Monetary Policy Effects on Bank Level Liquidity: Higher Frequency Evidence from Three Regimes*

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Abstract

Prior to the Great Recession of 2007-2009, the Federal Reserve operated in a reserve scarce environment to control short-term interest rates such as the federal funds rate. Unconventional monetary policy during the crisis pushed the federal funds rate against the zero lower bound (ZLB), whereas the interest rate normalization (lift-off) thereafter has happened in the context of reserve abundance. We exploit weekly variation in bank-balance sheets to explore the heterogeneity in responses to monetary policy under these three distinct regimes: pre-crisis, ZLB, and lift-off. We find that the use of the banking data at the quarterly frequency can produce weak and misleading impulse responses of our measure of net liquidity to the shadow short-term interest rate. Furthermore, whereas the quarterly data do not point to meaningful differences in responses to monetary policy between large and small banks, these differences are pronounced in the weekly data. These findings shed new light on the transmission of monetary policy to bank liquidity.

Keywords: banking, finance, monetary policy, operating framework, liquidity, financial stability, macro-prudential tools,

JEL Codes: E51, E52, E58, G18, G21

***Preliminary and incomplete; please do not cite or circulate; comments are welcome**. The views expressed in this paper are those of the author and are not necessarily reflective of views at the Federal Reserve Bank of Dallas or the Federal Reserve System. Any errors or omissions are the sole responsibility of the authors. We would like to thank Laton Russell for excellent research assistance and Scott Konzem, Rebecca Zarutskie, and the Division of Monetary Affairs of the Federal Reserve Board of Governors for providing access to the H8 data.

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1 Introduction

A large volume of the recent academic research and policy work has focused on the various monetary policy tools that the Federal Reserve has employed in response to the severe macroeconomic impact of the Great Recession of 2007-2009. In particular, quantitative easing (QE) and forward guidance were employed to ease financial conditions and improve macroeconomic performance via monetary policy. More recently, as the federal funds rate (FFR) target has been increased, policy concerns have shifted towards "quantitative tightening" (QT) and interest rate normalization. These dynamics suggest that the Federal Reserve has managed the most recent business cycle with three distinct regimes: normal or pre-crisis that occurred in the context of reserve scarcity and positive federal funds rate; the zero lower bound (ZLB) on the federal funds rate that gave rise to quantitative easing and resulted in reserve abundance; and the lift-off or interest rate normalization that is similar to the pre-crisis period because of the positive FFR and to the ZLB period because of the reserve abundance. In this paper, we examine the effect that these three distinct monetary policy regimes have had on liquidity formation at commercial banks. We use the weekly Schedule H8 banking data collected by the Federal Reserve at weekly and quarterly frequencies and compare them to the quarterly equivalents from the Call Reports, which are the most widely used source of banking data. We find that monetary policy has strong effects on banks' liquidity formation in the weekly data that has varied over the three regimes. Furthermore, we document the significant differences in responses of large and small banks to monetary policy over these regimes. In contrast, the quarterly data show weak responses of our measure of net liquidity over the three regimes with virtually no difference in the responses of small and large institutions.

In the fall of 2008, with its total assets of about $900 billion and the FFR target declining below 1%, the Federal Reserve announced the first round of quantitative easing, dramatically expanding the size of its balance sheet. By early 2015, the total assets of the Federal Reserve peaked at over $4.5 trillion, or about 25 percent of U.S. gross domestic product. Naturally, this lead to the creation of substantial amounts of liquidity in the banking system as Federal Reserve assets are not only financed by Federal Reserve Notes, which have been growing about seven percent per year over the last decade, but also to a large extent by reserves of the banking system. As Figure 1 illustrates in a stylized manner this has forced a change in the operating framework of the Fed.

What are the implications for the net liquidity provisions of the banking sector and is there meaningful heterogeneity across banks?

On October 6, 2008 the Board of Governors of the Federal Reserve announced that will be be paying interest on depository institutions' required and excess reserves (Federal Open Market Committee, 2008).[1]

In particular, we distinguish three different regimes: (i) no interest on reserves, thus reserves are essentially taxes due to the opportunity cost of holding them with zero yield, (ii) interest on reserves at the ZLB, and (iii) interest on reserves during the lift-off period.

As traditional levers of implementing monetary policy became less effective, the Federal Reserve introduced new tools to establish a target range for the federal funds rate (Afonso, Armenter, and Lester, 2018). For further details about the "quantitative tightening framework" see Federal Open Market Committee (2014); Federal Open Market Committee (2015); Federal Open Market Committee (2017)

The classic depiction of the narrow lending channel calls for the Fed to operate on the steep part of the demand curve. The link is from bank reserves, to bank deposits, back to bank lending. Thus the state of bank balance sheets and their reserve liquidity position do play a major part in monetary transmission. Figure 1 provides a visual representation of the reserves market.

What are we doing? We compute the Net Liquidity Ratio (NLR), based on the percent total asset-scaled liquidity position of the bank, such that:

$$\text{Net Liquidity Ratio} = 100 \times \frac{\text{Asset Side Liquidity} - \text{Liability Side Liquidity}}{\text{Total Assets}} \tag{NLR}$$

See the Appendix for the computational details of the construction of this measure. Our empirical framework studies the dynamic impact of monetary policy on this variable under alternative regimes in the reserves market.

[1]The minutes on the phone conference are quite interesting in this respect. See https://www.federalreserve.gov/monetarypolicy/files/FOMC20081007confcall.pdf

What are we finding? We find that the responses of weekly net liquidity ratios are comparable to those based on quarterly reporting. This enables us to overcome the sample size (power) constraint since the time past "lift-off" has been limited. Based on that we find very different response dynamics of the net liquidity ratio in the period of lift-off. The responses are qualitatively different. Importantly, monetary policy contractions ...

What is the significance? Monetary policy does impact the liquidity holdings of commercial banks, but overall the effect appears muted.

Relation to the literature Gagnon and Sack (2014) is an early accessible summary of discussions surrounding the new monetary policy operating framework.[2] Among the advantages of the new operating framework they highlight that it enhances ...

A number of theoretical papers has examined the changes in the operational framework Afonso, Armenter, and Lester (2018); Armenter and Lester (2017)

The role of liquidity creating in banks has been widely studied empirically Berger and Bouwman (2009).

