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Explaining Fluctuations in the Thrift Savings Fund Daily Balance at U.S. Treasury

Abstract

In this paper we document and examine unusual fluctuations in the G-Fund, which is one of five funds available in a voluntary federal government employee retirement savings vehicle called the Thrift Savings Plan. The G-Fund is managed as "internally" held debt by the United States Department of Treasury. Our examination highlights two obscure facts about the G-Fund: 1) The fund is exclusively composed of one-day notes that Treasury redeems and reissues every business day. The daily turnover of the G-Fund results in about $55 trillion in debt reissuance annually; and 2) whenever the federal government is constrained by a debt ceiling, the G-Fund balance drops dramatically and typically does not return to pre-constraint balance levels until the debt ceiling is either expanded or suspended. We document these patterns and ask whether the G-Fund is managed in a way the represents the best interests of the fund contributors.

JEL-Codes: G230, H230, H550.

Keywords: thrift saving fund, public debt, debt ceiling, extraordinary measures, debt issuance, debt redemption.

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I. Introduction

Total federal government debt can be divided into marketable held (largely publicly held debt) and non-marketable debt (largely internally held debt). When funds are needed the United States (U.S.) Treasury Department (Treasury) issues bills, notes, and bonds, which are sold to corporations, financial institutions, the Federal Reserve, and other governments around the world. The publicly held component of debt tallied to $16 trillion in 2019. However, there is also a substantial amount of internally held debt, of which the largest component are the social security trust funds. Over time, more revenue has been collected from the payroll tax to fund social security survivor, retirement, and disability benefits than has been expended. This resulted in the formation of trust funds that are managed by Treasury as internally held debt. In 2019, the fund balance of the social security trust was about $2.8 trillion, all of which is held by Treasury. However, there are in fact more than 700 funds managed by Treasury, one of which is related to the Thrift Savings Plan. Total internally held debt in 2019 was about $6 trillion. Total federal debt is therefore the sum of publicly held in internally held debt, which tallied to $22 trillion in 2019, but by early 2021 had increased to $28 trillion.

In order to sustain ongoing debt, Treasury must redeem and then reissue expiring debt. In 2019, total debt redeemed and reissued was about $91 trillion in bills, notes, bonds, and other debt instruments. Given that total debt increased by $1.2 trillion in 2019, about $90 trillion was for reissuance of obligations coming to term. The amount of needed reissuance depends on the composition of debt outstanding with regard to term-length. The shortest-term length for publicly held debt is four weeks. Sustaining this type of short-term

debt requires 13 redemptions/reissuances over the course of a year. The longest term-length is a 30-year bond, which requires redemption and reissuance once every thirty years. In 2019, sustaining publicly held debt required about $13 trillion in redemptions and reissuance over the course of the year.

This means that the remaining $77 trillion in redemptions/reissuance must have occurred within the internally held debt category. In this paper we explore the fund that is responsible for the largest component of the $77 trillion in redemptions/reissuance of internally held debt—the Thrift Savings Plan's G-Fund. The G-Fund is one of five funds available in a voluntary federal government employee retirement savings vehicle called the Thrift Savings Plan (TSF), which is managed as "internally" held debt by Treasury. It is debt owed (with interest) to federal government employees and retirees who made contributions to the TSF. As a prelude to the full evaluation, we demonstrate the following: 1) The

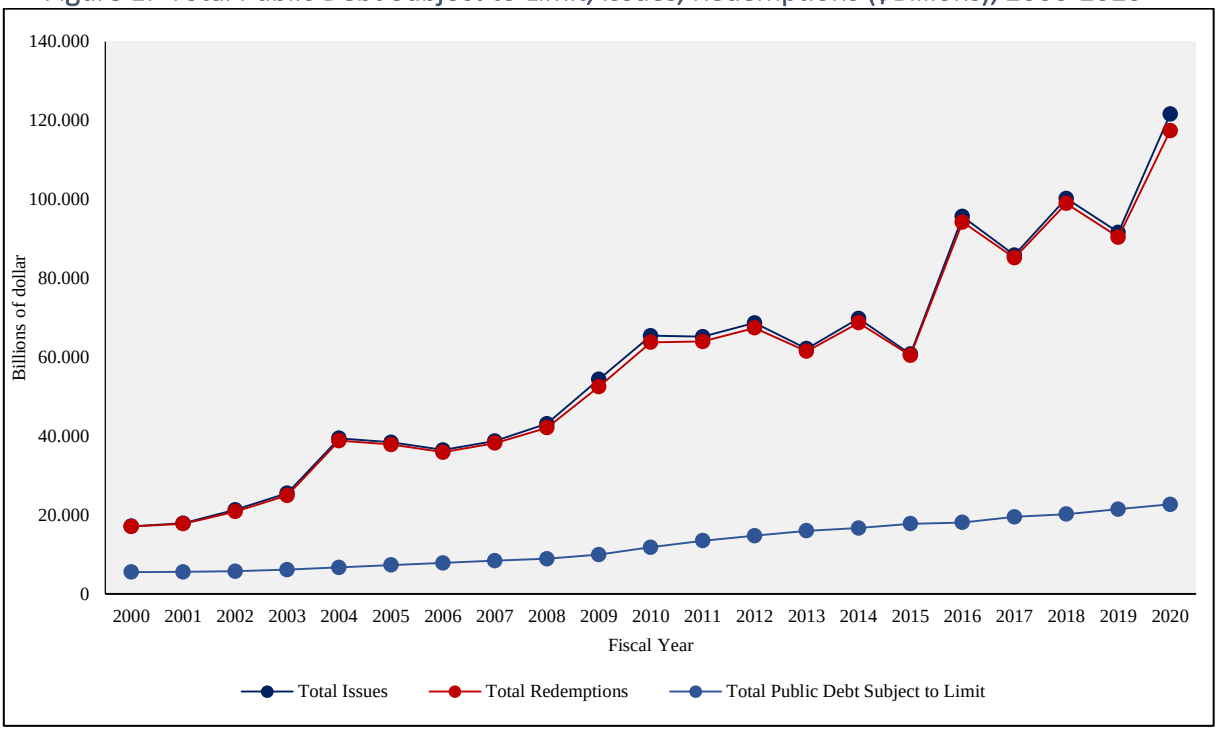
G-Fund is exclusively composed of one-day notes that Treasury redeems and reissues every business day. The daily turnover of the G-Fund resulted in about $55 trillion in debt reissuance in 2019; and 2) whenever the federal government is constrained by a debt ceiling, the G-Fund balance drops dramatically and typically does not return to pre-constraint levels until the debt ceiling is either expanded or suspended. Our objective in this paper is to clearly document these patterns and ask whether the G-Fund is managed in a way the represents the best interests of fund contributors.

II. Overview of Total Federal Debt

Treasury makes available an archive of the Daily Treasury Statement[1], where for each fiscal year and for each quarter we access daily information on the level of public debt subject to the limit, the total debt issued, and the total debt redeemed. This information is summarized in Figure 1, which shows the total annual amounts for each of these variables from 2000 through 2020. In 2000, total government debt was about $5.5 trillion, and debt redemptions and reissuance each tallied to about $17 trillion. In 2000, the reissuance to debt ratio was approximately 3; that is, the debt reissued and redeemed over the course of the year was about 3 times total federal debt. In 2020, the total government debt was about $28 trillion, and debt redemptions/reissuance were $117 and $121 trillion, respectively. The reissuance to debt ratio had increased to about 5.4. As shown in Figure 1, federal debt exhibits a positive linear trend over time, whereas redemptions and reissuance increased at a much faster pace.

[1] The data access link available here https://bit.ly/33mYnDQ. This web page contains the daily information of cash and debt operations of the United States Treasury from 1998 to date. Before 2020, the information is only in text and PDF format. To create Figure 1, we use the information contained in the last report of the last quarter of each fiscal year, that is, the report of the last day of September. This report contains the sums for each fiscal year and therefore summarizes all the annual information.

Figure 1: Total Public Debt Subject to Limit, Issues, Redemptions ($Billions), 2000-2020



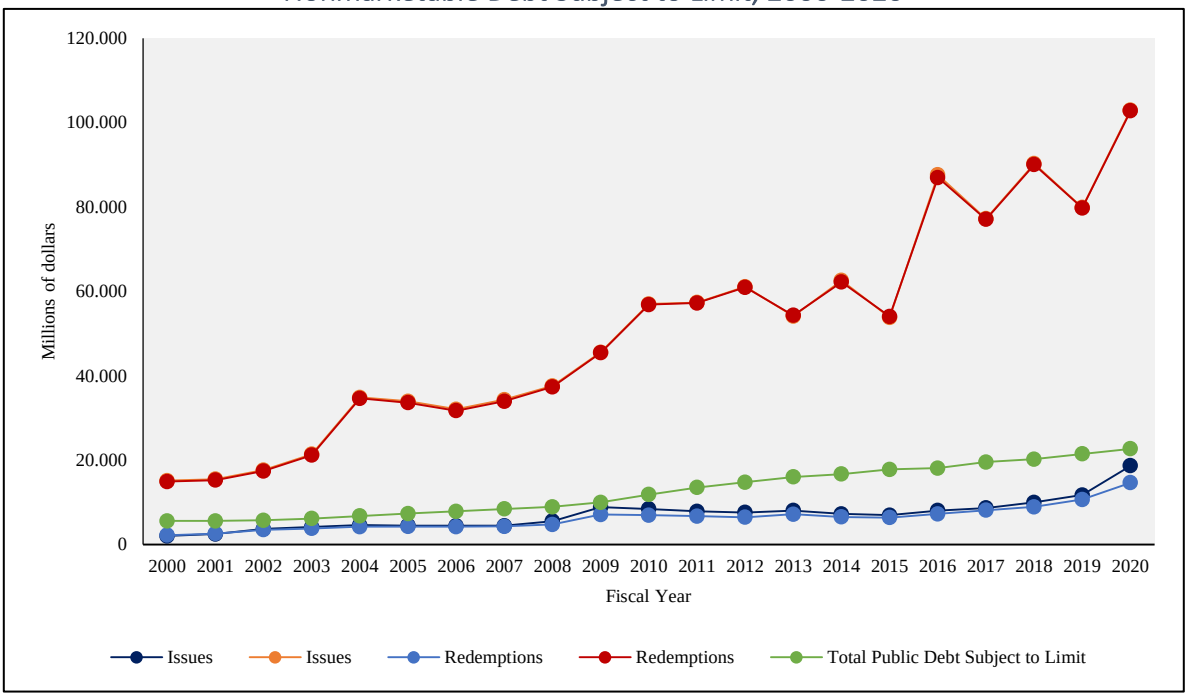
Source: Author's calculations based on U.S. Department of the Treasury information.
Note: The data used to generate this graph corresponds to Table A.1 in the Appendix

