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Policy Multipliers in Japan Under QQE

Sam Ouliaris and Celine Rochon

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Policy Multipliers in Japan Under QQE
Prepared by Sam Ouliaris and Celine Rochon

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ABSTRACT: This paper tests whether Japan's key macro policy multipliers have declined since 2013, the year that Japan introduced Qualitative and Quantitative Easing. We use the augmented Blanchard-Perotti structural VAR model introduced in Ouliaris and Rochon (2021) to study the dynamic effects of shocks in the central bank's asset holdings, interest rates, and debt levels relative to GDP on economic activity in Japan. We find that both the expenditure and tax multipliers of Japan have fallen, implying that the effectiveness of fiscal policy in Japan declined following the change in monetary policy. Moreover, we find that the efficacy of quantitative easing is small, implying the need for huge interventions to have a significant effect on real GDP, and that the effectiveness of quantitative easing has declined since 2013. We argue that the reduction in policy multipliers can be attributed to the upward trend in the government debt level relative to GDP which, despite historically low interest rates, has increased Japan's structural deficit, and the likelihood of reduced expenditures and higher taxes going forward.

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Author's E-Mail Address:	crochon@imf.org , sam.ouliaris@gmail.com

WORKING PAPERS

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Prepared by Sam Ouliaris and Celine Rochon¹

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Introduction

In this paper we assess the effects of high debt levels and prolonged low interest rates on key policy multipliers (fiscal and monetary) in Japan before and after the introduction of Quantitative and Qualitative Monetary Easing (QQE) in 2013 (henceforth, “pre- and post-QQE”). The empirical approach draws on an augmented version of Blanchard and Perotti (2002) formulated in Ouliaris and Rochon (2021). We characterize the effects of shocks in government expenditure and taxes using a Blanchard-Perotti style model in which we allow for the dynamic effects of shocks in central bank asset holdings, interest rates, and debt levels relative to GDP on economic activity.

We test for a structural break in key multipliers following the introduction of QQE in 2013, by allowing the coefficient on the debt ratio to change. The aim is to test the proposition that Japan would be less prepared to address future recessions or crises (such as COVID-19) because of elevated debt levels and significantly larger central bank balance sheets, both of which occurred in Japan since 2013.

We use the 2013 QQE episode as the break point for the analysis because our model not only provides estimates of the strength of QQE but also allows for a comparison of multipliers before and after the introduction of this unconventional monetary policy. Our model allows one to assess the impact of QQE and its effectiveness on the Japan economy allowing for changing debt levels relative to GDP, as we are interested in the profile of debt accumulation. By contrast, most papers focus on the evolution of economic growth and inflation following the introduction of QQE.

The growing debt-to-GDP ratio in Japan has resulted in a situation where, even with ultra-low interest rates, the cost of servicing public debt (interest payment plus redemption of the national debt) is Japan’s second-largest budget line.¹ The main way to address this issue is to reduce future budget deficits by increasing taxes or cutting public spending, both of which threaten the near-term growth of Japan and its potential GDP.

The empirical results show (positive) government expenditure shocks having, as expected, a positive effect on output, and (positive) tax shocks having a negative effect. However, the estimated multipliers have declined significantly since the start of QQE and the concomitant rise in the government debt-to-GDP ratio. We attribute this decline in part to the elevated debt levels and long-lasting deflation in Japan, both of which have increased the real debt burden on future Japanese generations.

¹ <https://www.mof.go.jp/english/policy/budget/budget/fy2023/02.pdf>

Model

The reduced form VAR specification used for this analysis is:

$$Y_t = \mu + \sum_{j=1}^p A_j Y_{t-j} + \sum_{i=0}^k (C_i + E_i Q_t) D_{t-i} + U_t \quad (1)$$

where $Y_t = [T_t, G_t, X_t, BS_t, R_t]'$ is a five-dimensional vector in the logarithms of quarterly taxes, primary spending, GDP, the central bank balance sheet size—all measured in real, per capita terms—and the real interest rate. D_t is the debt-to-GDP ratio, and its coefficient can change depending on the value of the indicator variable Q_t .

