practice. Consequently, in this paper we investigate the long-run relationship between the credit and money multipliers in Japan.

Keywords: Money Supply, Money Stock, Money Multiplier, Credit Multiplier

JEL Classfication: E51, E41, E42

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## 1. Introduction

A standard argument is that while money creation and credit creation have different channels, they provide the same theoretical size of multipliers. In practice, there is usually some difference owing to the coverage or definition of bank loans and monetary aggregates. To explain this discrepancy in multipliers, Honda (2004) provides a theoretical case using a simple T-account explanation to demonstrate the impact of the restriction of some banks in making additional loans because of capital requirements. However, no empirical investigation is undertaken. Accordingly, if the theoretical conclusion is to be meaningful, there should be a long-run relationship such that the money multiplier and credit multiplier are equal.

Following the asset bubble burst and the first Basel Accord in 1989, bank loans in Japan shrank such that a so-called "credit crunch" took place and the credit multiplier fell dramatically. This change implies that the above theoretical conclusion has no empirical meaning even if we are unable to find any evidence of a long-run relationship. In this paper, we attempt to identify the long-run relationship between the credit and money multipliers and investigate the possibility of structural change using Japanese data.

The remainder of the paper is structured as follows. Section 2 discusses the trends in the Japanese credit and money multipliers. Section 3 conducts an empirical investigation using a gradual switching model and Japanese data. Section 4 provides some concluding remarks.

## 2. Actual credit and money multipliers in Japan

To calculate the money and credit multipliers in Japan, we can obtain data from the Bank of Japan's webpage (http://www.stat-search.boj.or.jp/index_en.html). For the money stock, we

use the M1 and M2 series since January 2003. According to the Bank of Japan, the definitions of these series are as follows.

**M1**: Currency in circulation + deposit money

where deposit money is defined as demand deposits (current deposits, ordinary deposits, saving deposits, deposits at notice, special deposits, and deposits for tax payments) minus checks and bills held by the surveyed financial institutions and all domestic depository institutions (comprising the financial institutions surveyed for M2, the Japan Post Bank, the Shinkumi Federation Bank, Shinkumi Banks, the Rokinren Bank, labor banks, Prefectural Credit Federations of Agricultural Cooperatives, Agricultural Cooperatives, Prefectural Credit Federations of Fishery Cooperatives, and Fishery Cooperatives).

**M2**: Currency in circulation + deposits

where the Bank of Japan limits the definition of deposits in this series to domestically licensed banks (excluding the Japan Post Bank), foreign banks in Japan, Shinkin Central Bank, shinkin banks, the Norinchukin Bank, and the Shoko Chukin Bank) to maintain conformity with the previous definition of the M2 money supply.

Because of the change in the definitions of the monetary aggregates in January 2003, we are obliged to estimate M1 and M2 for the earlier period. By using the annual growth rate of the former definitions of aggregate money supply, we estimate M1 and M2 from January 1980 to December 2002. According to the Bank of Japan, the main differences in the definitions of money stock and money supply are that in the M1 (money stock) series, securities companies, Tanshi companies, and nonresidents are not included as money holders. In the M2 (money stock) series, the main differences derive from the range of money holders included and the estimation method for some of the data. Apart from these differences, M2 (money supply) has the same range of money issuers and financial assets (except for nonresident yen deposits). For

M1 (money stock), the range of money issuers also differs from the M1 series (money supply) (in addition to the financial institutions surveyed for M1 in the former series, deposit money at the Japan Post Bank and other financial institutions are included). For bank loans, we obtain two types of aggregated bank loans: monthly average loans and discounts of all banks except shinkin banks (available since July 1991) and loans and discounts of all banks including shinkin banks (available after January 2000). We denote the former as L in this paper.

