



# The impact of unconventional monetary policy on the tail risks of stock markets between U.S. and Japan



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## ABSTRACT

Facing the economic downturn, the central bank of U.S. and Japan adopts the unconventional monetary policy to stimulate their economy. This paper studies the quantitative easing policy effectiveness via the tail risks of stock markets in the U.S., Japan and the other 74 countries. Although the stock markets of U.S. and Japan reveals the announcement-day effects of the QE policy, this study finds an asymmetric tail risk of return distribution on the QE policy effect. The post-period right-tail and left-tail risks of the stock markets are significantly smaller and larger than that of the pre-period of the QE programs, respectively. This implies that the tail risks of stock returns have dissimilar interdependence with the QE programs. Furthermore, the geographical dependence is the major factor that determines the contagion of stock market, and the fragility of foreign stock market caused by the US QE policy is larger than that of the Japan.

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## 1. Introduction

The subprime mortgage loan crisis in the US during early 2007, cash shortage problem of BNP Paribas in France in August 2007, the bank run of Northern Rock in Britain during September 2007, together with the failure of Lehman Brothers in September 2008 gave rise to the global financial crisis (Helleiner, 2011; Reinhart & Rogoff, 2009a,b) and caused unprecedented operation difficulties for the large financial institutions in the world. During the downturn of global stock markets, evaporation of liquidity in some markets, and deterioration of macroeconomic conditions in some countries, massive bailout actions such as conventional and non-conventional monetary policy are taken by government authorities to stabilize the financial system (Klyuev, de Imus, & Srinivasan, 2009; Palley, 2011). Open market operations, discount rate policy, and reserve requirement are examples of conventional monetary policies. On the other hand, quantitative easing (QE) program is an unconventional monetary policy by central bank to purchase huge amount of Treasury bonds and mortgage-based securities from the insolvent banks to provide demand and liquidity of bond markets. This will decrease the long-term interest rates, improve the credit worthiness of insolvent banks, and enhance the reserve account of central banks.

Japan adopted the quantitative easing monetary policy during the period of Asian financial crisis. The Bank of Japan (BOJ) implemented the zero interest rate policy to decrease the borrowing cost of firms during February 1999 to August 2000, and purchased Japanese government bonds to increase monetary supply from March 2001 to March 2006. Moreover, in response to the subprime crisis in 2008, the Bank of Japan purchased various sectors of bonds such as Japanese government bond, corporate bonds, commercial papers, and other fixed-rate instruments to overcome deflation and stimulate economy growth. However, the monetary policy was not strong enough to revive the fragile Japan economy. Therefore, the Bank of Japan adopted the comprehensive monetary policies with zero interest rate and asset purchasing program to re-stimulate the economy from October 2010 to April 2013 (Berkmen, 2012; Lam, 2011; Ueada, 2011). Furthermore, after the policy meeting of Bank of Japan on January 22, 2013, Bank of Japan announced another round of quantitative easing policy, including the Tokyo interbank offered rate remaining in the range of 0.0% to 0.1%, increasing the target inflation rate from 1% to 2%, as well as an indefinitely asset purchasing program that Bank of Japan will purchase 101 trillion yen of assets in 2013. From January 2013, Bank of Japan started to purchase 10 trillion of short-term Treasury bills and 3 trillion of long-term Treasury bond per month until the economic condition of Japan has recovered. The latest QE policy adopted by Japan is named as Super Quantitative Easing (Super QE) policy.

During the subprime crisis period, the Federal Reserve Bank (Fed) of the US also adopted a series of quantitative easing policy. In the first

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round of quantitative easing policy (QE1), during 24th November of 2008 to 31st March of 2010, \$1.25 trillion of mortgage-backed securities and \$200 billion of deferral agency debts were purchased by the Fed to increase the credit accessibility in private markets and to support the housing market, and \$300 billion long term treasury securities were purchased by the Fed to lower the interest rates. In the second round of quantitative easing policy (QE2), from 3rd November of 2010 to 30th June of 2011, up to \$600 billion of long term treasury securities were purchased by the Fed. In the third round of quantitative easing policy (QE3), from September 13, 2012, \$40 billion of mortgage-backed securities per month were purchased by the Fed indefinitely. In addition, the Federal Open Market Committee (FOMC) implemented the zero federal fund rate policy until 2015. To enlarge the policy effectiveness, the Federal Reserve started to increase the asset purchasing amount from \$45 billion to \$85 billion per month on December 12, 2012. The Fed decided to purchase \$40 billion of mortgage-backed securities and \$45 billion of Treasury bonds per month until the unemployment rate falls below 6.5% and the inflation rate is no larger than 2.5%. This is an enhanced version of QE3.