Rather than including the debt-ratio in Y_t , D_t is given a separate role in the VAR because it satisfies the following non-linear identity:

$$D_t = \frac{(1 + R_t)}{(1 + \Delta X_t)} D_{t-1} + PB_t \quad (2)$$

where ΔX_t is the real growth rate in GDP and PB_t denotes the primary balance. So defined, D_t does not depend on any unknown parameters. Moreover, it involves a specific nonlinear function for the coefficient of D_{t-1} , $\frac{(1+R_t)}{(1+\Delta X_t)}$, that would not be enforced if a standard VAR were estimated. We add current and lagged values of the debt-to-GDP ratio, D_t , to (1), although not necessarily in each equation (i.e., some coefficients may be chosen to be equal to 0).

For estimation purposes, equation (1) was first estimated with E_i set to 0 for all i (i.e., this model does not allow for any structural break in the response of Y_t to D_{t-i}). We call this model the “pre-QQE model”. We then re-estimated (1) without the zero constraint on the E_i vectors (i.e., this model allows for a structural break in the relationship between Y_t and the debt-to-GDP ratio). We call this model the “post-QQE model”. This model allows for a structural break in the relationship between Y_t and the debt ratio, D_{t-i} , using $\sum_{i=0}^k (C_i + E_i Q_t) D_{t-i}$ with $E_i \neq 0$. The (5×1) vectors E_i (of which there are $(k+1)$) allow for a possible change in C_i arising from the introduction of QQE in 2013. The indicator variable Q_t is equal to 0 for $t \leq 2012Q4$, and 1 for

$t \geq 2013Q1$. The null hypothesis that there is no structural break in the relationship between the debt ratio and Y_t is $E_i = 0$ for $i = 0$ to $(k + 1)$.²

Note there are feedback effects between D_t and the endogenous variables in the VAR, namely T_t, G_t, X_t, BS_t, R_t that need to be accounted for when calculating the impulse response functions.³ We do this by solving the estimated structural VAR together with the non-linear debt equation to obtain the baseline solution of the model (i.e., the solution of the model without additional structural shocks). Impulse responses are derived by calculating percentage deviations from the baseline caused by separate unit percentage shocks to T_t, G_t, X_t, BS_t, R_t .

$U_t = [t_t, g_t, x_t, bs_t, r_t]'$ is the vector of reduced form residuals, which in general will have non-zero covariance terms. The reduced form residuals have little economic significance as they are linear combinations of the "structural" or fundamental shocks of the corresponding structural VAR described below.

The (5×5) A_j matrices (of which there are p) contain the coefficients on the lagged dependent variables, and the (5×1) C_j vector (of which there are $(k+1)$) contain the coefficients on the debt-to-GDP ratio. As mentioned previously, some of the elements of A_j and C_j may be constrained to zero to prevent the debt-to-GDP ratio affecting a specific element of Y_t , either contemporaneously or with a lag.

The corresponding structural VAR (SVAR) associated with equation (1) can be written as

$$\Omega Y_t = \mu' + \sum_{j=1}^p A_j' Y_{t-j} + \sum_{i=0}^k (C_i' + E_i' Q_t) D_{t-i} + \Phi V_t \quad (3)$$

with structural shocks $V_t = [e_t^t, e_t^g, e_t^x, e_t^{bs}, e_t^r]'$, matrices of coefficients denoted

$$\Omega = \begin{pmatrix} 1 & -a_2 & -a_3 & -a_4 & -a_5 \\ -b_1 & 1 & -b_3 & -b_4 & -b_5 \\ -c_1 & -c_2 & 1 & -c_4 & -c_5 \\ -k_1 & -k_2 & -k_3 & 1 & -k_5 \\ -l_1 & -l_2 & -l_3 & -l_4 & 1 \end{pmatrix} \text{ and } \Phi = \begin{pmatrix} a_6 & a_7 & a_8 & a_9 & a_{10} \\ b_6 & b_7 & b_8 & b_9 & b_{10} \\ c_6 & c_7 & c_8 & c_9 & c_{10} \\ k_6 & k_7 & k_8 & k_9 & k_{10} \\ l_6 & l_7 & l_8 & l_9 & l_{10} \end{pmatrix}$$

² An alternative approach would be to estimate the model over independent samples, with no overlap, and test for changes in parameter estimates. We used the approach outlined in this section due to lack of data relative to the number of parameters needed to be estimated in the VAR.