Berger, Bouwman, Kick, and Schaeck (2016) focus on regulatory interventions and show using instrumental variables that they robustly decrease liquidity creation. Ours is a more monetary policy rather than regulatory policy approach. Furthermore, Berger and Bouwman (2013)

Ashcraft and Duffie (2007) Hamilton (1997)

Williamson (2018) Rocheteau, Wright, and Xiao (2018) Berentsen, Kraenzlin, and Müller (2018) distinguish carefully the optimality between an operating framework with excess versus scarce reserves in relation to the extend of fiscal support available. Without fiscal support a scarce reserve regime is preferable. Ennis (2018) The theoretical paper most closely related to our own work is Bianchi and Bigio (2017) develop a tractable theoretical model of banks' liquidity management and its response to monetary policy. The key to their models is a trade-off between profiting from lending and incurring a greater liquidity risk. Monetary policy impacts this trade-off.

[2] See also the recent conference by the New York Fed https://www.newyorkfed.org/newsevents/events/markets/2018/0928-2018.

Narrative table of content The subsequent section 2 covers the data employed in our empirical analysis. Since our exercise contains a substantial period when the monetary policy was constrained by the zero lower bound we give some details on the monetary policy measure employed in our estimates. We further give details on the hitherto rarely used underlying weekly microeconomic bank-level data and draw some comparisons to the more typically used lower frequency quarterly call reports. Our next section 3 discusses the empirical framework and our estimation results. We highly that inference using quarterly data is limited and the added value from employing weekly data to back out potential implications for the monetary policy quantitative tightening that will be forthcoming. Then section 4 draws out specific balance sheet implications with predictions for banking sector liquidity and Federal Reserve balance sheet size starting with the most recent observations. Finally, section 5 offers conclusions emphasizing the preliminary nature of our findings, yet highlighting the potential of the weekly dynamics for future work.

2 Data

This data section comes in two parts. First, we briefly discuss the measure of monetary policy that we are using throughout the paper to estimate the dynamic responses of the net liquidity ratio. This section also touches on the macroeconomic control that we employ to proxy for real, nonmonetary conditions. Second, we discuss the two distinct cross-sectional data sources for bank balance sheets.

We extract quarterly call report data from forms FFIEC 031 and FFIEC 041 as well as weekly reporting data underlying the aggregate series H8 using the forms FR 2644 (after 2009) and FR 2416 (prior to 2009) to estimate the response of net liquidity ratios of commercial banks.

2.1 Monetary Policy Regimes over the Business Cycle

We rely here primarily on the shadow short rate (SSR) developed by Krippner (2014).[3] While there are other approaches to constructing shadow rates, for instance (Wu and Xia, 2016), there

[3] See https://www.rbnz.govt.nz/research-and-publications/research-programme/additional-research/measures-of-the-stance-of-united-states-monetary-policy for the most recent vintage of the data.

are several reasons for relying on Krippner's framework, such as the relatively high frequency of the resulting measure, as well as several methodological advantages; see (Krippner, 2015; Krippner, 2017) for further discussion. Figure 2 describing the dynamic with the different backgrounds designating our three regimes of interest: blank—pre-crisis; red—ZLB; green—lift-off. See Table 1 for the specific dates that define these three regimes. Several features of the SSR dynamics stand out. First, the ZLB period is characterized by non-positive values of the SSR, reflecting the effective lower bound. Second, the weekly data have considerably more variation, especially during the ZLB period, as the Federal Reserve was actively influencing yields on bonds of longer maturities with its quantitative easing program.

Monetary Regime	Regime Description	Quarterly Start Date	Quarterly End Date	Weekly Start Date	Weekly End Date
(1)	Unconstrained policy, no interest rate on reserves	2001 Q2	2008 Q3	Apr 7, 2001	Dec 10, 2008
(2)	Policy constrained by the zero lower bound (ZLB), interest rate on reserves	2008 Q4	2015 Q3	Dec 17, 2008	Dec 9, 2015
(3)	Lift-off from ZLB, interest rate on reserves	2015 Q4	2018 Q4	Dec 16, 2015	Apr 18, 2018

Table 1: Monetary Policy Regimes

Nonmonetary controls While we are primarily interested in the response of banking sector net liquidity ratio in response to monetary policy, we include additional controls both to account for the dynamic nature of the data and for cyclical nature of monetary policy conduct. In order to ensure that our impulse responses are not driven by nonmonetary, real factors we include in our estimation current levels and lags of initial unemployment insurance claims that are available on a weekly basis (Haver code LIC@USECON, available also at the St. Louis FRED: https://fred.stlouisfed.org/series/ICSA). Figure 9 describes the dynamic evolution of this measure of real activity.

2.2 Banking Data: Quarterly Call Reports versus Weekly H.8 Data

This sections provides an overview of the cross-sectional data employed in the analysis. We draw primarily on two distinct data sources, one based a regulatory forms and one based on forms based on samples representative of the overall banking sector whose primary use is the accurate production of aggregate time-series data. Information related to the Call Report data will be incorporated in a future version of the paper.

Quarterly Call Report Data The quarterly panel benchmark data is derived from the standard call report forms—formally reporting form FFIEC 031 ("Consolidated Reports of Condition and Income for a Bank with Domestic and Foreign Offices").

For the asset side we define

$$\text{Asset Side Liquidity} = RCFDB989 + RCONB987$$
$$\text{Liability Side Liquidity} = WRSS2795 + \text{liqLnew}$$
$$\text{LiqNetTA} = 100 \times \frac{(\text{liqA} - \text{liqL})}{WRSS2170}$$

Starting point: total number of reporting institutions in H8 vs the Call Reports, Figure 3.

Distribution of assets in the two datasets, Figure 4.

Evolution of the distribution of the dependent variable, Figure 5

Consider the liquidity component on the asset side first.

Second, the liquidity component on the liability side consists of WRSS2795 prior to 2009.

Starting point: total number of reporting institutions in H8 vs the Call Reports, Figure 3.

Distribution of assets in the two datasets, Figure 4.

Evolution of the distribution of the dependent variable, Figure 5

Weekly H.8 Report Data In order to address the inference problem with a very small sample based on quarterly call report data we turn to forms FR 2644 ("Weekly Report of Selected Assets and Liabilities of Domestically Chartered Commercial Banks and U.S. Branches and Agencies of Foreign Banks—FR 2644"). On the asset side we extract the two components of item 3 ("Federal funds sold and securities purchased under agreement to resell"), specifically item 3.a WRSS1360 ("With commercial banks in the U.S. (including U.S. branches and agencies of foreign banks)") and item 3.b WRSS1390 ("With others (including nonbank brokers and dealers in securities and FHLB"). Prior to 2009 this items was reported as item 3 without subcomponents ("Federal funds sold and securities purchased under agreement to resell")

We extract quarterly call report data from forms FFIEC 031 and FFIEC 041 as well as weekly reporting data underlying the aggregate series H8 using the forms FR 2644 (after 2009) and FR 2416 (prior to 2009) to estimate the response of net liquidity ratios of commercial banks.