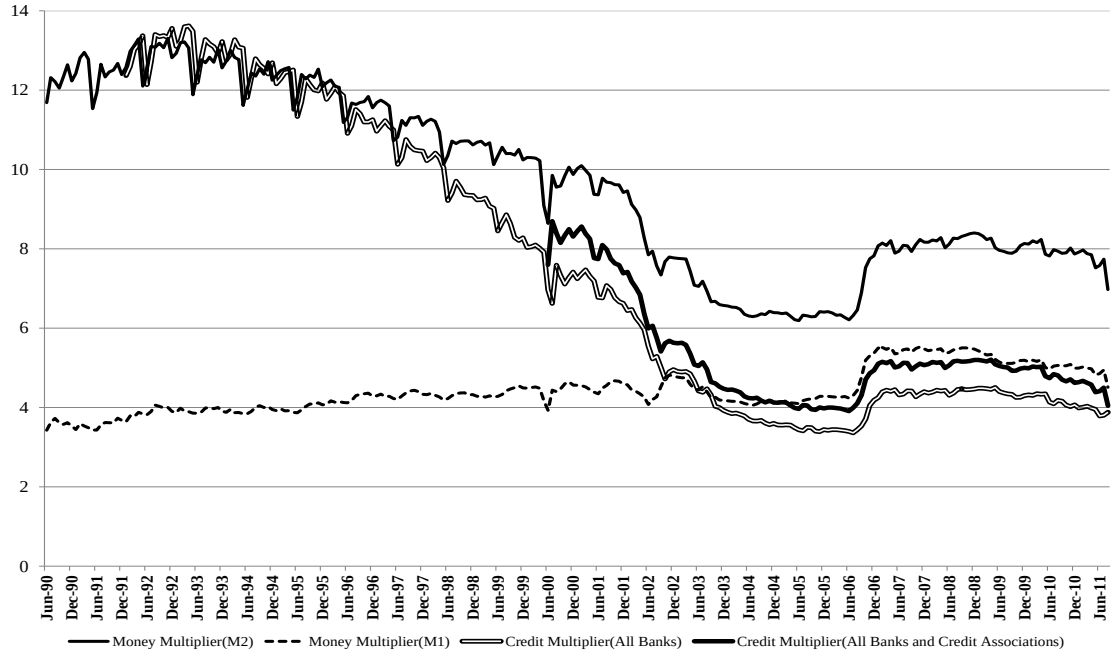


Fig. 1 Trends in credit and money multipliers

Table 1. Results of unit root tests

| | **Test statistics** | | |
|---|---|---|---|
| | L/H | M1/H | M2/H |
| WS | –1.84926 | –3.60676 | –2.79339 |
| DF | –3.09041 | –3.86077 | –2.87852 |
| | **p-values** | | |
| | L/H | M1/H | M2/H |
| WS | 0.74323 | 0.014919 | 0.14691 |
| DF | 0.10853 | 0.013726 | 0.16960 |
| | **Number of lags** | | |
| | L/H | M1/H | M2/H |
| WS | 26 | 26 | 26 |
| DF | 26 | 26 | 27 |

Notes: WS and DF are the weighted symmetric and Dickey–Fuller's $\tau_t$ tests, respectively.