Marketable vs Non-marketable Debt

Figure 1 can be disaggregated compare the marketable debt (most of which is publicly held debt) versus the non-marketable debt (most of which is internally held debt). This breakdown is shown in Figure 2 where we graph total marketable and non-marketable debt as well as total marketable and non-marketable redemptions mad reissuances. We also reported in the figure is debt subject to limit. Figure 2 clearly shows that non-marketable redemptions/reissuance has been growing rapidly and has experienced notable fluctuations from year to year. Nearly all non-marketable debt is held internally as one-day securities

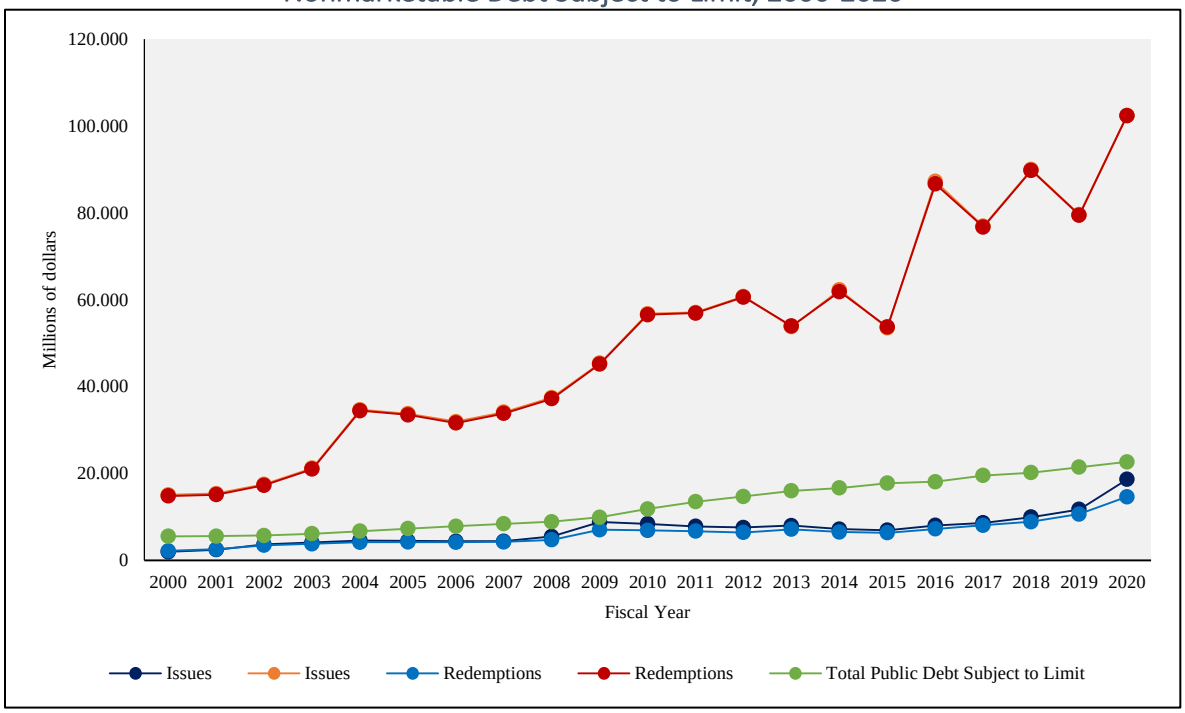
that are turned over every business day. Figure 3 shows that most of the non-marketable redeemed and issued debt comes from Government Account Series debt.

Figure 2: Marketable and Nonmarketable Redemptions and Reissuance, and Marketable and Nonmarketable Debt Subject to Limit, 2000-2020



Source: Author's calculations based on U.S. Department of the Treasury information.
Note: The data used to generate this graph corresponds to Table A.2 in the Appendix

Figure 3: Marketable and Nonmarketable Redemptions and Reissuance, and Marketable and Nonmarketable Debt Subject to Limit, 2000-2020



Source: Author's calculations based on U.S. Department of the Treasury information.
Note: The data used to generate this graph corresponds to Table A.3 in the Appendix

This very broad summary of total federal debt, redemptions, and reissuance shows that most of the redemptions and reissuances are occurring in the non-marketable (internally held) debt category. We now turn our attention to the fund that is generating the largest portion of internal redemptions and reissuances—the TSF G-Fund.

III. The Thrift Saving Fund (TSF)

As summarized by Skidmore et al., (2020), the Thrift Savings Plan (TSP) is a savings vehicle for federal government employees that has many of the same features of a typical 401k plan. It is composed by five funds: G, F, C, S, and I. The F, C, S, and I funds are passively managed by the investment company, BlackRock. The G-fund, however, is a

government securities fund held internally and is managed by Treasury. According to the 2018 TSF financial statement, total amount managed was $559 billion, of which about 45% was held in the G-Fund (Government Securities fund) which is entirely composed of one-day securities. As per U.S. Code § 8438 - Investment of Thrift Savings Fund (Section 5 (e) (1 and 2)), the Secretary of the Treasury is authorized to issue special interest-bearing obligations of the U.S., but the TSF Executive Director determines the term length based on "due regard" to the needs of the fund:

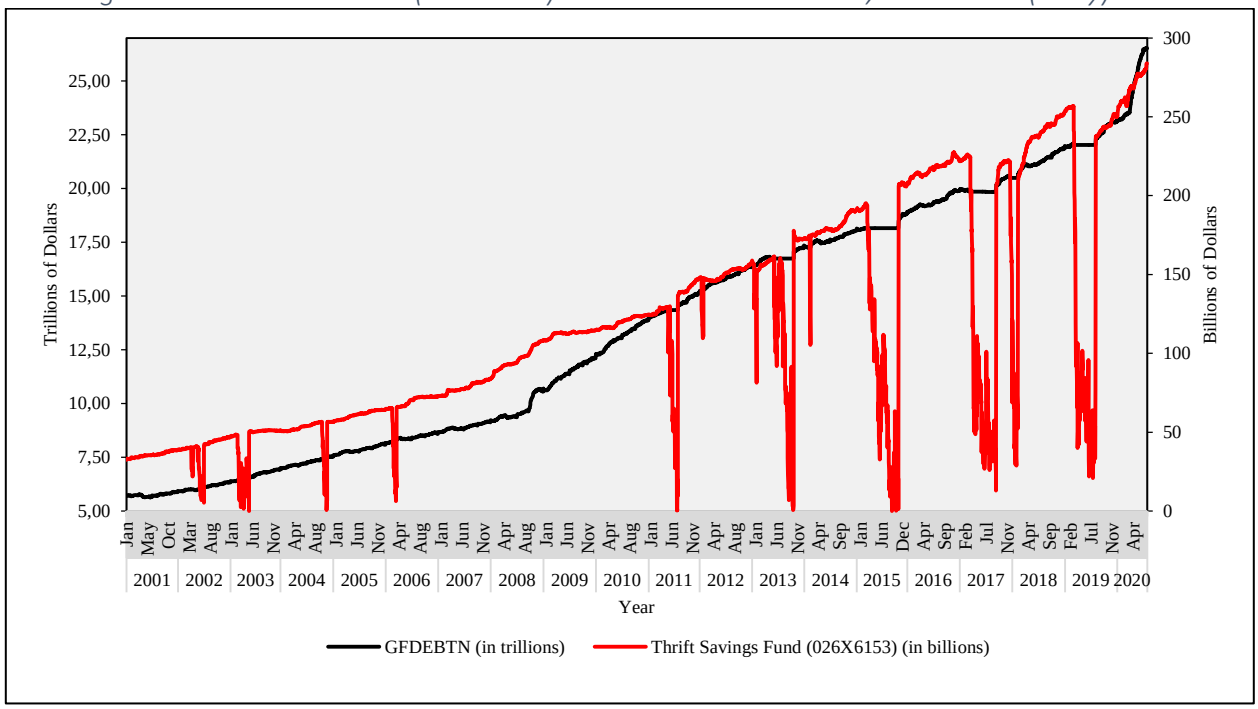
> (1) The Secretary of the Treasury is authorized to issue special interest-bearing obligations of the United States for purchase by the Thrift Savings Fund for the Government Securities Investment Fund.
>
> (2) (A) Obligations issued for the purpose of this subsection shall have maturities fixed with due regard to the needs of such Fund as determined by the Executive Director, and shall bear interest at a rate equal to the average market yield (computed by the Secretary of the Treasury on the basis of market quotations as of the end of the calendar month next preceding the date of issue of such obligations) on all marketable interest-bearing obligations of the United States then forming a part of the public debt which are not due or callable earlier than 4 years after the end of such calendar month.

The statute does not provide guidance on term length of obligations and, to our knowledge, the fact that G-Fund is exclusively composed of one-day securities is not widely known. However, the statute indicates that interest paid will be equivalent to longer-term interest-bearing obligations. For reference, the shortest-term length for marketable securities is four weeks. For reasons that are unclear, the Executive Director has made a decision to hold the entire G-Fund in one-day obligations that are redeemed and reissued, and according to statute, has done so having taken into consideration the needs of the fund. We interpret this to mean that they are holding one-day securities to meet the needs of fund contributors

(federal employees and retirees). It is unclear to us how holding one-day securities is in the best interest of the contributors, which should be the sole fiduciary responsibility of the TSF Executive Director and Board.

In this paper, we focus our attention specifically on the G-Fund. The time series data used in this paper come from three sources. First, we download from Treasury the daily balances of Total Public Debt (GFDEBTN) and the TSF G-Fund account 026X6153. We merge these two databases and adjust the dates to the business calendar in order omit weekends and holidays. We thus eliminate non workdays to develop a smooth time-series without gaps due to weekends and holidays. The result is a workday time series data from January 3rd, 2001 through July 31st, 2020. Figure 5 illustrates the GFDEBTN ($ trillions) and the TSF ($ billions) trends from 2001 to 2020. TSF shows an upward trend, but with significant variation over the days, months, and years, where in some periods the fund declines dramatically to levels close to zero. Most of the decreases correspond to periods where the debt trend is flat due to being constrained by debt limit. During these constrained periods, extraordinary measures are used to support essential government activities. We therefore add a third time series that illustrates to the debt limit (or debt ceiling), which we will discuss in detail in the next section.

Figure 4:Total Public Debt (GFDEBTN) and TSF G Series Trends, 2001-2020 (Daily)



Source: Author's calculations based on the daily balance of Treasury Account 026x6153 from June 2001 through April 2019. Daily balances were downloaded using Python.

