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Fifty Shades of QE: Robust Evidence

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Abstract

Fabo, Jančoková, Kempf, and Pástor (2021) show that papers written by central bank researchers find quantitative easing (QE) to be more effective than papers written by academics. Weale and Wieladek (2022) show that a subset of these results lose statistical significance when OLS regressions are replaced by regressions that downweight outliers. We examine those outliers and find no reason to downweight them. Most of them represent estimates from influential central bank papers published in respectable academic journals. For example, among the five papers finding the largest peak effect of QE on output, all five are published in high-quality journals (*Journal of Monetary Economics*, *Journal of Money, Credit and Banking*, and *Applied Economics Letters*), and their average number of citations is well over 200. Moreover, we show that these papers have supported policy communication by the world's leading central banks and shaped the public perception of the effectiveness of QE. New evidence based on quantile regressions further supports the results in Fabo et al. (2021).

JEL classifications: A11, E52, E58, G28

Keywords: Economic research, quantitative easing, QE, central bank, career concerns

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1. Introduction

Fabo et al. (2021) (henceforth "FJKP") compare the findings of central bank researchers ("central bankers") and academic economists ("academics") regarding the effectiveness of QE. They examine 54 studies that analyze the effects of QE on output or inflation in the U.S., UK, and the euro area. Their main result is that papers written by central bankers find QE to be more effective than papers written by academics. Specifically, central bank papers report larger effects of QE on both output and inflation. Central bank papers are also more likely to report QE effects on output that are significant, both statistically and economically, and they use more favorable language in their abstracts. Central bank researchers who report larger QE effects on output experience more favorable career outcomes.

Weale and Wieladek (2022) reexamine FJKP's analysis. First, they successfully replicate FJKP's results, which are based on standard OLS regressions. Second, they test the hypothesis that the residuals in those regressions are normally distributed. They reject normality, except for the language sentiment regressions. Finally, they rerun parts of FJKP's analysis using two "robust regression" methods, the median regression and the MM/MS regression, which downweight the influence of large residuals compared to OLS.[1] Based on these methods, they obtain the same conclusions as FJKP regarding language sentiment but different conclusions regarding the magnitudes of the estimated effects. Specifically, they cannot reject the null hypothesis that central bankers and academics report the same quantitative effects of QE on output and inflation. While Weale and Wieladek (2022)'s point estimates have the same signs as those of FJKP, they are smaller in magnitude and usually not statistically significant. Given the limitations of robust regressions, Weale and Wieladek (2022) do not use them to reexamine FJKP's evidence on significance reporting or career progression.

We are grateful to Weale and Wieladek (2022) for their illuminating analysis. It is clearly important to examine the robustness of the empirical findings reported in the economics literature, yet such studies are few and far between. By providing such analysis, Weale and Wieladek (2022) have performed valuable service to the profession. Moreover, they have done it in a very competent and professional manner.

In this paper, we build on Weale and Wieladek (2022) to shed more light on the robustness of FJKP's results. The main difference between FJKP and Weale and Wieladek (2022) is that the latter study uses robust regressions whereas the former relies on OLS regressions. Compared to OLS, robust regressions reduce the impact of outliers on the coefficient

[1] Weale and Wieladek (2022) use the MM estimator of Yohai (1987) for the specifications without dummy variables and the MS estimator of Maronna and Yohai (2000) where dummy variables are present.

estimates. A priori, it is not clear whether OLS regressions or robust regressions are more suitable. While OLS regressions are far more popular in practice due to their efficiency, robust regressions can be preferred when there is a concern that regression estimates are unduly affected by outliers—for example, when the outliers reflect data errors, or when they do not come from the same data-generating process as the remaining observations. Given the relatively small number of observations in FJKP's study, we are able to examine the individual outliers in their data to see whether they deserve to be downweighted.

We find no reason to downweight the outliers in FJKP's regressions. All of them come from studies that appear to be competent, written by credible authors. Most of these studies have been published in respectable academic journals, such as the *American Economic Journal: Macroeconomics*, *Economic Policy*, *Journal of Monetary Economics*, and *Journal of Money, Credit and Banking*. Many of them have been highly influential among researchers, having received hundreds of citations. A number of these studies have been mentioned in media outlets such as the *Financial Times* and the *Wall Street Journal* as well as in speeches of the world's leading central bankers such as the Fed's Ben Bernanke and Janet Yellen, the ECB's Benoît Cœuré and Isabel Schnabel, and the Bank of England's Andy Haldane and Huw Pill. It does not seem appropriate to put less weight on estimates from prominent studies that have shaped the public opinion about the effectiveness of QE. In fact, one might argue that such studies should be overweighted, given their disproportionate influence.

We also extend Weale and Wieladek (2022)'s analysis by reestimating FJKP's regression specifications using quantile regressions. For a wide range of quantiles, we estimate the difference between the QE effects estimated by central bankers and academics. We find a positive difference, in line with FJKP's OLS evidence. The point estimate is mostly statistically insignificant, but it is consistently positive (at 151 out of 152 quantiles considered). At the top quantiles, the estimates tend to be larger and more often significant.

The paper is organized as follows. In Section 2, we briefly comment on the role of residual normality in OLS regressions. Section 3 examines the outliers in FJKP's regressions, including their impact on researchers, central bank policy makers, and the general public. Section 4 presents new evidence from quantile regressions. Section 5 concludes.

2. Normality

Weale and Wieladek (2022) test the null hypothesis that the residuals in FJKP's regressions are normally distributed. Using the Jarque-Bera test, they reject this hypothesis in most specifications, except for the language sentiment regressions. They also show that the non-normality of the estimated QE effects pertains primarily to central bank papers. For such papers, kurtosis is much larger than 3.0 for all eight measures of QE effects, whereas for academic papers, this happens for only two of the eight measures (see Weale and Wieladek (2022)'s Table 1). Central bank papers are thus more likely than academic papers to report extreme estimates of the effects of QE. This interesting new finding is one of Weale and Wieladek (2022)'s novel contributions to the literature.

It is important to note that the OLS estimation method, used by FJKP, does not assume normally distributed residuals. The normality of the residuals is neither necessary nor sufficient for OLS estimates to be consistent. In other words, there is nothing inherently wrong with using OLS estimates when the residuals are not normally distributed.

In fact, without residual normality, the OLS estimator is also efficient, as long as the assumptions behind the Gauss-Markov theorem are satisfied. According to this theorem, the OLS estimator is the best linear unbiased estimator—it has the lowest sampling variance (i.e., the highest precision) among all linear unbiased estimators. The assumptions behind the Gauss-Markov theorem do not include normality.

Normality is not needed to conduct inference about OLS estimates, either. Given their relatively small sample, FJKP do not rely on asymptotic standard errors; instead, they use a wild bootstrap. Bootstrapping methods are based on the empirical distribution of the residuals. Therefore, a rejection of the normality of the residuals in some of FJKP's OLS regressions does not invalidate the OLS estimates or the inference about them.

Nonetheless, the evidence of non-normality is useful because it suggests that some of the datapoints could be outliers. As Weale and Wieladek (2022) correctly point out, OLS estimates can be sensitive to the outlying residuals. Therefore, in the next section, we take a closer look at the outliers in FJKP's dataset of estimated QE effects.

3. Outliers

It is well known that OLS estimates can be sensitive to outlying residuals. The reason is that the quadratic loss function inherent to OLS increases sharply with the magnitude of the residuals. To moderate this sensitivity, robust regressions use different loss functions that are less responsive to outliers. For example, the median regression, which is used by Weale and Wieladek (2022), minimizes the sum of absolute residuals rather than their squares. Other methods employ loss functions that penalize large residuals in different ways, all of them somewhat ad-hoc. For example, the MM estimator of Yohai (1987), which is also adopted by Weale and Wieladek (2022), is typically used with Tukey's bisquare weighting function, which downweights all nonzero residuals and completely disregards large residuals.

