

## Appendix

### How Individuals Respond to a Liquidity Shock:

### Evidence from the 2013 Government Shutdown

Michael Gelman, Shachar Kariv, Matthew D. Shapiro, Dan Silverman, Steven Tadelis

First Version: February 26, 2015

This Version: July 17, 2018

#### A. Financial App User versus Population Characteristics

	Financial App	ACS
Female	40.07	51.41
Age		
18-20	0.59	5.72
21-24	5.26	7.36
25-34	37.85	17.48
35-44	30.06	17.03
45-54	15.00	18.39
55-64	7.76	16.06
65+	3.48	17.95
Highest degree		
Less than College	69.95	62.86
College	24.07	26.22
Graduate School	5.98	10.92
Census Bureau Region		
Northeast	20.61	17.77
Midwest	14.62	21.45
South	36.66	37.36
West	28.11	23.43

TABLE A1. FINANCIAL APP VS. ACS DEMOGRAPHICS

Notes: The sample size for Financial App is 59,072, 35,417, 28,057, and 63,745 for gender, age, education, and region respectively. The sample size for ACS is 2,441,532 for gender, age, region and 2,158,014 for education.

Source: Gelman et al (2014).

## *B. Sample Selection*

All individuals in the analysis are selected so that they receive regular paychecks on the same schedule as most federal employees.

**Step 1 (Conditioning on the payroll periods of most federal employees)** - Individuals must receive paychecks in the following three periods. September 25 – October 2 , 2013, October 9 to October 16, 2013, and October 23 to October 30, 2013. Section F in the appendix includes most specific details of the pay dates for different federal governmental organizations. N = 191,548

**Step 2 (Conditioning on regular paychecks)** – Individuals must have a median time between paychecks of 12 to 16 days and a coefficient of variation of paycheck amount of less than 1. N = 107,192

**Step 3 (Conditioning on well-linked users)** – The ratio of credit card balance payments observed in credit card accounts to credit card balance payments observed in checking accounts must be greater than 0.8. N = 98,484

The three steps above are applied to all individuals in the data set.

The treatment and control group are further defined using the following criteria.

**Treatment Group** – Federal government workers who experienced a change in their paycheck of a 40% band around 0.61 [0.37,0.85]. N = 3,804

**Control Group** – Non-federal government workers and federal workers who didn't experience a change in their paycheck around a 40% band around 0.61 [0.37, 0.85]. N = 94,680

### *C. Recurring and Non-Recurring Spending*

Recurring spending is identified using both a combination of transaction description and transaction amount. This is a broader definition than in Gelman et al. (2014) where recurring spending is required to be a period payment in the exact same amount. This broadened definition includes periodic payments such as utility and phone bills that vary in amount from period to period.

**Transaction description** – All transactions within a user with the same description after stripping out non-alphabetical characters are grouped into potential recurring transaction groups. These groups are deemed recurring transactions if they satisfy the following properties

1. There exists more than four transactions in the series.
2. The median days between transactions falls into the span [6,8], [13,15], [26,34], or [57,63].
3. The coefficient of variation of the days between transactions is less than 0.6.

**Transaction amount** – All transactions within a user with the exact amount are grouped into potential recurring transaction groups. These groups are deemed recurring transactions if they satisfy the following properties

1. There exist more than four transactions in the series.
2. The median days between transactions falls into the span [6,8], [13,15], [26,34], or [57,63].

A transaction is coded as recurring spending if it is identified by either the transaction description or amount.

Non-recurring spending is total spending minus recurring spending and cash withdrawals.

### D. Alternative Control Group Measure

This section reproduces the key figures using a control group that consists of federal government employees not subject to the shutdown.