3 Empirical Framework and Estimation Results

In our empirical methodology we rely on panel versions of the local projections developed in Jordà (2005).

Our estimates reveal three important new findings. First, the weekly data shows markedly stronger dynamics both in the initial decline in the net liquidity ratio in response to a contractionary shock as well as in the subsequent reversal about three quarters to a year after the shock. The differences between the weekly and the quarterly data a more pronounced in the reversal. More specifically, the initial moentary contraction yields a drop in the net liquidity ratio by about 20 basis points for the first three quarters and a subsequent rise in the net liquidity ratio by 30 basis points for the quarterly data. For the weekly data the drop is slightly more pronounce, but the rebound is estimated to be about twice as sharp. These also appear to be slight timing differences in the dynamics with the quarterly data peaking earlier.[4]

The magnitude of that effects should be linked to the recent meeting with Treasury Secretary Steven Mnuchin with the six largest banks in the country.[5]

Second, the three regimes appear to have different dynamic responses to monetary policy shocks.

Third, our analysis reveals differences with regards to the responses of different sized banks.

[4]Perhaps this is linked to recent concerns, expressed

[5]See: https://twitter.com/stevenmnuchin1/status/1076958380361543681.

3.1 Baseline Estimation: Full Sample

$$y_{i,t+h} = \alpha_{i,h} + \beta_h SSR_t + \sum_{s=1}^{S} \beta_{h,s} SSR_{t-s} + \sum_{s=0}^{S} \gamma_{h,s} \log(IC_{t-s}) + \sum_{s=1}^{S} \delta_{t-s} y_{i,t-s} + e_{i,t+h}, \tag{1}$$

where $y_{i,t}$ is the net liquidity measure of bank i at time period t, SSR_t—is the Krippner short shadow rate, and $\log(IC_t)$ is the natural log of the seasonally adjusted log initial claims for unemployment insurance. β_h for $h = 1, \ldots, H$ maps out the impulse responses of the net liquidity measure with $H = 6$ in the quarterly data and $H = 72$ in the weekly data. Lags of variables in this settings appear as controls with $S = 1$ in the quarterly data and $S = 12$ in the weekly data.

Our estimates reveal a first novel finding that is displayed in Figure 6. The response of quarterly net liquidity ratios to a 100 basis points increase in the shadow short-rate leads a a 20 basis points decline in the net liquidity ratio for about two quarters and then a rise in the net liquidity ratio by about 30 basis points in the third quarter after the impulse. Given that the mean net liquidity ratio is about negative four percent, monetary policy merely moves five percent at its peak impact. As we shall see later, in different regimes monetary policy will prove to be more powerful.

In contrast, the dynamics of the weekly data are somewhat amplified, in particular in the upturn.

3.2 How has the effect of monetary policy changed of the three regimes?

$$y_{i,t+h} = \alpha_{i,h} + \beta_h SSR_t + \beta_h^z SSR_t Z_t + \beta_h^l SSR_t L_t + \Gamma_h Controls_{i,t} + e_{i,t+h}, \tag{2}$$

where Z_t and L_t are dummy variables designating the zero lower bound and lift-off periods, respectively, and $Controls_{i,t}$ are the lags of macroeconomic and dependent variables, as in 1, as well as Z_t and L_t. In this setting, the pre-crisis impulse responses are given by β_h, at the ZLB by $\beta_h + \beta_h^z$, and during lift-off by $\beta_h + \beta_h^l$.

Discuss Figure 7. Main angle: dramatic changes in the quarterly data, far more nuanced ones in the weekly

3.3 Bank size and the transmission of monetary policy to liquidity

$$y_{i,t+h} = \alpha_{i,h} + \beta_h SSR_t + \beta_h^z SSR_t Z_t + \beta_h^l SSR_t L_t + \beta_h^a SSR_t \log A_{i,t} \\ + \beta_h^{z,a} z SSR_t Z_t \log A_{i,t} + \beta_h^{l,a} SSR_t L_t \log A_{i,t} + \Gamma_h Controls_{i,t} + e_{i,t+h}, \tag{3}$$

where $\log A_{i,t}$ are the log total assets of bank i at time t. We define a 'large' bank as one having \$250b dollars in total assets and a 'small' bank as one with \$1b dollars in total assets. Note that in this setting the impulse responses are a function of bank size. Log total assets and interaction terms that do not include SSR are swept into $Controls$ for parsimony.

Discuss Figure 8. Main angle: no meaningful difference in the responses of small and large banks before the crisis and at the ZLB; large banks have stronger responses during lift-off; in the weekly data, smaller banks had stronger responses after 30-40 weeks than large banks, hence the difference in the transmission mechanism at lift-off is even more dramatic than in the quarterly data.

4 Implications for future banking liquidity

This section highlights the Implications of different monetary policy regimes for the future dynamics of bank liquidity. Propagate the estimates from the three regimes, including conditional on size forward and (hopefully) show sizable differences in distributional outcomes.

Our estimates going forward are inspired by the closing section of Afonso, Armenter, and Lester (2018) who estimate reserve balances along the normalization path of the Federal Reserve balance sheet.

So Afonso, Armenter, and Lester (2018) have a search model with homogenous GSE providing funding and bank borrowing and potentially lending amongst each other depending on the overall supply of reserves, policy rates and "other factors".

Bech and Klee (2011) also discuss the exit dynamics.