However, it is not clear that downweighting the outliers compared to OLS is the right thing to do. After all, OLS regressions are used far more frequently than robust regressions, presumably due to their desirable efficiency property mentioned earlier. Whether one wants to downweight the outlying observations should depend on one's belief regarding the validity of these observations. If one believes that the outliers are credible observations (as opposed to, say, data errors) coming from the same data-generating process as the remaining observations, then there is no need to downweight them.

In fact, downweighting the outliers can be the wrong thing to do. For example, a scientist analyzing seismic activity would be ill-advised to downweight major earthquakes, because these outliers are the most important observations. Similarly, outliers are likely to be of particular interest to a doctor analyzing a patient's heart rate history. In our context, papers reporting large effects of QE can be very important in forming the perception of the effectiveness of QE among academics, policy makers, and the general public. Below we show this is indeed the case. Specifically, we show that the papers reporting large QE effects have been influential in the academic literature, as measured by their citations and by the impact factors of the journals in which they were published. We also show that these papers have been prominently cited in the media as well as by leading central bank policy makers in their public speeches. Our analysis in Section 3 is similar in spirit to the narrative approach of Romer and Romer (1989).

3.1. Impact on the Academic Literature

FJKP present their evidence in a way that allows the reader to gauge the extent to which outliers are present. First, in their Table 1, FJKP report not only the means but also the medians of the estimated effects of QE. The medians are generally smaller than the means, but still sizable in magnitude. Given this evidence, it is not surprising that the median regressions in Weale and Wieladek (2022) produce smaller estimates compared to OLS. Second, in their Figures 2 and 3, FJKP show the full empirical distributions of the effects of QE on output and inflation, respectively, without suppressing outliers.

In our Figures 1 and 2, we use the information from FJKP's Figures 2 and 3 but present it differently. We provide scatter plots of the estimated effects of QE against the share of authors with central bank affiliation. Each article is represented by a circle, where the circle's area is proportional to the impact factor of the journal in which the article has been published.[2] We use the impact factors reported in FJKP's Internet Appendix, which come from the Clarivate Analytics Web of Science dataset. Because impact factors are available only for articles that have been published, the sample in Figures 1 and 2 excludes unpublished working papers (as of the end of FJKP's sample) and book chapters.

The scatter plots confirm the positive relation between the share of central-bank-affiliated authors and the magnitude of the estimated effects on output (Figure 1) and inflation (Figure 2). They further reveal that the papers reporting the largest effects of QE do not have systematically lower impact factors. On the contrary, one of the studies reporting the largest effects on output (Carlstrom et al. (2017)) is published in a journal with the second-highest impact factor in FJKP's sample (*AEJ Macro*). The only outlier with a particularly low impact factor is Cloyne et al. (2015), who report the largest effects on inflation. However, despite its low impact factor, Cloyne et al. (2015) has been influential inside the Bank of England, as we explain in Section 3.2 below.

We take a closer look at the outlying estimates in our Tables 1 and 2, where we list the five papers that report the largest effects on output (Table 1) and inflation (Table 2), without conditioning on published papers. Panel A of Table 1 shows that all five papers that find the largest peak effects of QE on output have central bank authors. For four of these papers, 100% of their authors are central bankers; for the fifth one, one co-author is. If the table had more rows, it would show an even stronger pattern: the top 10 papers that find the largest peak effects on output have at least one central bank author. In other words, among the 10 papers reporting the strongest peak effect of QE on output, not a single one is written solely by academics.

Importantly, none of the five papers listed in Panel A of Table 1 appear so unreliable that we would want to downweight their influence in OLS regressions. On the contrary, all five papers have been published in respectable academic journals—one in the *Journal of Monetary Economics* (impact factor: 2.11), three in the *Journal of Money, Credit and Banking* (impact factor: 1.04 to 1.47, depending on the year of publication), and one in *Applied Economics Letters* (impact factor: 0.48). Moreover, two of these papers have been

[2] We use the journal's impact factor for the year in which the article was published. The journal's impact factor provides a useful measure of the article's scientific impact. The figures look similar if we measure impact differently, by the article's citations. One advantage of the journal impact factor over citations is that the former metric does not mechanically grow over time, so it is easily comparable across articles published at different points in time.

highly influential: Gambacorta et al. (2014) has been cited 741 times and Weale and Wieladek (2016) 316 times.[3] We do not believe that downweighting these highly influential papers, which is what robust regressions do, would be appropriate.

We observe similar results in Panel B of Table 1, which lists the five papers that find the largest cumulative effects on output. All five of these papers have mostly central bank authors. All five have been published in respectable journals: one in *American Economic Journal: Macroeconomics* (impact factor: 3.17), one in *Economic Policy* (impact factor: 1.94), two in the *Journal of Money, Credit and Banking* (impact factor: 1.36 to 1.47, depending on the year), and one in *Applied Economics Letters* (impact factor: 0.48). One of these papers, Lenza et al. (2010), has been cited 564 times. A similar pattern emerges for the standardized effects on output reported in Panels C and D of Table 1, where the size of the QE shock is standardized to 1% of the country's GDP. The papers in Panels C and D have even more citations, on average.

Table 2 lists the five papers that report the largest peak (Panel A) or cumulative (Panel B) effects of QE on the price level. Panels C and D list the papers with the largest standardized effects. Just like in Table 1, in each of the four panels, all five papers have at least one central bank author (and 14 of the 20 papers are written solely by central bankers, with no academic co-authors). If the table had more rows, it would show that the top 17 (13) papers that find the largest peak (cumulative) effects on inflation have at least one central bank author. While only half of the papers listed in Table 2 have been published as of the end of FJKP's sample, some of the unpublished papers have been highly influential. For example, four papers in Panel A, and four in Panel B, have been cited more than 150 times. In Panels C and D, all papers have been cited more than 150 times. Again, it is not clear to us why one would want to put less weight on these highly influential papers.

Table 3 shows that among the bottom five papers that find the smallest effects on output, four have zero central bank authors. This is true in all four panels—for the total peak effect on output (Panel A), total cumulative effect on output (Panel B), standardized peak effect on output (Panel C), as well as standardized cumulative effect on output (Panel D). Panels B and D contain six papers because of a tie: two papers report the same cumulative effect on output. Similarly, among the papers that report the smallest effects on inflation (Table 4), the majority have zero central bank authors.

The papers that report the smallest effects of QE on output and inflation do not appear to be of particularly low quality either. All papers in Table 3 are reasonably well cited,

[3] All citation numbers come from Google Scholar as of December 30, 2022.

with at least 14 citations each and an average number of citations of 179. The average impact factor among the published papers in Table 3 is 1.00. These summary statistics are remarkable in light of the well-documented publication bias in favor of positive results (e.g., Fanelli (2010)). In Table 4, the average number of citations (369) and the average impact factor (1.87) are even higher. Moreover, some of the papers that were not published at the time that FJKP collected their data have since been published. For example, Neuenkirch (2016), who reports the smallest cumulative effect on inflation, is listed as a working paper in Table 4. This paper was published in 2020 in the *Open Economies Review*, whose most recent impact factor is 1.50, according to the Clarivate Analytics Web of Science.

Our discussion of outliers at the beginning of Section 3 examines outliers in OLS residuals, whereas in Tables 1 through 4, we define outliers as the most extreme total (not residual) reported effects of QE. We make this choice because there is only one total effect, whereas there are multiple residuals depending on which variables are included on the right-hand side of the regression. It is not clear a priori residuals from which OLS regression one should consider—with or without controls, with or without fixed effects, etc.

In the Appendix, we report the counterparts of Tables 1 through 4—Tables A.1 to A.4—in which outliers are redefined based on OLS residuals. To get as far away from Tables 1 through 4 as possible, we consider OLS regressions with the strictest set of controls, which are reported in columns (3) and (6) of FJKP's Tables 2 and 3. The right-hand side variables in those regressions include the share of authors with central bank affiliation, the number of authors, average author experience, and country fixed effects.

