

# Japanese Quantitative Easing

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An event study of the financial market reactions to  
the Bank of Japan's quantitative easing program

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## **1. Introduction**

Quantitative easing has recently gained credibility as an important part of the monetary policy toolkit of several major central banks. While still considered “unconventional”, this policy has been employed by three central banks to combat the effects of financial crises and stave off deep recessions. Recently, quantitative easing has gained notoriety through its use by the Bank of England (BOE) and the US Federal Reserve (Fed) in combating the effects of the 2008 financial crisis. However, the focus of this paper is the first use of quantitative easing by a central bank: when the Bank of Japan (BOJ) instituted the Quantitative Easing Policy (QEP) in March 2001. This policy intervention was inaugurated to respond to the deflationary pressures that accompanied the period of stagnation in Japan’s economy from 2001 to 2006. This paper uses an event study to analyze the financial market impact of the BOJ’s use of quantitative easing. Using this method, the impact of the QEP on Japanese government bond yields, corporate bond yields, equity markets, and several indicators of the general state of the economy are analyzed, in order to develop a conclusion on the overall effectiveness of the QEP.

Section 2 provides an overview of quantitative easing as a monetary policy tool, and the various theories of how it is transmitted to the real economy. Section 3 presents the history of the Japanese “lost decade” from 2001 to 2006, as well as the context for the BOJ’s introduction of the QEP. Section 4 presents a review of other research on the BOJ’s QEP and the quantitative easing programs of other central banks. Section 5 performs an event-study analysis of the impact of the QEP on the economy’s financial markets. Section 6 provides a discussion of the results of this paper’s analysis in comparison to the results of several other analyses performed on the impact of quantitative easing policies by the BOJ, the BOE, and the Fed. Finally, section 7 provides a summary of the results and concluding thoughts.

## 2. Quantitative easing

### 2.1 Unconventional monetary policy

Central banks provide a key support to the monetary and financial structure of an economy. One of the most important roles of a central bank is its ability to conduct monetary policy in order to encourage or reign in the growth of the real economy. Monetary policy is, broadly speaking, a toolkit that a central bank uses to change an economy's money supply. The goal of this is to stimulate or inhibit the flow of credit and change the level of interest rates. Stimulating credit and lowering interest rates encourages borrowing and investment, which encourages economic growth. Commonly, the target used to guide a central bank's monetary policy is the rate of inflation, with the goal being to keep inflation at a low and stable level; however, gross domestic product (GDP) and unemployment targets are also used. Obviously, these targets are strongly associated by their common link to the performance of the real economy.

Currently, conventional monetary policy refers to how central banks directly intervene in the money market to affect interest rates in the economy. Central banks do this by changing their key policy rate; and with it the deposit rates and interest rates that they pay and charge banks on overnight lending and borrowing. This interest rate acts as a cap for the overnight lending rate in the interbank money market, which is the interest rate on funds that financial institutions lend to one another overnight.<sup>1</sup> The central bank provides monetary stimulus to the economy by lowering its key policy rate, which will lower bank borrowing costs and is expected to pass through to the wider economy and result in a decrease in interest rates and a general expansion of credit. This easing of credit is, in turn, expected to stimulate borrowing for investment and spending, with the end result of propping up aggregate demand.

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<sup>1</sup> Lorenzo B. Smaghi, "Conventional and unconventional monetary policy," *Keynote lecture at the International Center for Monetary and Banking Studies (ICMB)*, (April 28, 2009): 1-2.

The problem with this conventional approach to economic stimulus is that nominal interest rates cannot become negative, because cash can always be used as a store of value with a zero nominal interest rate.<sup>2</sup> Therefore, when the key policy rate reaches this zero lower bound (ZLB), it cannot be lowered any further; so no further monetary stimulus can be provided to the economy through conventional monetary policy. In response to this problem, central bankers have expanded their toolkit to include several new monetary expansion options to use at the ZLB. These new policies, collectively labelled unconventional monetary policy, include conditional interest rate commitments, credit easing, and quantitative easing.<sup>3</sup> Conditional interest rate commitments are when a central bank commits to holding its key policy rate at a low level for a predetermined period of time, with the goal of influencing the private sector's inflation expectations. Credit easing is the term used when a central bank alters the composition of the assets that it holds on its balance sheet, usually with the goal of providing liquidity to frozen financial markets. Quantitative easing is when a central bank expands its balance sheet, by expanding the reserve deposits that it holds for financial institutions, in order to purchase large quantities of financial assets, usually long-term government bonds.<sup>4</sup> For the purposes of this paper it will be important to have a theory of how the monetary expansion of quantitative easing is transmitted through the financial markets to the real economy, eventually leading to economic growth and higher inflation.

## **2.2 Transmission channels**

There are three main transmission channels through which quantitative easing is theorized to impact the real economy. The first, and arguably the most accepted theory in the

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<sup>2</sup> Ben S. Bernanke, Vincent R. Reinhart, and Brian P. Sack, "Monetary Policy Alternatives at the Zero Bound: An Empirical Assessment," *Brookings Papers on Economic Activity*, no. 2 (2004): 1.

<sup>3</sup> Bernanke et al. (2004): 5-24.

<sup>4</sup> Smaghi (2009): 3-6.

economic literature, is the portfolio rebalancing channel.<sup>5</sup> When the central bank purchases long-term government bonds, or other financial assets, as part of its asset purchase program, it bids up their market prices, thus, lowering the yield of these assets. The yield on government bonds can be decomposed into the short-term risk-free rate and the term premium, the additional yield required to compensate investors for accepting a fixed yield for a long term. Because quantitative easing results in the central bank removing a significant amount of long-term bonds from the financial market, the term premium required for investors to hold these long-term assets falls. Another way to view this effect is by considering that the private sector is exchanging its financial assets (e.g., government bonds) for cash. If we consider cash and other financial assets to be imperfect substitutes for one another, this decrease in financial assets in the overall private sector will tend to increase prices and decrease yields broadly on financial assets in the economy.<sup>6</sup> Investors respond to the increased price of government securities by rebalancing their portfolios; selling their government securities and purchasing other assets.<sup>7</sup> This collective rebalancing increases the prices of assets generally throughout the financial market. Also, the higher asset prices increase the wealth of asset holders. The combination of lower long-term interest rates and increased wealth result in a lower cost of borrowing and an increase in spending and investment. This combines to stimulate aggregate demand in the economy, close the output gap, and spur inflation.

The second potential mechanism is the signalling channel. This theory holds that the use of quantitative easing by a central bank could provide the private sector with a credible signal of the central bank's intention to keep interest rates low for an extended period of time. Essentially,

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<sup>5</sup> J. Gagnon, M. Raskin, J. Remache, and B. Sack, "Large-Scale Asset Purchases by the Federal Reserve: Did They Work?" *Federal Reserve Bank of New York Staff Reports*, no. 441 (2010): 3-5.

<sup>6</sup> Bernanke et al. (2004): 16-17.

<sup>7</sup> Gagnon et al. (2010): 3-5.

this means that the quantitative easing program provides credibility to the central bank's conditional interest rate commitment. This signal could then lead the private sector to expect interest rates to remain low for an extended period, resulting in increased levels of borrowing for investment and spending. One of the ways that quantitative easing could create this signal is that, because the asset purchases result in the central bank holding a large quantity of long-term government bonds on its balance sheet, the central bank would incur losses on these securities if it raised interest rates before unwinding its purchases.<sup>8</sup> If the private sector expects that the central bank will only slowly unwind its balance sheet, to avoid placing a monetary drag on the economy, this will provide a credible signal that the central bank will keep interest rates low for an extended period of time, even if the economy recovers.

The third potential transmission mechanism is the liquidity channel. This theory stems from how quantitative easing results in the private sector exchanging its long-term sovereign bonds for more liquid reserve balances, thereby increasing the liquidity in the financial market.<sup>9</sup> Another way of viewing this is that the central bank's asset purchase program establishes ongoing demand for long-term government bonds, such that institutional investors know that they can always sell their securities to the central bank if needed. This effect reduces the liquidity premium on highly-liquid securities, like government bonds. However, this implies that government bond yields should decrease in response to quantitative easing, which is contrary to the other two theories. This theory introduces the possibility that the QEP may have offsetting effects on government bond yields.