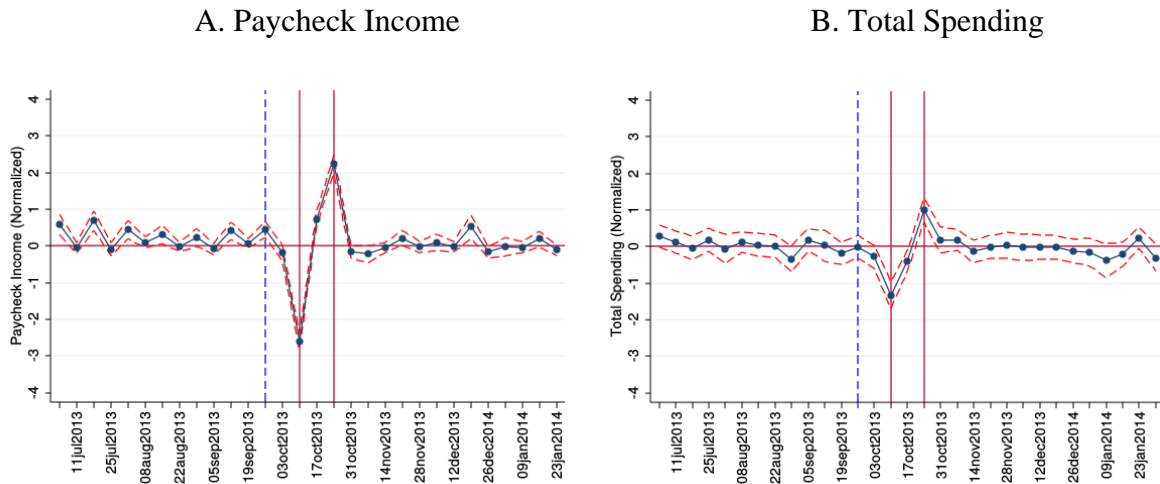


FIGURE A1. ESTIMATED RESPONSE OF NORMALIZED PAYCHECK INCOME AND NORMALIZED TOTAL SPENDING TO GOVERNMENT SHUTDOWN

*Notes:* Difference-in-difference estimates based on equation (1). The Paycheck income plot is estimated using additional controls which include paycheck week and treatment group interactions.  $N = 3,804$  and  $N = 2,988$  for treatment and control group respectively. The estimation period is January 17, 2013 to May 22, 2014. The figures, however, display only the period from July 4, 2013 to January 30, 2014.

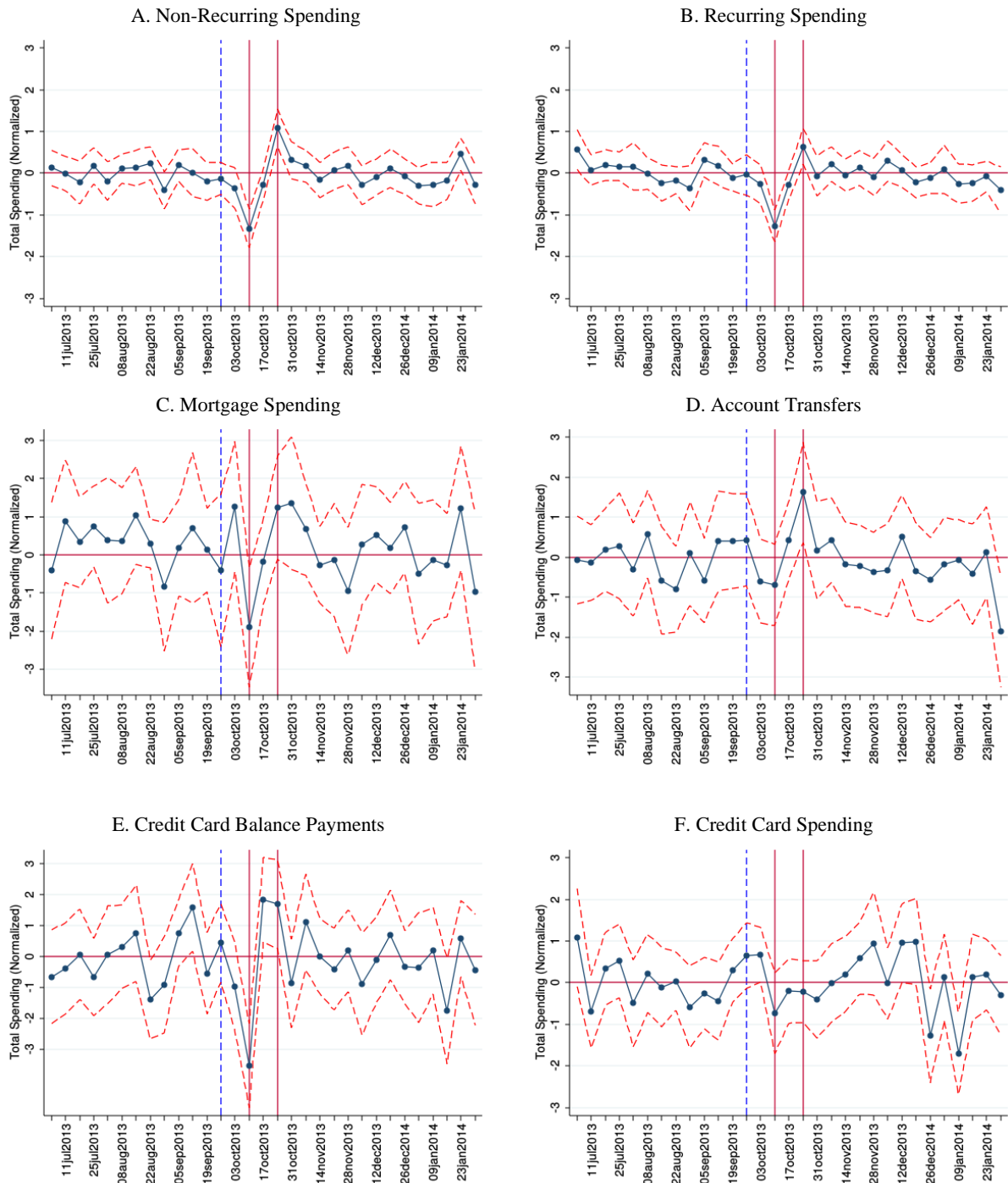


FIGURE A2. ESTIMATED RESPONSE OF SPENDING CATEGORIES TO GOVERNMENT SHUTDOWN

Notes: N = 3,804 and N = 2,988 for treatment and control group respectively.