Comparing Tables 1 to 4 with Tables A.1 to A.4 reveals a lot of overlap between the papers classified as outliers based on total versus residual effects. Therefore, the main conclusions from Tables 1 to 4 apply also to Tables A.1 to A.4. The outlier papers have been influential. For the effects on output, all the residuals that are more than two standard deviations above zero come from three well-published central bank papers whose average impact factor is 1.67 and average citation count 58.33. For the effects on inflation, all such residuals come from three central bank papers, two of which are published, and whose average citation count is 217.67.[4] To summarize, the outliers in FJKP's sample correspond to papers that have been influential in the academic literature.

[4]Note that the same paper appears three times in Panel B of Table A.2 because it provides separate estimates of the effect of QE for three regions (U.S., UK, and the euro area), and all three estimates are OLS outliers.

3.2. Impact on Central Bank Policy Makers

The evidence presented in the previous section suggests that the outliers in FJKP's sample have been highly influential among academics. Their impact on central bank policy makers is more difficult to observe. Public speeches by central bank officials offer a rare glimpse into which papers have influenced the policymaking inside central banks. We therefore search the speeches of prominent central bankers, available on the websites of the Bank of England, ECB, and the Federal Reserve, for references to the studies listed in Tables 1 and 2. Below we provide some examples, starting with the Bank of England.

A recent public speech by Huw Pill, member of the Bank of England's Monetary Policy Committee, refers to Cloyne et al. (2015). Recall from Table 2 and Figure 2 that Cloyne et al. (2015) report the largest effects of QE on inflation, both peak and cumulative. Cloyne et al. (2015) has had only modest academic impact so far—with eight citations, it is the least cited study in Table 2, by far (all other papers in Table 2 have more than 150 citations). Yet, it has had significant policy impact because its empirical model has influenced the Bank's policy analysis. Specifically, Pill (2022) argues that[5]

"We need a more structural view of QE transmission. In the annex to this paper, we sketch out a very simple monetary framework as a starting point. The 'toy model' outlined in the annex is a highly stylised version of parts of the much richer empirical model presented in Cloyne et al. (2015), which has been used to undertake analysis at the Bank of England. That monetary framework may help answer important questions about the dynamics of these policies. As we will see in the next section, such a model helps address questions such as: what is the relative importance of the stock of purchases announced versus the flow of purchases conducted? Does the impact of QE fade over time? What influences the relative potency of QE over time?"

Another member of the Bank of England's Monetary Policy Committee, Andy Haldane, refers to ten papers when summarizing the evidence on the effectiveness of QE on page 44 of his lecture on *"QE: the story so far"* (Haldane (2016)). Eight of these papers cover Europe, UK, and the U.S., which are studied by FJKP (the two remaining papers cover Japan). Three of those eight papers appear in the top-five lists in our Tables 1 and 2: Baumeister and Benati (2013), Gertler and Karadi (2013), and Weale and Wieladek (2016).[6]

[5]The third sentence of this quote comes from footnote 16 in Pill (2022). In Pill's speech, this footnote appears between the second and fourth sentences of this quote. We have inserted the footnote into the text of the speech, to simplify the exposition of the quote.

[6]To his credit, Mr. Haldane interprets this evidence with caution. When describing it during his lecture, he characterizes the evidence as "a bit mixed and a bit murky" and the impact of QE on GDP and prices

Papers that find large effects of QE on output and inflation have also been influential at the Federal Reserve. One example comes from Ben Bernanke, Chair of the Federal Reserve's Board of Governors, in Bernanke (2012). His argument that QE has provided "significant help for the economy" is supported by the findings of Chung et al. (2012):

"Model simulations conducted at the Federal Reserve generally find that the securities purchase programs have provided significant help for the economy. For example, a study using the Board's FRB/US model of the economy found that, as of 2012, the first two rounds of LSAPs may have raised the level of output by almost 3 percent and increased private payroll employment by more than 2 million jobs, relative to what otherwise would have occurred."

Recall that Chung et al. (2012) appears in four of the eight top-five lists in our Tables 1 and 2, one for output and three for inflation. In addition, in footnote 15 of the same speech, Bernanke cites Baumeister and Benati (2013), which appears in two of the top-five lists, one for output and one for inflation.

Another Fed Chair, Janet Yellen, cites Engen et al. (2015), an unpublished Federal Reserve working paper that finds one of the largest cumulative effects of QE on inflation, in her January 2017 speech (see footnote 21 in Yellen (2017)):

"Engen, Laubach, and Reifschneider (2015) find that the FOMC's guidance, together with its asset purchases, provided significant economic stimulus in the years following the financial crisis."

Turning to the ECB, we find that its thinking about the effectiveness of QE has been influenced by the outliers, too. For example, two members of the ECB's Executive Board cite Andrade et al. (2016), an unpublished ECB working paper that finds one of the largest effects of QE on inflation. This paper appears in all of the top-five lists in Table 2. First, in her February 2020 speech, Isabel Schnabel cites Andrade et al. (2016) in support of the following statement (see footnote 1 in Schnabel (2020)):

"The first hypothesis is that unconventional policy instruments have been ineffective. Although we have not yet heard the final word on this topic, in my opinion the available empirical evidence broadly dismisses this view."

Second, Benoît Cœuré refers to Andrade et al. (2016) in his speech in September 2018 (see footnote 5 in Cœuré (2018)) when stating:

"Starting in June 2014, forward guidance has been complemented by a series of credit

as "relatively uncertain," according to the Youtube video recording of the lecture.

easing measures that have also entailed large-scale asset purchases and the adoption of negative interest rates. Empirical evidence confirms that these measures have jointly provided substantial additional policy accommodation that has been instrumental in securing a return of inflation to levels closer to 2%."

These examples demonstrate that many of the papers reporting the largest effects of QE have had substantial influence on monetary policy makers, supporting policy communication at the Bank of England, ECB, and the Federal Reserve. Given that top policymakers have chosen to cite these particular papers, they presumably view the papers as offering trustworthy evidence. It does not seem desirable to downweight the influence of such papers; if anything, they should probably be weighted more.

3.3. Impact on the General Public

Papers reporting large effects of QE also help form the public perception of the effectiveness of QE, via their media coverage. For example, consider the following quote from The Financial Times (2015), which appears in footnote 1 of FJKP:

"The good news is that, by most accounts, QE appears to have succeeded at boosting growth and lifting inflation. Martin Weale, a member of the BoE's interest-rate setting Monetary Policy Committee, found asset purchases worth 1 per cent of national income boosted UK gross domestic product by about 0.18 per cent and inflation by 0.3 per cent. A study by John Williams, president of the San Francisco Federal Reserve, concluded that asset purchases had reduced the US unemployment rate by 1.5 percentage points by late 2012 and helped the economy avoid deflation."

This quote is based on the results from two studies that make a total of eight appearances in the top-five lists in our Tables 1 and 2: Weale and Wieladek (2016) and Chung et al. (2012). In addition to the above coverage by *The Financial Times*, both studies are cited in *The Wall Street Journal*. The Wall Street Journal (2011) refers to Chung et al. (2012) in its article titled *"Fed paper details benefits of asset purchases"* and writes:

"The Federal Reserve's asset buying program has boosted growth, lowered unemployment and warded off what almost certainly would have been a descent into a deflationary price environment, new research published by the Federal Reserve Bank of San Francisco argues."

Weale and Wieladek (2016) are cited prominently in the article titled *"Bank of England says its QE worked better than thought"* in The Wall Street Journal (2014):

"Did the Bank of England's asset-purchase program have more pop than previously thought? A new paper from the central bank itself says it did. [...] A new study published Thursday by Monetary Policy Committee member Martin Weale and BOE economist Tomasz Wieladek took a different methodological approach and estimated QE1 in the U.K. lifted GDP by 2.5% and raised the level of prices by 4.2%."