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<sup>8</sup> A. Krishnamurthy, A. Vissing-Jorgensen, S. Gilchrist, and T. Philippon, "The Effects of Quantitative Easing on Interest Rates: Channels and Implications for Policy," *Brookings Papers on Economic Activity* (2011): 218.

<sup>9</sup> Krishnamurthy et al. (2011): 219-220.



### 3. History of the BOJ's quantitative easing policy

#### 3.1 Japanese "Lost Decade"

The BOJ introduced the QEP against a backdrop of long-lived economic stagnation in the country. The Japanese economy experienced the collapse of an asset price bubble in 1992, the 1997 Asian financial crisis, and the collapse of the global technology bubble in 2001. This set of economic events brought about a period of economic stagnation and deflation spanning from the mid-1990s to the mid-2000s, in a period termed the "lost decade".<sup>10</sup> During this time, the economy experienced several severe recessions that were followed by only modest recoveries, with real GDP growing only one percent per year, on average, over the ten-year period.<sup>11</sup> The consumer price index fell continuously over this period, dropping by a total of three percent over the decade.

As early as the mid-1990s, the BOJ had already exhausted much of its scope for conventional monetary easing. This was done to combat the effects of the burst of the asset price bubble in the Japanese economy in 1992. Between 1995 and 1998 the BOJ maintained the overnight call rate, its key policy rate, at 0.5 percent to provide continued monetary stimulus.<sup>12</sup> However, structural problems in the nation's banking sector, caused by excessive corporate borrowing and high levels of non-performing loans, led to the failures of several large banks during this period. This caused financial institutions to hoard liquidity, which prevented conventional monetary easing from leading to an expansion of credit and lower interest rates. The BOJ resumed lowering the overnight call rate in 1998, in response to the Asian financial crisis, until it reached the ZLB in early 1999, but with no appreciable economic impact.

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<sup>10</sup> J. Makin, "Japan's Lost Decade: Lessons for the United States in 2008," *American Enterprise Institute for Public Policy Research*, (2008): 1-2.

<sup>11</sup> N. Oda and K. Ueda, "The Effects of the Bank of Japan's Zero Interest Rate Commitment and Quantitative Monetary Easing on the Yield Curve: A Macro-Finance Approach," *Bank of Japan Working Paper Series*, no. 5 (2005): 3.

<sup>12</sup> Oda et al. (2005): 3-4.

This led to the introduction of the BOJ's zero interest rate policy in April 1999. This was an early example of a conditional interest rate commitment, where the central bank committed to maintaining the overnight call rate at near-zero levels until the risk of deflation was overcome.<sup>13</sup> This commitment was maintained for only one year, however, because a slight economic recovery in the summer of 2000 led the central bank to raise the overnight call rate slightly to 0.25 percent. This move proved premature, as several months later the global collapse of the technology bubble caused the economy to deteriorate and head towards recession yet again. This prompted the BOJ to lower the overnight call rate to 0.15 percent and introduce a new monetary easing tool, the QEP, in March 2001.

### **3.2 The BOJ's quantitative easing policy**

The QEP was a novel form of monetary policy for the BOJ that lasted from 2001 to 2006. The policy was based on three main parts. The first was a change in the key policy metric that the central bank used for targeting its monetary policy. The BOJ switched from using the overnight call rate to using the value of current account balances (CAB) that it holds for financial institutions.<sup>14</sup> Along with this, the BOJ announced that it would increase these reserves to a level substantially higher than was required under the old metric, in order to inject liquidity into the economy and lower interest rates. The increases in reserves were primarily attained through the outright purchase of long-term Japanese government bonds (JGB). The second part of the QEP was a conditional interest rate commitment that the central bank would provide liquidity to the economy through asset purchases until deflationary concerns had abated. In effect, this meant when the year-over-year change in the consumer price index (CPI) stabilized at zero or

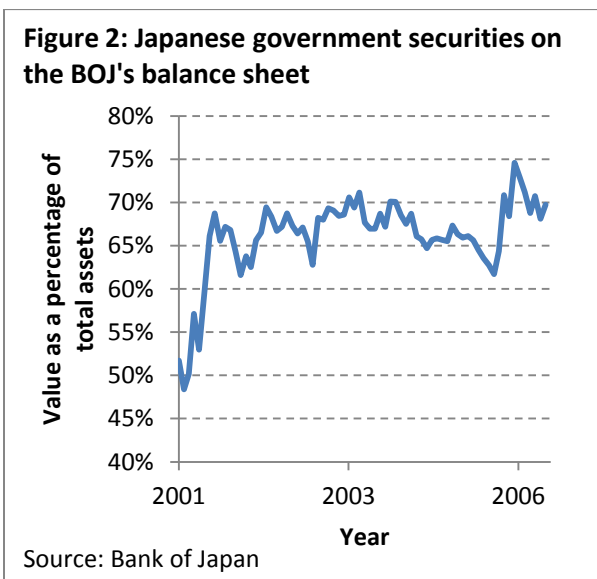
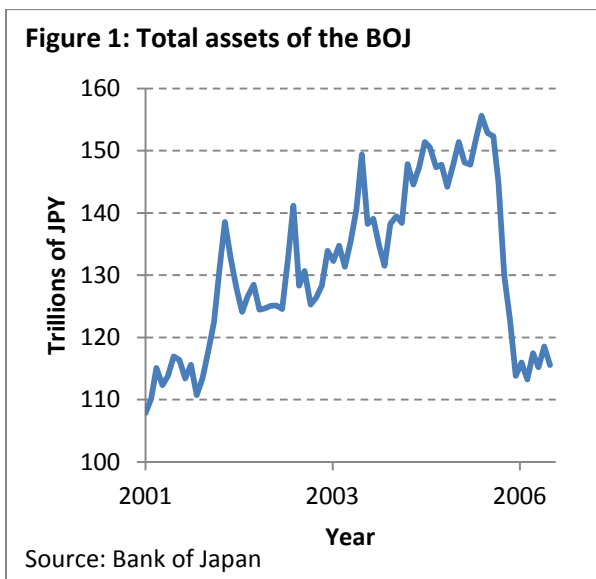
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<sup>13</sup> Oda et al. (2005): 3-4.

<sup>14</sup> H. Ugai, "Effects of the Quantitative Easing Policy: A Survey of Empirical Analyses," *Bank of Japan Working Paper Series*, no. 06-E-10 (2006): 2.

experienced an increase. The third part was a caveat that, if necessary to provide more liquidity, the BOJ would increase the amount of JGBs that it purchased, up to a specified ceiling.

The BOJ commenced the QEP in March 2001, by increasing its target reserve balance from the previously required level of four trillion yen to five trillion yen.<sup>15</sup> The central bank successively raised this target until it reached 30 trillion yen in January 2004, where it held its target until exiting from the policy in 2006. In order to provide these reserves, the BOJ initially engaged itself in purchasing 400 billion yen of long-term JGBs per month. As the economy deteriorated over the first few years of the QEP, the central bank progressively raised this amount to 1.2 trillion yen per month by October 2002, and held the pace of bond-buying steady for the remainder of the program. At the peak of the program, in mid-2005, the BOJ had amassed 63 trillion yen of long-term JGBs, which accounted for around 65 percent of the total assets on its balance sheet (see Figures 1 & 2). The result of this massive liquidity injection was the decline of the overnight call rate, the central bank's standard target for conventional monetary policy, to virtually zero (0.001%) for most of the duration of the policy.



<sup>15</sup> Ugai (2006): 2-3.