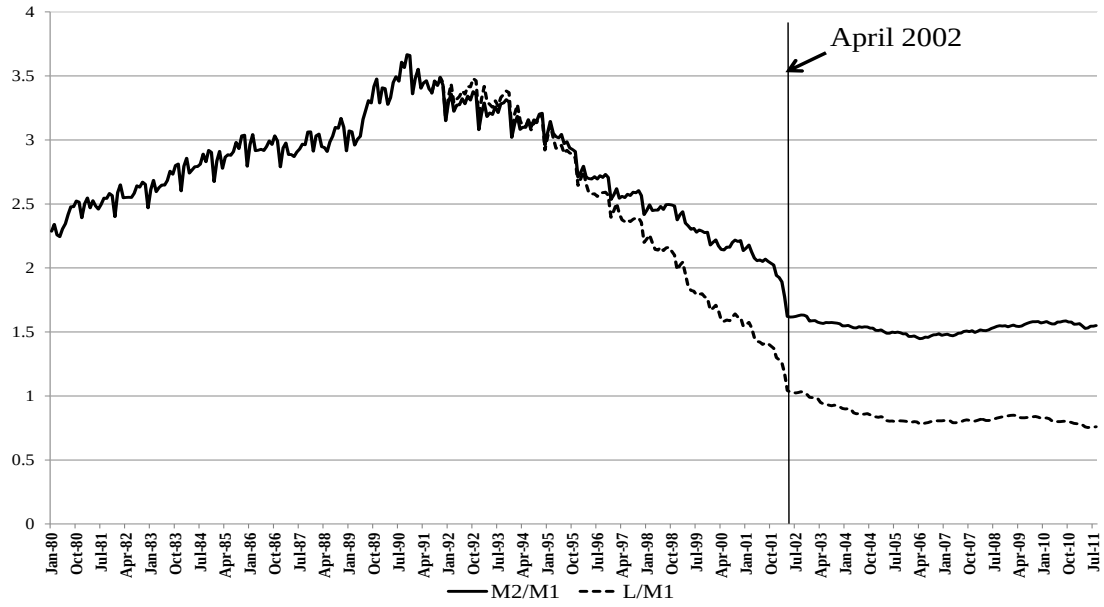


Fig. 2 Trends in M2/M1

Fig. 1 plots the credit and money multipliers which are the ratios of M2 and bank loan to the monetary base (H), which is also called base money or high-powered money. One of the most interesting features we can see is the trend in the credit multiplier. In the early 1990s, the credit multiplier was almost the same size as the M2 money multiplier; by the early 2000s, the credit multiplier had fallen below the M1 money multiplier. Based on the unit root tests in Table 1, both the ln(L/H) and ln(M2/H) series have a unit root, but after April 2002, the ratio of these two series to the M1/H appears more stable, as shown in Fig. 2. This suggests a structural change in the relationship. Furthermore, this structural change may have been gradual, and ln(L/H) and ln(M2/H) may have correspondingly changed their properties from a nonstationary to a stationary time series. To consider these possibilities, in the next section, we use a vector error correction model (VECM) with gradual switching to analyze the relationship between these series.

## 3. Gradual changes in the long-run relationship

In this section, we apply a gradual switching regression. This method was originally proposed by Ohtani and Katayama (1985) and Ohtani, Kakimoto and Abe (1990) and subsequently modified by Konno and Fukushige (2002). In estimating this model, we first introduce the following dummy variables for the gradual changes in the constants and the coefficients:

$$\begin{aligned} \lambda_t &= 0 && \text{for} \quad t = 1, \dots, t_1^* \\ &= \frac{t - t_1^*}{t_2^* - t_1^*} && \text{for} \quad t = t_1^* + 1, \dots, t_2^* \\ &= 1 && \text{for} \quad t = t_2^* + 1, \dots, T \end{aligned}$$

and search for the starting and end points ($t_1^*$ and $t_2^*$) using the maximum likelihood method. In the present analysis, I apply this approach to the VECM as follows:

$$\begin{bmatrix} \Delta \ln\left(\frac{L}{H}\right)_t \\ \Delta \ln\left(\frac{M2}{H}\right)_t \end{bmatrix} = \begin{bmatrix} \theta_1 \\ \theta_2 \end{bmatrix} \left[ \ln\left(\frac{L}{H}\right)_{t-1} - (\alpha_1 + \alpha_2 \lambda_t) - (\beta_1 + \beta_2 \lambda_t) * \ln\left(\frac{M2}{H}\right)_{t-1} \right]$$

$$+ \sum_{s=1}^{S} \begin{bmatrix} \phi_{11,s} & \phi_{12,s} + \phi_{122,s}\lambda_t \\ \phi_{21,s} & \phi_{22,s} + \phi_{222,s}\lambda_t \end{bmatrix} \begin{bmatrix} \Delta \ln\left(\frac{L}{H}\right)_{t-s} \\ \Delta \ln\left(\frac{M2}{H}\right)_{t-s} \end{bmatrix} + \begin{bmatrix} \epsilon_{1t} \\ \epsilon_{2t} \end{bmatrix}$$

where we assume the gradual switching occurs in the coefficients for M2/H. For the estimation, we used monthly data from September 1992 to July 2011, fixed the lag length (S = 6), and searched for the starting point ($t_1^*$) between January 1995 and December 1998, and for the endpoint ($t_2^*$) between January 1995 and April 2008.