Another highly visible article, The Financial Times (2017), suggests that the findings in Engen et al. (2015), one of the outlying studies that was also cited prominently by Janet Yellen, were "near the consensus of Fed thinking on the subject" at the time:

"This study, by Eric Engen, Thomas Laubach and David Reifschneider, presents conclusions that may be near the consensus of Fed thinking on the subject at present. The Fed study suggests that the effect of the entire QE programme was to reduce 10 year term premium, and therefore the bond yield, by 120 basis points in 2013. This is estimated to have reduced US unemployment by about 1.25 percentage points and increased inflation by about 0.5 percentage points."

We do not find it desirable to downweight estimates that may approximate the consensus of Fed thinking on the effectiveness of QE.

Studies finding large macroeconomic effects of QE in the euro area have also received prominent news coverage. For example, an article in The Wall Street Journal (2016), titled *"The ECB's Asset Purchase Program: an Early Assessment; ECB paper finds the macroeconomic impact of its quantitative easing can be expected to be sizable,"* directly quotes the authors of Andrade et al. (2016):

"The program's quantitative easing announcement in January 2015 "has significantly and persistently reduced sovereign yields on long-term bonds and raised the share prices of banks that held more sovereign bonds in their portfolios," authors Philippe Andrade, Johannes Breckenfelder, Fiorella De Fiore, Peter Karadi and Oreste Tristani say. They also find evidence suggesting that the introduction of the bond-buying program helped the ECB guide long-term inflation expectations closer to its price stability objective."

The coverage of these papers is not limited to English-speaking media. For example, The Wall Street Journal Germany (2013) writes:

"The current study is not the first to be conducted and published on the subject of quantitative easing, but it comes to markedly more pessimistic results than others, such as the one by Christiane Baumeister and Luca Benati from the year 2010 or the one by Han Chen,

Vasco Curdia, and Andrea Ferrero from the year 2012."[7]

In sum, many outlier studies have shaped the public perception of the effectiveness of QE. As we show in Sections 3.1 and 3.2, they have also substantially affected the academic literature as well as the policy makers at central banks. Downweighting these studies, which is what the replacement of OLS with robust regression would do, seems hard to justify a priori. In fact, one might argue that, given their prominence and public impact, these studies should be given larger, not smaller, weights in FJKP's analysis. FJKP report that when they weight each study by its citations, they obtain similar results.

4. New Evidence from Quantile Regressions

The traditional OLS regression, used by FJKP, models the conditional mean of the dependent variable. In contrast, a quantile regression models a given conditional quantile of the dependent variable. A special case of a quantile regression is Weale and Wieladek (2022)'s median regression, where the quantile is the 50th percentile, or the median. In this section, we extend Weale and Wieladek (2022)'s analysis by moving beyond the median and examining the full conditional distribution. We estimate quantile regressions at a wide range of quantiles, ranging from the 5th to the 95th percentile.

Figure 3 reports the results from our quantile regressions for the estimated effects of QE on output. We include the same control variables and fixed effects as in FJKP's Table 2, columns (3) and (6) (i.e., the number of authors, average author experience, and country fixed effects). For each of the 19 quantiles (5th, 10th, 15th, ..., 95th), the figure reports the point estimate of the slope coefficient on *CB Affiliation*, along with the 90% and 95% confidence intervals. We obtain those intervals by using 10,000 replications of the pairs cluster bootstrap procedure used by Weale and Wieladek (2022).

Our main finding is that the point estimate of the slope on *CB Affiliation* is consistently positive. The estimate is positive at 75 out of the 76 quantiles considered (19 quantiles times four panels of Figure 3), and the only negative value is very close to zero. The estimate is statistically insignificant at most quantiles, but it is substantially larger, and in some cases significant, at the top of the conditional distribution. For example, for the total peak effect on output (Panel A), the effect of *CB Affiliation* is 1.87 percentage points at the 90th percentile, compared to 0.77 percentage points at the 10th percentile. Both estimates are significant at the 90% confidence level. The difference between the effects of *CB Affiliation*

[7] The quote has been translated from German into English by the authors.

at the 90th and 10th percentiles represents almost one standard deviation of the estimated peak effect on output (see Table B.9 of FJKP's Internet Appendix). The same differences in the remaining panels of Figure 3 are also large. For example, for the standardized peak effect on output (Panel C), the effect of *CB Affiliation* is 0.07 at the 10th percentile but 0.26 at the 90th percentile, though neither estimate is statistically significant.

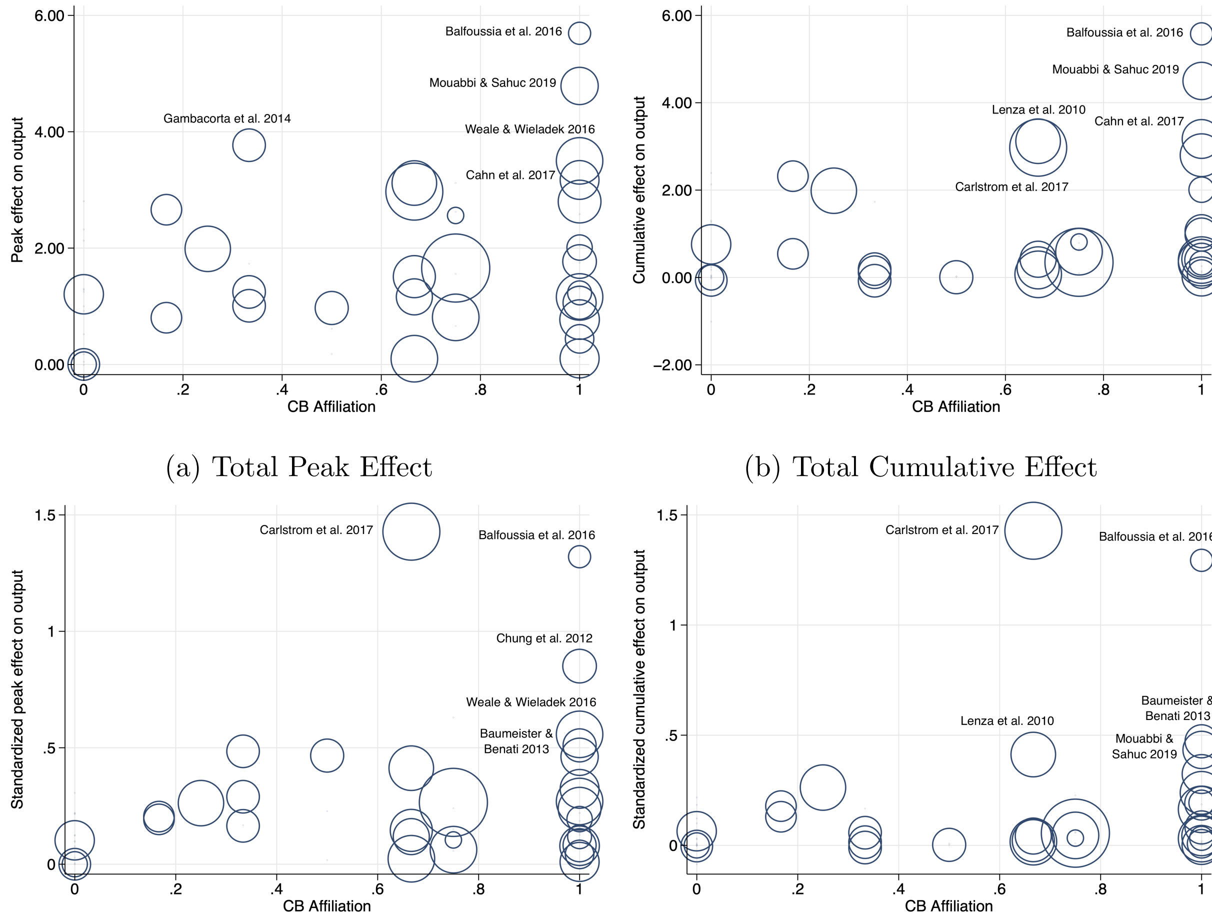
Figure 4 shows similar patterns for the effect of QE on inflation. The point estimate of the slope on *CB Affiliation* is positive at all 76 quantiles, and it tends to be larger at higher quantiles, especially for the peak effect (Panels A and C). For example, in Panel C, the estimated slope is 0.06 at the 10th percentile but 0.15 at the 90th percentile. Statistical significance is again more often present at the top quantiles, and it is more common than in Figure 3, especially for the peak effect. In both Panels A and C, the estimate is significant at 10 of the 19 quantiles at the 90% confidence level, and at six quantiles at the 95% level. The lower significance compared to OLS regressions is not surprising given the superior efficiency of the OLS estimator under the Gauss-Markov assumptions, as noted earlier. The inability of the quantile regression to detect significance could reflect a lack of power.