E. Liquidity Over the Pay Cycle

The following figure shows the median Liquidity Ratio over the paycheck cycle relative to the day of week the paycheck is received.

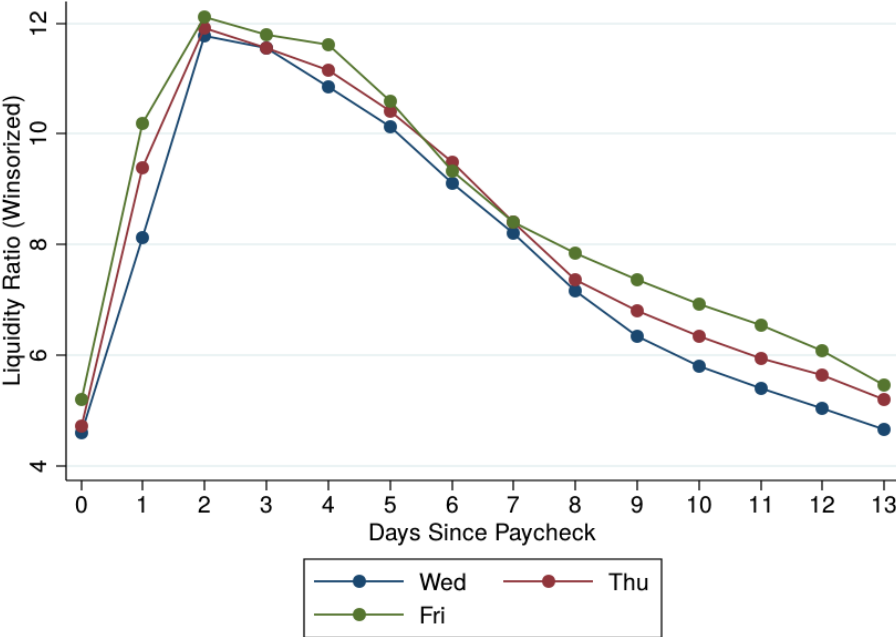


FIGURE A3. LIQUIDITY RATIO MEDIAN OVER THE PAYCHECK CYCLE

F. Analyzing households in the 90<sup>th</sup> percentile of the liquid asset distribution

The results from Figure 9 show that the response of spending to the government shutdown varies by the level of liquid assets households hold. While the spending response of the highest tercile is modest, it is not zero. Focusing attention on the top 10% of the liquid assets distribution, however, shows a still more muted response as seen in Figure A4.

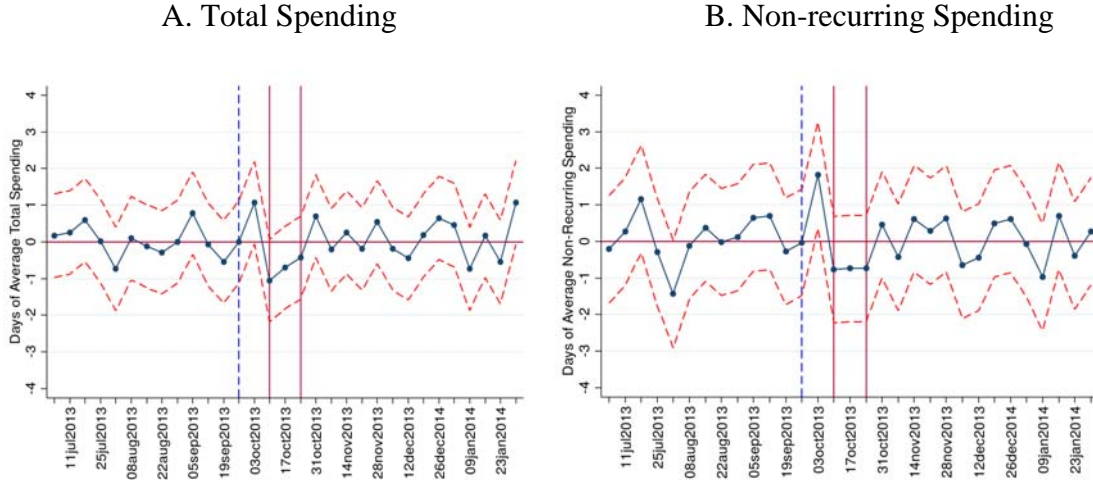


FIGURE A4. ESTIMATED RESPONSE OF SPENDING CATEGORIES TO GOVERNMENT SHUTDOWN BY THE 90<sup>TH</sup> PERCENTILE OF THE LIQUID ASSET DISTRIBUTION

*Notes:* The spending and payment category in each panel is normalized by the household-level daily average for that category. The treatment group includes 367 households and the control group includes 7,583 households. Liquid assets are expressed as a ratio of checking and savings account balances to average daily spending. Average liquid assets are 120 days for this subset of households.

This combination of results is consistent with the idea of mental accounting by moderately high liquid-asset households who refrain from using available savings and instead delay recurring payments. It also seems consistent, however, with the idea that delaying recurring payments makes sense even for those with moderately high liquid asset balances because the delays are so low cost and there remained uncertainty about the length of the shutdown and the timing of

repayment for the missing paycheck. Those with the highest liquid asset balances would reasonably have less concern about that form of uncertainty.

