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The case of Japan

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Yuzo Honda

Kansai University

and

Minoru Tachibana

Osaka Prefectural University

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ABSTRACT

The purpose of this paper is to provide objective statistical evidence on the effectiveness of nontraditional monetary policy. The quantitative easing monetary policy, adopted by the Bank of Japan for the period from March 2001 to March 2006, had a stimulating effect on investment and production at least through the Tobin's q channel.

JEL classification: E51

Keywords: Quantitative easing, Stock prices, Newly issued stocks, Investment, Vector autoregression

Address for correspondence: Yuzo Honda, Kansai University, Takatsuki-shi, Osaka 569-1095, Japan

1. Introduction

The question of whether nontraditional monetary policy measures have real effects is controversial and ongoing, largely because there are insufficient data to identify the impacts of nontraditional monetary policy measures.

The Japanese Economic Association (JEA) organized a panel discussion on “Evaluation of Nontraditional Monetary Policy” at the association’s 2011 Autumn Meeting, the record of which was published in JEA (2012). Although some panelists expressed skepticism about the effectiveness of nontraditional monetary policy measures for the macroeconomy, their assertions were based on no or little empirical evidence. The purpose of this paper is to show that such claims conflict with statistical data. Rather, the data suggest that the Bank of Japan’s (BOJ) quantitative easing (QE) monetary policy had significant impacts on production by inducing changes in stock prices. Furthermore, it seems evident that Tobin’s q (the ratio of market value of installed capital to replacement cost of capital) was working as a channel through which monetary policy shocks were transmitted to investment in the real sector.

2. Vector autoregressions (VARs)

Assessments of the effectiveness of monetary policy usually include variables on production, prices and the short-term interest rate in a VAR. During the period of QE from March 2001 to March 2006, however, the BOJ used the total balance of bank reserves (TBBR) as its operating target, because the overnight call rate (the standard operating target) was stuck at virtually 0%. Hence, if we restrict our sample to the period from March 2001 through March 2006, and replace the short-term interest rate with TBBR, we can directly apply the standard VAR method to analyze the efficacy of nontraditional monetary policy during the QE period.

We start with the simplest three-variable VAR model with indices of industrial production (*y*), consumer price index (*p*) and TBBR included in the VAR. With this three-variable VAR, the results are clear-cut: TBBR affected production y. The question then arises regarding the channel by which variation in TBBR affected y. Keeping in mind the need to be parsimonious in our model specification, we add one variable at a time. As the fourth variable, we tried various options, including government bond rates of different maturities, stock prices and exchange rates, and found that stock prices had a significant influence on production. Stock prices thus became the fourth variable in our four-variable VAR model. As for the data on TBBR, the results were virtually the same, whether we used the actually realized balances of bank reserves or the target numbers officially announced by the BOJ.

The results of the four-variable VAR model indicate that changes in the BOJ's TBBR target immediately led to changes in stock prices and then to changes in production with some time lags.

Results from three analytic tools—Granger causality tests, impulse response analysis and variance decomposition—unanimously support the above findings. This is the main result in our first paper (Honda *et al.*, 2007; HKT hereafter). The weakness of HKT is the small sample size, meaning our findings might not be robust.

To improve statistical inference, in Honda and Tachibana (2011; HT hereafter), we extended the sample period from March 2001 through March 2006 to January 1996 through March 2010, thus increasing the sample size from 60 to 171. Introducing dummy variables into the VAR, we fully exploited prior information on structural changes of operating targets from the short-term interest rate to TBBR during the QE period.

We consider three kinds of VAR models in Table 1. Model (i) is the simplest five-variable VAR, including prices (*p*), production (*y*), the overnight call rate (*r*), stock prices (*s*) and the actual TBBR (*m*), multiplied by the dummy variable (*d1*), where *d1* takes the value 1 during the QE period and 0 otherwise. In ordinary times, the BOJ sets its operating target to the overnight call rate. However, with the overnight call rate stuck near 0% during the QE period, BOJ used TBBR as its operating target. This is why we include the variable TBBR (*m*) during the QE period only in model (i). In model (i), "*c*", "c_1" and "c_2" denote (5 × 1) vectors of intercept parameters.

<Table 1 around here>

Model (ii) is the six-variable VAR, including two dummy variables, *d1* and *d2*, where the second dummy variable *d2* takes the value 0 during the QE period and 1 otherwise. Model (i) has the shortcoming of treating the QE period and ordinary time periods asymmetrically, because the variable (*d1* × *m*) takes values m during the period of QE and 0 otherwise. With the second dummy variable (*d2* × *m*) included, model (ii) treats the QE period and ordinary time periods symmetrically, and allows the variable TBBR (*m*) to have different dynamic effects on other variables during the QE period compared with ordinary time periods. Model (ii) has an advantage over model (i) in that we can treat the QE period and ordinary time periods symmetrically, although at the cost of losing efficiency of estimation with the increased number of parameters.