Table 2 presents the results of the estimation. We omit the estimated coefficients for the lagged explanatory variables. In Model 1, the constant term is not statistically significant, so we remove it and estimate Model 2. All of the estimated coefficients in Model 2 are statistically significant. The estimated starting point for the gradual switching is September 1991, and the endpoint is April 2002. The estimated long-run relationship before January 1997 is:

Table 2. Empirical results and long-run relationships

| | Model 1 | Model 2 |
|---|---|---|
| Long-run relationship | | |
| Constant | –0.2345 | — |
| | (–0.706) | |
| $\lambda_t$ | –0.88777* | –1.21386** |
| | (–2.117) | (–12.0698) |
| M2/H | 1.0998 | 1.00835 |
| | (8.381) | (317.875) |
| $\lambda_t$ ×M2/H | 0.143921 | 0.276492 |
| | (0.815) | (5.526) |
| **Δ**L/H equation | | |
| $\theta_1$ | 0.430884 | 0.46264 |
| | (4.586) | (5.700) |
| S.E. of Regression | 0.02483 | 0.02496 |
| R-squared | 0.3329 | 0.3257 |
| DW Ratio | 1.964 | 1.975 |
| **Δ**M2/H equation | | |
| $\theta_2$ | 0.398081 | 0.444318 |
| | (4.503) | (5.745) |
| S.E. of Regression | 0.02376 | 0.02375 |
| R-squared | 0.2981 | 0.2985 |
| DW Ratio | 1.964 | 1.976 |
| $t_1^*$ | January 1998 | January 1997 |
| $t_2^*$ | February 2007 | February 2007 |

Notes: t-values in parentheses.

S.E. of Regression and DW Ratio are the standard errors of the regression and the Durbin–Watson ratio, respectively.

** and * indicate statistical significance at the 5% and 1% level, respectively.

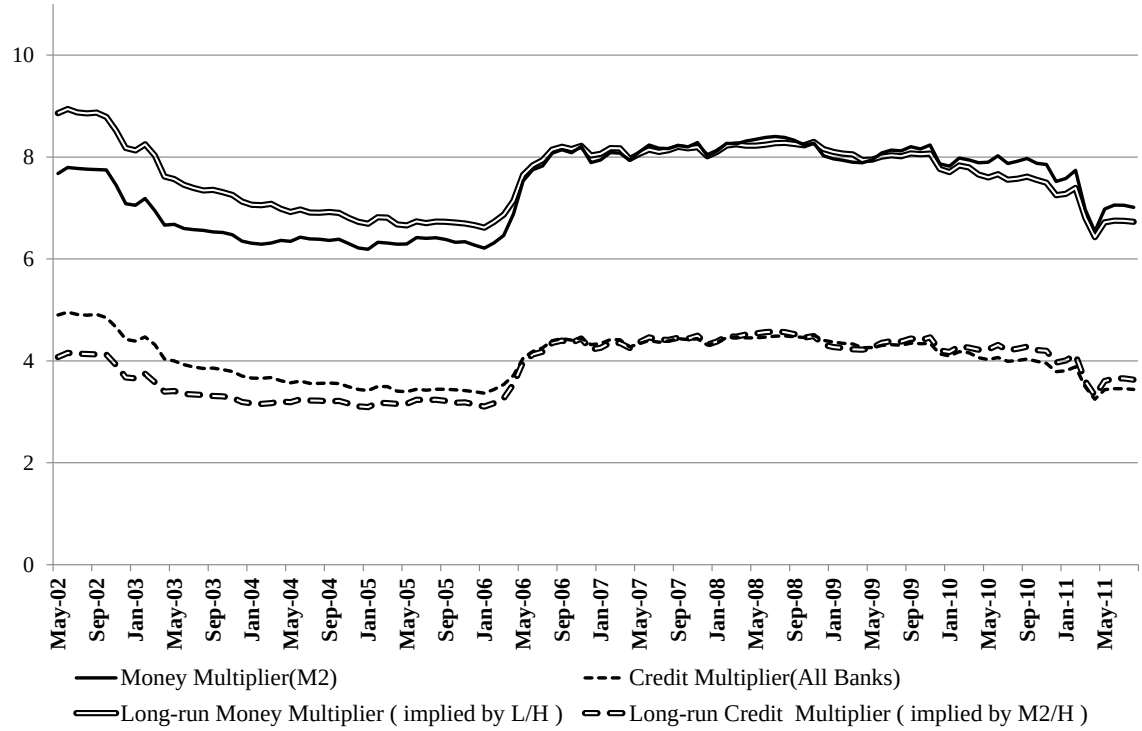


Fig. 3 Long-run and actual multipliers

$$\ln\left(\frac{\mathrm{L}}{\mathrm{H}}\right) = 1.008 * \ln\left(\frac{\mathrm{M2}}{\mathrm{H}}\right)$$

and after March 2007 is:

$$\ln\left(\frac{\mathrm{L}}{\mathrm{H}}\right) = 1.285 * \ln\left(\frac{\mathrm{M2}}{\mathrm{H}}\right) - 1.214.$$

Fig. 3 presents the actual and estimated long-run multipliers. As shown, the actual multipliers follow the estimated long-run multipliers, suggesting a long-run equilibrium, or convergence in levels.