### *G. Identifying Federal Employees*

Most federal employees (88%) are employees of Cabinet Level Agencies such as the Department of Defense (DoD), the Department of Veterans Affairs (DVA), and the Department of Energy (DoE). The rest are employees of Independent Agencies such as the Environmental Protection Agency (EPA) or the Social Security Administration. We are able to identify employees who are paid via direct deposit by capturing the transaction description of their recurring paychecks. Federal employees have the text “FED SAL” included in their transaction description. In total, we observe 12,573 users who we believe to be employed by the federal government during the time of the shutdown. Our data set identifies roughly 0.4% of the U.S. population over 18 (1,000,000 / 241,780,000). Since the Financial App population over samples younger working Americans, an upper bound would be an identification rate of 0.7% (1,000,000 / 144,303,000). Therefore, we would expect to observe between 8,400 to 14,700 federal employees. Our figure of 12,576 falls within this range. The transaction description also contains details about which federal organization the employee works for. Sometimes the description will list the department that the employee works for but there are cases where the description only lists the agency that processes the payroll of federal employees. There are four main agencies that process the payroll of federal employees. The largest agency is the Defense Finance and Accounting Service (DFAS) which provides payroll service for defense related departments such as the DoD and the DVA. However, they also service non-defense related organizations such as the EPA and the DoE. DFAS pays about 54% of federal employees. The second largest payroll service is the National Finance Center (NFC) which started off only servicing the Department of Agriculture



but subsequently expanded to over 170 organizations including the Department of Commerce, Department of Justice, Federal Bureau of Investigation, and the Congressional Budget Office. NFC pays about 31% of federal employees. We are unable to distinguish between departments paid by the NFC because they all use the keyword “AGRI.” The third largest service is the Interior Business Center (IBC) which started off supporting the Department of Interior (DoI) but expanded to service other agencies such as the Department of Transportation (DoT), and the National Science Foundation. The IBC services around 7% of federal employees. We are able to identify employees working for institutions serviced by the IBC such as the Department of Interior (DoI) and the Department of Transportation (DoT). Lastly, the General Service Administration (GSA) services many non-cabinet level agencies such as the Office of Personnel Management and the Railroad Retirement Board. The following table compares the fraction of employees employed in each agency in our data compared to the U.S. population for the largest agencies. The distribution of employees identified in the Financial App data roughly matches the U.S. population.

Table A2—Fraction of employees in each agency

	Financial App	U.S. Population
DFAS (DoD, DVA, etc)	46%	54%
National Finance Center (DoJ, DoA, DoL,	34%	31%
Department of Interior	2%	3%
Department of Transportation	4%	3%
Department of State	1%	1%

*Notes:* The fractions for the Financial App data are calculated as the number of users under each agency divided by the total number of users identified as having the keyword “FED SAL” in a paycheck received in either September or October 2013. We are not able to further identify agencies under DFAS and NFC.

### *G. Identifying Effects of the Shutdown*

There were many different situations that employees faced before and during the shutdown that potentially impacted their paycheck income. Some employees were not affected at all because their pay came from sources other than appropriations legislation. Military employees had their pay protected by the “Pay Our Military Act” signed into law on September 30, 2013 which appropriated funds even if a shutdown occurred. Others were furloughed and then recalled at various dates throughout the shutdown. Although we are not able to identify all of these possible situations, we are able to identify how paycheck amounts changed. Most federal government employees are paid on a bi-weekly basis. The pay periods and dates are usually set by the agency that handles payroll. For example, DFAS pays most employees on Thursday and Friday depending on the agency. For the NFC, the EFT date is Monday. For IBC, the EFT pay dates are on Tuesday. For GSA, the pay dates are Friday. In some situations, the paycheck may post one day early or late due to the characteristics of each financial institution. Although the actual pay dates may vary according to each agency, most employees share the same pay period dates. The relevant pay periods for this analysis are September 22 - October 5, 2013 and October 6 - October 19, 2013. Since the shutdown started during the latter part of the first relevant pay period, employees did not receive payment for 5 days out of the 14 day pay period. Their paycheck for that period is roughly 64% (9/14) of their regular paycheck because the shutdown was still in effect. Since the government shutdown ended before the next paycheck date, users who only received 64% of their paycheck were fully reimbursed by paychecks received after the shutdown ended. This event was a pure temporary shock in the sense that it had no impact on permanent income but simply reallocated income across time. The following figures show the pay dates for each payroll processing agency.