5 Conclusion

We examine the important topic of the liquidity impact of monetary policy across three different regimes. The relevance of this question relates to serious estimates about the implications of "quantitative tightening" in a framework with interest rates on reserves. We first show that the uncondition responses of the banking sectors net liquidity ratio is comparable across two different panel data sets: quarterly "call" report data based on FFIEC 031/041 and weekly balance sheet data based on FR 2644 and FR 2416, that underlies the production of the so-called H.8 tables ("Assets and Liabilities of Commercial Banks in the United States") published regularly by the Federal Reserve.[6]

Our findings are threefold: First, the dynamic responses of the quarterly and weekly data are consistent with initial contractions in liquidity in response to monetary policy contractions. After about one year, there is an expansion the net liquidity ratio. While the first finding is reassuring with regards to the underlying data, the second finding, the dynamics are somewhat different during the three regimes of no interests on reserves, zero lower bound with interest on reserves and "lift-off" with interest on reserves. The quarterly data, due to sample restrictions, shows meaningful deviations in the responses whereas the weekly data, reassuringly shows marked consistent responses across the three different sample episodes. Third, the higher frequency weekly data enables us to discern underlying heterogeneity in the response data that would be masked by quarterly cross-sectional data. Prior to the 2015 "lift-off" the response of smaller and larger banks was similar for about half a year, then at about nine months, the response of the largest banks are substantially stronger. This patterns is reverse during the lift-off period. Such differential responses would be unobserved using the standard quarterly call reports.

[6]For more information see https://www.federalreserve.gov/releases/h8/current/default.htm

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Figures

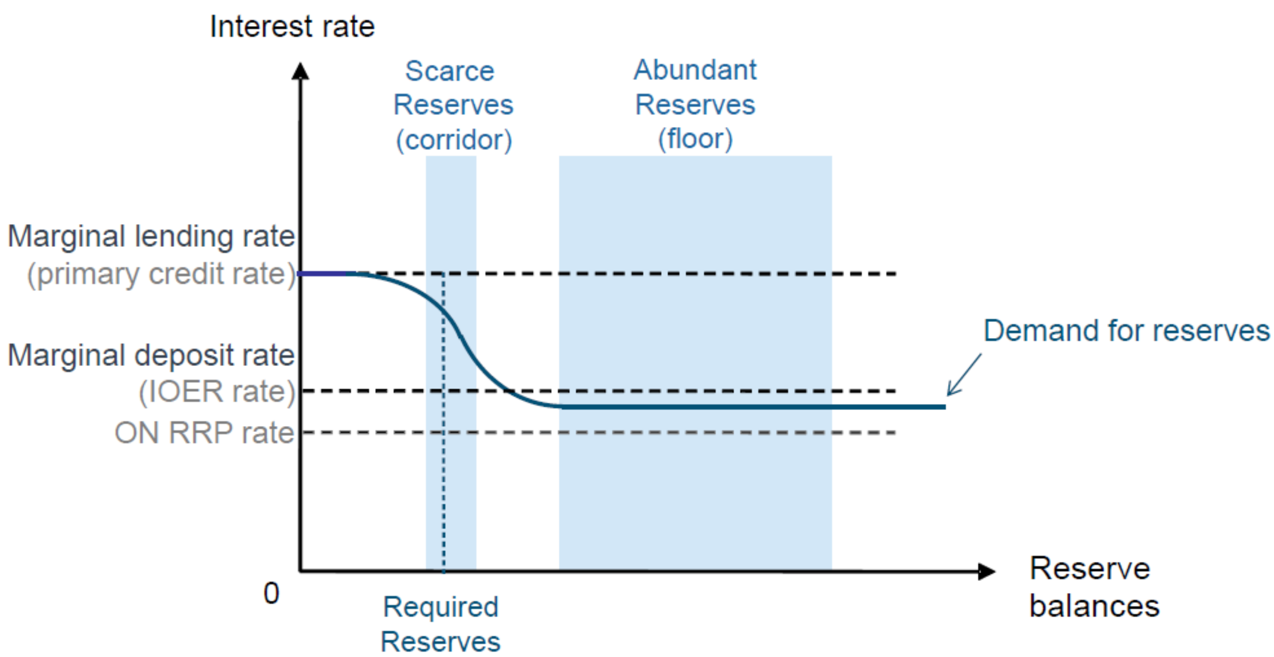

Figure 1: Stylized Illustration of Different Operating Frameworks

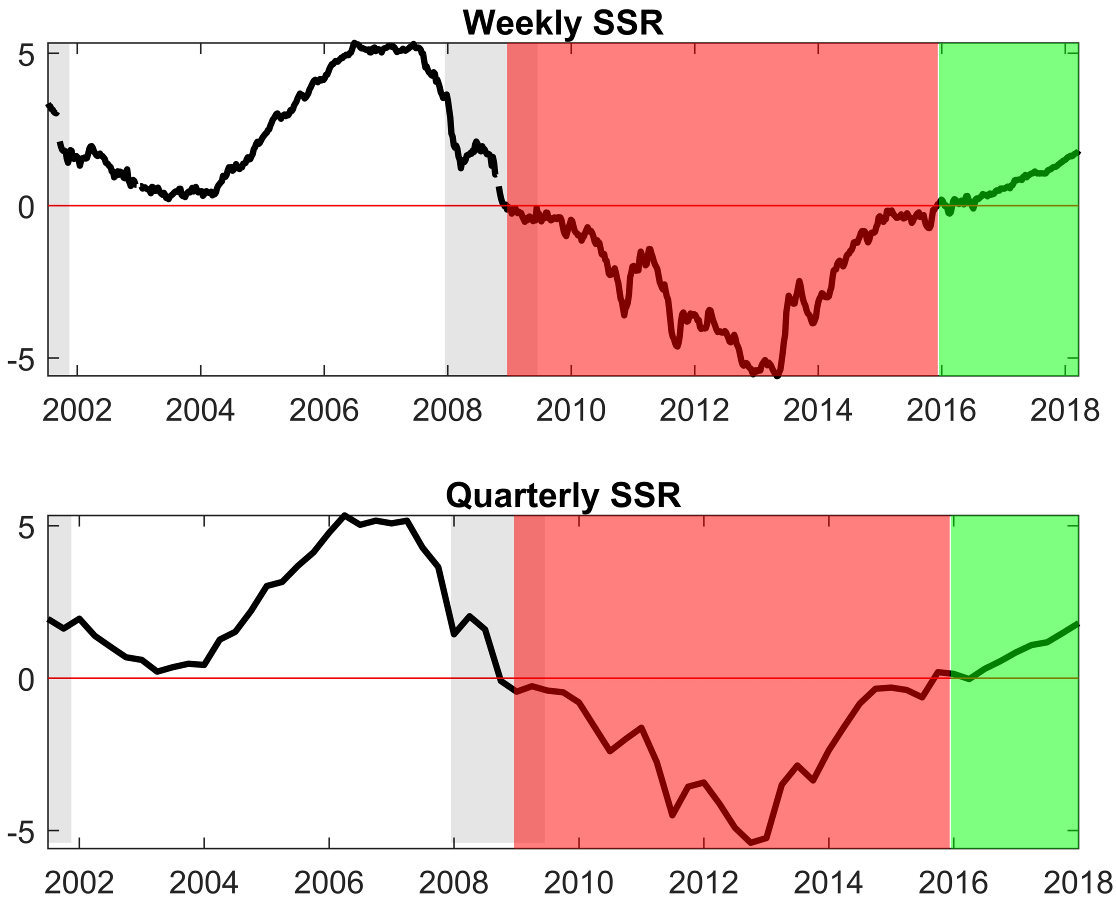

Figure 2: Shadow federal funds rate over three monetary policy regimes. Unshaded—pre-crisis; red shade—zero lower bound period; green shade—monetary policy normalization; grey shade—NBER-defined recessions.