This result shows that before January 1997, the relationship between the credit and money multipliers is quite similar to the theoretical conclusion. However, after March 2007, the credit multiplier became more sensitive to the money multipliers, and this meant that the

credit multiplier fell below the money multiplier. As Honda (2004) suggested, when capital requirements restrict the lending of some banks, the credit multiplier becomes less than the money multiplier. Our result indicates the realization of Honda's (2004) assumption in the Japanese economy.

## 4. Concluding remarks

From Fig. 1 and Table 2, we can conclude that there is a long-run relationship between the credit and money multipliers in Japan but that a structural change in this long-run relationship took place between 1991 and 2007 such that the credit multiplier became less than the money multiplier. This result accords with the theoretical argument in Honda (2004). During this period of gradual change, the Basel Accord was introduced into the Japanese bank system, and the so-called "credit crunch" arose. Honda (2002), Ito and Sasaki (2004) and Watanabe (2007), among others, have likewise investigated the effects of these changes. However, almost none of these studies investigated the changes in the credit and/or money multipliers. Using our empirical analysis, we identified a new empirical feature associated with the shrinkage of the loan market in Japan linked with two kinds of changes. The first is the decline in the M2 money multiplier itself. The second is the structural change in the long-run relationship between the credit and money multipliers. The former potentially depends on the macroeconomic shock and its effect in shrinking the total size of bank deposits. The latter implies that the behavior of banks changed through the introduction of the capital requirements in the Basel Accord. We require further and separate theoretical and empirical study of these changes in order to investigate their effects more closely.

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## Appendix Post estimation period

We estimated the long run relationships by the monthly data from September 1992 to July 2011. After July 2011, there existed several political changes. Most recent one is the change in administrations by the Liberal Democratic Party in December 2012. So-called "Abenomics" was introduced and the Governor of Bank of Japan was changed to Mr. Kuroda in March 2013. The estimated results in this paper might be affected by the "so-called" Kuroda's Bazooka, so we check some relationships in this Appendix.

It is clearly show in Fig A1 that the Kuroda's Bazooka increased the Japanese monetary base drastically. In Fig A2, the money and credit multipliers fall down rapidly according to the increases of monetary base. However, also in Fig A2, our estimated long run relationship in section 3 is still stable. If Mr. Kuroda aims to increase the bank lending as a final target, more drastic increase of monetary base might be needed.