## 4. Literature review

### 4.1 Other analyses of the BOJ's quantitative easing policy

Oda et al. (2005) developed and estimated a structural no-arbitrage model to analyze the effectiveness of the BOJ's QEP.<sup>16</sup> This macro-finance approach focused on studying the reaction of yields on medium- and long-term JGBs, and decomposing this effect between the term premium and risk premium components of long-term yields. The authors' novel approach was to compare the experience of the yield curve under the QEP to a counterfactual scenario, where the BOJ would have maintained its key policy rate at the ZLB for the duration of the economy's deflationary period. In addition, the counterfactual included the adoption of a zero interest rate commitment by the BOJ. By explicitly modeling this counterfactual, the authors hoped to eliminate the other monetary policy measures and focus on estimating the effect of the quantitative easing part of the QEP. They concluded that the quantitative easing program had an insignificant effect on the Japanese financial markets. The model estimated that the decrease in yields on long-term government bonds was mainly due to the central bank's zero interest rate commitment, which acted through lowering the market's expected short-term interest rate. The risk premium, theorized to act through the portfolio rebalancing transmission mechanism, was not estimated to have changed significantly throughout the duration of the QEP.

Bernanke et al. (2004) found a similar conclusion for the QEP's effect on JGB yields.<sup>17</sup> The paper developed a term structure model for yields on JGBs. The model, a vector autoregression (VAR) model with four lags, was developed and estimated using data from 1982 to 2004 on the one-year Euroyen futures rate, the BOJ's key policy rate (i.e., the overnight call rate), the rate of inflation, and the unemployment rate. The model was then fitted by using actual JGB yields. A novel technique used in the paper was to incorporate the effect of the ZLB, which

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<sup>16</sup> Oda et al. (2005): 18.

<sup>17</sup> Bernanke et al. (2004): 76-77.

eliminated the scope for decreases in interest rates, on the path of government bond yields. The term structure model was then used to develop yield curves for the government bonds. The model's yield curves were good at predicting the actual yield curve during much of the period from 1982 to 2004. However, the actual yield curves diverged to become lower than the model's prediction after 2001, when the QEP was introduced. As in the paper reviewed above, the authors attributed most of the effect on interest rates to the zero interest rate commitment by the BOJ. However, they did find that the deviation of the actual yield curve from that predicted by the model increased immediately after the introduction of the QEP. The authors conclude that this evidence "gives some reason to believe that nonstandard policies in Japan have been effective in lowering longer-term interest rates". This may be due to the signalling channel, where the use of quantitative easing and the associated purchases of government bonds gives credibility to the central bank's commitment to keeping interest rates low for an extended period of time.

#### **4.2 Event study analysis of quantitative easing by other central banks**

Joyce et al. (2010) performed an event study of the UK's financial market reaction to the Bank of England's (BOE) quantitative easing policy.<sup>18</sup> The BOE instituted an asset purchase program in March 2009 to inject liquidity into the market and lower interest rates. The goal was to encourage economic growth through spending and investment, which would lead to meeting its inflation target. The central bank mostly purchased long-term UK government bonds. The paper used an event study method to determine the impact of the BOE's asset purchase program on the prices of various asset classes in the UK financial market. It looked at the QE-related announcements made by the BOE over the life of the program, and then analyzed the change in the yield or price of the assets over a two-day window after the announcement was released.

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<sup>18</sup> Joyce et al. (2010): 5-27.

These two-day changes were then aggregated over all of the announcements to derive an estimate of the degree to which the quantitative easing program suppressed yields and bid up asset prices. The paper found that the BOE's quantitative easing program suppressed yields on UK government bonds by around 100 bps, and the effect came mostly through the portfolio rebalancing transmission channel. However, the authors were not able to draw conclusions on the effect of the program on corporate bond yields or equity prices.

Gagnon et al. (2010) evaluated the impact of the Fed's Large-Scale Asset Purchase facility (LSAP) on the nation's financial markets.<sup>19</sup> This paper used an event study, similar to the one performed in Joyce et al. (2010), as part of its analysis. The authors also developed a model of the 10-year term premium in the US financial markets, using factors that included the supply of long-term US government bonds. Using this, the authors were able to determine the effect of the asset purchases on the term premium. The paper found that the central bank's quantitative easing led to a suppression of long-term interest rates by 30 to 100 bps, mostly through lowering the term premium component of the yields on these assets.

## **5. Analysis of the BOJ's quantitative easing policy**

### **5.1 Event-study method**

The event-study method that will be used in this analysis is based on the method used in Joyce et al., which evaluated the effects of the BOE's quantitative easing policy on the UK financial market in the wake of the financial crisis of 2008.<sup>20</sup> This methodology involves analyzing the reaction of financial markets to new information regarding the quantitative easing policy. This is done by observing the changes in asset prices and yields around the dates of

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<sup>19</sup> Gagnon et al. (2010): 21-30.

<sup>20</sup> M. Joyce, A. Lasaosa, I. Stevens, and M. Tong, "The financial market impact of quantitative easing," *Bank of England Working Paper*, no. 393 (2010): 6.

announcements regarding the quantitative easing policy. The benefit of the event-study method is that it provides the clearest direct impact of quantitative easing on the financial market. While the goal of quantitative easing is to lower interest rates and encourage economic growth, the relationship between the asset purchases made under the quantitative easing policy and changes in the economy is complicated by other monetary policies measures, changes in fiscal policies, and a host of other factors that could alter the long-run effect of the program. Looking solely at a nation's macroeconomic indicators is unlikely to provide a clear picture of the effect of the policy. Therefore, the clearest impact of quantitative easing should be in the reaction of the financial market to the news of government purchases.<sup>21</sup> This method is based on the efficient market hypothesis, which states that asset prices in a liquid market should respond quickly to incorporate new information. Thus, while asset prices should adjust gradually over the days leading up to the announcement to incorporate the market's expectation, it is expected that asset prices will change quickly after the announcement is released to incorporate the unanticipated information in the central bank's announcement regarding changes to its asset purchase program.

In order to analyze the effect of the BOJ's QEP, this paper will observe the change in the yields on JGBs, the yields on Japanese corporate bond indices, and the levels of equity market indices. The change in yields on long-term JGBs will provide a measure of the effectiveness of the policy in lowering yields on the asset purchased; the first part of the transmission mechanism. Indices for Japanese corporate bonds and equities will be used to measure the extent to which the rebalancing effect causes prices to rise, and yields to fall, generally throughout the financial market; the second part of the transmission mechanism. The final part of the transmission mechanism will be briefly analyzed, using several macroeconomic indicators to show the state and progress of the Japanese economy.

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<sup>21</sup> Joyce et al. (2010): 3-28.

The analysis will observe the change from the closing trade price on the day before the announcement to the closing trade price a specific number of trading days after the announcement has been made. If this window is too short, the analysis may miss some of the effects of the announcement on the financial markets.<sup>22</sup> If it is too long, the effect may become obscured by other news and events. The change in each asset's price or yield is found for each announcement date. These changes are then aggregated over all of the announcement dates to find the overall impact of the QEP on the financial markets. In performing the study, the reaction of each asset class using one-day, two-day, three-day, one-week, and one-month time intervals are calculated and analyzed. This allows the event study window to be calibrated so that it picks up the extent of the financial market reaction. However, only the most relevant time interval for the particular asset class will be used to report the results. In reporting the results of the event study, a two-day time interval will be used in analyzing the reaction of JGBs and corporate bonds. This means that effect will be measured based on the difference between the closing yield the day before the announcement and the closing yield the day after the announcement. When analyzing the downstream impact on equities, the announcement window used in reporting will be increased to one week, since this asset class is further along the transmission mechanism and it is expected that financial markets will take longer to fully price the news into these asset prices.

During the BOJ's QEP, which spanned five years between March 2001 and March 2006, the central bank made sixteen announcements regarding the program. The release dates, as well as summaries of the press releases made by the BOJ, are provided for each QEP-related announcement in Table 1 (see the Figures and Tables sections at the end of this paper). The first announcement, made on 19 March 2001, inaugurated the QEP and detailed the pillars of the

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<sup>22</sup> Joyce et al. (2010): 15.



program, which have been previously discussed in this paper. With the exception of one relatively weak announcement made on 18 September 2001, the first six announcements made by the BOJ regarding the program contained information on very aggressive plans by the central bank to expand the size of the program. These five announcements, made over the first 19 months of the QEP, rapidly expanded both the total level of CABs and the rate at which the central bank would purchase long-term JGBs. The middle stage of the QEP, marked by the eight announcements made between December 2002 and January 2004, involved the BOJ raising the ceiling on the total level of CABs; merely extending the life of the program without accelerating purchases. The end of the program occurred between April 2004 and March 2006, when the BOJ's announcements indicated that it was scaling back the QEP. The following event study will seek to determine the aggregate impact of the program on the financial markets while the program was still ramping up in an attempt to ease monetary conditions. Therefore, in the following analysis of the QEP, only the eleven announcements made during the early and middle stages of the QEP will be considered in calculating the aggregate effect of the program. The five announcements made during the late stages of the program will be analyzed separately.