To summarize, our quantile regression analysis shows that FJKP's main results are qualitatively robust across the whole conditional distribution, based on the point estimates. The results tend to be stronger at the top of the conditional distribution.

5. Conclusion

FJKP conclude that papers written by central bankers find QE to be more effective than papers written by academics. FJKP's evidence is based on OLS regressions. Weale and Wieladek (2022) show that this evidence becomes weaker when OLS regressions are replaced by robust regressions that downweight outliers. We examine the outliers in FJKP's data and find no reason to downweight them. The outlying estimates of the effects of QE come from credible papers, most of which have been published in respectable academic journals and highly cited by researchers. They have also been cited in leading media outlets and in public speeches of prominent central bank policy makers. We do not find it desirable to put less weight on estimates from influential papers that have impacted the perception of the effectiveness of QE in the eyes of top central bank officials and the general public.

We extend Weale and Wieladek (2022)'s analysis by reestimating FJKP's regression specifications using quantile regressions, for a wide range of quantiles. Just like FJKP, we estimate a positive difference between the QE effects estimated by central bankers and academics. While the point estimate of this difference is mostly statistically insignificant, it is consistently positive across quantiles. FJKP's findings thus emerge not only from OLS regressions but also from quantile regressions. The point estimate tends to be larger, and more often significant, at the top quantiles. Further research is needed to understand this variation in the point estimates across the conditional distribution.



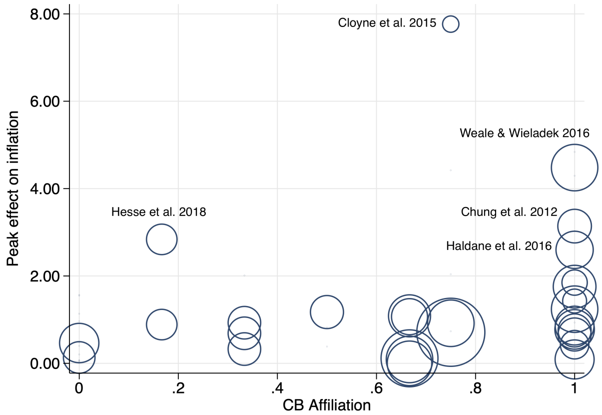
(a) Total Peak Effect

(b) Total Cumulative Effect

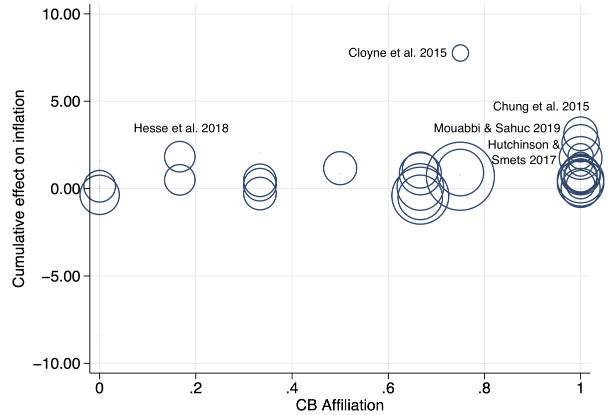
(c) Standardized Peak Effect

(d) Standardized Cumulative Effect

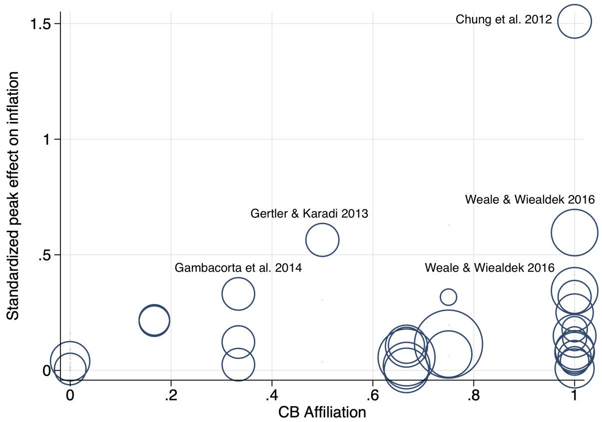
Figure 1. Effects of QE on Output and Central Bank Affiliation. The figure shows scatter plots of the estimated effect on output against the share of authors with central bank affiliation. References are provided for the five studies with the largest estimated effects of QE on output, conditional on being published. The size of the circle is proportional to the impact factor of the journal in which the respective study was published.



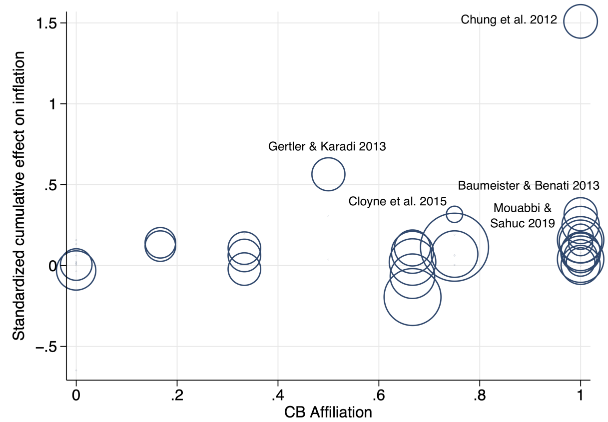
(a) Total Peak Effect



(b) Total Cumulative Effect

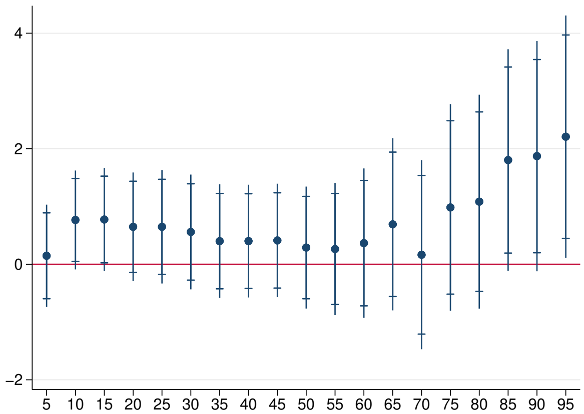


(c) Standardized Peak Effect

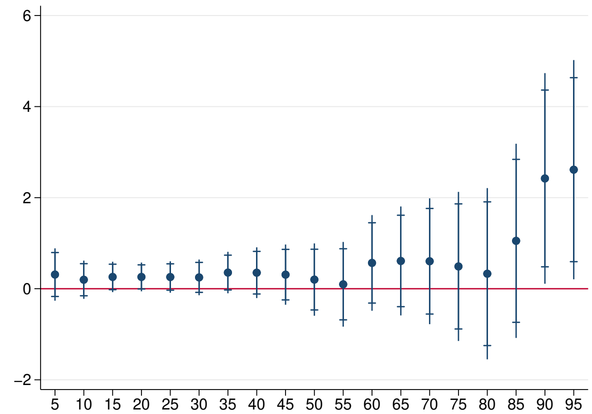


(d) Standardized Cumulative Effect

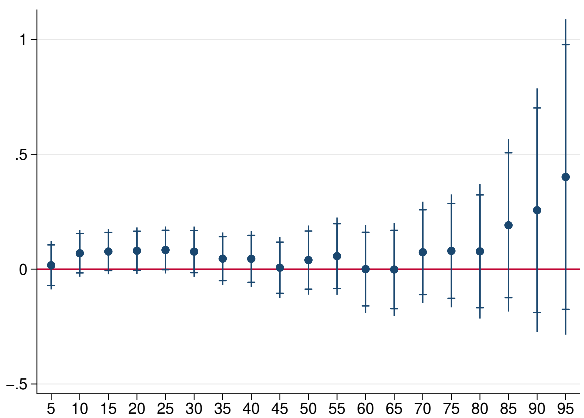
Figure 2. Effects of QE on Inflation and Central Bank Affiliation. The figure shows scatter plots of the estimated effect on inflation against the share of authors with central bank affiliation. References are provided for the five studies with the largest estimated effects of QE on inflation, conditional on being published. The size of the circle is proportional to the impact factor of the journal in which the respective study was published.