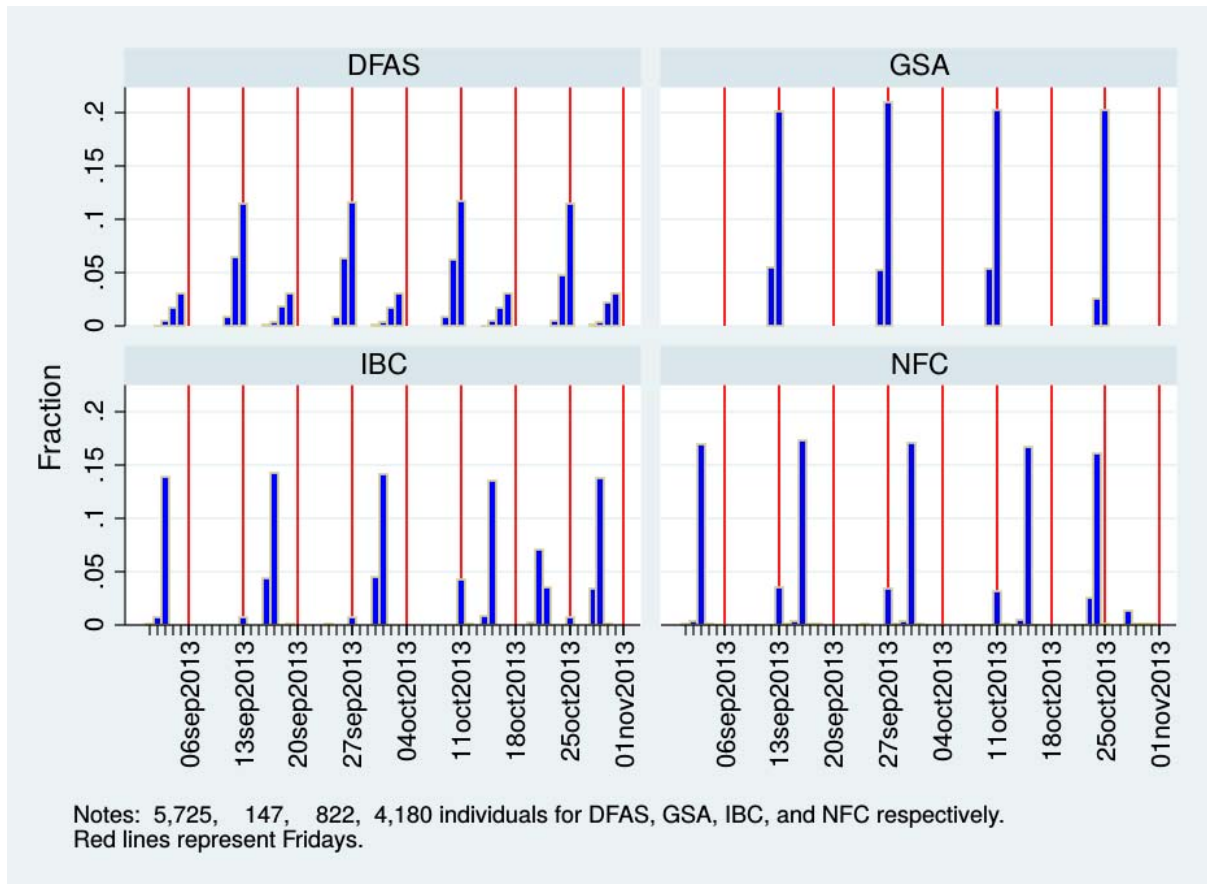


Figure A5. Paycheck histogram by agency

Back pay for accrued hours was handled differently by each agency. DFAS rolled the back pay into the first paychecks for each employee after the shutdown ended and did not appear to change the timing. NFC and GSA also incorporated back pay into the first paycheck after the shutdown but paid people early the Thursday before their usual Monday pay date. IBC processed back pay during the week after the shutdown ended in a separate check. This paycheck was received during a week in which paychecks are not usually received. The figures below plot the time series of pay dates for each payroll agency.

*Temporary loss of paycheck income* — We further analyze the paycheck data to look for signs of the temporary loss of paycheck income as a result of the shutdown. We take all federal

employees and look at the fraction between their current and last paycheck. For a typical employee affected by the shutdown, the paycheck will be around 60% of the previous paycheck. This fraction will vary by hours worked and withholding rates. We define a binary variable that equals 1 if the fraction is between 0.5 and 0.7. This variable is meant to be a rough check for employees affected by the shutdown. The following figure shows the fraction of users who experienced a fraction of paycheck change between 0.5 and 0.7 by pay dates.