IV. The Debt Ceiling

The Treasury data source provides historical information regarding the U.S. federal government debt limit. According to Treasury, the debt limit or debt ceiling is the "total amount of money that the government is authorized to borrow to meet all existing legal obligations."[2] This restriction can be and has been modified by Congress 22 times during the 2000-2020 period. Based mainly on the work of Austin (2015) and Austin (2019)[3], we present Table 1 that shows all the dates when the debt ceiling was modified; the changes

[2] https://home.treasury.gov/policy-issues/financial-markets-financial-institutions-and-fiscal-service/debt-limit

[3] We have carried out a comparative analysis through different sources to corroborate the information on the specific dates where the debt ceiling was modified. Other sources includes The Bipartisan Policy Center (https://bipartisanpolicy.org/debt-limit-history/) and Wikipedia (https://en.wikipedia.org/wiki/History_of_United_States_debt_ceiling).

include debt ceiling increases as well as periods of debt limit suspensions. According to Treasury, increases in the debt ceiling are necessary because "failing to increase the debt limit would have catastrophic economic consequences"[4]. In the last period, Congress suspended the debt ceiling, giving room for the federal government to borrow as much as need to fund extraordinary measures taking during the COVID-19 crisis. All the debt ceiling expansions and suspensions dating back to 2001 are shown in Figure 5 along with the Total Public Debt.

Table 1: Historical Debt Ceiling Levels, 2000-2020

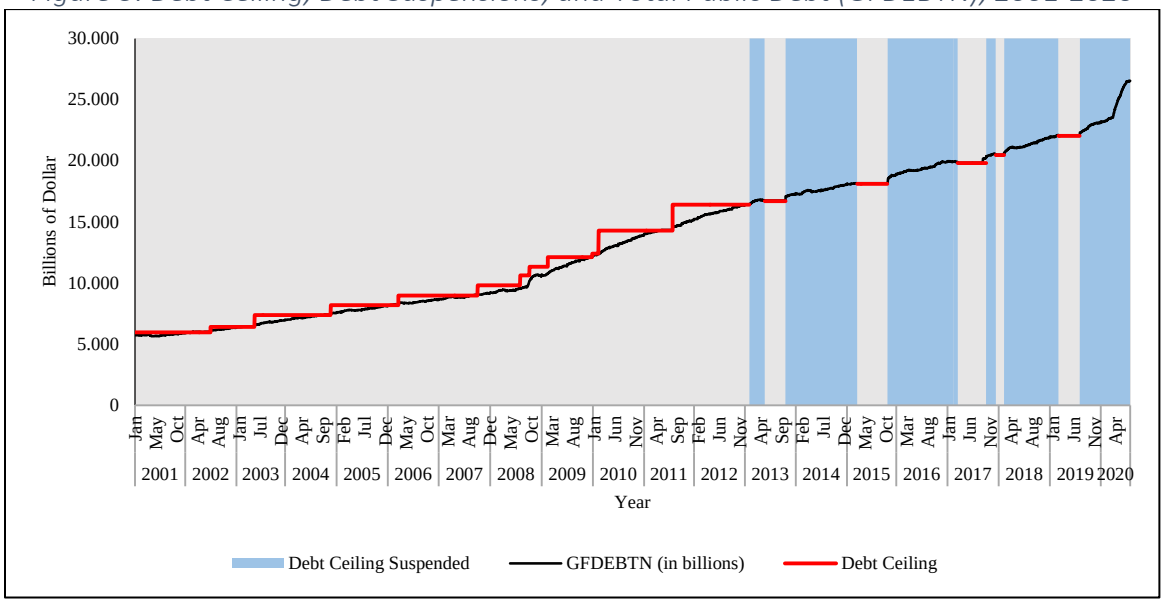
Events	Month	Day	Year	Debt Ceiling ($ Billions)
0				5,950
1	June	28	2002	6,400
2	May	27	2003	7,384
3	November	19	2004	8,184
4	March	20	2006	8,965
5	September	29	2007	9,815
6	July	30	2008	10,615
7	October	3	2008	11,315
8	February	17	2009	12,104
9	December	28	2009	12,394
10	February	12	2010	14,294
11	August	2	2011	16,394
12	February	4	2013	Suspended
13	May	19	2013	16,699
14	October	17	2013	Suspended
15	March	16	2015	18,113
16	October	30	2015	Suspended
17	March	16	2017	19,809
18	September	30	2017	Suspended
19	December	9	2017	20,456
20	February	9	2018	Suspended

[4] https://home.treasury.gov/policy-issues/financial-markets-financial-institutions-and-fiscal-service/debt-limit

21	March	2	2019	22,030
22	August	2	2019	Suspended

Source: Author's table based on Austin (2015) and Austin (2019) reports.
Note: values are in nominal terms, not adjusted by interest or inflation.

Figure 5: Debt Ceiling, Debt Suspensions, and Total Public Debt (GFDEBTN), 2001-2020



Source: Author's calculations based on Austin (2015) and Austin (2019) reports.

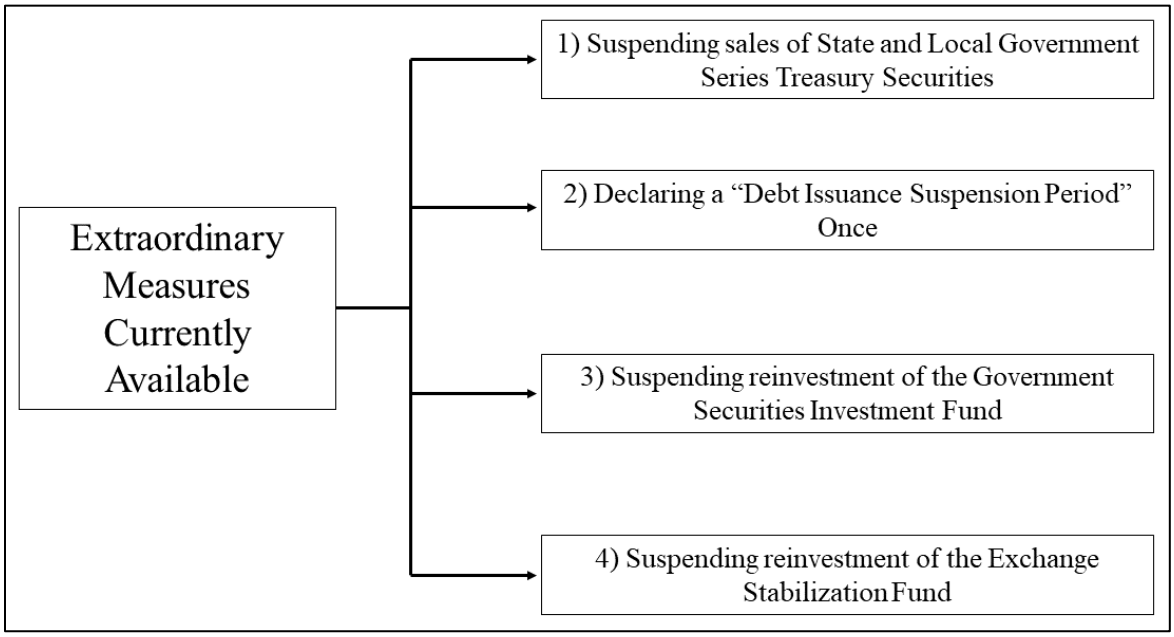
What extraordinary measures do government authorities take to fund essential services during the debt ceiling constraint periods? According to Treasury, "secretaries in both Republican and Democratic administrations have exercised the authority to take certain extraordinary measures in order to prevent the United States from defaulting on its obligations as Congress deliberated on increasing the debt limit" (U.S. Department of the Treasury, 2019). Figure 6 provides a summary of the available types of Extraordinary Measures. The third measure indicates that once the debt limit has been reached the Treasury has authority to suspend the daily reinvestment of the Treasury securities held by the TSF G Fund. According to Treasury (2019), once the debt limit is expanded or suspended, the G-Fund is made whole (which means that the Treasury is required to restore

the fund balance plus interest on the next business day). Figures 4 and 5 show that Treasury has indeed suspended the TSF G-fund many times as part of these extraordinary measures. According to U.S. Code § 8438 - Investment of Thrift Savings Fund (Section 5 (g)), the Secretary of the Treasury may suspend issuance to the G-Fund when constrained by the debt limit:

> Notwithstanding subsection (e) of this section, the Secretary of the Treasury may suspend the issuance of additional amounts of obligations of the United States, if such issuances could not be made without causing the public debt of the United States to exceed the public debt limit, as determined by the Secretary of the Treasury.

We were unable to find information about where the funds go or how they are used during these periods. If Treasury is unable to issue obligations, the funds should either be returned to a TSF account and/or held in escrow on behalf of the contributors. The funds could then be returned to the TSF fund at Treasury once debt again can be issued. However, it is unclear where these funds are being held or whether they are being used in ways that are not in the sole interests of fund contributors, the federal employees and retirees. Note that the statute requires all funds to be returned with interest once the debt suspension period ends. Contributors of the fund should be fully aware of the actions taken with their money and be compensated for the additional risk/volatility borne by the fund contributors.

Figure 6: Available Extraordinary Measures



Source: Author's compilation based on Department of the Treasury (2019).

V. Hypotheses

The discussion and data presented above provide a framework for developing several hypotheses:

1) The daily turnover de facto enables the Treasury to use the G-fund as a kind of "slush fund", which could potentially be used for a variety of purposes beyond providing fund contributors with a stable return. Given the limited publicly available data, we are not able to formally test this hypothesis.
2) During the debt constraint periods, Treasury transfers the G-Fund balance to the General Fund and uses them to pay and interest on marketable debt coming to term as well as cover required federal spending. Given the limited publicly available data, we are again not able to formally test this hypothesis. We do not have access to information on how these funds are used during the debt constraint periods. Treasury officials have not responded to our inquiries.

Government documents[5] suggest that Treasury cannot legally redeem and reissue G-Fund debt during debt constraint periods because doing so would violate the debt ceiling. However, redeeming and then reissuing debt does not increase the overall debt, but rather maintains debt and existing levels. This leads to a third testable hypothesis:

3) The variability in the TSF G-fund over time is driven to the debt constraint periods.

Next, we present a formal empirical evaluation to explain the extraordinary volatility in the G-Fund.

VI. Empirical Analysis

Data

In the previous sections, we introduced the time series of data that we will use in the empirical analysis. In summary, we compiled daily data the TSF G-Fund, total public debt and the debt ceiling. This information is used to create the variables we use to understand the relationship between the public debt, debt ceilings, and the TSF G-Fund. Before presenting our formal analysis, we provide an overview of the TSF G-Fund series and its relationship to historical events arising from debt ceiling constraints, debt ceiling expansions, and debt ceiling suspensions.