## **5.2 Government bonds**

The BOJ purchased massive quantities of long-term JGBs outright as part of its QEP, paying for them by increasing the CABs (i.e., reserves) that it holds for financial institutions. According to the portfolio rebalancing effect and the signaling channel, two of the theorized transmission mechanisms relating quantitative easing to the real economy, these asset purchases should result in higher prices and suppressed yields on the asset being purchased, namely JGBs. The BOJ's announcements regarding the QEP explicitly outlined the central bank's plan for the rate at which it purchased JGBs per month. It is expected that the market would react quickly to the new information in these announcements and adjust the prices and yields of these assets

accordingly. Thus, if the QEP was successful in impacting the financial markets, it is expected that this would be manifested in lower JGB yields in the event study.

The aggregate effect of the QEP on JGBs during the first two-and-a-half years of the new policy, using only the first eleven announcements in the event-study analysis, is a significant decrease in long-term yields. Figure 3 shows the aggregate impact using a two-day window around these announcement dates. This illustrates that, during the first two-and-a-half years of the QEP, yields fell considerably when the central bank made announcements regarding the program. This aggregate impact is also in line with expectations, as bonds at greater maturities experienced greater suppression in yields, with the 30-year rate falling by 25 bps over the announcements. This is a significant decline, since the series of two-day changes in the 30-year JGB yield over the period from 2001 to 2006 has a mean of zero and a standard deviation of 5.2 basis points. The results from using the three-day and one-week intervals show very little additional change in yields, which means that all of the financial market's reaction is incorporated in the two-day interval. This event-study analysis shows that the QEP resulted in the suppression of long-term sovereign yields, in line with the expectations developed from the two main theories of the effect of quantitative easing, the portfolio rebalancing effect and the signaling channel. The QEP is, therefore, considered successful in impacting the government bond market.

It is interesting to note that the event study also shows the significant reversal in yields that occurred as the BOJ slowly exited from the program. During the last two-and-a-half years of the program, the impact of QEP announcements was to increase yields considerably, especially on long-term government bonds. As Figure 4 shows, the yields on 30-year government bonds increased by 45 bps across the announcements made between October 2003 and March 2006,

completely reversing the suppression of long-term rates that occurred during the first two-and-a-half years of the program. This can be attributed to these announcements not providing any details of expansions to the program. In fact, the last few announcements made regarding the QEP indicated that the BOJ was planning an exit from the program. The government bond markets would have priced this information into the bond prices, resulting in this significant increase in yields.

Another way of looking at the results of this event study on the impact of the QEP on sovereign yields is to divide the announcements according to the information that they contained. Figure 5 shows the aggregate effect on JGB yields using all sixteen announcements, which include announcements where the BOJ pledged to increase its CABs, increase its purchase rate of JGBs, and ease its collateral restrictions for borrowing from its lending facilities. Using only the eleven announcements where the central bank said it would raise the limit on CABs or increase its rate of government bond purchases gives the results in Figure 6. The suppression of short-term yields is still evident here, but the effect on long-term yields is now almost neutral. Finally, looking only at the five announcements where the central bank increased its rate of government bond purchases gives the results in Figure 7. This shows a very clear suppression of government bond yields, with the decrease in yields being greatest for the bonds at greater maturities, as expected given the main theories of transmission. This analysis shows that the greatest reaction of JGB yields to the QEP announcements was when the central bank indicated that it was increasing its purchase rate for JGBs. This means that government bond yields increased, overall, for the other eleven announcement dates where the rate of government bond purchases remained stable, but the limit of CABs was increased or collateral requirements were eased. A potential reason for this phenomenon is that the bond markets were expecting the BOJ

to increase its rate of JGB purchases on these dates. Thus, when the announcements said that the BOJ was planning to keep its rate of purchases stable, the bond markets reacted by reversing the effect on sovereign yields.

This leads to the topic of how much of the bond market's reaction was priced into JGB yields before the announcements were released. Figure 8 shows the aggregate change in the sovereign yield curve over the two-day period before each BOJ announcement was made public. This is meant to estimate the degree to which the bond markets anticipated the impact of each announcement, and incorporated an expectation of the policy news into JGB yields before the announcement was released. The results show that long-term government bond yields decreased significantly over the two days before each announcement, by 25 bps for 30-year maturities. Thus, the event study shows that half of the impact that the QEP had on JGBs was incorporated into yields before each announcement was released. The other half of the impact was due to the surprise effect, wherein the BOJ's announcement surpassed the market's expectations and resulted in further declines in yields in the days following the announcements.

Finally, in order to fully understand the impact of the QEP on the sovereign yield curve, it is necessary to look at how these yields changed over the duration of the program. Figure 9 shows the yields for JGBs of different maturities over the QEP's life. The major trends apparent in this chart are twofold. The first is the significant downward trend in yields for all maturities between late-2001 and late-2002. This coincides with the series of BOJ announcements stating that the central bank would increase the rate at which it purchased JGBs as part of the QEP. The second major trend is that, after the reversion of the yields for all maturities to their long-run levels in early-2003, yields stayed relatively constant throughout the remainder of the QEP.

Combining this information with the results of the event study suggests that the QEP mitigated other economic pressures and kept yields from rising above their long-run levels.

### **5.3 Corporate bonds**

The BOJ did not purchase large quantities of corporate bonds outright as part of the QEP. However, corporate bond yields should be affected by the rebalancing effect, the second stage in the transmission mechanism, through the reduction in the term premium. If markets are efficient, and market participants price the information about changes in the QEP relatively quickly, then an event study should reveal declines in yields on corporate bonds on dates around QEP announcements. Again, the theory that quantitative easing affects the term premium component in yields can be tested by determining whether the program had a greater impact on longer-term yields. Another way of looking at this effect is to consider that, as the BOJ's demand for JGBs bids up their market price, it is expected that investors would rebalance their portfolios by selling off their low-yield government bond holdings in favor of other assets. Since corporate bonds are another fixed income asset class, they would be expected to receive much of the funds from rebalancing. As rebalancing causes excess funds to flow into the corporate bond market, it is expected that this would bid up prices and cause yields to decline in this asset class, as well.

The event study results of the reaction of corporate bond yields to the first eleven QEP announcements, consistent with those used in the study of government bonds, are shown in Figure 10. The aggregate impact of the QEP, using a two-day window around the announcement dates, is that high-quality corporate bonds (i.e. AAA- and A-rated) experienced an aggregate decrease in long-term yields as a result of the QEP, by 10 bps for 10-year maturities. Also, as shown in Figure 11 for AAA-rated bonds, the spread between corporate bond yields, across all quality ratings, and government bond yields increased at all maturities. This shows that the QEP announcements had a greater impact on the JGB yields than they did on the corporate bond

yields. The analysis of the AAA-rated corporate bonds also shows that the announcements suppressed long-term yields more than short-term yields, which provides further evidence that the QEP reduces the term premium component of yields. The overall analysis shows that the QEP was successful in impacting corporate bond yields for high-quality bonds.

It is interesting to note, however, that lower-quality corporate bonds experienced a more muted effect from the QEP. BBB-rated corporate bonds had a neutral reaction at the short and long ends of the yields curve, as shown in Figure 12. For BBB-rated corporate bonds with moderate maturities, yields actually increased significantly in reaction to the QEP-related announcements, by 40 bps for 9-year maturities. This shows that the rebalancing effect in the corporate bond market is only seen in the higher-rated bonds. This is expected, as these high-quality bonds more closely resemble government securities, and are expected to receive a greater share of the funds that are rebalanced out of JGBs.