³ An alternative approach to incorporating debt in the VAR would be to linearize the debt equation (1) and add constraints on the coefficients of the lags of D_t, T_t, G_t , to ensure that equation (1) is satisfied (see Ouliaris *et al.* (2018)).

and

$$\begin{aligned}\mu' &= \Omega^{-1}\mu, \\ A'_j &= \Omega^{-1}A_j, j = 1, \dots, p \\ C'_i &= \Omega^{-1}C_i, i = 0, \dots, k \\ E'_i &= \Omega^{-1}E_i, i = 0, \dots, k\end{aligned}$$

Φ is chosen to be diagonal. We suggest the following $\frac{n(n-1)}{2} = 10$ identification restrictions for Ω :

$$\Omega = \begin{pmatrix} \mathbf{1} & -a_2 & -\mathbf{1.18} & \mathbf{0} & -a_5 \\ -b_1 & \mathbf{1} & \mathbf{0} & \mathbf{0} & -b_5 \\ -c_1 & -c_2 & \mathbf{1} & -c_4 & -c_5 \\ \mathbf{0} & \mathbf{0} & -k_3 & \mathbf{1} & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & -l_3 & \mathbf{0} & \mathbf{1} \end{pmatrix} \text{ and } \Phi = \begin{pmatrix} a_6 & \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & b_7 & \mathbf{0} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & c_8 & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & \mathbf{0} & k_9 & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} & l_{10} \end{pmatrix}$$

With these restrictions, the model has 15 unknown parameters. Given the 15 unique values in the reduced form covariance matrix which can be estimated and used to infer the 15 unknown parameters in Ω and Φ combined, the model is exactly identified.

The first row of the matrix models the evolution of taxes and can be interpreted as follows: unexpected movements in taxes within a quarter, t , can be driven separately by four factors: the response of taxes to unexpected movements in expenditure, a_2g_t , the response of taxes to unexpected movements in GDP, a_3x_t , with $a_3 = 1.18$, the response to unexpected movements in the real interest rate, namely a_5r_t , and the response to structural shocks to taxes, $a_6e_t^t$. A similar interpretation applies to unexpected movements in spending in the second row, the balance sheet in row 4 and the interest rate in row 5. The 3rd row states that unexpected movements in output can be attributed to unexpected movements in taxes, spending, the balance sheet or interest rate, or to an unexpected structural shock to output, e_t^x .

The chosen identification in the above matrices is richer than that of Blanchard-Perotti (2002) to the extent that taxes respond to expenditure (via a_2) and expenditure responds to taxes (via b_1) within the same model. In Blanchard-Perotti (2002), one model allows taxes to respond to structural shocks to spending, $a_7e_t^g$, while another model allows expenditure to respond to structural shocks to taxes, $b_6e_t^t$. They do not allow for direct and simultaneous responses of taxes to expenditure, and expenditure to taxes, as they set a_2 and b_1 equal to 0. Our model displays exact identification without such arbitrary assumptions.

As in Blanchard and Perotti (2002), we rely on institutional information about tax, transfer, and spending programs to constrain the parameters a_3 and b_3 . In general, these coefficients capture two different effects of activity on taxes and spending: the automatic effects of economic activity

on taxes and spending under existing fiscal policy rules, and any discretionary adjustment made to fiscal policy in response to unexpected events within the quarter.

The key to Blanchard and Perotti's approach to identification is to recognize that the use of quarterly data virtually eliminates the second channel (i.e., $b_3 = 0$). They cite direct evidence on the conduct of fiscal policy that suggests that it takes policymakers and legislatures more than a quarter to learn about a GDP shock, decide what fiscal measures to take in response, pass these measures through the legislature, and implement them.

The estimate of the elasticity of taxes to a shock in expenditure in Japan, after allowing for cyclical effects, is 1.18 (for quarterly data). We take this value as a starting point and assess below the sensitivity of our estimates of the fiscal multiplier to reasonable deviations of a_3 from 1.18.