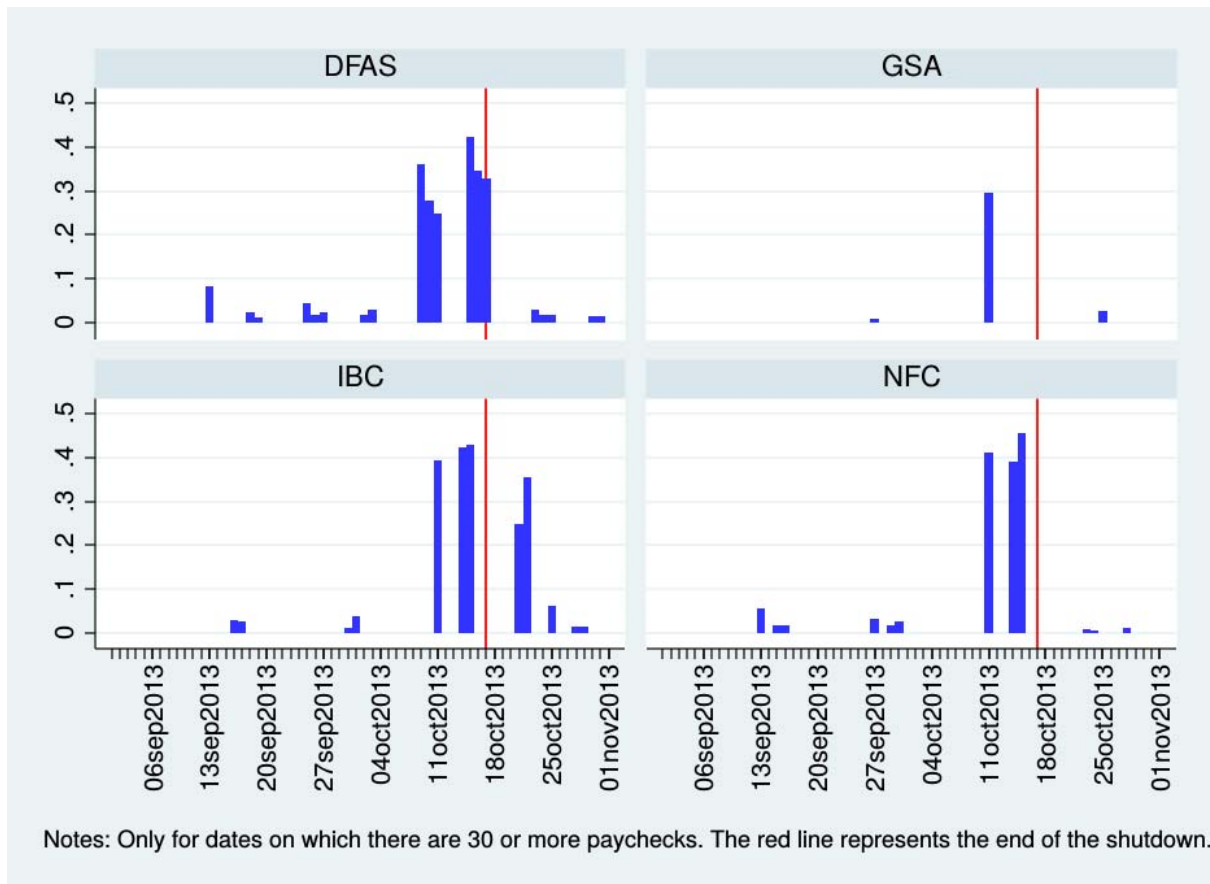


Figure A6. Fraction of users with paycheck ratio of 0.5-0.7 by agency

There is a large jump in the fraction of users that experience a drop in paycheck around 0.6 during the first paycheck received after the shutdown began. DFAS has a wider range of pay dates so the smaller paychecks are received from October 9 to October 17. NFC and GSA have

more uniform pay dates that range from October 11 to October 15. For IBC, the first range of dates from October 11 to October 15 represents the smaller paycheck. The second range of dates from October 21 to October 23 represents the back pay received after the shutdown ended. The following figure shows a histogram for the fraction of each paycheck change for the first paycheck received after the shutdown began. In all agencies, there is a bimodal distribution with mass around 0.6 and 1. The mass at 0.6 represent those affected by the shutdown while the mass at 1 represents those who were unaffected. The results are consistent with the fact that employees paid by DFAS and GSA are more likely to have been paid out of funds that were not affected by the shutdown. In particular many employees paid by DFAS were protected by the “Pay Our Military Act” signed on September 30 right before the shutdown began.