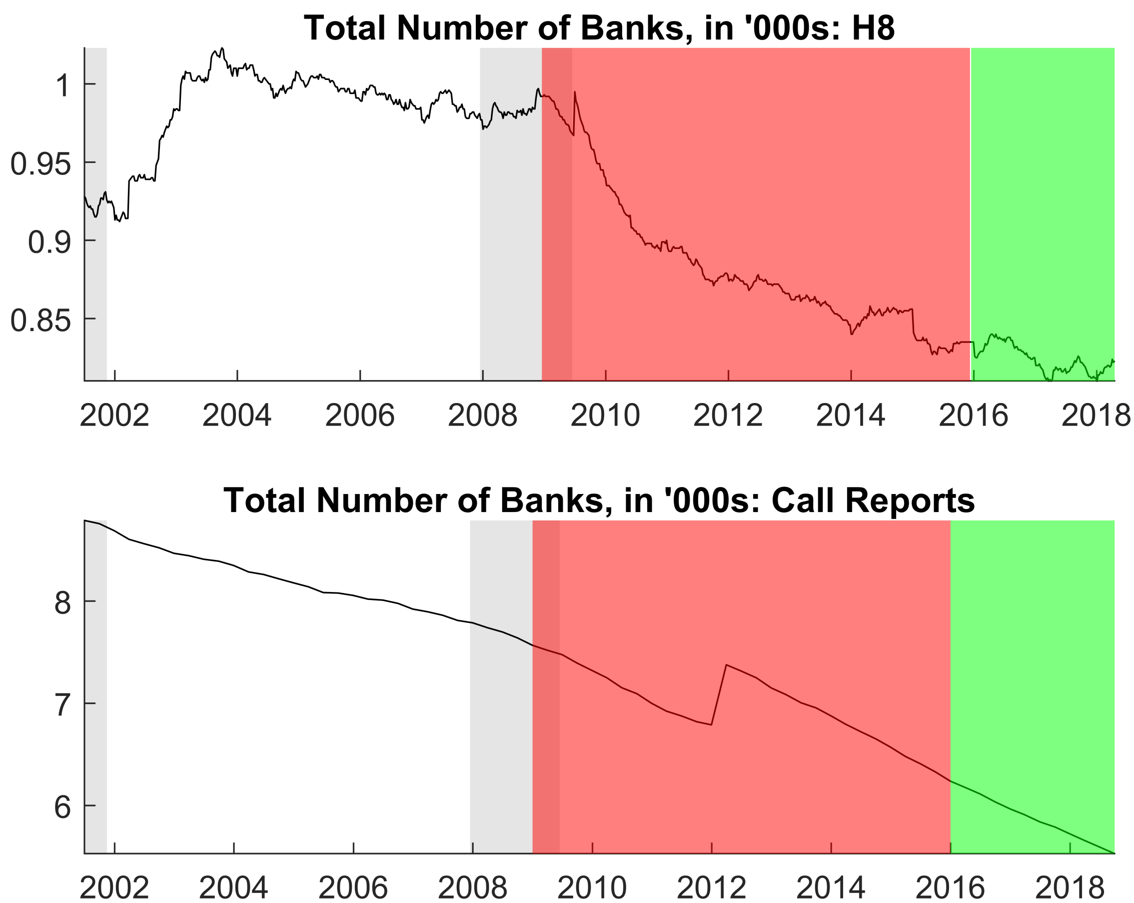

Figure 3: Number of reporting institutions: Schedule H8 vs the Call Reports. Unshaded—pre-crisis; red shade—zero lower bound period; green shade—monetary policy normalization; grey shade—NBER-defined recessions.