The identification chosen assumes that only the structural shocks of a given variable impact on that variable, implying a diagonal Φ matrix (i.e., structural shocks are uncorrelated). In addition, we assumed that unexpected movements in the balance sheet or the interest rate are not subject to movements in taxes and expenditure, but only to their respective structural shocks and to output movements. Lastly, we assumed that unexpected movements in taxes and expenditure are not subject to movements in the balance sheet.

Data and Estimation Approach

We estimated both models using quarterly data for Japan over 1981Q3-2020Q3. As explained in the previous section, using quarterly data justifies the use of the constraint $b_3 = 0$ toward achieving exact identification of the fiscal shocks. The central bank assets are the Bank of Japan (BoJ) asset holdings as at the end of each quarter. The real interest rate is the 10-year bond yield less the inflation rate, the latter measured using the GDP deflator. Lastly, the debt-to-GDP ratio is the outstanding debt of the general government divided by nominal GDP.

To estimate the SVAR, we first estimated an unconstrained VAR in levels with a single lag of the 5 endogenous variables (i.e., real expenditure per capita, real revenue per capita, real GDP per capita, BoJ balance sheet assets, and the real interest rate), and the debt-to-GDP ratio as a separate variable (see (3)). The lag length p was chosen using the Schwarz Information Criterion. All the variables were confirmed to possess unit roots using standard unit root procedures, and we also tested for cointegration but did not detect a single cointegrating vector.

As such, the appropriate procedure for estimation purposes is a structural VAR in the first difference of the data.

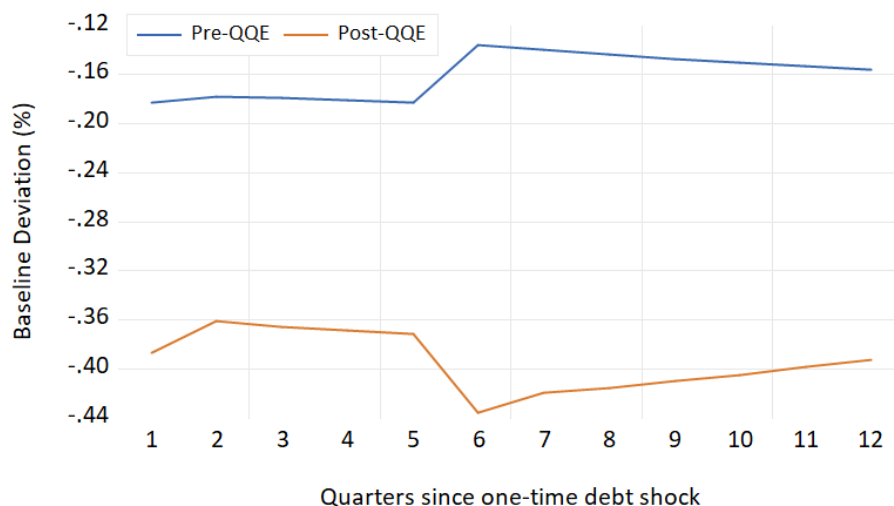
Results

We now consider various policy adjustment scenarios and discuss the response of real GDP per capita to these shocks in the models with and without structural breaks at 2013Q1. The model is estimated using quarterly data spanning 1981Q3- 2020Q3. We assume without loss of generality that the shock occurs in 2017Q3 for both the pre- and post-QQE models, thereby yielding response functions over 12 quarters. We shock each variable by one percentage point and express the corresponding response in GDP as a percentage change relative to the baseline.

Our first experiment involves a percentage point increase in the debt ratio possibly due to a negative one-time exogenous shock to the economy. Figure 1 shows the resulting percentage change in real GDP per capita relative to the baseline for the post-QQE and pre-QQE models. Following the one percentage point shock to the debt ratio, real GDP decreases initially both pre- and post-QQE, with the negative effect being larger post-QQE in absolute terms, compared to pre-QQE. The null hypothesis of no structural break can be rejected: the Wald statistic for the null hypothesis that $E'_i = 0$ is 44.8 with a p-value of zero. The large initial negative impact on real GDP may be due to negative expectations, including expectations of higher taxes, arising from higher debt. Both theoretical and empirical papers provide evidence that debt has a negative impact on the macro economy in the long run, especially when the debt to GDP ratio exceeds a threshold. The main channels that explain this relationship include private saving (via the impact of taxes to finance the interest payments on the debt on households' consumption and saving behavior), public investment (via the debt overhang), total factor productivity (via incentives for work, and the use of capital and labor) and long-term interest rates (via crowding out of private investment).⁴