The change in corporate bond yields over the lifespan of the QEP shows a clear effect from the program. Figure 13 shows the yields, for 5-year maturities, on the bond indices for three ratings classes. A-rated corporate bonds saw yields decrease continuously from early-2002 until mid-2005. It is interesting to note that corporate bond yields continued declining even after government bond yields stabilized in early-2003. Also, note that the spread between bonds of different qualities was very high at the introduction of the program, but was squeezed to a very small margin by 2005. Overall, the decrease in higher-rated corporate bond yields over the duration of the QEP supports the conclusion of the event study, that the QEP had a suppressive effect on high-quality corporate bond yields.

## **5.4 Equities**

Another asset class that the QEP is expected to impact is equities. The central bank's initial asset purchases create liquidity and bid up the prices of government bonds. The resulting

increase in investor wealth should be rebalanced to other assets in the search for yield. As with corporate bonds, it is expected that some of these rebalanced funds will be reinvested into domestic equities. Therefore, according to the rebalancing effect, it is expected that the QEP should increase the prices of equities throughout the market. Looking at the two main Japanese equity indices, the TOPIX and the Nikkei 225, will show how the equity markets reacted to the QEP. A wider window around the announcement dates will be necessary for this event study, since it is expected that the stock market will take longer to fully incorporate the new information in the QEP announcements into asset prices. This is because these assets are further removed from the long-term low-risk fixed income assets that are actually purchased by the central bank. Looking at the impacts on the equity indices from the announcements, it is clear that the equity market's reaction is typically fully incorporated around five trading days after the announcement is released. Therefore, a one-week window will be used in the event study for equities.

The equity markets generally reacted favorably to the announcements regarding the QEP. At each stage of the QEP's lifespan, the effect of the program was a widespread increase in asset prices on the Japanese stock market. During the program's first two-and-a-half years, including the eleven announcements that have been used in the previous event studies, equity indices rose by an aggregate amount of 23 percent over the five trading days following the announcement dates. Much of this increase is due to the strong 8 percent increase in equities following the BOJ's initial announcement instituting the QEP. This is likely due to the markets taking a positive view on the central bank's unconventional measures, believing that the aggressive methods signaled that the BOJ was serious about supporting the financial markets and the Japanese economy. There was also a very positive reaction in the equity markets to the

announcements where the central bank pledged to increase the rate at which it purchased government bonds as part of the QEP. The QEP effect seen in the government and corporate bond studies, where the effect on prices was positive in the early stages of the program and turned negative in the latter stages, is also evident in the equity data. Equity indices only rose 5 percent in aggregate during the five announcements made over the final stages of the policy. Overall, the QEP had a very clear and positive impact on the Japanese equity markets.

Figure 14 shows the levels of the two main Japanese equity indices during the lifespan of the QEP. The graph shows a general downward trend in the indices over the initial stages of the policy and a general upward trend over the final stages. The latter can be seen as the BOJ's justification for exiting the policy at that time. Overall, this corroborates the effect seen in the JGB and corporate bond markets, where the general trends in the prices and yields over the duration of the QEP are counter to what the event study shows was the effect of the program.

## **5.5 Economic impact**

To supplement the analysis on the financial market reactions, this section will briefly outline the changes in several broad macroeconomic indicators over the duration of the QEP. This will seek to see whether any long-lasting positive economic effects occurred during the program's lifespan. This will start with a discussion of the Japanese bank funding costs, using the Tokyo Interbank Offered Rate (TIBOR) as a proxy. Then it will look at the effect of the QEP on the money supply and inflation in the Japanese economy. Finally, it will look at the growth in Japan's GDP over this time period.

One aim of the QEP was to lower bank funding costs. This is an initial step in the transmission mechanism, as the increased liquidity leads financial institutions to expand the supply of credit in the economy. This expansion of credit, combined with lower interest rates, is then expected to result in increased borrowing for investment, with a resulting expansion in



economic growth. Figure 15 shows TIBOR, at different maturities, over the period when the QEP was in effect. This rate is a measure of the cost for one financial institution to borrow from another and is a proxy for short-term bank borrowing costs. The graph shows that bank borrowing costs fell dramatically during the early stages of the QEP. TIBOR stabilized at around 10 bps, a very low level, for the duration of the program. The rate only increased as the BOJ's intention to exit from the QEP started to become evident in early 2006. This shows a clear correlation between the central bank's liquidity provision and the suppression of bank borrowing costs in Japan under the QEP.

As argued in the introduction, quantitative easing should be viewed primarily as a monetary policy measure. Under the QEP, the BOJ injected liquidity into the Japanese economy with the result of massively increasing the money supply. The objective of this policy was, primarily, to end the deflation that had racked the economy for the previous two years. In this respect, the QEP was successful. As shown in Figure 16, six months after the start of the program, the Japanese economy saw its inflation rate start to rise. After two years, during which the BOJ successively stepped up the rate at which it purchased government bonds, the economy registered a positive year-over-year inflation rate. The central bank, following the conditional commitment that it set up at the inauguration of the policy, exited from the QEP after the economy's inflation rate had stabilized around 2 percent and the threat of deflation had subsided.

Finally, another goal of these unconventional monetary policy measures was to stimulate economy activity. Figure 17 shows the annualized growth rate of the Japanese economy over the QEP's lifespan. Real economic activity was erratic during this period. The crash in 2001 marked the low point in output. The economy made several short rallies, but these were short-lived and

were followed with shallow recessions. However, there is a general upward trend in the growth rate over the period.

## **6. Discussion**

### **6.1 Comparison to other research**

As a check on the robustness of the event study results to changes in the methods and variables used to analyze the effectiveness of the Japanese QEP, the results will be compared to other research that used different methods of analysis. Oda et al. (2005) used a structural macro-finance approach and estimated that the QEP had an insignificant effect on Japan's financial markets. Bernanke et al. (2004) developed a term structure model for JGB yields and concluded that there was some evidence that the QEP had lowered long-term interest rates. The results of the event study used in this paper support the conclusion made in Bernanke et al. (2004), that the QEP was effective in lowering long-term interest rates. However, this paper goes further, concluding that the QEP also suppressed yields on high-quality corporate bonds and led to higher equity prices.

The results of the event study also contradict the findings in Oda et al. (2005) and Bernanke et al. (2004) regarding their conclusion that the decrease in long-term interest rates was mostly due to the BOJ's zero interest rate policy. The event study performed in this paper only analyses the effect of the QEP, not the zero interest rate policy. The results show that the QEP suppressed long-term interest rates by approximately 25 bps, which is approximately the same effectiveness as is attributed to the zero interest rate policy in these two studies. Therefore, the event study provides evidence that the QEP was at least as effective as the zero interest rate policy in suppressing long-term interest rates.

Another contradiction is that Bernanke et al. (2004) attributed the small impact of the QEP on interest rates to the signalling effect. However, the event study in this paper shows evidence to support the portfolio rebalancing channel as the main transmission mechanism, which impacts interest rates by reducing the term premium. This effect is evident in the result that the decrease in government and corporate bond yields in the event study was greater for longer-term bonds.

## **6.2 Comparison to other quantitative easing policies**

In order to understand the significance of the results of this paper, the results obtained for the BOJ's QEP will be compared to research on the effects of the rounds of quantitative easing undertaken by the BOE and the Fed in the wake of the 2008 financial crisis. Joyce et al. (2010) estimated that the BOE's quantitative easing program led to a reduction in long-term UK government bond yields of 100 bps. Gagnon et al. (2010) concluded that the Fed's first round of quantitative easing reduced US government bond yields by 30 to 100 bps.

Overall, the impact of the BOJ's QEP on long-term government bond yields, estimated in this paper as a suppression of 25 bps for the 30-year rate, is significantly smaller than the impact of the BOE's and the Fed's uses of quantitative easing, according to these two studies. The most likely cause of this difference in effectiveness is the disparity in the level of each nation's sovereign bond yields when their program was inaugurated. Yields on JGBs were around 150 bps when the BOJ introduced the QEP, while long-term US and UK government bonds had yields greater than 400 bps at the time that their respective central banks began their quantitative easing programs. Therefore, it can be argued that the BOJ, using conventional and other forms of unconventional monetary policy, had already substantially suppressed JGB yields before introducing the QEP. This made it more difficult for the QEP to obtain any further decreases in government bond yields.