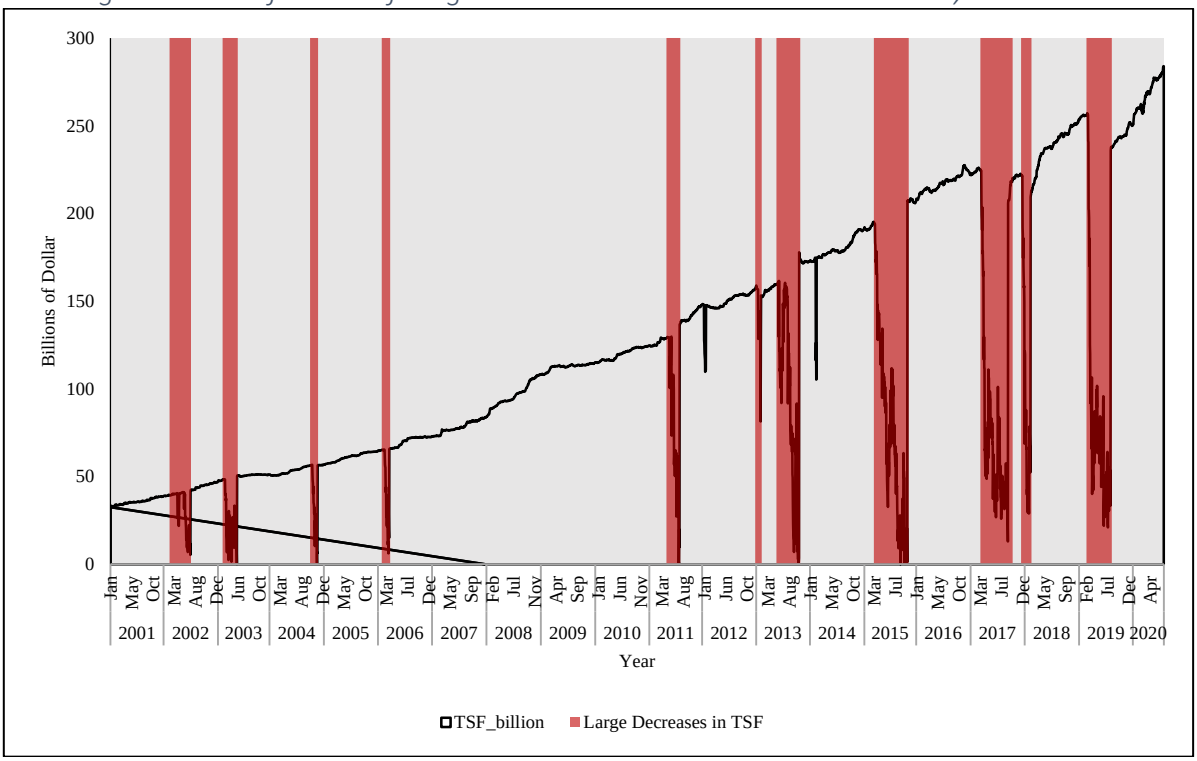
[5] The following link allows access to these documents: https://bit.ly/3upwuqv. The most pertinent documents are official letters from the Treasury Department to the Congress dating from 2011 onwards. The relevant documents for our investigation are titled *"Report to Congress on the Operation and Status of the G Fund"*, which are letters from the Secretary of the Treasury to report to Congress representatives about the operation and status of the Government Securities Investment Fund (the G Fund) of the Thrift Savings Fund during a debt issuance suspension period (each letter addresses the most recent suspension period).

Figure 7 presents TSF G-Fund trends over time where we have identified all the major balance reductions that occurred in the period between 2001 and 2020. In total, there are eleven time-intervals where the TSF experienced significant variation in daily fund balances. The beginning and end of each of these periods is marked by one of the following events.

- **FDL (Federal Debt Limit):** This variable marks the day when the Total Federal Debt (GFDEBTN) is constrained by the Debt Ceiling.[6]
- **DCE (Debt Ceiling Expansion):** This variable marks the day on which a Debt Ceiling Expansion occurs (recall that the dates of these events are found in Table 1).
- **SUSP (Suspension of the Debt Ceiling)**: This variable indicates when the debt ceiling was suspended.

[6] The measure of public debt we use does not perfectly reflect debt subject to limit. Thus, we have some cases where the debt exceeds the limit because some minor amounts of debt are not subject to the limit.

Figure 7: Identification of Large Decreases in the TSF G-Fund Balance, 2001-2020



Source: Author's calculations.

Taking into consideration Figure 7, we isolate each of the decreases into separate events. Figure 8 shows each debt ceiling constraint period overlayed with TSF G-Fund balances. For each event, we identify the historical dates related to the large decreases in the TSF G-Fund. Each event corresponds to each of the key days marked in the figure using colored vertical lines: 1) a red line for a FDL day, 2) a green line for a DCE day and 3) a purple line for a SUSP day.

Two patterns emerge in Figure 8. First, we see that the beginning is marked by a FDL day. Within days of a FDL day there is a significant decrease in the TSF G-Fund; in a number of cases the balance decreases to nearly 0, and then recovers completely once a DCE occurs. In other words, when a budget constraint is imposed, the TSF G-Fund balance

diminishes. During these periods, these funds are shifted into another account/location and may be used for unreported purposes. Once the debt ceiling is expanded or suspended, the balance restored. This pattern is observed in the first four events. The suspension of the debt ceiling becomes an instrument of budgetary relief. The fifth event begins with a FDL day, the TSF G-Fund balance decreases by nearly half, and then recovers after a SUSP day. This pattern is repeated for all subsequent events, with the difference that each fund decline begins with a FDL and ends with either a DCL or SUSP day.

Figure 8 (Part I): Large TSF G-Fund Balance Decreases and Fund Recovery

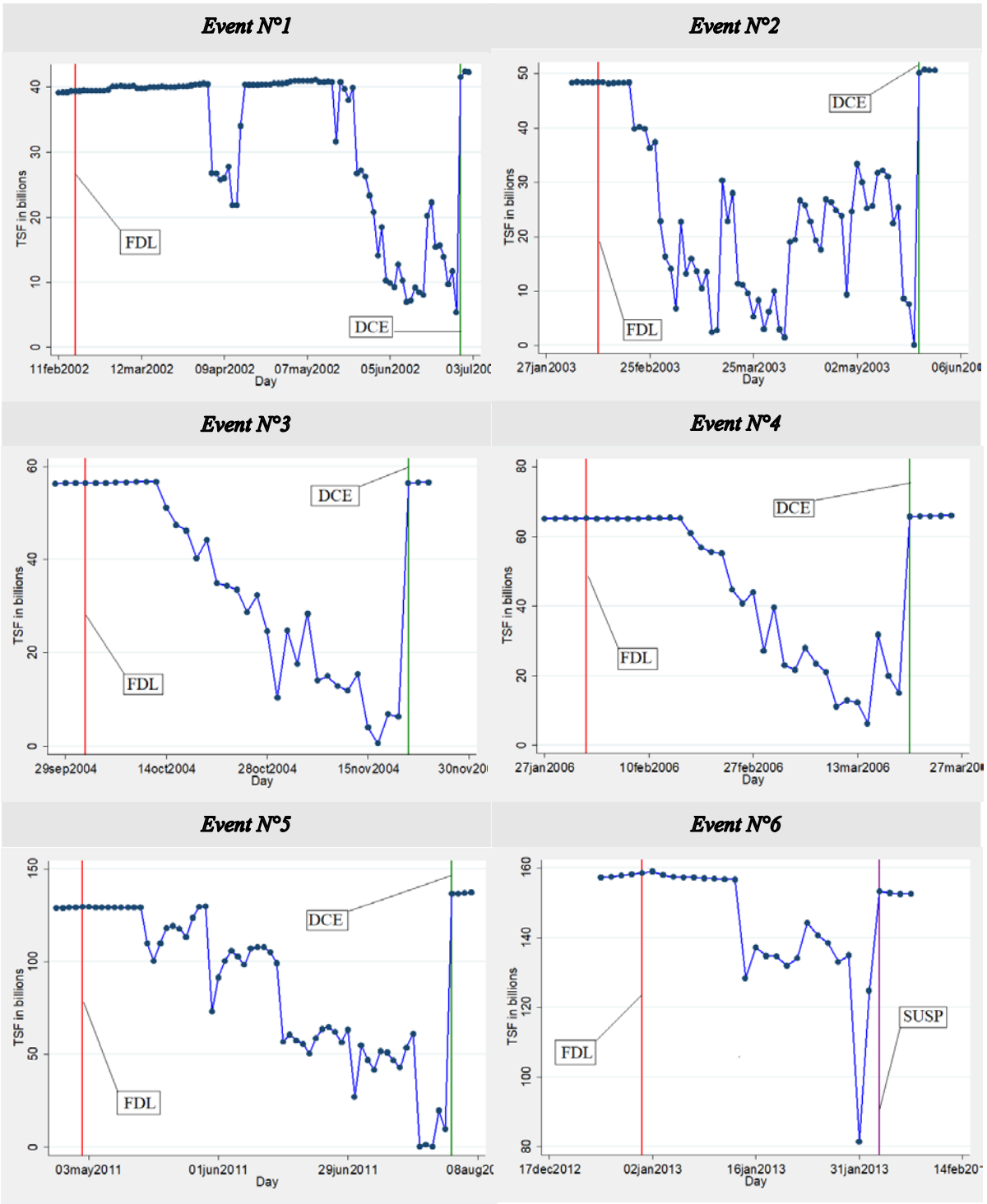
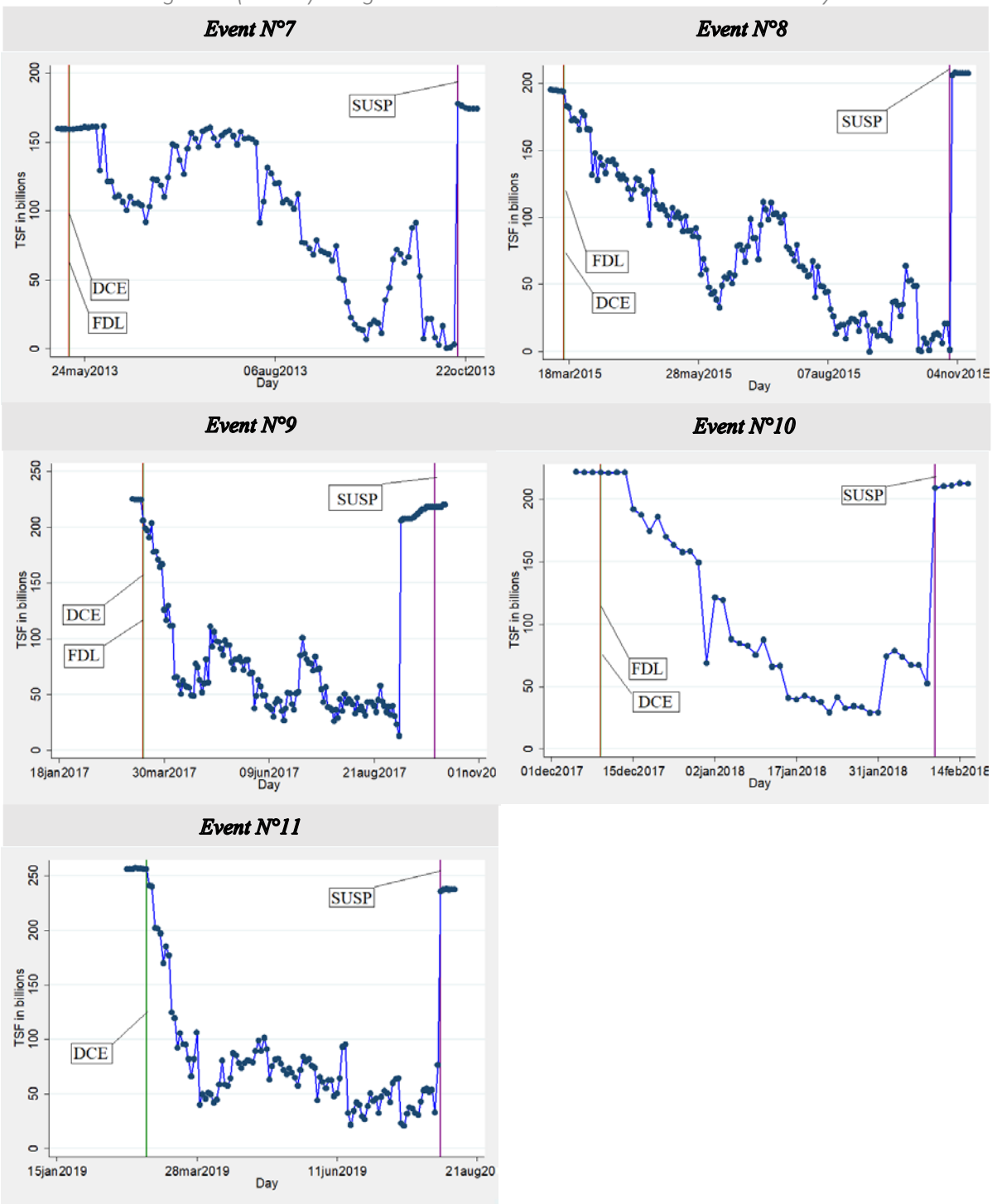