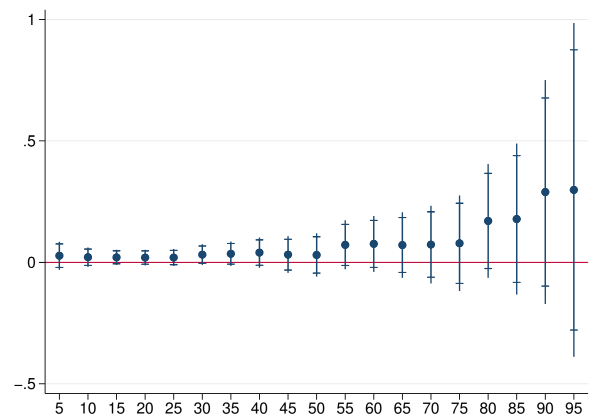
(a) Total Peak Effect



(b) Total Cumulative Effect

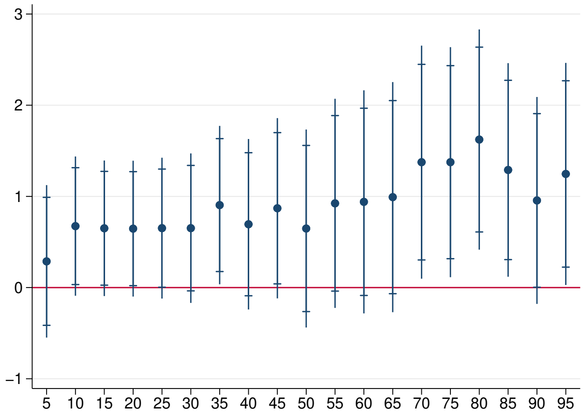


(c) Standardized Peak Effect

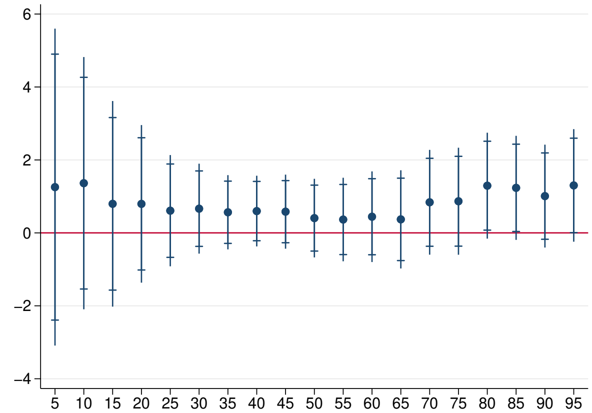


(d) Standardized Cumulative Effect

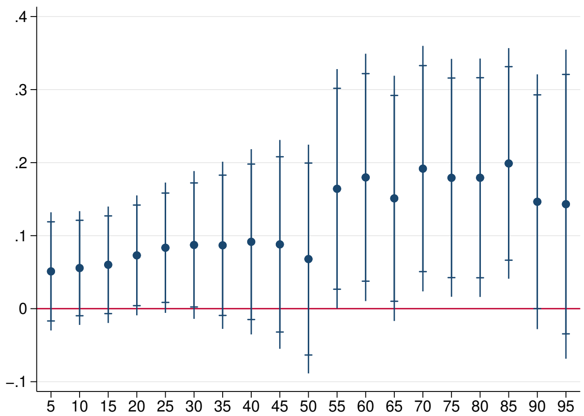
Figure 3. Effects of QE on Output: Estimates from Quantile Regressions. The figure plots the effect of CB affiliation on the estimated effect of QE on output using quantile regressions. We include the same controls and fixed effects as in Table 2, columns (3) and (6) of FJKP. 90% and 95% confidence intervals are obtained using 10,000 replications of the pairs cluster bootstrap with normal approximation.



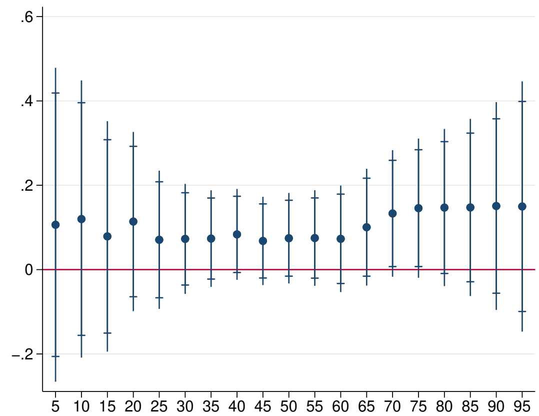
(a) Total Peak Effect



(b) Total Cumulative Effect



(c) Standardized Peak Effect



(d) Standardized Cumulative Effect

Figure 4. Effects of QE on Inflation: Estimates from Quantile Regressions. The figure plots the effect of CB affiliation on the estimated effect of QE on inflation using quantile regressions. We include the same controls and fixed effects as in Table 3, columns (3) and (6) of FJKP. 90% and 95% confidence intervals are obtained using 10,000 replications of the pairs cluster bootstrap with normal approximation.

Table 1
Largest Reported Effects of QE on Output

This table lists papers with the five largest reported standardized and non-standardized effects on output, the journal they have been published in, its impact factor, the share of authors with central bank affiliation, the number of citations as of 30 December 2022, and the z-score (i.e., the number of standard deviations the estimate is away from the mean).

	Journal	Impact factor	CB Affiliation	Citations	Z-Score
Panel A: Largest Total Peak Effects					
Balfoussia and Gibson (2016)	AEL	0.48	1	15	3.40
Mouabbi and Sahuc (2019)	JMCB	1.36	1	31	2.65
Gambacorta et al. (2014)	JMCB	1.04	0.333	741	1.81
Weale and Wieladek (2016)	JME	2.11	1	316	1.59
Cahn et al. (2017)	JMCB	1.47	1	40	1.32
Panel B: Largest Total Cumulative Effects					
Balfoussia and Gibson (2016)	AEL	0.48	1	15	3.83
Mouabbi and Sahuc (2019)	JMCB	1.36	1	31	2.96
Cahn et al. (2017)	JMCB	1.47	1	40	1.87
Lenza et al. (2010)	EP	1.94	0.667	564	1.83
Carlstrom et al. (2017)	AEJ Macro	3.17	0.667	129	1.71
Panel C: Largest Standardized Peak Effects					
Carlstrom et al. (2017)	AEJ Macro	3.17	0.667	129	4.31
Balfoussia and Gibson (2016)	AEL	0.48	1	15	3.92
Chung et al. (2012)	JMCB	1.10	1	473	2.22
Haldane et al. (2016)	BoE WP	-	0.75	152	1.42
Weale and Wieladek (2016)	JME	2.11	1	316	1.16
Panel D: Largest Standardized Cumulative Effects					
Carlstrom et al. (2017)	AEJ Macro	3.17	0.667	129	4.90
Balfoussia and Gibson (2016)	AEL	0.48	1	15	4.39
Baumeister and Benati (2013)	IJCB	1.07	1	707	1.28
Mouabbi and Sahuc (2019)	JMCB	1.36	1	31	1.13
Lenza et al. (2010)	EP	1.94	0.667	564	1.05

Table 2
Largest Reported Effects of QE on Inflation

This table lists papers with the five largest reported standardized and non-standardized effects on inflation, the journal they have been published in, its impact factor, the share of authors with central bank affiliation, the number of citations as of 30 December 2022, and the z-score (i.e., the number of standard deviations the estimate is away from the mean).