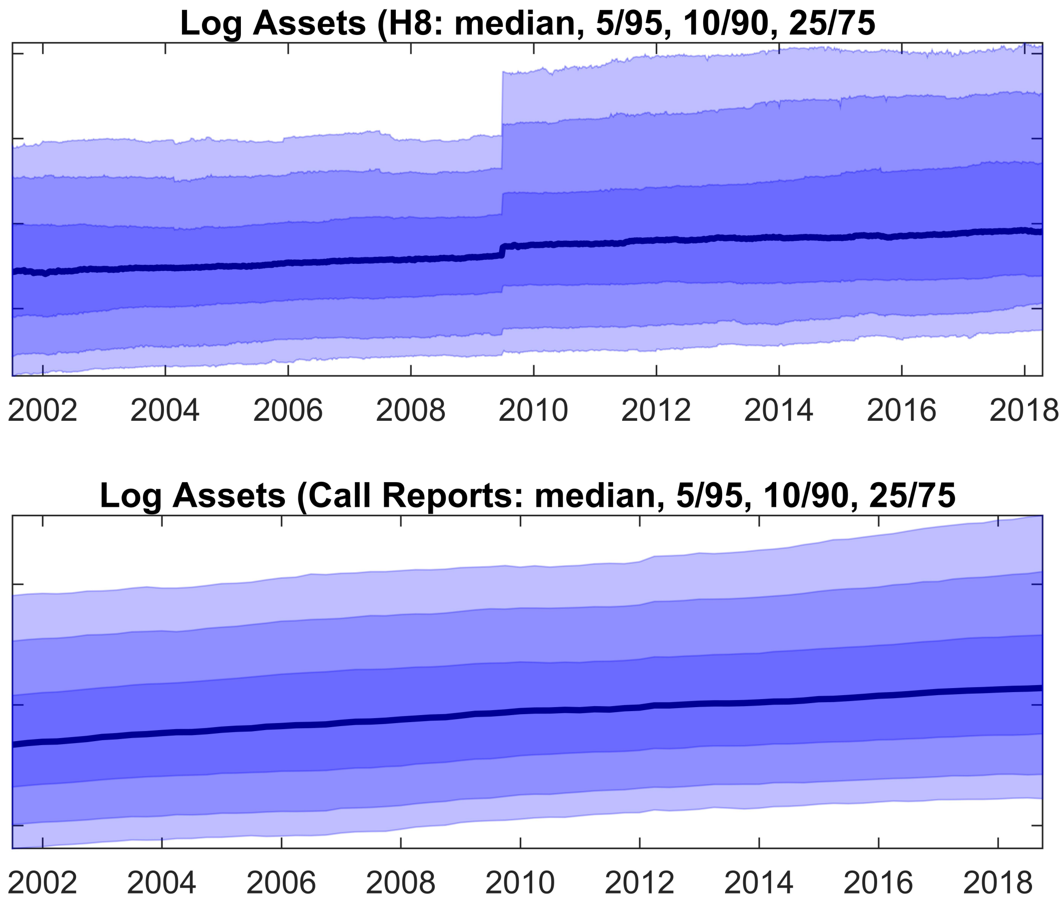

Figure 4: Distribution of assets: black line—median; darkest shade—interquartile range; medium shade—10th to 90th percentile; lightest shade—5th to 95th percentile.

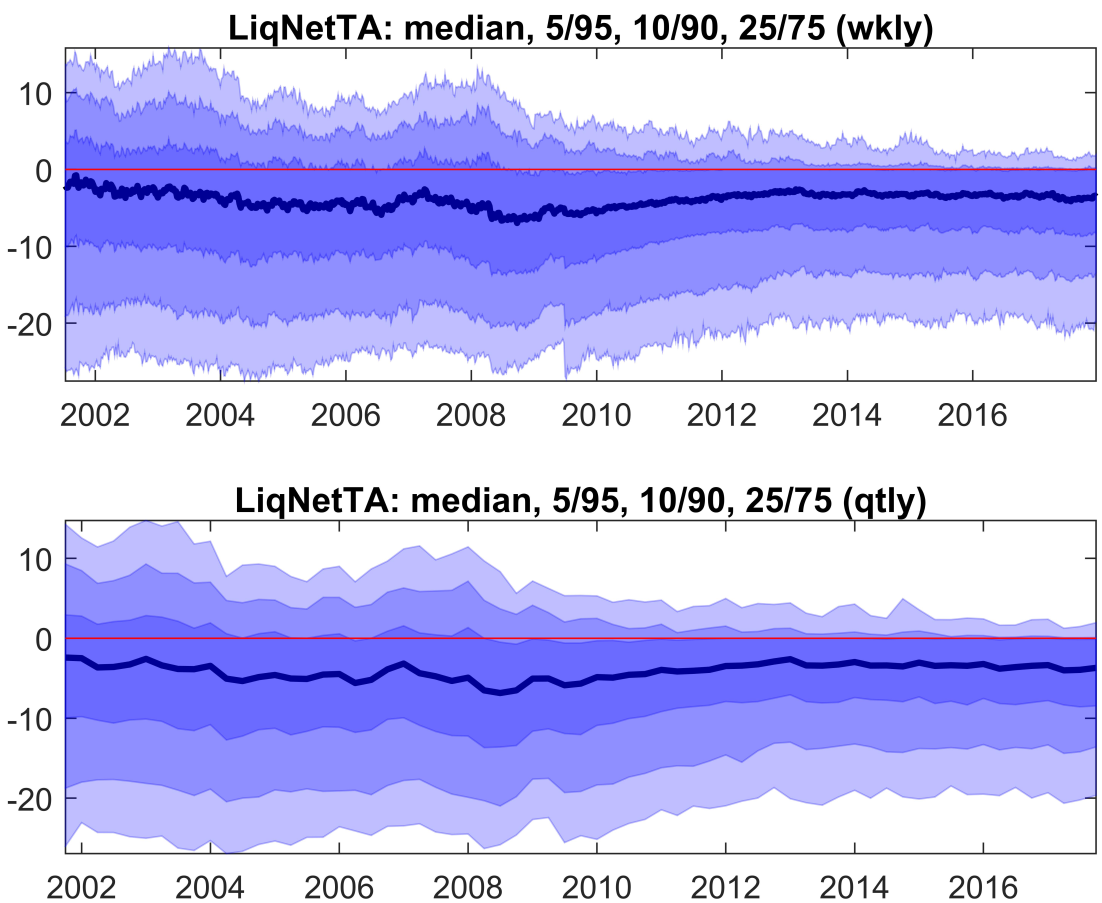

Figure 5: Distribution of the net liquidity ratio: black line—median; darkest shade—interquartile range; medium shade—10th to 90th percentile; lightest shade—5th to 95th percentile