⁴ The shock explored in this first experiment is independent of the primary balance, interest rates and output. It is an arbitrary, exogenous shock, which impacts debt directly, and ultimately impacts output.

Figure 1: Debt Multiplier, One Percent Shock (+), Pre-and Post-QQE



The next scenario involves a percentage point increase in government expenditure. Figure 2A shows the percentage change in real GDP per capita relative to the baseline (i.e., the fiscal multiplier) for the post-QQE and pre-QQE models. Note that following the shock in expenditure, both the pre-QQE and the post-QQE multipliers display a positive response in terms of real per capita GDP though the fiscal multiplier has clearly declined since the onset of QQE in 2013Q1, suggesting that the use of expansionary fiscal policy financed by debt accumulation is counterproductive.⁵ The estimated coefficient on the debt ratio in the real GDP per capita equation is negative pre- and post-QQE. Moreover, the post-QQE estimate is significantly more negative,⁶ suggesting substantially larger (negative) feedback effects from increases in the stock of government debt. While it is difficult to isolate the precise reasons for the decline, it can in part be attributed to the feedback mechanism between an increase in expenditure and rises

⁵ The data sample used in this paper includes the periods when the zero-interest rate policy (ZIRP) and yield curve control (YCC) policy have been implemented in Japan. Note that using 2016Q4 as the structural break point based on the introduction of QQE with YCC at that time does not change the conclusions obtained in this paper (using the introduction of QQE as the structural break point). We note that significantly larger cumulative fiscal responses are reported in Goode, Lui and Nguyen (2021) for Japan. They use a structural VAR without debt that conditions on the zero-lower bound (ZLB) period (1995-2020), in contrast to our paper that includes debt, and uses QQE as the structural break. Their estimate of the cumulative fiscal multiplier for 10 quarters after the fiscal shock is greater than 1 for the ZLB period, when the drag from the debt stock via the interest rate channel was small. Moreover, the estimated expansionary effect for the ZLB period is significantly larger than 1 during recessionary periods. Given the findings of our paper, their estimates of the fiscal multiplier during the ZLB period may decline if the debt-ratio is included in their structural VAR model.

⁶ The null hypothesis of no structural break is rejected. The Wald statistic for this null is 18.5, with a p-value of zero.

in government debt, contributing, other things being equal, to larger fiscal deficits and debt accumulation in subsequent periods owing to higher interest payments on the debt stock.