	Journal	Impact factor	CB Affiliation	Citations	Z-Score
Panel A: Largest Total Peak Effects					
Cloyne et al. (2015)	Manch. Sch	0.26	0.75	8	4.17
Bridges and Thomas (2012)	BoE WP	-	1	172	2.25
Weale and Wieladek (2016)	JME	2.11	1	316	2.01
Haldane et al. (2016)	BoE WP	-	0.75	152	1.97
Andrade et al. (2016)	ECB WP	-	1	361	1.89
Panel B: Largest Total Cumulative Effects					
Cloyne et al. (2015)	Manch. Sch	0.26	0.75	8	3.53
Bridges and Thomas (2012)	BoE WP	-	1	172	2.03
Andrade et al. (2016)	ECB WP	-	1	361	1.75
Chung et al. (2012)	JMCB	1.10	1	473	1.16
Engen et al. (2015)	Fed WP	-	1	260	1.10
Panel C: Largest Standardized Peak Effects					
Chung et al. (2012)	JMCB	1.10	1	473	5.48
Haldane et al. (2016)	BoE WP	-	0.75	152	1.83
Weale and Wieladek (2016)	JME	2.11	1	316	1.69
Gertler and Karadi (2013)	IJCB	1.07	0.5	503	1.56
Andrade et al. (2016)	ECB WP	-	1	361	0.94
Panel D: Largest Standardized Cumulative Effects					
Chung et al. (2012)	JMCB	1.10	1	473	5.42
Gertler and Karadi (2013)	IJCB	1.07	0.5	503	1.73
Andrade et al. (2016)	ECB WP	-	1	361	1.14
Bridges and Thomas (2012))	BoE WP	-	1	172	0.98
Baumeister and Benati (2013)	IJCB	1.07	1	707	0.76

Table 3
Smallest Reported Effects of QE on Output

This table lists papers with the five smallest reported standardized and non-standardized effects on output, the journal they have been published in, its impact factor, the share of authors with central bank affiliation, the number of citations as of 30 December 2022, and the z-score (i.e., the number of standard deviations the estimate is away from the mean).

	Journal	Impact factor	CB Affiliation	Citations	Z-Score
Panel A: Smallest Total Peak Effects on Output					
Hausken and Ncube (2013)	Book	-	0	94	-1.30
Bluwstein and Canova (2016)	IJCB	0.98	0	120	-1.29
Lyonnet and Werner (2012)	IRFA	0.62	0	108	-1.29
Balatti et al. (2017)	WP	-	0	25	-1.26
Chen et al. (2012)	EJ	2.12	0.667	686	-1.21
Panel B: Smallest Total Cumulative Effects on Output					
Hausken and Ncube (2013)	Book	-	0	94	-1.53
Gambacorta et al. (2014)	JMCB	1.04	0.333	741	-0.77
Bluwstein and Canova (2016)	IJCB	0.98	0	120	-0.76
Falagiarda (2014)	IJMEF	-	0	46	-0.72
Lyonnet and Werner (2012)	IRFA	0.62	0	108	-0.71
Pesaran and Smith (2016)	Res. Econ	N/A	0	163	-0.71
Panel C: Smallest Standardized Peak Effects on Output					
Bluwstein and Canova (2016)	IJCB	0.98	0	120	-0.86
Hausken and Ncube (2013)	Book	-	0	94	-0.86
Lyonnet and Werner (2012)	IRFA	0.62	0	108	-0.86
Balatti et al. (2017)	WP	-	0	25	-0.84
Burlon et al. (2019)	JPM	1.49	1	14	-0.82
Panel D: Smallest Standardized Cumulative Effects on Output					
Hausken and Ncube (2013)	Book	-	0	94	-0.84
Gambacorta et al. (2014)	JMCB	1.04	0.333	741	-0.55
Bluwstein and Canova (2016)	IJCB	0.98	0	120	-0.52
Falagiarda (2014)	IJMEF	-	0	46	-0.52
Lyonnet and Werner (2012)	IRFA	0.62	0	108	-0.51
Pesaran and Smith (2016)	Res. Econ	N/A	0	163	-0.51

Table 4
Smallest Reported Effects of QE on Inflation

This table lists papers with the five smallest reported standardized and non-standardized effects on inflation, the journal they have been published in, its impact factor, the share of authors with central bank affiliation, the number of citations as of 30 December 2022, and the z-score (i.e., the number of standard deviations the estimate is away from the mean).

	Journal	Impact factor	CB Affiliation	Citations	Z-Score
Panel A: Smallest Total Peak Effects on Inflation					
Lenza et al. (2010)	EP	1.94	0.667	564	-0.94
Neuenkirch (2016)	WP	-	0	10	-0.94
Balatti et al. (2017)	WP	-	0	25	-0.91
Popescu (2015)	WP	-	0	2	-0.89
Balatti et al. (2017)	WP	-	0	25	-0.89
Panel B: Smallest Total Cumulative Peak Effects on Inflation					
Neuenkirch (2016)	WP	-	0	10	-4.79
Lenza et al. (2010)	EP	1.94	0.667	564	-0.72
Carlstrom et al. (2017)	AEJ Macro	3.17	0.667	129	-0.67
Wu and Xia (2016)	JMCB	1.51	0	1939	-0.65
Gambacorta et al. (2014)	JMCB	1.04	0.333	741	-0.61
Panel C: Smallest Standardized Peak Effects on Inflation					
Lenza et al. (2010)	EP	1.94	0.667	564	-0.78
Neuenkirch (2016)	WP	-	0	10	-0.78
Balatti et al. (2017)	WP	-	0	25	-0.76
Bluwstein and Canova (2016)	IJCB	0.98	0	120	-0.75
Burlon et al. (2019)	JPM	1.49	1	14	-0.74
Panel D: Smallest Standardized Cumulative Peak Effects on Inflation					
Neuenkirch (2016)	WP	-	0	10	-3.01
Carlstrom et al. (2017)	AEJ Macro	3.17	0.667	129	-1.24
Lenza et al. (2010)	EP	1.94	0.667	564	-0.74
Popescu (2015)	WP	-	0	2	-0.62
Wu and Xia (2016)	JMCB	1.51	0	1,939	-0.60

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A Appendix

Table A.1
Largest Residuals from OLS Regressions for the Effects of QE on Output

This table lists the papers corresponding to the five largest residuals from the OLS regressions reported in columns (3) and (6) of Table 2 in FJKP. We also report the journal they have been published in, its impact factor, the share of authors with central bank affiliation, the number of citations as of 30 December 2022 (17 February 2023 for papers marked by *), and the z-score of the residual (i.e., the number of standard deviations it is away from zero).