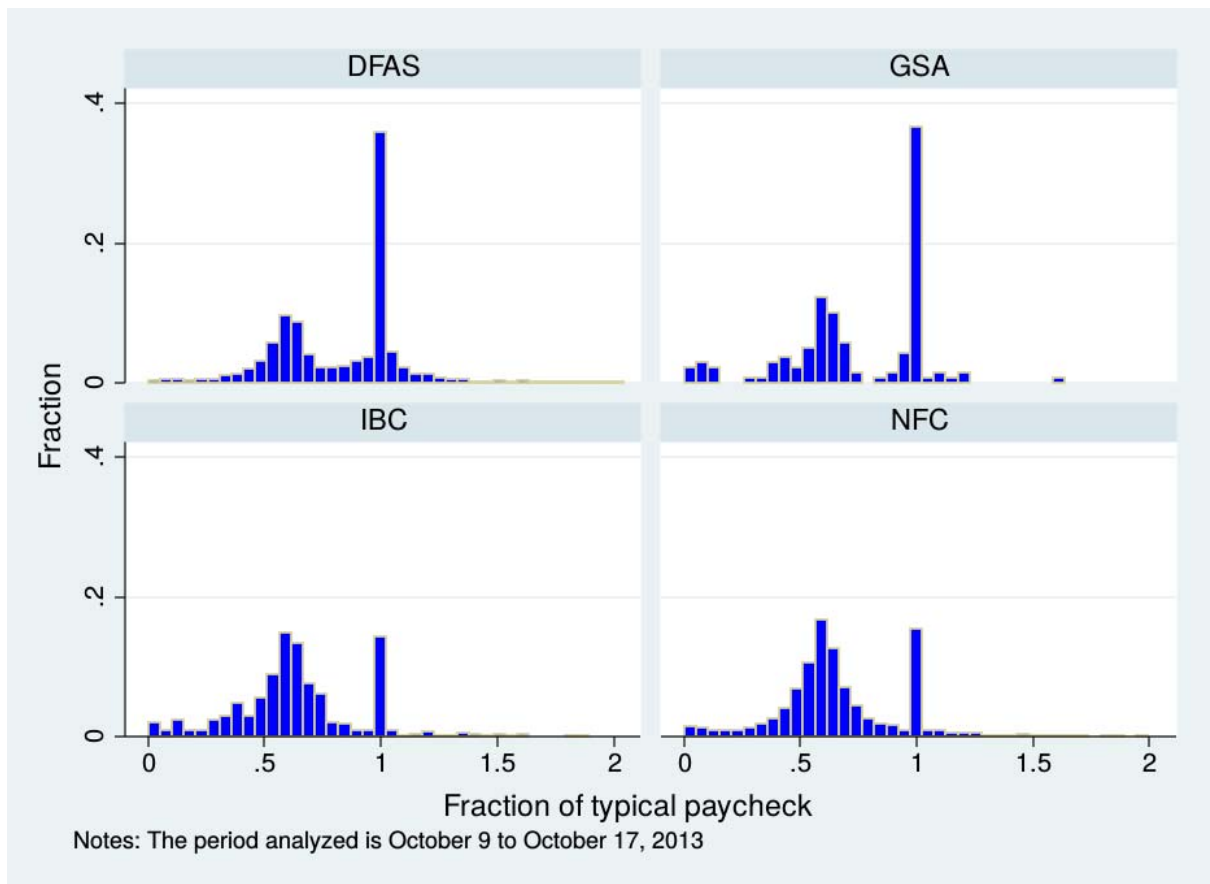


Figure A7. Histogram of fraction of paycheck by agency

*Recovery of temporarily lost income* — We perform a similar analysis to analyze paycheck trends after the shutdown ended. Here we look for the fraction of users who receive a paycheck two or more times the previous paycheck. This is a rough check for the back pay of income owed but not paid during the shutdown. As expected, there is a jump in large paychecks during the first paycheck week after the shutdown ended.