Figure 8 (Part II): Large TSF G-Fund Decreases and Fund Recovery



Source: Author's calculations.

Table 2: Descriptions of Each TSF G-Fund Decrease

Event Number (1)	Start Date (2)			End Date (3)			Number of days in the total time interval (in business days) **BP0** (4)	Number of days before full balance recovery (in business days) **BP1** (5)	Number of days only where the TSF decreases (in business days) **BP2** (6)	What is the episode that marks the beginning? (7)		What is the episode that marks the end? (8)	
	Month	Day	Year	Month	Day	Year				FDL	DCE	DCE	SUSP
1	February	15	2002	June	28	2002	93	92	29	✓		✓	
2	February	10	2003	May	27	2003	62	61	54	✓		✓	
3	October	1	2004	November	19	2004	32	31	23	✓		✓	
4	February	2	2006	March	20	2006	31	30	20	✓		✓	
5	May	2	2011	August	2	2011	57	56	46	✓		✓	
6	December	31	2012	February	4	2013	23	21	11	✓			✓
7	May	19	2013	October	17	2013	102	101	91	✓	✓		✓
8	March	16	2015	October	30	2015	149	149	148	✓	✓		✓
9	March	16	2017	September	30	2017	139	122	122	✓	✓		✓
10	December	9	2017	December	11	2017	41	40	36	✓	✓		✓
11	March	2	2019	August	2	2019	105	103	102		✓		✓

Source: Author's calculations.

Note: Column (1) indicates the event number that appears in Figure 8. Each event corresponds to a noticeable decrease in the TSF G-Fund balance. Columns (2) and (3) indicate the month, day, and year in which each event begins and ends, respectively. Column (4) indicates the total number of days the events last. Column (5) indicates the total number of days since an event began and the TSF G-Fund decreases to its minimum amount. that is, we do not count the day or days of recovery of the balance. Column (6) counts only the days in which the TSF declines. The start dates of each event are marked by a FDL or DCE day. However, when an FDL or DCE day occurs, several days may pass before the TSF G-Fund drops. Therefore, this column does not consider initial days without movement in the TSF G-Fund balance. Finally, column (7) and (8) indicate what type of day (FDL, DCE, SUSP) marks the beginning and end of each of the events.

In Table 2 we present more detailed information on each of these events. Columns (2) and (3) indicate the exact start and end date where one or two of the three days occurred: FDL, DCE, or SUSP. Columns (7) and (8) show precisely what type of day marks the beginning and end of each event. Additionally, column (4) indicates the number of days that elapse during each of the events where the TSF G-Fund declines. The average number of days is approximately 76 (business days). Column (5) indicates the number of days that occur before the TSF recovers the full balance. Notice that the number of days in column (5) will be less than the number of days in column (6), because we are not counting that small window of time where the balance recovers to the levels it had prior to when the TSF declined. Finally, column (6) indicates the number of days of the most binding period; that is, it includes only those days where the TSF G-Fund actually declined. Column (4) shows the number of days between the two vertical lines that appear in Figure 8. Likewise, for the interested reader we present Appendix Figures 4A and 5A that correspond with columns (5) and (6).

Note that we have named columns (4), (5), and (6) as *Binding Period 0* (**BP0**), *Binding Period 1* (**BP1**) and *Binding Period 2* (**BP2**), respectively. The information presented in these columns is the key for generating the independent variables that we will use in the next section. Specifically, each of these variables corresponds to an indicator variable that takes on a value of 1 during the days that we have defined as a binding period in Table 2, and 0 for the other the days in our sample. The main idea is that these variables signal the periods when the public debt is constrained by a debt ceiling, and then use this

information to explain the decreases in the TSF G-Fund balance. In the following section we provide a formal time series analysis of this relationship.

Empirical Strategy

In this section we provide the empirical strategy we use to estimate the effect of public debt behavior, debt ceiling, and debt suspension on the TSF G-Fund based on a time series econometric specification as outlined in Wooldridge (2018). We rely on the three debt ceiling measures described above as independent variables. However, by construction *BP1* and *BP2* correspond to subsets of *BP0*, just as *BP2* is also a subset of *BP1*. Mathematically, we define $t^0_{FDL,DCE}$ as the day that marks the start of a binding period which can be either a FDL, a DCE, or both as indicated in Table 2. Similarly, we define $t^1_{DCE,SUSP}$ as the day that marks the end of a binding period, which can be either a DCE or a SUSP day. Using these definitions, equations (1), (2) and (3) define the rules associated to each variable.

$$BP0_t = \begin{cases} 1 \; if \; t \in [\, t^0_{FDL,DCE}, t^1_{DCE,SUSP}] \\ 0 \qquad Otherwise \end{cases} \tag{1}$$

$$BP1_t = \begin{cases} 1 \; if \{\, t \in [t^0_{FDL,DCE}, t^1_{DCE,SUSP})\} \wedge \left\{ TSF_t < TSF_{t^1_{DCE,SUSP}} \right\} \wedge \{TSF_t - TSF_{t-1} \leq 0\} \\ 0 \qquad Otherwise \end{cases} \tag{2}$$

$$BP2_t = \begin{cases} 1 \; if \{\, t \in (t^0_{FDL,DCE}, t^1_{DCE,SUSP})\} \wedge \left\{ TSF_t < TSF_{t^0_{FDL,DCE}} \right\} \wedge \left\{ TSF_t < TSF_{t^1_{DCE,SUSP}} \right\} \wedge \{TSF_t - TSF_{t-1} \leq 0\} \\ 0 \qquad Otherwise \end{cases} \tag{3}$$

Each variable imposes additional restrictions to the set that is included in the binding period. $BP0_t$ takes a value of 1 for the days that are in between the binding period including the first and last day marked by a FLD, DCE or SUSP, and 0 otherwise. $BP1_t$ takes the value of 1 for the days that are included in the binding period but without taking

into account the last day, because the TSF G-Fund balance had already recovered by that time. Hence, the two additional restrictions imposed with $BP1_t$ is such that this variable takes on value of 1 only when the balance is decreasing and until it reaches the lowest point. Finally, $BP2_t$ takes the value of 1 only for the period where the TSF G-Fund decreases, which is a subset of the whole period $[\, t^0_{FDL,DCE}, t^1_{DCE,SUSP}]$. Because the three variables are similar and the interpretation is the same, for ease of notation from this point forward we collapse the notation to BP_t to refer to the three variables. Due to the stylized facts emerging from Figure 8, we expect a negative effect from BP_t to TSF_t and hence, negative regression coefficients associated with these variables.

The first time series model we use is the Geometric Distributed Lag (GDL) model, which is a simplification of the more generalized Infinite Distributed Lag (IDL). The IDL is specified by equation (4), where TSF_t is the balance of the TSF G-Fund in time t, BP_t is a dummy variable that takes the value of 1 if we are in the interval of the binding period from Table 2 and 0 otherwise, α is the intercept and u_t is the error term.

$$TSF_t = \alpha + \delta_0 BP_t + \delta_1 BP_{t-1} + \delta_2 BP_{t-2} + \cdots + u_t \tag{4}$$

The binding period begins when the debt is constrained by the debt ceiling and ends after a debt ceiling expansion or suspension. The TSF G-Fund decreases in response to being constrained by the debt ceiling and then increases once the debt ceiling is either expanded or suspended. Therefore, the TSF G-Fund balance depends on BP and potentially its lagged values. Hence, the next question is how many lags we need to accurately model this relationship. The IDL model proposes infinite lags which is empirically impossible to implement; however, by making assumptions we simplify the model to create an estimable

equation. Consequently, we assume that δ_j depends on two parameters, γ and ρ, such that $\delta_j = \gamma\rho^j$ for all $j = 0,1,2, ...$, with the restriction that $|\rho| < 1$. This restriction ensures that $\delta_j \to 0$ as $j \to \infty$, which means that the impact of BP_{t-j} on TSF_t will decrease as j becomes larger. The intuition behind this assumption is that time lags of BP will at some point end in terms of identifying days outside the binding period, and therefore the days where the TSF G-Fund balance is no longer affected. Applying this assumption to equation (4) results in equation (5). If we lag equation (5) over one period and then multiply by ρ, we obtain equation (6). Finally, if we subtract (6) from (5) we obtain the equation to be estimated in (7), where $\alpha_0 = \alpha(1-\rho)$ and $v_t = u_t + \rho u_{t-1}$.

$$TSF_t = \alpha + \gamma BP_t + \gamma\rho BP_{t-1} + \gamma\rho^2 BP_{t-2} + \cdots + u_t \tag{5}$$

$$\rho TSF_{t-1} = \rho\alpha + \gamma\rho BP_{t-1} + \gamma\rho^2 BP_{t-2} + \gamma\rho^3 BP_{t-3} + \cdots + \rho u_{t-1} \tag{6}$$

$$TSF_t = \alpha_0 + \rho TSF_{t-1} + \gamma BP_t + v_t \qquad for\ t = 1,2, ... \tag{7}$$