Model (iii) assumes that the effects of TBBR on other variables might differ for each of three periods, namely, the period of QE, the period before the QE and the period after the QE. Model (iii) includes three dummy variables, *d1*, *d3* and *d4*, where *d3* takes the value 1 during the period before the QE only and 0 otherwise, and *d4* takes the value 1 during the period after the QE only and 0 otherwise, respectively.

By increasing the sample size from 60 in HKT to 171 in HT, we were able to obtain more precise estimates on the relationships between the macroeconomic variables, and thereby increase the statistical power of hypothesis testing on the effectiveness of QE. The qualitative results in HT turned out to be virtually the same as in HKT.

Figure 1 reports the response estimates of prices (*p*), production (*y*) and stock prices (*s*) to a one standard deviation shock in TBBR (*m*). The dotted lines indicate the 90% confidence bounds, obtained through Monte Carlo simulations of 500 repetitions. In all three models, responses in prices (Core CPI) are negligible, but those in production (IIP) and stock prices are significantly different from zero. Stock prices react immediately but production only with some time lags, as expected.

<Figure 1 around here>

HT also reported the estimates of impacts of 1 trillion yen increases in the TBBR target on production and stock prices. Readers can consult the original paper for details.

3. Transmission via the Tobin's q channel

3.1. Stock prices and newly issued stocks

Changes in stock prices can affect the real sector through four possible channels (see HT for details). Here we examine only one of these, the Tobin's q channel, and report that it played a crucial role in transmitting financial shocks to the real economy.

3.1.1. Correlation

Figure 2 shows movements in stock prices (Nikkei 225) and the corresponding amounts of newly issued stocks (including convertible bonds and warrants) during the period of QE (March 2001 through March 2006).

<Figure 2 around here>

In March 2003, the Japanese government injected bank capital of about 1.8 trillion yen into Resona Bank in a bid to prevent the turmoil from spreading through the entire Japanese economy. Hence, March 2003 is clearly an outlier in our sample, and we exclude it from both Figure 1 and our statistical analysis.

In Figure 2, we find a downward trend in stock prices before March 2003, but an upward trend after that. Comparing the former 24-month period (March 2001 through February 2003) with the latter 36-month period (April 2003 through March 2006), we observe the tendency that the amounts of newly issued stocks for the latter period are clearly larger than those for the former period. Indeed, this was the case. The average amount of newly issued stocks increased from 213 billion yen in the former period to 356 billion yen in the latter period, a rise of 67%. With a t-value of 2.55, we reject the null hypothesis at the significance level of 1% that the means of the amounts of newly issued stocks are the same for the two subsamples.

The average stock price (Nikkei 225) increased from 10,699 yen in the former period to 11,608 yen in the latter, which suggests a positive correlation between stock prices and the amounts of newly issued stocks. This assertion is supported by further data: the correlation coefficient turns out to be 0.34 between stock prices and the amounts of newly issued stocks.

3.1.2. Causality from stock prices to newly issued stocks

The data reveal more than that. A comparison of the two subsamples shows that the rate of increase in the average amounts of newly issued stocks, 67%, is far greater than the corresponding rate of increase in stock prices, 8.5%. This finding agrees with the idea of Tobin's q, suggesting causality from stock prices to newly issued stocks. That is, the higher stock prices induced firms to issue larger amounts of new stocks. Fitting a straight line to the data between stock prices s_t on the right-hand side and the amounts of newly issued stocks a_t on the left-hand side, we find the following ordinary least squares (OLS) estimates:

$$\underset{}{a_t} = \underset{(1.06)}{-188{,}975} + \underset{(2.77)}{43.366}\, s_t. \qquad (1)$$

The sample period covers from March 2001 through March 2006 with the outlier sample of March 2003 excluded. Numbers in parentheses in Eq. (1) indicate the respective t-values of the estimates. The t-values indicate that stock prices s_t affect the amounts of newly issued stocks a_t at the significance level of 1%, consistent with the hypothesis that Tobin's q worked as a transmission channel from the financial to the real sector.

3.2. Stock prices and fixed investment

Did the increase in newly issued stocks really lead to increased production in the latter half of the QE period? Only quarterly data are available for fixed investment, and we admit, at the outset, that it is difficult to answer the above question statistically.