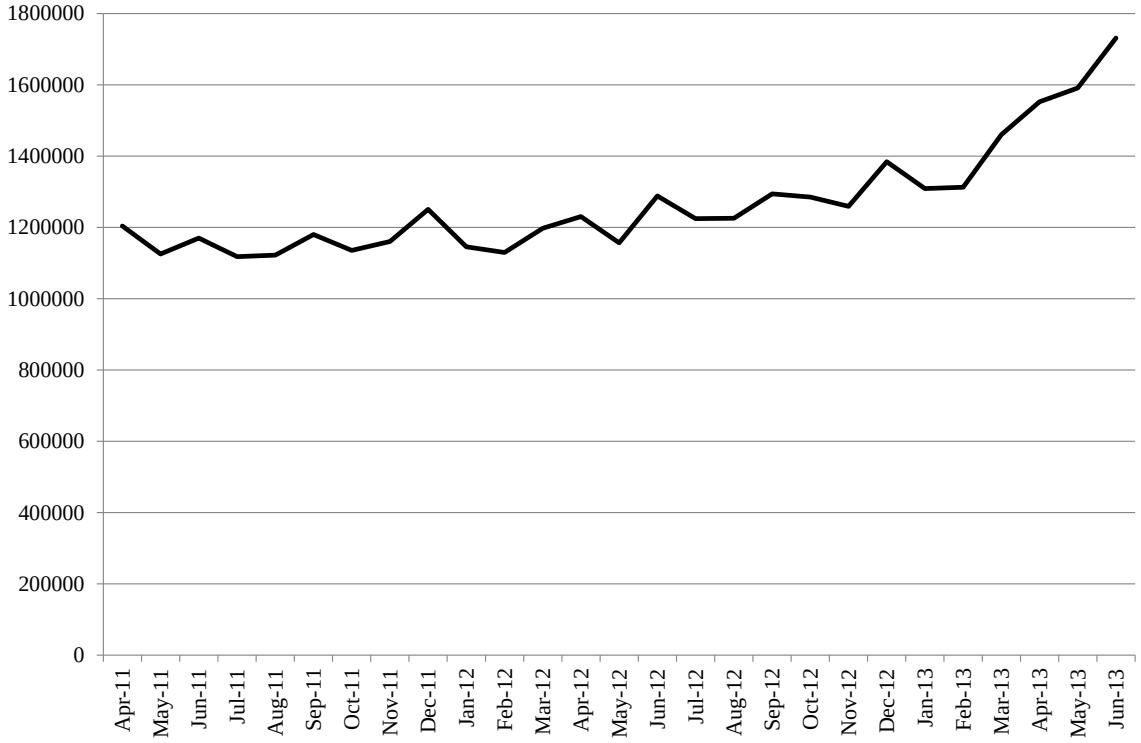


Fig. A1 Monetary base after April 2011

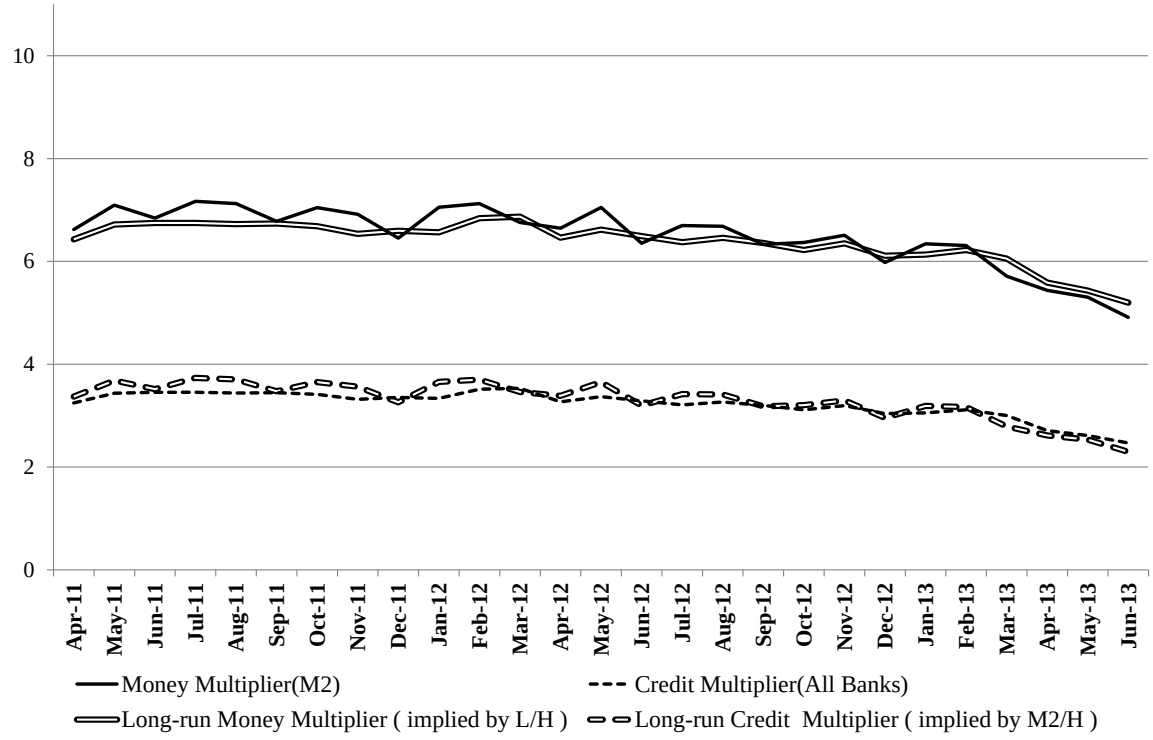


Fig. A2 Actual and estimated long-run multipliers after April 2011