There are two important features about equation (7) that must be discussed. First, one of the assumptions to obtain consistent estimates from an OLS estimator is the zero-correlation assumption, meaning that $E(\boldsymbol{x_t}'u_t) = \mathbf{0}$. However, by construction we have $E(TSF_{t-1}u_t) \neq 0$, even assuming independence between u_t with respect to BP_t and all past values of TSF_t and BP_t. Therefore, assuming BP_t is exogenous, we need an instrumentalized TSF_{t-1} in equation (7). Since u_t and u_{t-1} are uncorrelated with BP_{t-1}, the most suitable instruments to estimate (7) are BP_t, and BP_{t-1}. In this case, we estimate equation (7) with Instrumental Variables (IV) and adjust by serial correlation in v_t. Second, we exploit the fact that $\{u_t\}$ may contain a specific kind of serial correlation such

as assuming that $\{u_t\}$ follows an AR(1) model, as indicated by equation (8), with $E(e_t) = 0$ and $Var(e_t) = \sigma_e^2$.

$$u_t = \rho u_{t-1} + e_t \tag{8}$$

Using the assumption from equation (8) we restate equation (7) as a dynamically complete model as shown in equation (9). This model can be estimated by OLS, providing consistent estimates. Nevertheless, obtaining consistent estimates depends greatly on the assumption that $\{u_t\}$ follows an AR(1) model, which implies that ρ is the same parameter in equations (8) and (9). We use McClain & Wooldridge (1995) to test this assumption. Finally, it is worth noting that due to the nature of the underlying geometric series in this model, the long-run propensity (LRP) impact is $\gamma/(1-\rho)$, and can be generated from the regression coefficients.

$$TSF_t = \alpha_0 + \rho TSF_{t-1} + \gamma BP_t + e_t \tag{9}$$

In addition to the GDL model, we also use a more general model called Rational Distributed Lag (RDL). Following the same notation as in the previous equations, the RDL model can be specified as it appears in equation (10), which now includes a lag of BP_t as an additional independent variable. The LRP in this case is $(\gamma_0 + \gamma_1)/(1-\rho)$.

$$TSF_t = \alpha_0 + \rho TSF_{t-1} + \gamma_0 BP_t + \gamma_1 BP_{t-1} + v_t \qquad for\ t = 1,2,\ldots \tag{10}$$

Below, we present the findings from both models with their LRP specifications to estimate the effect of BP_t on TSF_t.

Results

Before presenting the formal regression analysis, we must establish whether the process that the TSF data follows is a unit root process or a stationary series. This is

important because a unit root process implies that a shock in a contemporaneous time has a long-lasting impact, and therefore, the trend is deterministic. Consider the following AR(1) model for the TSF data.

$$TSF_t = \alpha + \rho TSF_{t-1} + e_t \qquad t = 1,2, \ldots \tag{11}$$

If $\{TSF_t\}$ follows (11), then it has a unit root process if and only if $\rho = 1$. Notice that if $\alpha = 0$ and $\rho = 1$, $\{TSF_t\}$ follows a random walk without drift. Likewise, if $\alpha \neq 0$ and $\rho = 1$, $\{TSF_t\}$ follows a random walk with drift. We subtract TSF_{t-1} from both sides of equation (11) to obtain equation (12)

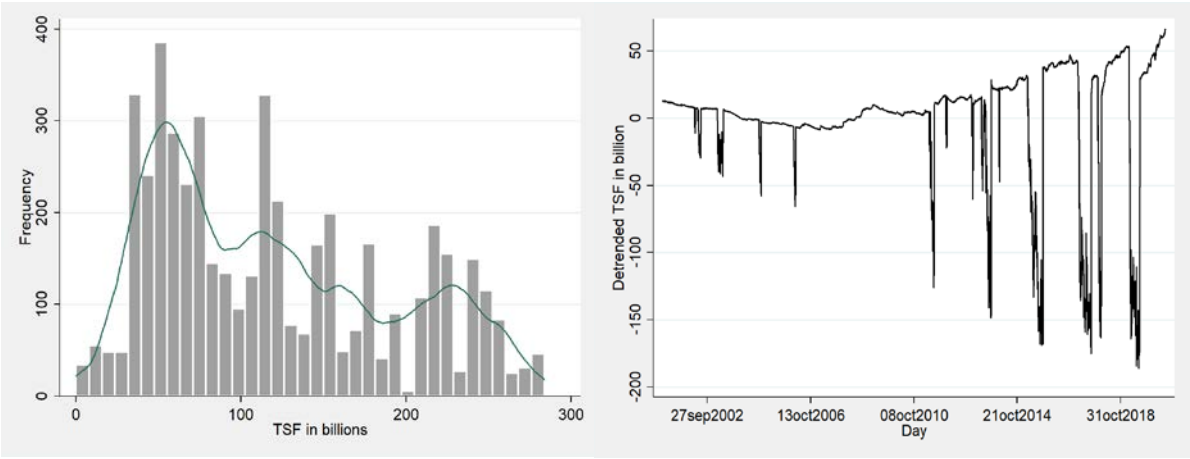
$$\Delta TSF_t = \alpha + \theta TSF_{t-1} + e_t\,, \;\; t = 1,2, \ldots \tag{12}$$

where $\theta = \rho - 1$, and assuming that the model is dynamically complete, we test the following hypothesis, $H_0: \theta = 0$ against $H_1: \theta < 0$. Under the null hypothesis, the usual t statistic does not apply and so we must use the Dickey-Fuller distribution. We also test whether $\{TSF_t\}$ follows a trend-stationary process. This can be done by modifying equation (12) to include a time trend as an explanatory variable.

Before testing the unit root hypothesis, we briefly describe the statistical properties of the dependent variable. Figure 9 (left) shows the distribution of the TSF G-Fund in $ billions, which reveals a distribution with positive skewness that ranges from 0.05 (minimum value) to 283.91 (maximum value). The sample mean value correspond to approximately 119, while the median value and standard deviation are approximately $108 and $71 billion, respectively. The result of the unit root test is presented in Table 3, which shows the estimation of equation (12) with and without a time trend. Note that in the literature these tests are known as Dickey-Fuller and Augmented Dickey-Fuller test. As

shown in Table 3, we reject the null hypothesis that the process is unit root at the 1% significance level for both types of models. Therefore, we can safely use the asymptotic theory to establish statistical significance in the remainder of the analysis. Finally, in Figure 9 (right) we plot the detrended TSF G-Fund, which corresponds to our dependent variable from this point forward.

Figure 9: Histogram and Detrended TSF Plots



Source: Author's calculations.
Note: Left side: histogram of TSF in billions of dollars with a kernel density estimate. Right side: graph of the residuals from the regression in column (3) of Table 3, which means the detrended TSF.

Table 3: Dickey-Fuller, Augmented Dickey-Fuller Test and Detrended TSF G-Fund Regression

	(1) AR1 (TSF)	(2) AR1 with time trend (TSF)	(3) Detrended TSF
TSF_{t-1}	-0.00623***	-0.01809***	
	(0.00165)	(0.00273)	
$Time\ Trend$		0.00075***	0.04063***
		(0.00014)	(0.00044)
$Constant$	0.7914***	0.36398	118.7923***
	(0.22847)	(0.24102)	(0.61579)
Observations	4,864	4,864	4,864

MacKinnon approximate p-value	0.0031		0.0000		
	Test Statistic	1% Critical Value	Test Statistic	1% Critical Value	
Dickey-Fuller Test	-3.778	-3.430	-6.617	-3.960	

Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Note: Column (1) and (2) show the Dickey-Fuller and Augmented Dickey-Fuller test, respectively. The dependent variable in these regressions is $\Delta TSF_t = TSF_t - TSF_{t-1}$. Column (3) show the regression to detrend the dependent variable TSF_t.

Table 4 presents results from the different econometric specifications as discussed in the previous section. The GDL (OLS) correspond the linear model in equation (9) which assumes that the error term follows a specific form of autocorrelation. The GDL (IV) estimates equation (7) by IV without assuming any form regarding the autocorrelation in the error term. Finally, the RDL estimates equation (10) by explicitly including the lag of the independent variable. Columns (1), (2), and (3) use the variable BP0 in the regressions, columns (4), (5), and (6) use the BP1 variable and columns (7), (8), and (9) use the BP2 variable. All standard errors are robust to heteroskedasticity and autocorrelation in the GDL (IV) and RDL estimations.

First, we discuss the results for the variable BP0. If we assume that the error term follows the assumption of equation (8), then as shown in column (1) the average effect of being in the binding period 0 is a decrease in the TSF of about $3.5 billion. Additionally, this model implies a long-run propensity effect of approximately -88, which mean that being in the binding period 0 leads to a long-run decline in the TSF of about $88 billion. We use McClain & Wooldridge (1995) to test the assumption on the error term process. The procedure involves the construction of an LM test for the AR(1) serial correlation and

a common coefficients regression. The null hypothesis is that the parameter ρ in equation (8) is the same as in equation (7). We obtain an LM test statistic of 17.85 (associated to a p-value of 0.000133) which provides evidence against the null hypothesis. Therefore, we proceed to estimate the linear model by an IV estimator (see column 2). Recall that the instrument that we are using is the lag of the BP0 variable, assuming exogeneity in the contemporaneous effect of BP0 on the TSF G-Fund. In this case, the magnitude of the estimate is larger (it implies a decrease in $16 billion) but it is not statistically significant. Finally, we calculate the RDL specification (see column 3), where we find that the decrease is almost $12 billion but again is not statistically significant.

Second, we analyze the results for the variables BP1 and BP2. Using the same test as was used previously, we rule out in both cases that the error term follows the assumption reflected in equation (8). Thus, even though we do not have full confidence in the OLS estimates, we still present these results in Table 4 for comparison. In the case of the IV regression, we find that being in the binding period 1 decreases the TSF in $42 billion on average, while being on the binding period 2 decreases the TSF in about $52 billion. Both estimates are statistically significant at the 1% level. When we include the lag dependent variable in the RDL, the estimated effects correspond to a decrease in the TSF of $52 billion and nearly $60 billion in the two cases, respectively. In general, the better fitting model is the RDL based on the R-squared measure. Additionally, in all cases we calculate the long-run propensity impact, but we focus on the last regression found column (9). This LRP estimate corresponds to a negative impact of almost $124 billion. In other words, being in the binding period 2 situation, which implies a situation where the TSF abruptly

decreases due to a debt ceiling constraint, leads to a substantial decline in the TSF G-Fund of $124 billion in the long run. Note, however, that once the debt ceiling is expanded or suspended, the fund balance returns to the pre-emergency amounts.

Table 4: Result of the three econometric specifications using in each regression the three key variables: BP0, BP1 and BP2.