Gagnon et al. (2010) also concluded that the suppression of yields extended beyond the assets that were directly purchased as part of the program, indicating that a portfolio rebalancing effect was observed. This parallels the finding in this paper that the BOJ's QEP caused a reduction in yields of high-quality corporate bonds and an increase in equity prices, neither of which were directly purchased as part of the program.

Finally, these two papers also concluded that the effect of quantitative easing was primarily transmitted through a reduction in the term premium. The event study performed for the BOJ's QEP found that the reduction in yields was greater for longer-maturity bonds, which supports the view that the asset purchases caused the greatest impact on the term premium.

## **7. Conclusion**

The BOJ instituted the QEP, an unconventional monetary policy measure, in early-2001 to provide additional monetary easing to the Japanese economy after reaching the ZLB. This paper has sought to evaluate the overall effectiveness of the QEP by analyzing the first stage in the policy's transmission channel: the impact of the program on the financial markets. The event-study analysis conducted on the BOJ's QEP indicates that the program had a significant positive impact on the Japanese financial markets. The analysis found that the QEP suppressed long-term JGB yields by over 25 bps, using the aggregate of the two-day impact on yields across the first eleven announcements. Long-term yields on high-quality corporate bonds were suppressed by 10 to 30 bps. Equity markets also reacted favourably to news regarding the QEP, rising by 23 percent in aggregate over the one-week intervals following these announcements.

The analysis also illuminated the role of the portfolio rebalancing channel in the transmission of the effects of quantitative easing. The event study showed that the decrease in government and corporate bond yields was greater for bonds at the long end of the yield curve.

This indicates that the term premium component of bond yields is being reduced as a result of the QEP's asset purchases, which is predicted by the theory of the portfolio rebalancing channel. On the other hand, the analysis does not point to a role for the signalling effect, since there is no evidence that the overnight risk-free rate was suppressed by the QEP announcements.

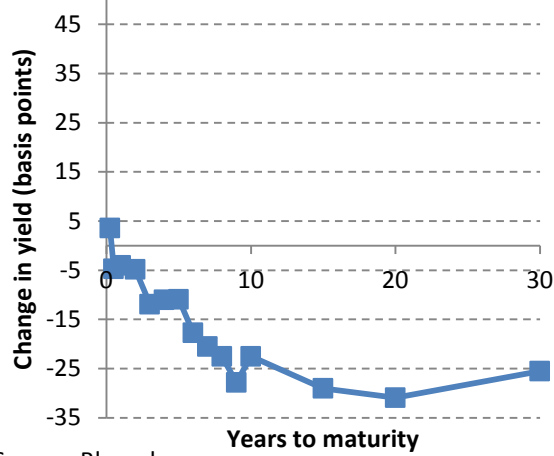
Further research on this topic could focus on analyzing the importance that the shock of an announcement has on the financial market's reaction. As shown in the event study for JGBs, it is expected that prior to the BOJ releasing an announcement regarding the QEP, the financial markets will have already developed an expectation as to the BOJ's plans and incorporated this into prices. Therefore, it is expected that the financial market's reaction following an announcement's release will only reflect the extent to which the BOJ's plan exceeded or fell below these expectations. A formal study of this "surprise effect" would be informative. Other event studies could also perform a detailed review of the other economic and financial news that was released around the QEP announcement dates. This would allow the effects of this non-QEP information to be considered and removed so that it does not contaminate the calculated impact of the QEP, which is a concern with this type of analysis.

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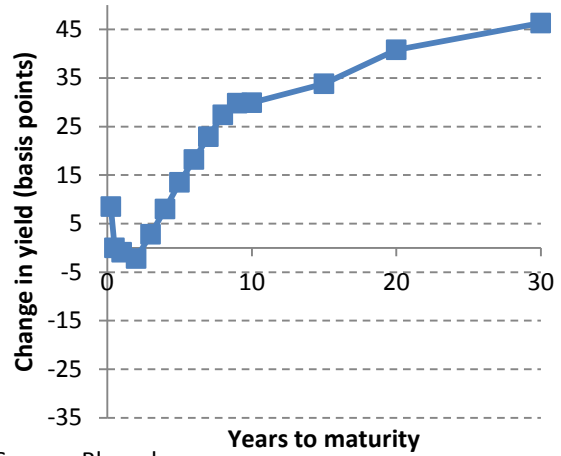
## Figures