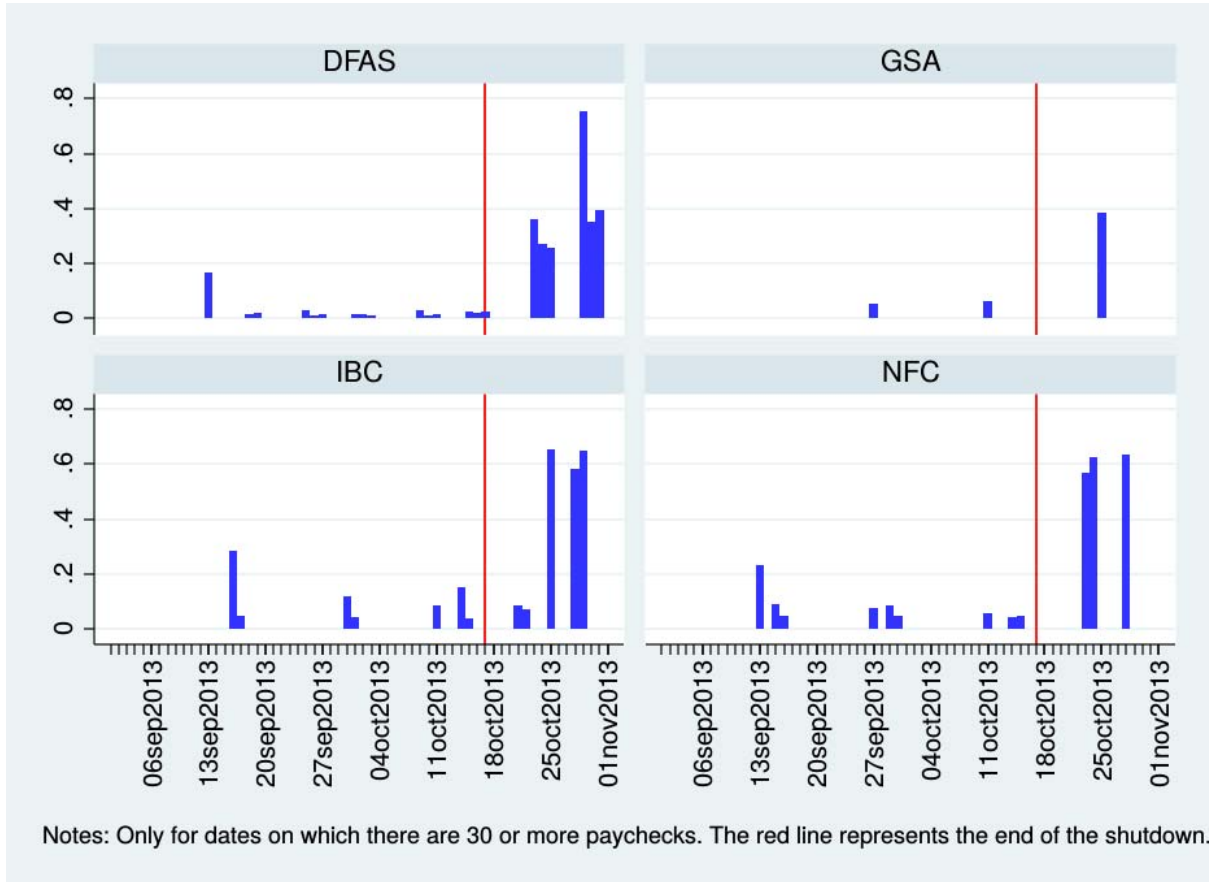


Figure A8. Fraction of users with paycheck ratio > 2 by agency

The following figure shows a histogram of the fraction of the paycheck income of the first paycheck received after the shutdown relative to the paycheck received two pay periods ago. For most users, the paycheck received two pay periods ago should be the regular pre-shutdown paycheck. Since employees were compensated for the temporary loss of income suffered during the shutdown, the fraction should be centered on 1.4 (1.4/1) for employees impacted by the

shutdown. The exception to the rule is for users paid through IBC. For those organizations, the reimbursement pay was received in a separate check the week after the shutdown ended. Therefore, the ratio between the paycheck received during their regular pay period and the paycheck two pay periods ago should be 1.6. This represents the ratio of the return to the standard paycheck (1) divided by the smaller paycheck received as a result of the shutdown (0.6). There is a similar pattern to the previous section where fewer employees who were paid by DFAS and GSA were affected by the shutdown.

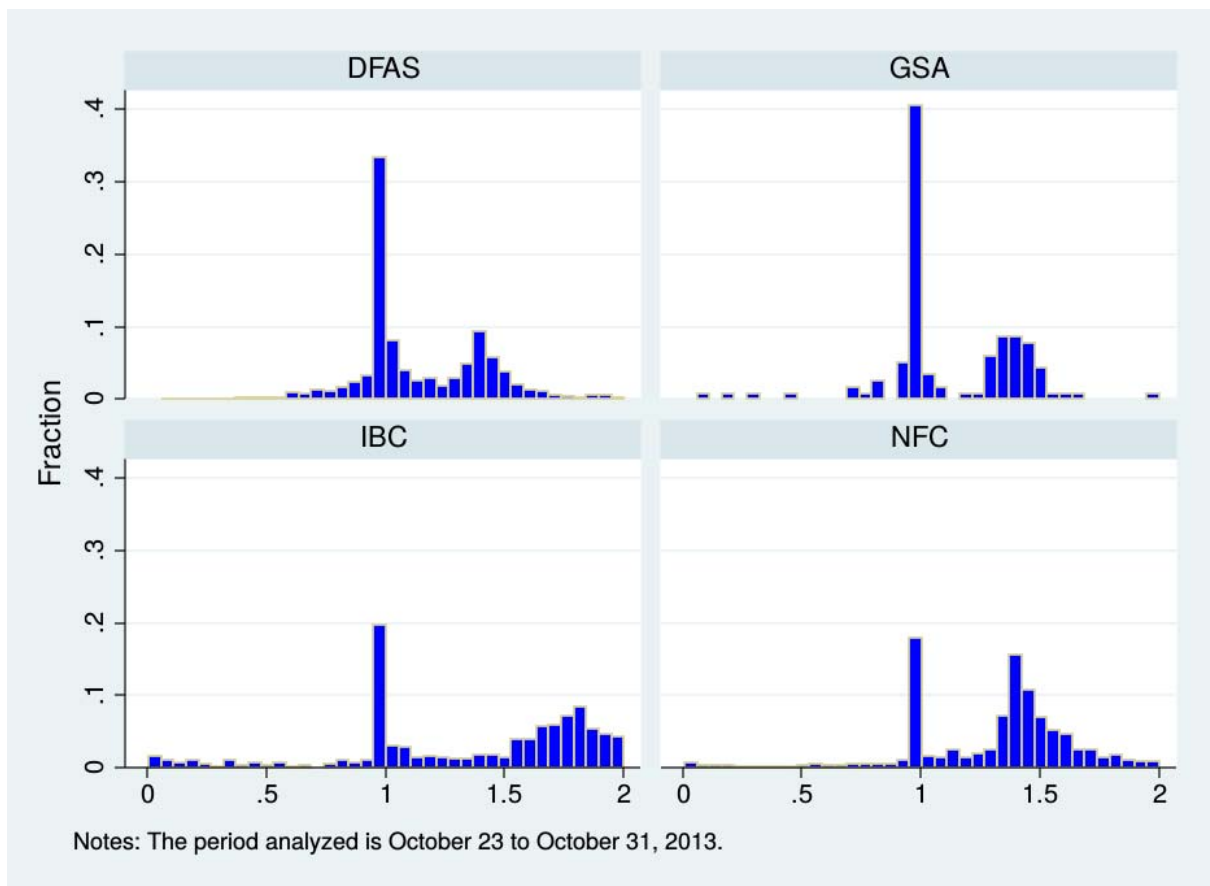


Figure A9. Histogram of fraction of paycheck by agency