	(1) GDL (OLS)	(2) GDL (IV)	(3) RDL	(4) GDL (OLS)	(5) GDL (IV)	(6) RDL	(7) GDL (OLS)	(8) GDL (IV)	(9) RDL
$\widehat{TSF_{t-1}}$	0.961***	0.801***	0.963***	0.941***	0.499***	0.964***	0.925***	0.461***	0.958***
	(0.00379)	(0.154)	(0.00787)	(0.00372)	(0.106)	(0.00672)	(0.00404)	(0.0933)	(0.00774)
$BP0$	-3.475***	-16.10	-11.42						
	(0.429)	(12.75)	(9.027)						
$BP0_{t-1}$			8.228						
			(8.688)						
$BP1$				-6.734***	-42.14***	-52.00***			
				(0.427)	(10.74)	(14.33)			
$BP1_{t-1}$						47.91***			
						(14.09)			
$BP2$							-9.313***	-52.33***	-59.48***
							(0.496)	(10.79)	(13.47)
$BP2_{t-1}$									54.31***
									(13.17)
Constant	0.614***	2.805	0.565***	1.141***	7.082***	0.698***	1.339***	7.470***	0.748***
	(0.138)	(2.199)	(0.144)	(0.135)	(1.705)	(0.159)	(0.134)	(1.572)	(0.169)
LRP	-88.0714	-80.7851	-85.0930	-114.2817	-84.0239	-114.9324	-123.3653	-97.1679	-123.9574
Observations	4864	4864	4864	4864	4864	4864	4864	4864	4864
R^2	0.964	0.951	0.964	0.965	0.865	0.971	0.966	0.875	0.973

Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: In all regressions the dependent variable is the detrended TSF in billions of dollars. Each column indicates the econometric specification we are using: Geometric Distributed Lag (GDL) by OLS and by IV estimators, and Rational Distributed Lag (RDL). Columns (1), (2), and (3) use the variable BP0 in the regressions, columns (4), (5), and (6) use the variable BP1 in the regressions, and columns (7), (8), and (9) use the variable BP2 in the regressions. Column (1), (4) and (7) show non-robust standard errors assuming that equation (8) holds. Columns (2), (3), (5), (6), (8) and (9) use HAC standard errors by Newey-West estimator, assuming an automatic bandwidth of 48.

VII. Conclusion

In this paper we document the relationship between the federal debt, the federal debt ceiling and the TSF G-Fund daily balance. We show clearly with our analyses that during periods when the federal debt is constrained by a debt ceiling the TSF G-Fund balance decreases by almost $60 billion on average, with a long-term effect of a decrease of nearly $124 billion. For context, on July 31st, 2020 (the last day available in our data) the balance of the TSF was $284 billion. We also document the fact that for reasons that are unclear, Treasury holds the entire G-Fund balance in one-day securities that are redeemed and reissued every business day. This generates about $55 trillion in security redemptions and reissuance annually. Though we reached out to Treasury to ask questions about the management of the G-Fund, we have not received a response.

Given that the TSF has a stated passive investment strategy, we would expect that very stable fund balances with all the TSF funds, and especially the G-Fund. With the sole fiduciary responsibility of managing the G-Fund in a way that serves the interest government employees and retirees who contributed to the fund, we are unaware of any rationale that could justify the use of one-day securities or the fund balance variability exhibited in this fund. Treasury indicates that debt constraint periods prevent the issuance of obligations for the fund, which is the rationale for pulling funds out of the G-Fund and holding them elsewhere, possibly the general fund. It is also possible that these are being used during the debt constraint periods of meet other obligations. Given this information, we ask two questions: 1) If the G-Fund was composed of longer-term securities instead of one-day securities, there would be no need to redeem and reissue the obligations. Why

hold the entire G-Fund in one-day securities? 2) Given that fund is exclusively composed of one-day securities, it redeems and reissues the notes every business day. How does redeeming and reissuing the balance of the entire G-Fund on a daily basis on net increase the federal debt beyond the limit? The total debt does not change. The patterns in the G-Fund daily balance documented in this paper raise additional questions:

- Does the decision to hold the entire G-Fund balance in one-day securities give Treasury greater flexibility in managing those funds, and if so, what other purposes does the fund serve?
- Is the volatility in the TSF G-Fund we document consistent with the stated passive (and secure/stable) investment strategy articulated by the TSF?
- Are federal employees and retirees who have made contributions to the G-Fund aware of the fluctuations in their retirement savings? Would the contributors approve of such volatility if they were aware of what was happening with their retirement savings?
- Given the volatility of the G-Fund, should TSF contributors be compensated for the additional risk they assume?
- Is holding the entire G-Fund balance in one-day securities in the best interests of G-Fund contributors?

Our goal in preparing this manuscript is to shed light on the Treasury's management of this fund. We hope our evaluation increases transparency and ultimately causes Treasury officials and Congress to carefully reexamine the management of the retirement savings of more than 6 million contributors. Last, given the extraordinary measures taken by the

federal government during the COVID-19 crisis in terms of $ trillions in debt expansion in 2020, 2021 and beyond coupled with $ trillion in monetary interventions, the risks to the economy and by extension the potential for instability within debt markets is a concern. In August2021, the debt suspension that was authorized in 2019 will come to an end. Once again, Treasury may undertake "extraordinary" measures that include suspending the issuance of obligations for the TSF G-Fund. TSF contributors should be made fully aware of how the G-Fund is managed; it is the fiduciary responsibility of the TSF Board and Executive director to provide information and act in the sole interests of fund contributors.

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VIII. Appendix

A1. Table of Total Issuance, Total Redemption and Total Public Debt Subject to Limit

Fiscal Year	Total Issues	Total Redemptions	Total Public Debt Subject to Limit
2000	17,128	17,110	5,568
2001	17,935	17,802	5,592
2002	21,313	20,893	5,733
2003	25,539	24,984	6,161
2004	39,445	38,849	6,738
2005	38,414	37,860	7,333
2006	36,485	35,911	7,871
2007	38,744	38,243	8,420
2008	43,137	42,120	8,921
2009	54,417	52,532	9,960
2010	65,432	63,781	11,853
2011	65,198	63,969	13,511
2012	68,683	67,407	14,747
2013	62,163	61,492	16,027
2014	69,814	68,728	16,699
2015	60,775	60,449	17,781
2016	95,649	94,226	18,113
2017	85,856	85,185	19,538
2018	100,238	98,966	20,209
2019	91,617	90,413	21,475
2020	121,649	117,424	22,687

Source: Author's calculations based on U.S. Department of the Treasury information.
Note: Values are rounded in billions of US nominal dollars.

Fiscal Year	Issues		Total Issues	Redemptions		Total Redemptions	Total Public Debt Subject to Limit
	Marketable	Nonmarketable		Marketable	Nonmarketable		
2000	1,998	15,130	17,128	2,207	14,903	17,110	5,568
2001	2,477	15,459	17,935	2,570	15,232	17,802	5,592
2002	3,693	17,621	21,313	3,487	17,406	20,893	5,733
2003	4,139	21,399	25,539	3,815	21,168	24,984	6,161
2004	4,604	34,841	39,445	4,218	34,631	38,849	6,738
2005	4,480	33,934	38,414	4,241	33,619	37,860	7,333
2006	4,425	32,060	36,485	4,207	31,704	35,911	7,871
2007	4,434	34,310	38,744	4,289	33,954	38,243	8,420
2008	5,537	37,600	43,137	4,749	37,371	42,120	8,921
2009	8,855	45,562	54,417	7,081	45,451	52,532	9,960
2010	8,421	57,012	65,432	6,932	56,848	63,781	11,853
2011	7,851	57,346	65,198	6,725	57,244	63,969	13,511
2012	7,590	61,093	68,683	6,465	60,943	67,407	14,747
2013	8,028	54,135	62,163	7,182	54,310	61,492	16,027
2014	7,238	62,576	69,814	6,540	62,188	68,728	16,699
2015	6,946	53,829	60,775	6,386	54,062	60,449	17,781
2016	8,054	87,594	95,649	7,248	86,978	94,226	18,113
2017	8,646	77,210	85,856	8,107	77,078	85,185	19,538
2018	9,993	90,244	100,238	8,915	90,051	98,966	20,209
2019	11,734	79,882	91,617	10,665	79,748	90,413	21,475
2020	18,681	102,969	121,649	14,653	102,770	117,424	22,687

A2. Marketable and Nonmarketable Issues, Marketable and Nonmarketable Redemptions and Public Debt Subject to Limit

Source: Author's calculations based on U.S. Department of the Treasury information.
Note: Values are rounded in billions of US nominal dollars.