	Journal	Impact Factor	CB Affiliation	Citations	Z-Score
Panel A: Largest OLS Residuals for Total Peak Effect on Output					
Balfoussia and Gibson (2016)	AEL	0.48	1	15	3.17
Mouabbi and Sahuc (2019)	JMCB	1.36	1	31	2.48
Gambacorta et al. (2014)	JMCB	1.04	0.33	741	1.90
Neuenkirch (2016)	WP	-	0	10	1.39
Weale and Wieladek (2016)	JME	2.11	1	316	1.33
Panel B: Largest OLS Residuals for Total Cumulative Effect on Output					
Balfoussia and Gibson (2016)	AEL	0.48	1	15	3.49
Mouabbi and Sahuc (2019)	JMCB	1.36	1	31	2.66
Carlstrom et al. (2017)	AEJ Macro	3.17	0.67	129	1.90
Dahlhaus et al. (2018)	JMCB	1.78	1	59*	1.81
Neuenkirch (2016)	WP	-	0	10	1.66
Panel C: Largest OLS Residuals for Standardized Peak Effect on Output					
Balfoussia and Gibson (2016)	AEL	0.48	1	15	4.07
Carlstrom et al. (2017)	AEJ Macro	3.17	0.67	129	4.04
Chung et al. (2012)	JMCB	1.10	1	473	1.63
Falagiarda (2014)	IJMEF	-	0	46	0.99
Haldane et al. (2016)	BoE WP	-	0.75	152	0.86
Panel D: Largest OLS Residuals for Standardized Cumulative Effect on Output					
Carlstrom et al. (2017)	AEJ Macro	3.17	0.67	129	4.78
Balfoussia and Gibson (2016)	AEL	0.48	1	15	4.19
Baumeister and Benati (2013)	IJCB	1.07	1	707	1.05
Mouabbi and Sahuc (2019)	JMCB	1.36	1	31	0.96
Lenza et al. (2010)	EP	1.94	0.67	564	0.94

Table A.2

Largest Residuals from OLS Regressions for the Effects of QE on Inflation

This table lists papers corresponding to the five largest residuals from the OLS regressions reported in columns (3) and (6) of Table 3 in FJKP. We also report the journal they have been published in, its impact factor, the share of authors with central bank affiliation, the number of citations as of 30 December 2022 (17 February 2023 for papers marked by *), and the z-score of the residual (i.e., the number of standard deviations it is away from zero).

	Journal	Impact Factor	CB Affiliation	Citations	Z-Score
Panel A: Largest OLS Residuals for Total Peak Effect on Inflation					
Cloyne et al. (2015)	Manch. Sch.	0.26	0.75	8	3.86
Bridges and Thomas (2012)	BoE WP	-	1	172	1.78
Weale and Wieladek (2016)	JME	2.11	1	316	1.54
Andrade et al. (2016)	ECB WP	-	1	361	1.41
Haldane et al. (2016)	BoE WP	-	0.75	152	1.16
Panel B: Largest OLS Residuals for Total Cumulative Effect on Inflation					
Cloyne et al. (2015)	Manch. Sch	0.26	0.75	8	3.43
Bridges and Thomas (2012)	BoE WP	-	1	172	2.16
Hausken and Ncube (2013)	Book	-	0	94	1.08
Hausken and Ncube (2013)	Book	-	0	94	0.96
Hausken and Ncube (2013)	Book	-	0	94	0.85
Panel C: Largest OLS Residuals for Standardized Peak Effect on Inflation					
Chung et al. (2012)	JMCB	1.10	1	473	5.21
Gertler and Karadi (2013)	IJCB	1.07	0.5	503	1.25
Weale and Wieladek (2016)	JME	2.11	1	316	1.12
Haldane et al. (2016)	BoE WP	-	0.75	152	1.08
Falagiarda (2014)	IJMEF	-	0	46	0.85
Panel D: Largest OLS Residuals for Standardized Cumulative Effect on Inflation					
Chung et al. (2012)	JMCB	1.10	1	473	5.07
Gertler and Karadi (2013)	IJCB	1.07	0.5	503	1.66
Bridges and Thomas (2012)	BoE WP	-	1	172	1.18
Falagiarda (2014)	IJMEF	-	0	46	0.92
Hausken and Ncube (2013)	Book	-	0	94	0.82

Table A.3
Smallest Residuals from OLS Regressions for the Effects of QE on Output

This table lists the papers corresponding to the five smallest residuals from the OLS regressions reported in columns (3) and (6) of Table 2 in FJKP. We also report the journal they have been published in, its impact factor, the share of authors with central bank affiliation, the number of citations as of 30 December 2022 (17 February 2023 for papers marked by *), and the z-score of the residual (i.e., the number of standard deviations it is away from zero).

	Journal	Impact Factor	CB Affiliation	Citations	Z-Score
Panel A: Smallest OLS Residuals for Total Peak Effect on Output					
Burlon et al. (2019)	JPM	1.49	1	14	-1.69
Harrison (2011)	Book	-	1	35*	-1.63
Gambetti and Musso (2017)	ECB WP	-	0.5	154*	-1.29
Kühl (2018)	IJCB	0.79	1	20*	-1.27
Balatti et al. (2017)	WP	-	0	25	-1.18
Panel B: Smallest OLS Residuals for Total Cumulative Effect on Output					
Hausken and Ncube (2013)	Book	-	0	94	-1.23
Burlon et al. (2019)	JPM	1.49	1	14	-1.18
Kühl (2018)	IJCB	0.79	1	20*	-1.13
Darracq-Pariès and Kühl (2017)	BB WP	-	1	13*	-1.10
Andrade et al. (2016)	ECB WP	-	1	361	-1.06
Panel C: Smallest OLS Residuals for Standardized Peak Effect on Output					
Hausken and Ncube (2013)	Book	-	0	94	-1.39
Fuhrer and Olivei (2011)	Fed Brief	-	1	56*	-1.24
Chen et al. (2012)	EJ	2.12	0.67	686	-1.17
Engen et al. (2015)	Fed WP	-	1	260	-1.15
Burlon et al. (2019)	JPM	1.49	1	14	-1.03
Panel D: Smallest OLS Residuals for Standardized Cumulative Effect on Output					
Hausken and Ncube (2013)	Book	-	0	94	-1.02
Gertler and Karadi (2013)	IJCB	1.07	0.5	503	-0.88
Engen et al. (2015)	Fed WP	-	1	260	-0.86
Sahuc (2016)	EL	0.56	1	50*	-0.82
Kühl (2018)	IJCB	0.79	1	20*	-0.78

Table A.4
Smallest Residuals from OLS Regressions for the Effects of QE on Inflation

This table lists papers corresponding to the five smallest residuals from the OLS regressions reported in columns (3) and (6) of Table 3 in FJKP. We also report the journal they have been published in, its impact factor, the share of authors with central bank affiliation, the number of citations as of 30 December 2022 (17 February 2023 for papers marked by *), and the z-score of the residual (i.e., the number of standard deviations it is away from zero).

	Journal	Impact Factor	CB Affiliation	Citations	Z-Score
Panel A: Smallest OLS Residuals for Total Peak Effect on Inflation					
Churm et al. (2015)	BoE WP	-	0.75	59*	-1.71
Kapetanios et al. (2012)	EJ	2.12	0.75	505*	-1.54
Balatti et al. (2017)	WP	-	0	25	-1.48
Burlon et al. (2019)	JPM	1.49	1	14	-1.38
Baumeister and Benati (2013)	IJCB	1.07	1	707	-1.35
Panel B: Smallest OLS Residuals for Total Cumulative Effect on Inflation					
Neuenkirch (2016)	WP	-	0	10	-4.36
Haldane et al. (2016)	BoE WP	-	0.75	152	-1.10
Lenza et al. (2010)	EP	1.94	0.67	564	-1.05
Burlon et al. (2019)	JPM	1.49	1	14	-1.02
Carlstrom et al. (2017)	AEJ Macro	3.17	0.67	129	-0.87
Panel C: Smallest OLS Residuals for Standardized Peak Effect on Inflation					
Carlstrom et al. (2017)	AEJ Macro	3.17	0.667	129	-1.59
Del Negro et al. (2017)	AER	4.53	0.75	536*	-1.44
Chen et al. (2012)	EJ	2.12	0.67	686	-1.37
Balatti et al. (2017)	WP	-	0	25	-1.15
Dahlhaus et al. (2018)	JMCB	1.78	1	59*	-1.01
Panel D: Smallest OLS Residuals for Standardized Cumulative Effect on Inflation					
Neuenkirch (2016)	WP	-	0	10	-2.27
Carlstrom et al. (2017)	AEJ Macro	3.17	0.67	129	-2.06
Chen et al. (2012)	EJ	2.12	0.67	686	-0.94
Del Negro et al. (2017)	AER	4.53	0.75	536*	-0.92
Lenza et al. (2010)	EP	1.94	0.67	564	-0.90

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