Constructing three months of average data of stock prices, S_t, and regressing fixed investment I_t on stock prices S_t, we find the following OLS estimates:

$$I_{t+4} = \underset{(5.74)}{12517.13} + \underset{(2.18)}{0.42}\, S_t. \qquad (2)$$

Numbers in parentheses indicate the t-values. The sample period covers from the first quarter of 2001 through the first quarter of 2006, but the sample size of 21 is too small to give enough information to identify the effects of other variables. Hence, we should be cautious when interpreting the estimation results in Eq. (2). Nevertheless, the t-value of the estimate of stock prices S_t turns out to be 2.18, and is statistically significant at the 1% level. This result does not disagree with the hypothesis that higher stock prices induced firms to issue larger amounts of new stocks, which in turn led to increases in fixed investment and production.

4. Concluding remarks

Our findings are tentative and only suggestive, as our results are based on BOJ data on its QE monetary policy, the length of which is limited to about five years. Nevertheless, we believe that it is worth publicizing the objective empirical results of the present paper, given the pressing nature of the issue that central banks in advanced economies are currently facing.

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Table 1

VAR models

VAR model (i)

$Y = (p, y, r, d1 \times m, s)'$, $c = c_1 + (c_2 \times d1)$

VAR model (ii)

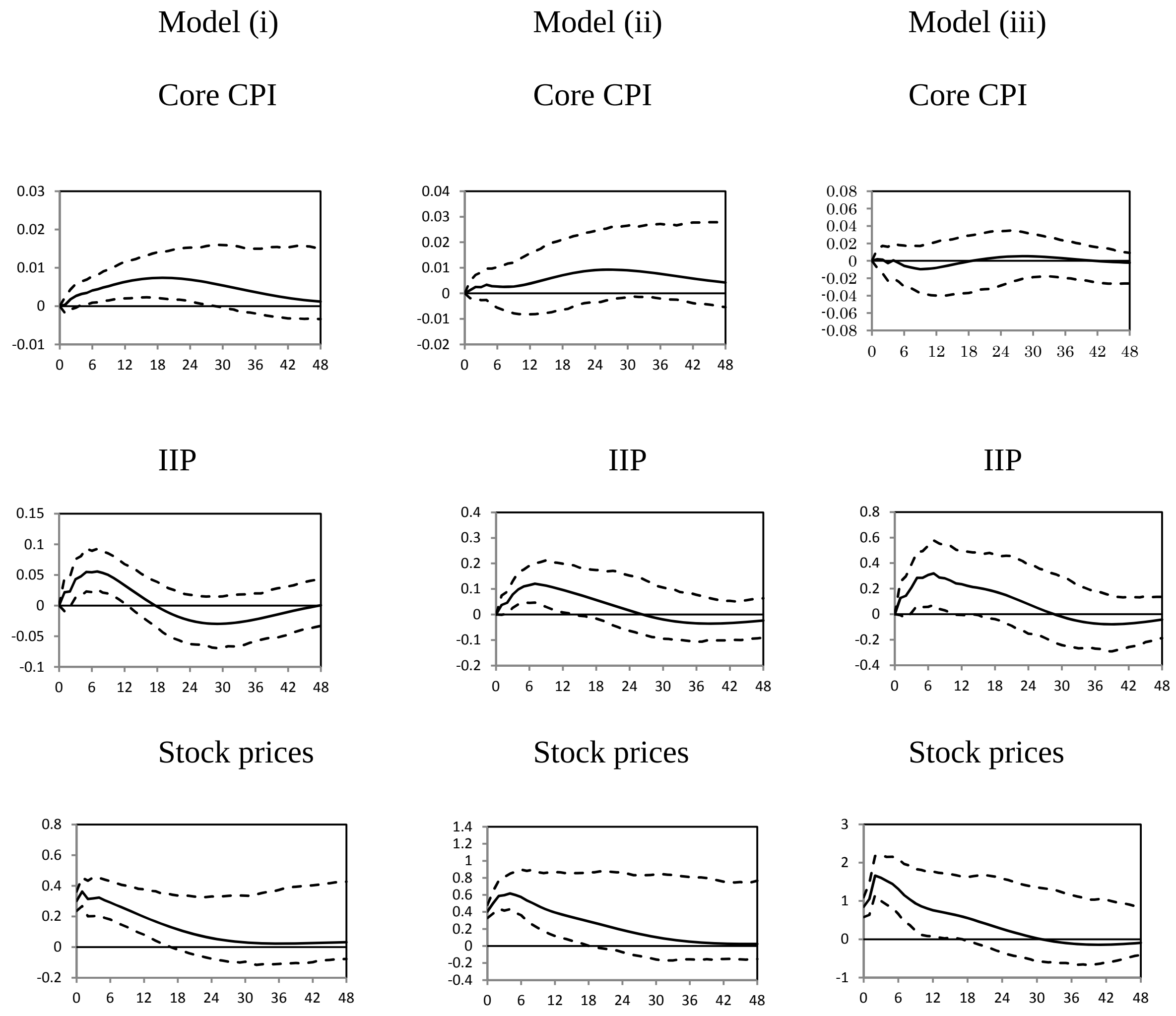
$Y = (p, y, r, d1 \times m, d2 \times m, s)'$, $c = c_1 + (c_2 \times d1)$