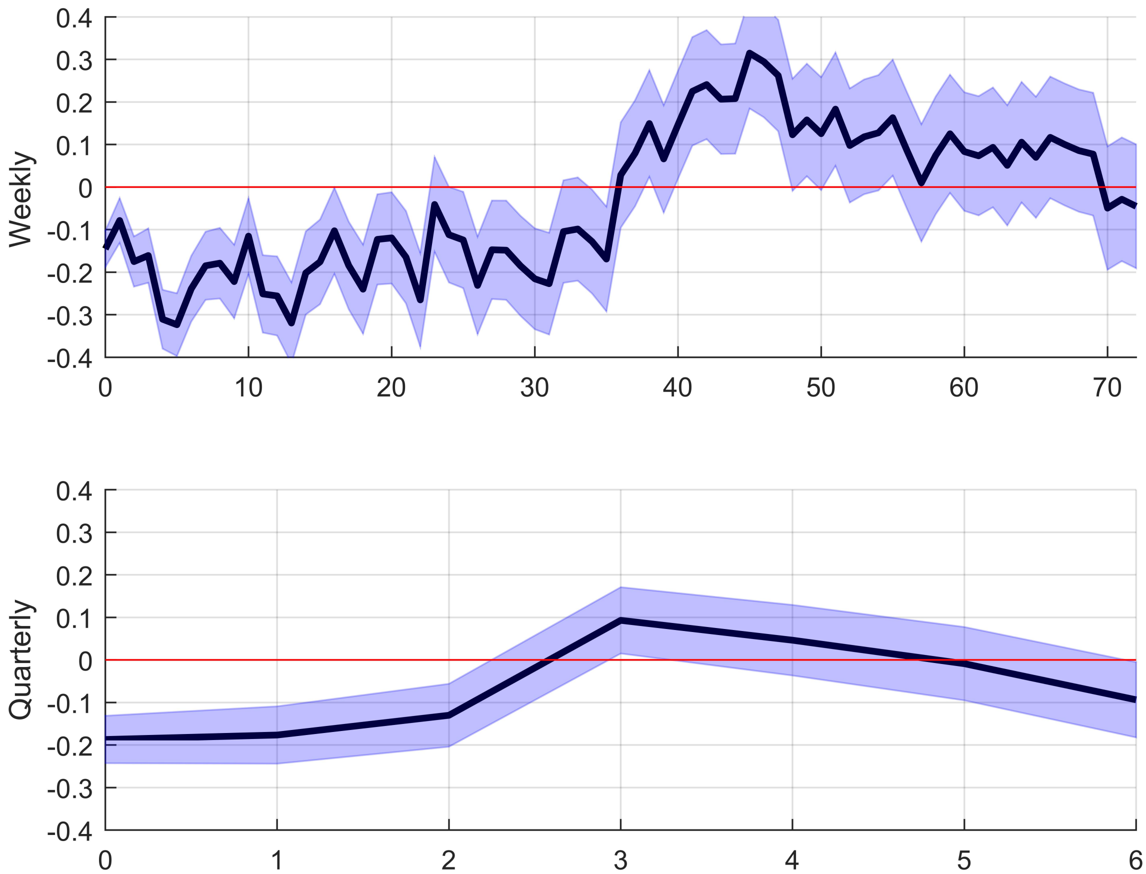

Figure 6: Net liquidity impulse responses at alternative frequencies: Estimates from H8 in 2001-2018.

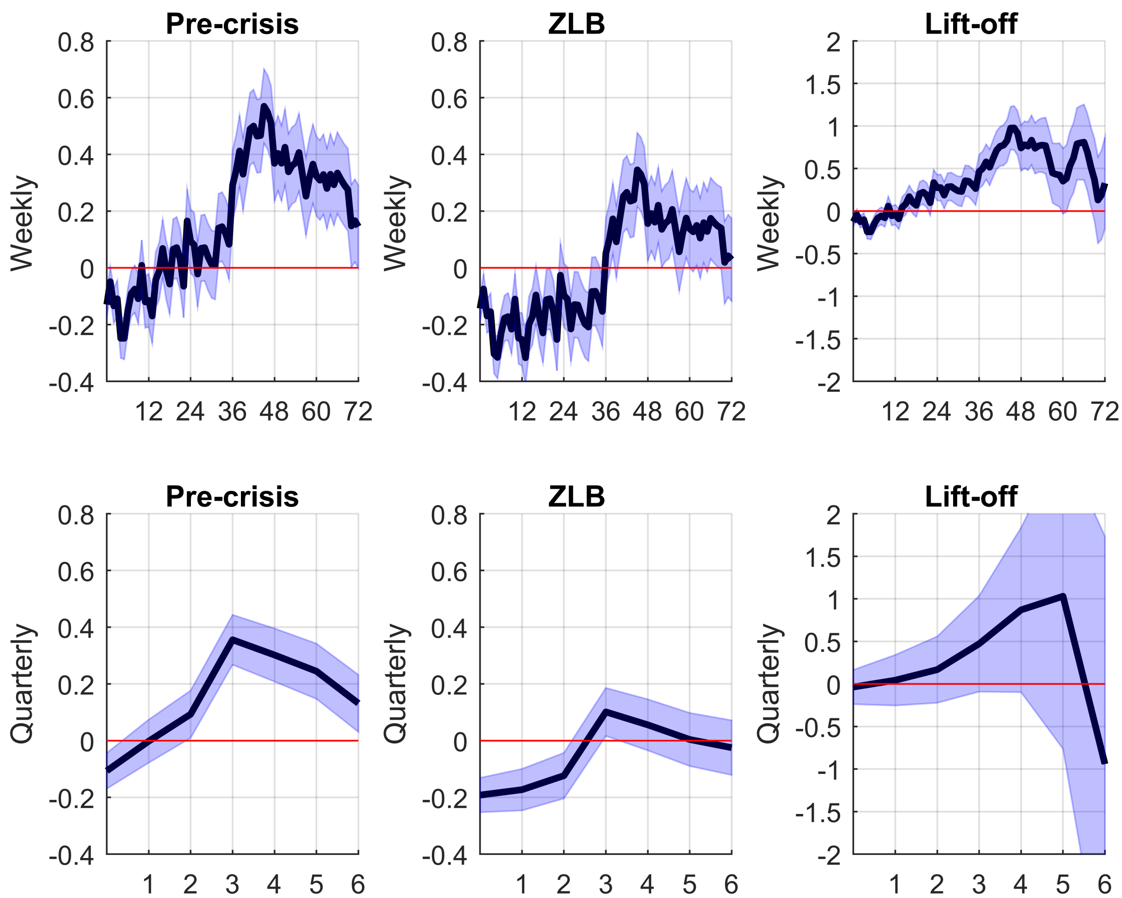

Figure 7: Net liquidity impulse responses at alternative frequencies, by subperiod.