**Figure 3:** Aggregate effect on JGB yields of the first 11 announcements



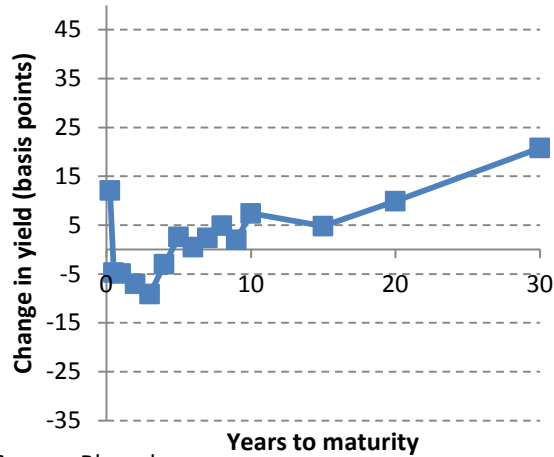
Source: Bloomberg

**Figure 4:** Aggregate effect on JGB yields of the last 5 announcements



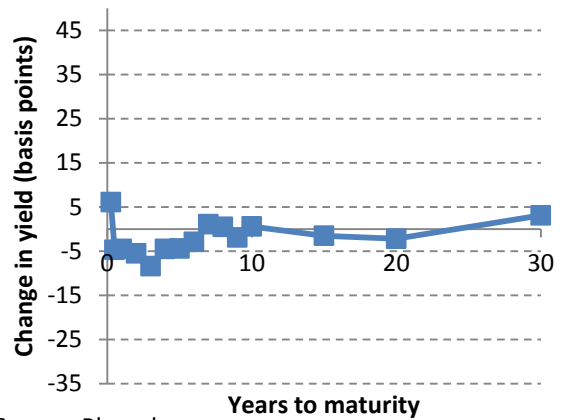
Source: Bloomberg

**Figure 5:** Aggregate effect on JGB yields of all 16 announcements



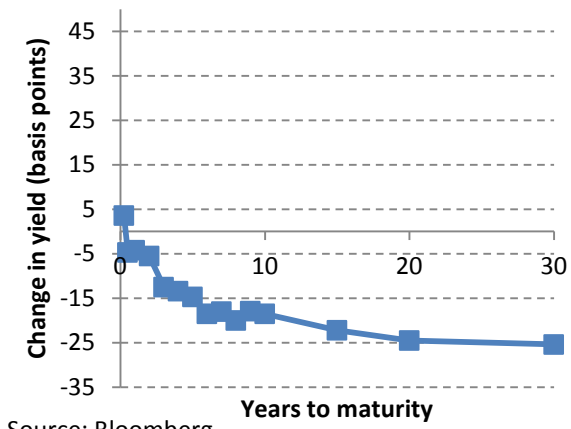
Source: Bloomberg

**Figure 6:** Aggregate effect on JGB yields of the 11 announcements with CAB or JGB purchase rate increases



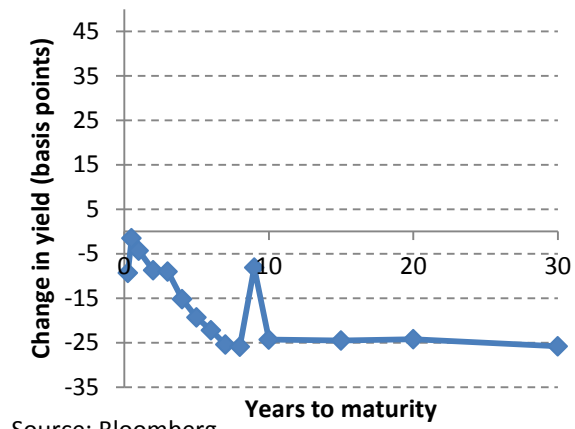
Source: Bloomberg

**Figure 7:** Aggregate effect on JGB yields of the 5 announcements with JGB purchase rate increases



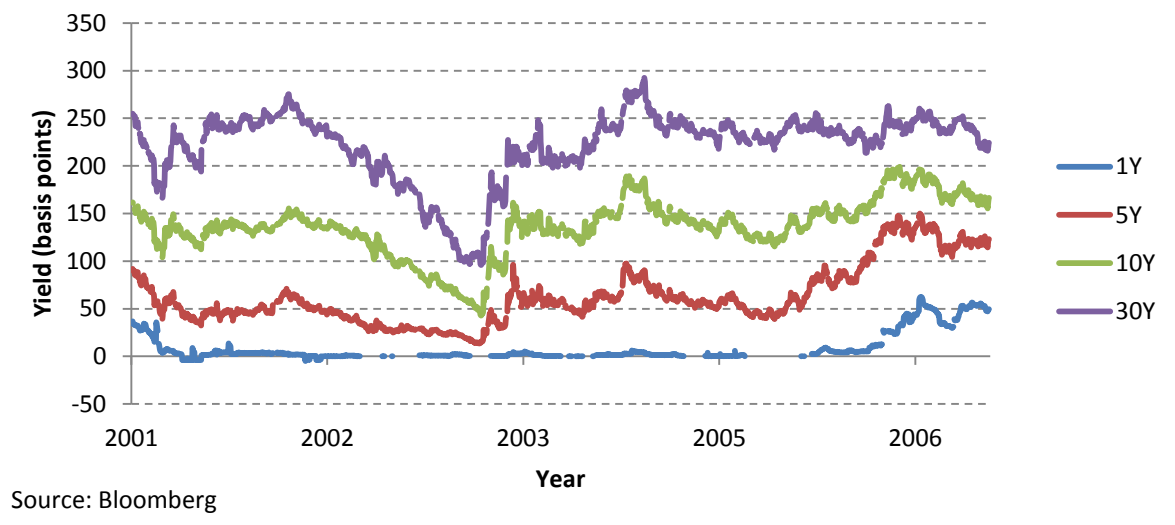
Source: Bloomberg

**Figure 8:** Aggregate effect on JGB yields of the market's anticipation of the first eleven announcements



Source: Bloomberg

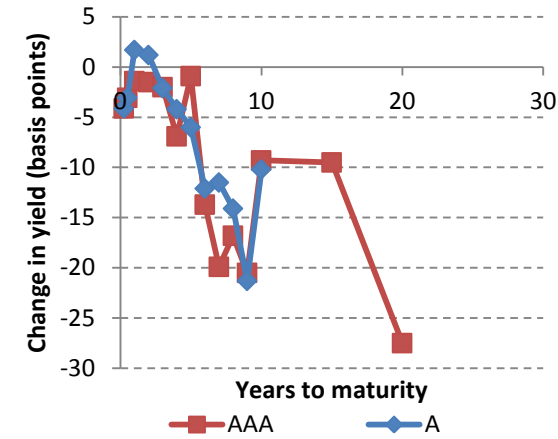
**Figure 9:** JGB yields, for different maturities, over the duration of the QEP