VAR model (iii)

$Y = (p, y, r, d1 \times m, d3 \times m, d4 \times m, s)'$, $c = c_1 + (c_2 \times d1) + (c_3 \times d4)$

Honda and Tachibana (2011)

Fig. 1. Impulse response analysis



Honda and Tachibana (2011)

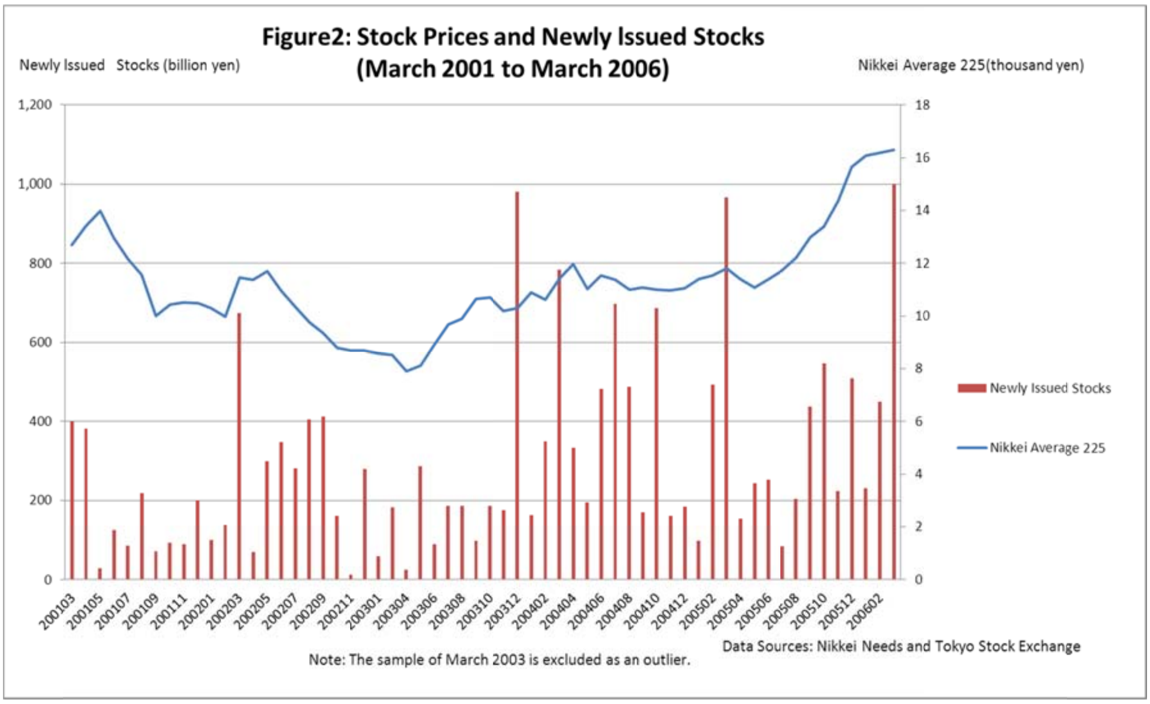


Figure2: Stock Prices and Newly Issued Stocks
(March 2001 to March 2006)
Newly Issued Stocks (billion yen)
Nikkei Average 225(thousand yen)
1,200
1,000
800
600
400
200
0
18
16
14
12
10
8
6
4
2
0
Newly Issued Stocks
Nikkei Average 225
200103
200105
200107
200109
200111
200201
200203
200205
200207
200209
200211
200301
200304
200306
200308
200310
200312
200402
200404
200406
200408
200410
200412
200502
200504
200506
200508
200510
200512
200602
Data Sources: Nikkei Needs and Tokyo Stock Exchange
Note: The sample of March 2003 is excluded as an outlier.