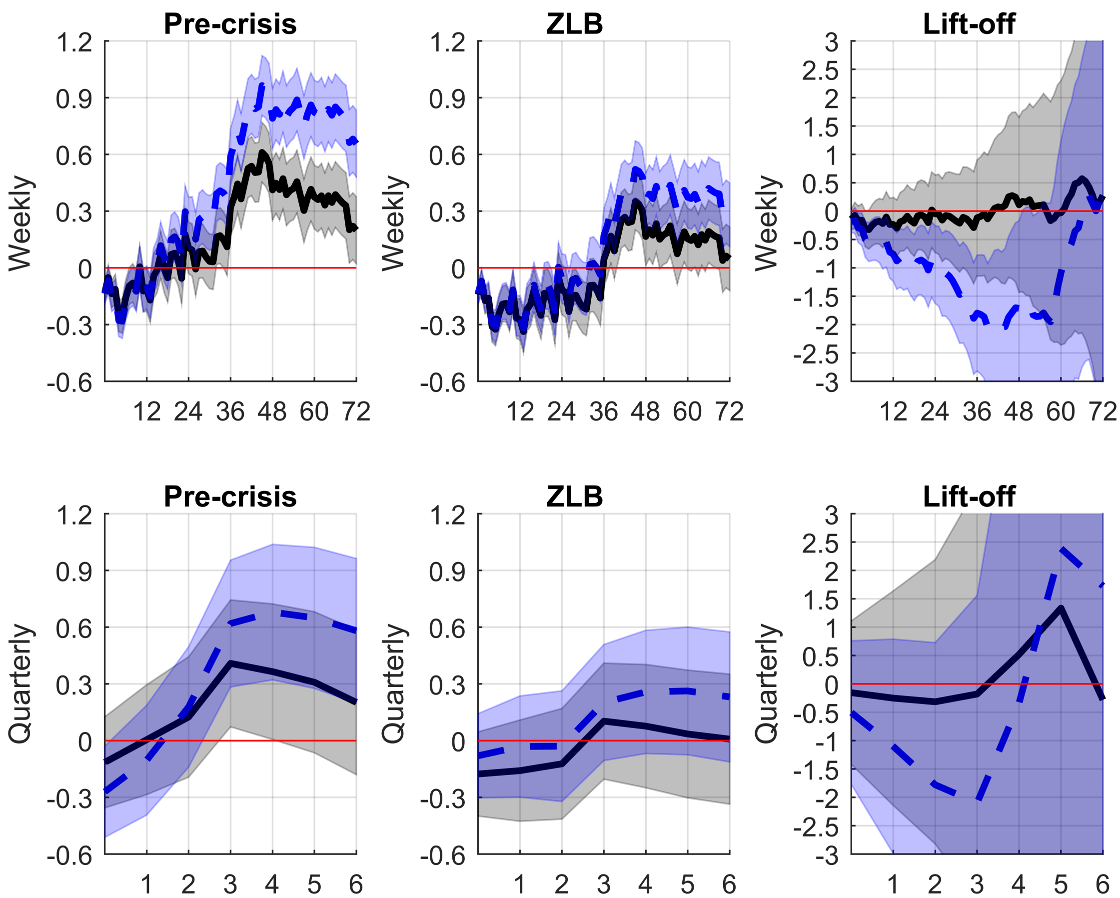

Figure 8: Net liquidity impulse responses at alternative frequencies, by subperiod: black lines/areas—\$250b in total assets; blue lines/areas—\$1b in total assets.

Tables

ONLINE APPENDIX

For the asset side we define

$$\text{liqAnew} = WRSS1360 + WRSS1390$$

this pieces the variables together given the break in 2009

$$\text{liqA} = WRSS1350 + \text{liqAnew}$$

for the liability side

$$\text{liqLnew} = WRSSA286 + WRSSA287;$$

this pieces the variables together given the break in 2009

$$\text{liqL} = WRSS2795 + \text{liqLnew}$$

$$\text{LiqNetTA} = 100 \times \frac{(\text{liqA} - \text{liqL})}{WRSS2170}$$

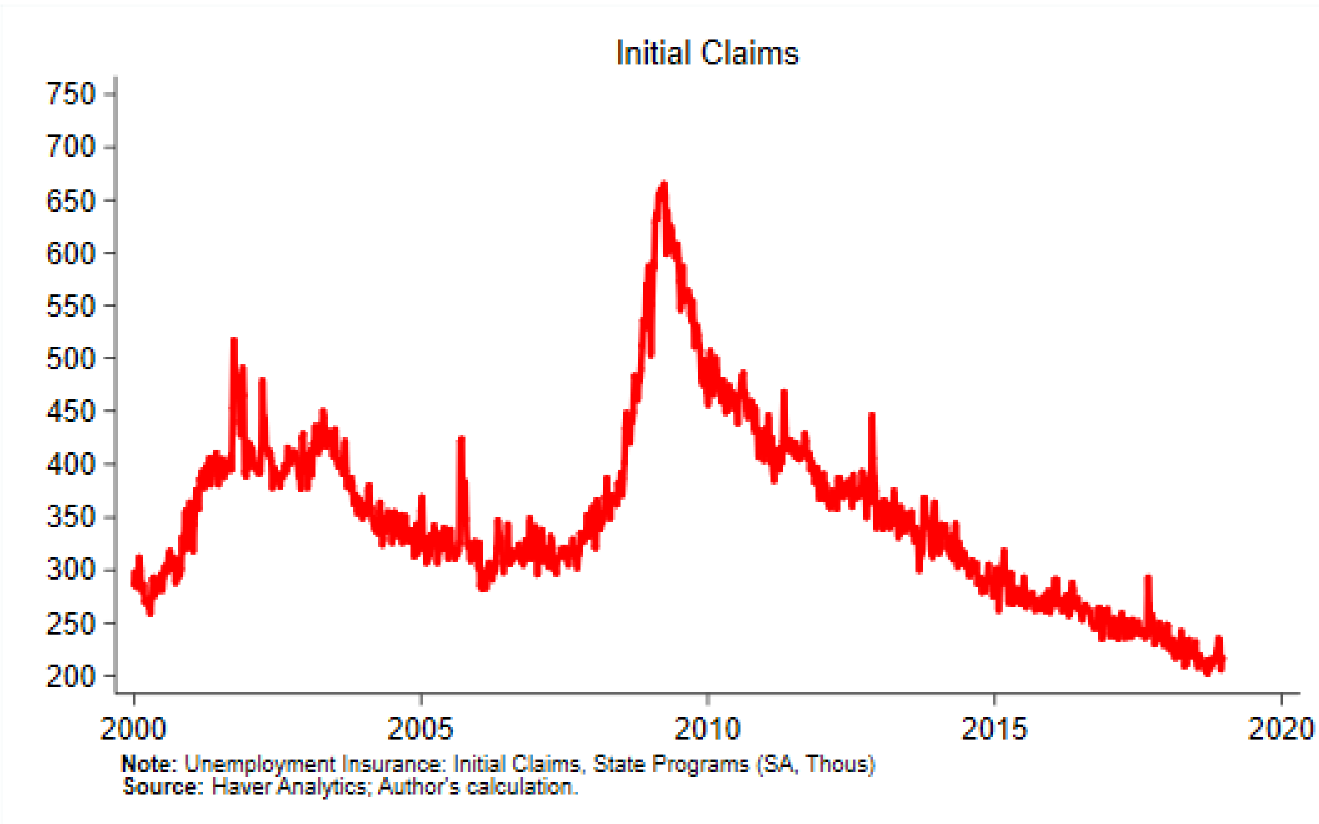

Figure 9: Initial Claims in the Sample Period from 2000-2018