Source: Bloomberg

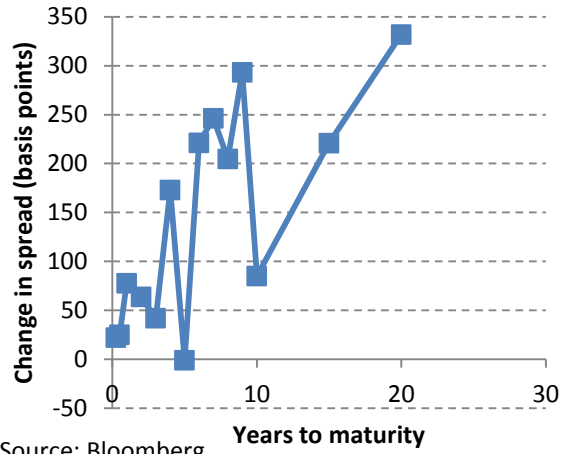


**Figure 10:** Aggregate effect on high-quality corporate bond yields



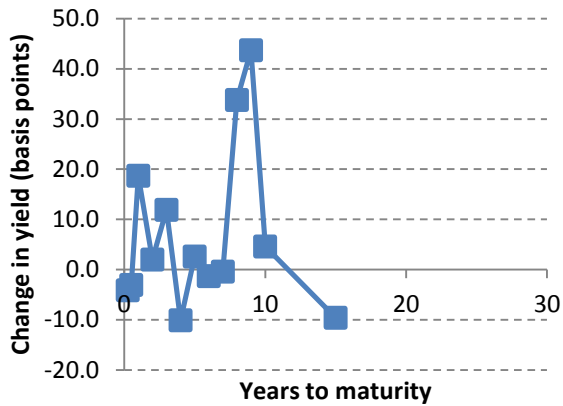
Source: Bloomberg

**Figure 11:** Aggregate effect on AAA-rated corporate bond spread (over JGB)



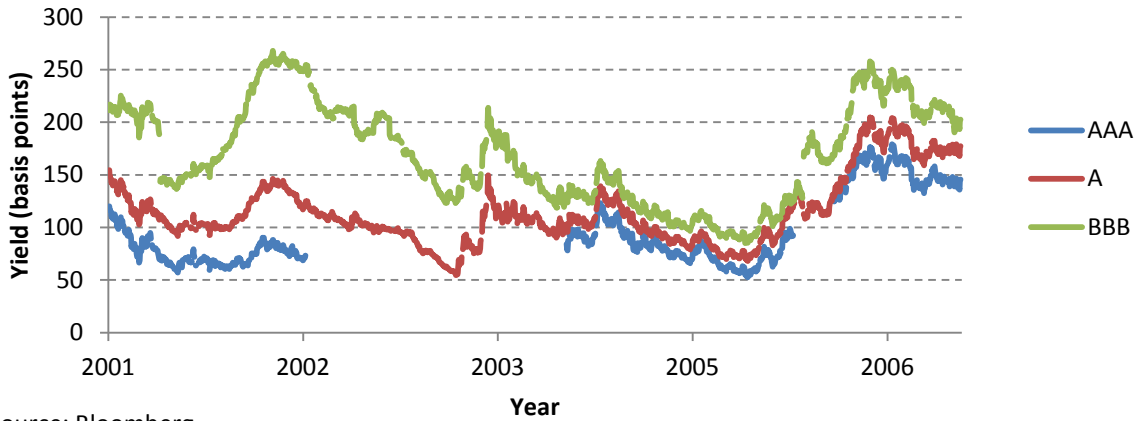
Source: Bloomberg

**Figure 12:** Aggregate effect on BBB-rated corporate bond yields



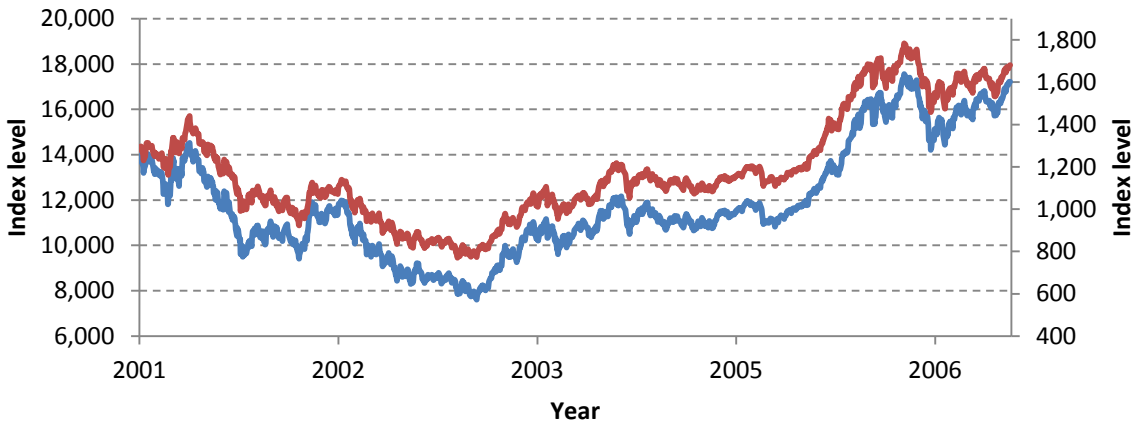
Source: Bloomberg

**Figure 13:** 5-year corporate bond yields, for different ratings classes, over the duration of the QEP



Source: Bloomberg

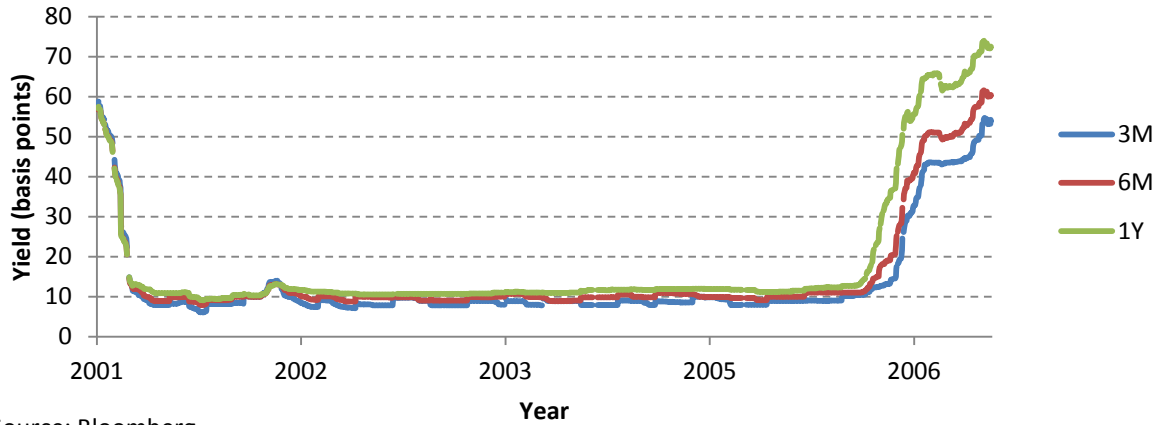
**Figure 14:** Nikkei 225 and TOPIX equity indices over the duration of the QEP



Source: Bloomberg

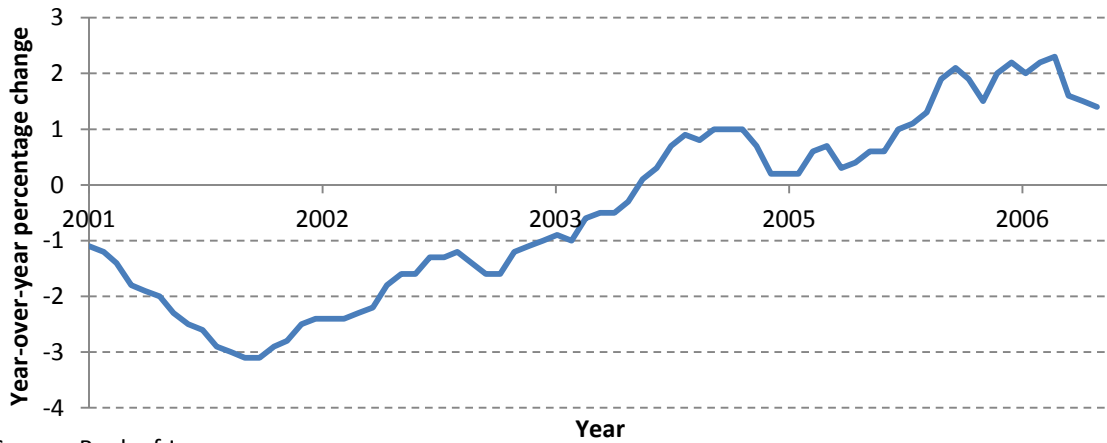
— Nikkei 225 Index (left) — TOPIX Index (right)

**Figure 15:** Tokyo Interbank Offered Rate (TIBOR), for different maturities, over the duration of the QEP



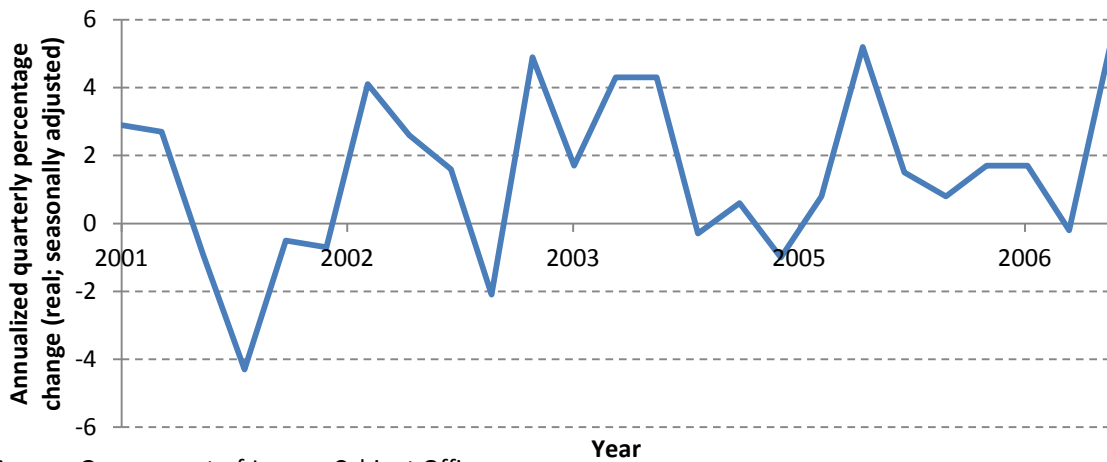
Source: Bloomberg

**Figure 16:** Japanese consumer price index (CPI) inflation over the duration of the QEP



Source: Bank of Japan

**Figure 17:** Quarterly growth of Japanese GDP over the duration of the QEP



Source: Government of Japan - Cabinet Office

## Tables

**Table 1: BOJ Monetary Policy Releases referencing the QEP**

<b>Date</b>	<b>Economic context</b>	<b>CAB levels</b>	<b>JGB purchases</b>
<b>19 March 2001</b>	The economy's recovery had deteriorated and there were mounting deflationary pressures. Policy change designed to fight deflationary pressures.	Inaugurated QEP; increased from 4 trillion to 5 trillion	Increased to 400 billion per month
<b>14 August 2001</b>	Both foreign and domestic demand continued to weaken.	Increased to around 6 trillion	Increased to 600 billion yen per month
<b>18 September 2001</b>	BOJ worried about illiquidity in financial system negating the transmission of monetary policy to the real economy.	Increased to above 6 trillion	-
<b>19 December 2001</b>	BOJ worried about illiquidity in the financial market.	Increased to around 10-15 trillion	Increased to 800 billion yen per month
<b>28 February 2002</b>	BOJ addressing risk of excess liquidity demand.	Provide more liquidity	Increased to 1 trillion yen per month
<b>30 October 2002</b>	The economy stabilized, while deflation continued.	Increased to around 15-20 trillion	Increased to 1.2 trillion per month
<b>17 December 2002</b>	BOJ eased collateral restrictions to ensure liquidity in corporate financing.	-	-
<b>25 March 2003</b>	The economy remained stable, while deflation continued.	Increased to around 17-22 trillion	-
<b>30 April 2003</b>	The economy remained stable, while deflation continued.	Increased to around 22-27 trillion	-
<b>20 May 2003</b>	Economic outlook improved in the short term. Federal bailout of a major commercial bank was granted.	Increased to around 27-30 trillion	-
<b>11 June 2003</b>	Commenced purchases of asset-backed securities, to encourage corporate financing.	-	-
<b>10 October 2003</b>	Deflationary pressures eased.	Increased to around 27-32 trillion	-
<b>20 January 2004</b>	The economy started to slowly recover, with inflation near zero.	Increased to around 30-35 trillion	-
<b>9 April 2004</b>	Commenced a lending facility to improve liquidity of market for JGB.	-	-
<b>20 May 2005</b>	The economy continued to recover slowly.	CABs may fall short of target	-
<b>9 March 2006</b>	The economy continued to recover steadily.	Change target back to overnight call rate; reduce CABs over time	Purchases to continue at same rate

Source: Bank of Japan – Monetary Policy Releases