The impacts of quantitative easing monetary policies of Japan and US on their economic conditions and financial markets have been studied on various fields. On the impact of inflation rate and unemployment rate, Chung, Laforte, Reifschneider, and Williams (2011) show that the asset purchasing program of Fed lowered the unemployment rate by 1.5% and also helped avert deflation. However, Liu, Mumtaz, Theodoridis, and Zanetti (2013) reveal a 0.7% unemployment rate rise and a 1% average inflation rate decrease in 2010. Berkmen (2012) develops a structural VAR model and shows that the monetary easing policy of BOJ has higher impacts on economic conditions than on inflation during 1998–2010. Tandon, Saxena, and Chandan (2012) analyze the return of stock indexes, interest rates, employment rates, inflation rates and industrial outputs to study the policy effects of QE1 and QE2 by Fed. It is shown that QE1 decreased the inflation rate and QE2 raised the inflation rate. In addition, QE1 and QE2 both decreased unemployment rate. Baumeister and Benati (2013) explore the macroeconomic effects of a compression in the long-term bond yield spread within the period of 2007–2009. Their result suggests that the US and UK unconventional monetary policy actions have averted significant risks both of deflation and of output collapses comparable to those that took place during the Great Depression. Yamamoto et al. (2013) apply VAR model to evaluate the effectiveness of Japanese Quantitative Easing policy in 2012 on the domestic inflation rate and net exports. They predict that the inflation rate will be hard to reach the 2% target and net exports will not increase at the end of 2014. Hayo and Ono (2014) examine the correlation between the asymmetry of sectoral relative-price changes and the aggregate inflation rate. They show that short-run inflation, monetary policy, and aggregate demand are the major factors that affect the asymmetry of sectoral price changes.

On the impacts of unconventional policy effect on the asset prices, Kurihara (2006) finds that foreign exchange rate and the US stock market mainly affect the stock returns of Japanese market during the implement period of easing monetary policy since March 19, 2001. Lam (2011) finds significantly cumulative announcement effects of the BOJ monetary easing policies on various financial market indicators. The empirical results of Ueda (2011) reveal that the monetary policy of the BOJ generated expected impacts on asset prices, except for foreign exchange rate. Bagliano and Morana (2012) study the transmission channels of macroeconomic and financial shocks through a 50-country macroeconomic model during the period of 1980–2009. They find that a stronger evidence of an asset prices channel, rather than a liquidity channel within the US market. The financial disturbances are transmitted to foreign countries through the US stock price dynamics.

The prior researches mainly focus on the policy effects on unemployment rate, inflation rate, and stock returns when a government authority exercises its own easing monetary policy. When the stock markets are blooming, the tail characteristics of return distributions are trivial.

However, investors may experience extremely negative returns during the large market downturns (Agarwal & Naik, 2004; Jansen & De Vries, 1991). Since the exercising periods of super quantitative easing policy by Japan and the third round of quantitative easing policy by Fed overlap each other, this is a good opportunity to study the monetary policy effects of two countries on the tail characteristics of return distributions. Prior researches consider only the average returns on stock markets and ignore the tail characteristics of return distributions. The relationship between the unconventional monetary policy and the tail risk of stock markets, and the tail risk of foreign countries when the US and Japan implement their QE policy have not been addressed. This paper fills the literature gap by comparing the tail risk of the US and Japan QE policy effects on the stock markets.

This paper adopts the extreme value theory to study the tail characteristics of stock return distributions of the US and Japan separately during the unconditional monetary policy period. Secondly, the comparison of the unconditional monetary policy intensity between the US and Japan on the tail characteristics of home and foreign stock returns are studied to find out the most contagious areas or countries when the US and Japan adopt the QE policies. Countries besides the US and Japan are classified into geographical part and economic condition part. The geographical part covers countries among the areas of America, Asia-Pacific, Africa and Middle-East, and Europe, while the economic condition part covers developed, emerging and frontier markets. Finally, the policy effects on the upside and downside tail risks of stock markets are studied in this paper to understand the interdependency between QE policy and the tail characteristics of stock return distributions.

The stock price returns are not normally distributed as shown in the studies of Fama (1970), Grieb and Reyes (1999), Smith, Jefferis, and Ryoo (2002), Groenewold and Ariff (1999), Abraham, Seyyed, and Alsakran (2002), and Worthington and Higgs (2004). This paper also provides the evidences of not normally distributed phenomenon of the stock returns in the US, Japan, and the rest of the world. Therefore, the tail characteristics of return distributions are worthy to be discussed. Our major findings are discussed as followed: First, this study finds an asymmetry tail risk of return distribution on the QE policy effect, that is, the interdependence between QE program and the upside as well as downside tail risks of stock markets are dissimilar. The post-announcement right-tail risks of stock returns significantly decrease, while the post-announcement left-tail risks of Japan and foreign return distribution significantly increase. Furthermore, the post-period right-tail risks of the stock markets are significantly smaller and the post-period left-tail risks of the stock markets are significantly larger than that of the pre-period of the Fed QE3 program and the Bank of Japan Super QE program. It implies that the dependency of QE policy with right- and left-tail is skewed and significant. Second, our result suggests that the geographical dependence is the major factor that determines the contagion of foreign stock market. In calculating and comparing the contagion of foreign stock markets between the QE programs launched by US and Japan, our results reveal that America is the most contagious area among the foreign countries by the US unconventional monetary policy during 2013. Europe area is less contagious than America. The least fragile area is Asia-Pacific. In contrary, the Super QE program adopted by the Bank of Japan has caused the Asia-Pacific area, especially Thailand, Philippines, and Malaysia, to be the most fragile. America area is the least affected by the policy of the Bank of Japan. Third, the fragility of stock market caused by the US QE policy is larger than that of the Japan. Nevertheless, the contagion effects of stock market by Japan and the US gradually release when the length of the post policy increases. For the post 3-month period, the rest of the world has 1.87% of distressed probability conditional on the US QE3, and only 0.79% of co-crash probability on the Japan super QE program. The t statistics reveal that the rest of the world stock market is significantly highly infected by the unconditional monetary policies of the Fed and the Bank of Japan. In addition, the fragile

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