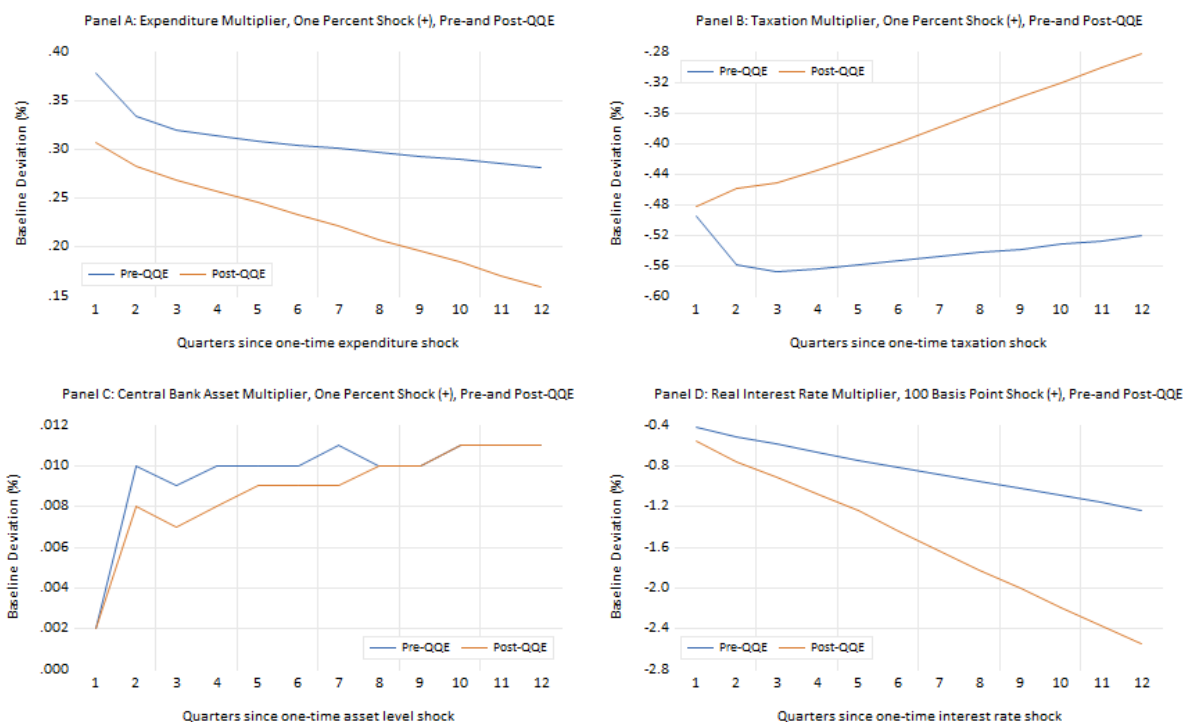
The second scenario involves a percentage point increase in government taxes. Figure 2B shows the change in real GDP per capita relative to the baseline (i.e., the tax multiplier) for the post-QQE and pre-QQE periods. Following the shock in taxes, both multipliers display a consistent negative response in terms of real GDP per capita, but the pre-QQE tax multiplier is larger in absolute value terms relative to the post-QQE period. The larger negative pre-QQE effect of the tax shock could be attributed to the impact of an increase in taxes on the subsequent consumption/saving and leverage behavior of households. Also, there is an uncertainty element regarding the transitory versus permanent nature of tax policy, which also impacts the consumption/saving and leverage behavior, and ultimately, GDP.⁷

For the third scenario, we consider a one-time percentage point increase in the central bank's balance sheet relative to GDP that is not reversed (exogenously) in later periods. Figure 2C shows the change in real GDP per capita with respect to the baseline, for both the post-QQE and pre-QQE models (respectively). Following the shock, both multipliers are positive but rather small, raising doubt about the effectiveness of quantitative easing. The post-QQE multiplier is slightly smaller than the pre-QQE multiplier for the first 8 periods after the shock, but the difference is not significant. Again, the reduced efficacy of quantitative easing after QQE can be attributed in part to the increased debt stock.

In the fourth scenario, we consider a 100 basis points increase in the interest rate. The interest rate in the next quarter then reverts to its previous level. Figure 2D shows the change in real GDP per capita relative to the baseline. The increase in interest rates has the expected negative impact on the economy in both models. However, this negative impact is notably stronger in the post-QQE model compared to the pre-QQE for all quarters. This could be due to the higher government debt in the post-QQE period, which implies higher interest payments on the debt, and other things being equal, faster accumulation of debt and a larger drag on real GDP per capita from positive shocks to the real interest rate.

⁷ These findings are robust to the specific setting of the tax elasticity parameter (i.e., 1.18). It can be shown that both the expenditure and BoJ asset holding multipliers are inversely related to the value of the tax elasticity parameter.

Figure 2: Japan Multipliers for Real GDP Per Capita, Pre- and Post-QQE



Conclusion

We studied the change in the fiscal multipliers in Japan relative to their pre-QQE levels using an augmented Blanchard-Perotti model to allow for the dynamic effects of shocks in the central bank balance sheet, interest rates and debt levels on real GDP per capita. We found evidence that expenditure and tax multipliers have fallen under QQE, implying that the effectiveness of fiscal policy has declined. The analysis also raises doubts about the effectiveness of unconventional monetary policy via central bank asset purchases. The estimated QQE multiplier is not strong and appears to have declined post 2013.

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