



# Determining structural breaks in central bank reaction functions of the financial crisis



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## ABSTRACT

Determining breakpoints in central bank reaction functions is crucial to monitor the decisions of the governing councils correctly. This is especially true during the recent financial crisis. However, reaction functions do not necessarily change at the beginning of a crisis and so the specific breakpoints need to be estimated rather than being set exogenously. While central bank reaction functions typically include more than one exogenous variable it is possible that the breakpoints in the reaction coefficients change from one independent variable to the other. We develop an estimation strategy using real-time data that account explicitly for variable breakpoints in the different independent variables. Using Taylor reaction functions for the ECB and the Fed we show that there are indeed different breakpoints with respect to the lagged interest rate, the inflation rate and the output gap within the financial crisis, in which the reaction coefficients tend to be significantly lower. Out-of-sample forecasts underline the result of a less volatile reaction of central banks during the crisis period.

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## 1. Introduction

The financial crisis hit the world economy in 2007 with the burst of the housing bubble in the US and intensified considerably after the collapse of Lehman Brothers in late 2008. Up to now we have not found an exit to this crisis. Unemployment rates are still high and output in many industrial countries is just catching up with their pre-crisis levels. Moreover, serious sovereign debt problems especially in Europe limit the influence of fiscal policy in setting a stimulus to the economy.

Therefore, central banks seem to be the only ones that can set an end to the crisis by providing the economy with liquidity. In fact, most central banks have done so in the crisis. The two central banks of the most important economic areas, the European Central Bank (ECB) and the US-Federal Reserve (Fed) have been at the forefront of this development. While the Fed has performed three rounds of quantitative easing by this more than tripling the size of the Fed's balance sheet,<sup>2</sup> the ECB was more reluctant to provide the banks with more liquidity. Changing their tender procedure from partial to full allotment and setting up a small scale asset purchase program compared to the Fed were the changes in ECB-policy. In 2011M12 and 2012M2 the ECB flooded the markets with additional 1 trillion Euro for the period of three years, thus the size of the

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<sup>2</sup> In the first round the balance sheet was expanded from about 0.9 trillion US-Dollar in 2008M8 to about 2.2 trillion US-Dollar by the end of the year. Quantitative Easing II raised the balance sheet additionally by 0.6 trillion between 2010M11 and 2011M6. Finally, in Quantitative Easing III the Fed bought assets worth 85 billion US-Dollars every month as a maximum.

balance sheet even expanded these of the Fed. Moreover, in 2012 the ECB announced Outright Monetary Transaction (OMT) a program designed to buy government bonds once the country calls for financial assistance via the European Stability Mechanism (ESM). In addition in mid-2014 the ECB once more provided the banking system with liquidity for now four years via Targeted Long-Term Refinancing Operations (TLTRO) if the additional liquidity is used to expand credit creation in the private sector with the exception of house purchases. While all of these measures are newly introduced in the crisis, it is hard to quantify their impact empirically with standard monetary policy reaction functions. So we neglect these additional measures in the following.

But what are the reasons for the different strategies of both central banks within the crisis? One explanation is the differing mandate of both. While the ECB has to guarantee stable prices and only if this goal is achieved can promote additionally economic growth, the Fed has a triple mandate of stable prices, maximum employment and moderate long term interest rates. So the Fed has to have a broader focus and might face a tradeoff between the three goals. However, also the ECB seems to have deviated from their mandate in late 2011 by lowering the interest rate twice even though the inflation rate was clearly above the announced inflation target of less than but close to two percent. This was the first time that the ECB lowered rates with inflation rates above target.

So both central banks seem to have adjusted their strategies considerably within the crisis. But up to now the literature providing quantitative evidence of when and how those have changed is still quite scarce even after more than five crisis years. Therefore, this article aims to fill this gap by looking at central bank reaction functions and how they are altered within the crisis. Most frequently the reaction function proposed by [Taylor \(1993\)](#), the so-called Taylor rule, is used to evaluate central bank performance. Even though the Taylor rule is easy to apply by looking at only the inflation rate and some output measure, it proved to fit the actual interest rate path of many central banks quite well. That is why we estimate Taylor reaction functions in this article for a period including the crisis and try to find evidence of structural breaks in this rule with respect to all exogenous and individual variables.

Therefore, the article proceeds as follows: Section 2 gives a short literature review on research done in the field of Taylor reaction functions within the financial crisis so far. Since the crisis has not yet ended this article provides, besides its unique estimation technique, updates to many of those because we can rely on more data. Section 3 presents the two step estimation strategy used in this article to first find structural breaks and second estimate the size of adjustment by both central banks. Section 4 explains the construction of our real-time dataset used here because it models the interest rate decision better than relying on ex-post revised data. Section 5 shows the results and a comparison of in-sample and out-of-sample interest rates, the latter being the ones of an unchanged pre-crisis Taylor reaction function. Section 6 finally concludes.

## 2. Literature review

Some authors have suggested that there is a structural break in central bank reaction functions in the recent financial crisis. [Gorter, Jacobs, and de Haan \(2009\)](#) were among the first to add data on the financial crisis to (augmented) Taylor reaction functions and compared them to the pre-crisis results for the ECB. Setting the breakpoint exogenously to 2007M1 and estimating one Taylor reaction function for the pre-crisis era and one for the whole sample period up to 2009M7, they find an almost unchanged response to the inflation rate and a lower response to the output gap.

[Belke and Klose \(2010\)](#) additionally investigated whether other variables like money, credit and asset price growth or risk spreads need to be added to the reaction function of the ECB and the Fed. Setting the breakpoint to 2007M8 they find indeed an altered role for inflation and the output gap as well as for the additionally added variables in the recent crisis. However, the response differs depending on whether the reaction of the ECB or the Fed is investigated.

[Klose \(2011a\)](#) explicitly accounted for the zero lower bound in determining differences in the pre- and crisis era. The author sets up a model using the real rather than the nominal interest rate as dependent variable and finds with this approach also an altered response of the ECB and the Fed to inflation and output after 2007M8.

[Baxa, Horvath, and Vasicek \(2011\)](#) estimate time varying coefficients for the Fed, the BoE, the Reserve Bank of Australia, the Bank of Canada and the Sveriges Riksbank adding an indicator of financial instability. In general they find that their financial stress indicator should be added to Taylor reaction functions only in crisis times since otherwise it is mainly insignificant.

Finally, [Eichler and Hielscher \(2012\)](#) incorporate banking and sovereign debt crisis risk measures into Taylor reaction functions for the pre- and crisis period for two groups of EMU countries. Setting the breakpoint to 2007M8 they also confirm that the reaction function has changed. However, it is surprising that they do not find a significant response to the inflation in the pre-crisis era.

While all of the above mentioned articles set the breakpoint (if specified) exogenously [Martin and Milas \(2010\)](#) and [Gerlach \(2011\)](#) are to the best of our knowledge the only ones to account for the endogeneity of one possible breakpoint. Focusing on the BoE [Martin and Milas \(2010\)](#) estimate Taylor reaction functions adding a measure of financial instability into the regression. Assuming a breakpoint in 2007M4 which is also supported by a breakpoint test<sup>3</sup> they find a lower response to both the inflation rate and the output gap.

<sup>3</sup> Due to the sample period up to 2010M1 and the trimming needed to adopt structural break tests they are unable to account for later or multiple adjustments of the reaction function.

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