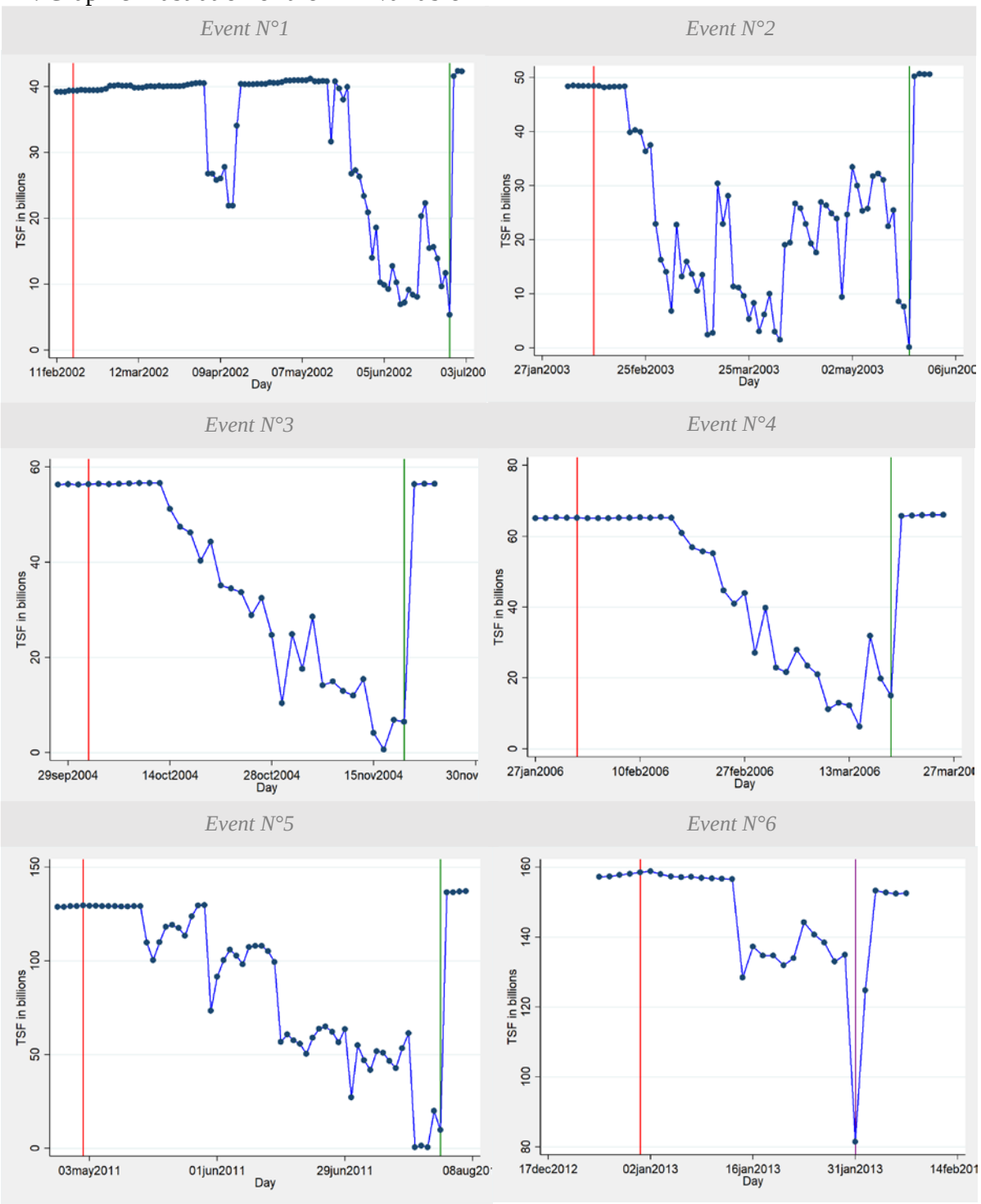
Fiscal Year	Issues		Redemptions		Total Public Debt Subject to Limit
	Marketable	Gov. Account Series (Issues)	Marketable	Gov. Account Series (Redemptions)	
2000	1,998	15,086	2,207	14,837	5,568
2001	2,477	15,384	2,570	15,146	5,592
2002	3,693	17,518	3,487	17,303	5,733
2003	4,139	21,231	3,815	21,026	6,161
2004	4,604	34,675	4,218	34,457	6,738
2005	4,480	33,766	4,241	33,515	7,333
2006	4,425	31,955	4,207	31,613	7,871
2007	4,434	34,145	4,289	33,840	8,420
2008	5,537	37,493	4,749	37,222	8,921
2009	8,855	45,384	7,081	45,227	9,960
2010	8,421	56,763	6,932	56,572	11,853
2011	7,851	57,089	6,725	56,941	13,511
2012	7,590	60,747	6,465	60,601	14,747
2013	8,028	53,807	7,182	53,943	16,027
2014	7,238	62,250	6,540	61,841	16,699
2015	6,946	53,508	6,386	53,707	17,781
2016	8,054	87,218	7,248	86,627	18,113
2017	8,646	76,916	8,107	76,749	19,538
2018	9,993	89,968	8,915	89,761	20,209
2019	11,734	79,609	10,665	79,453	21,475
2020	18,681	102,430	14,653	102,367	22,687

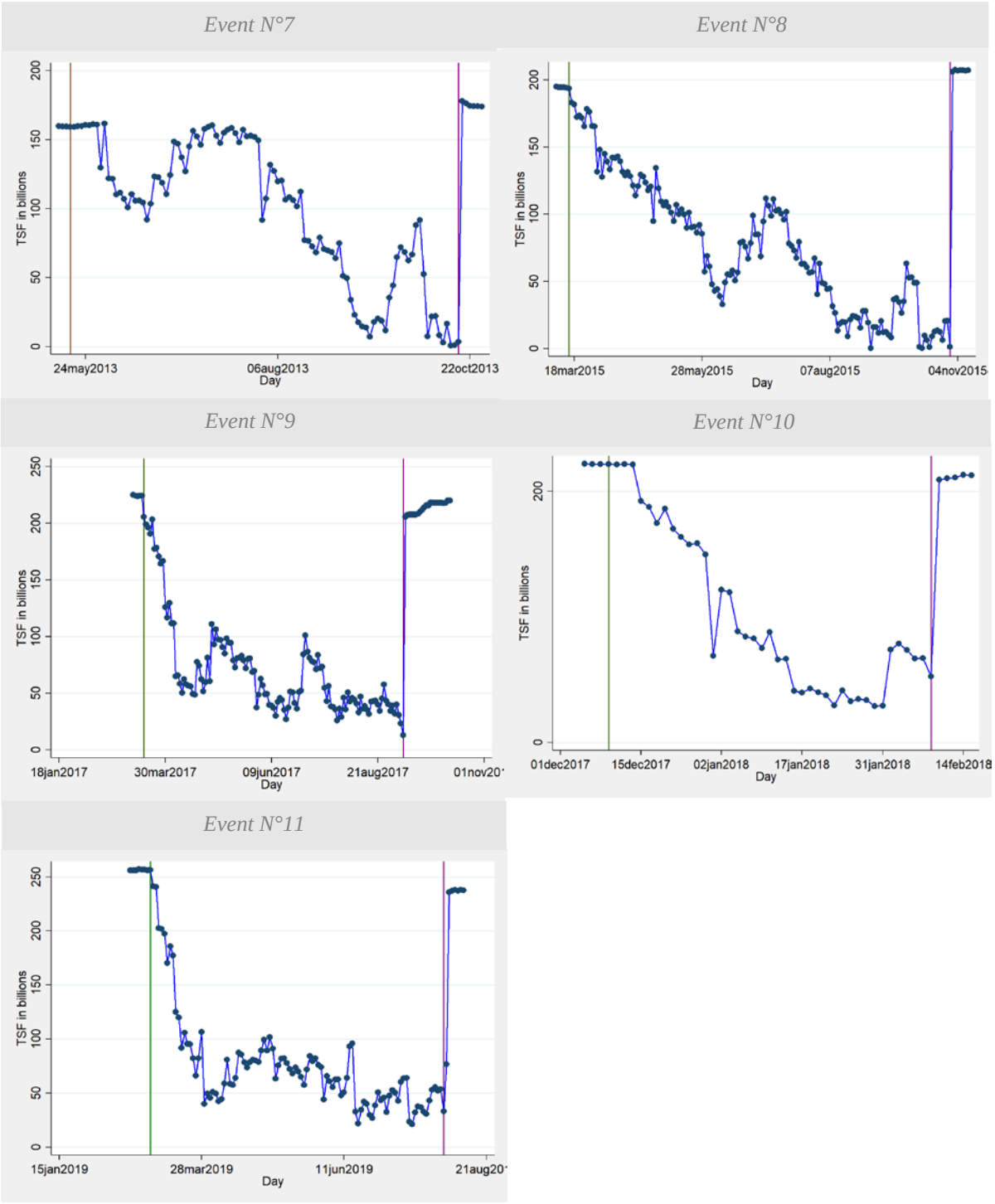
A3. Marketable and Nonmarketable Issues, Marketable and Nonmarketable Redemptions and Public Debt Subject to Limit

Source: Author's calculations based on U.S. Department of the Treasury information.

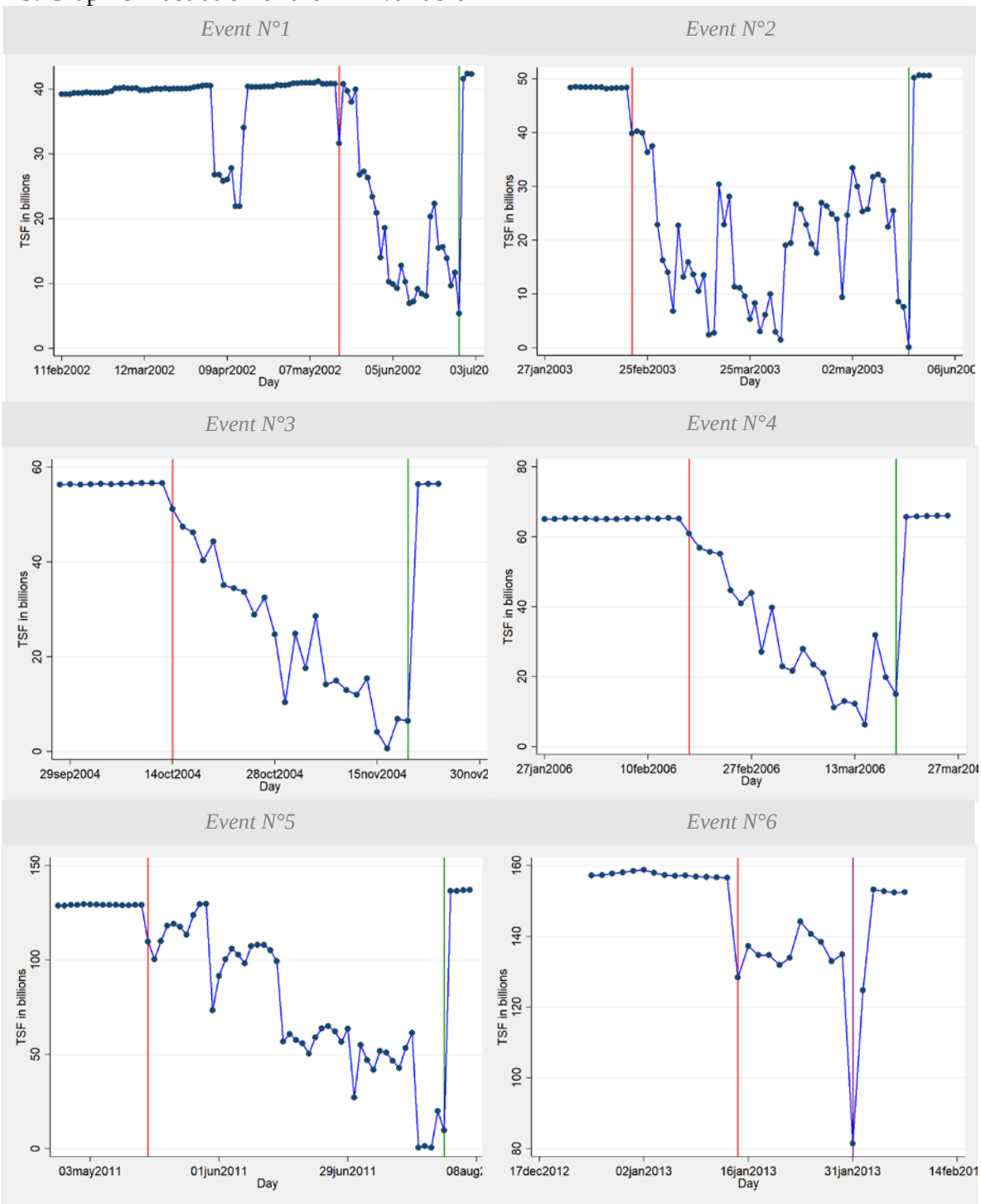
Note: Values are rounded in billions of US nominal dollars.

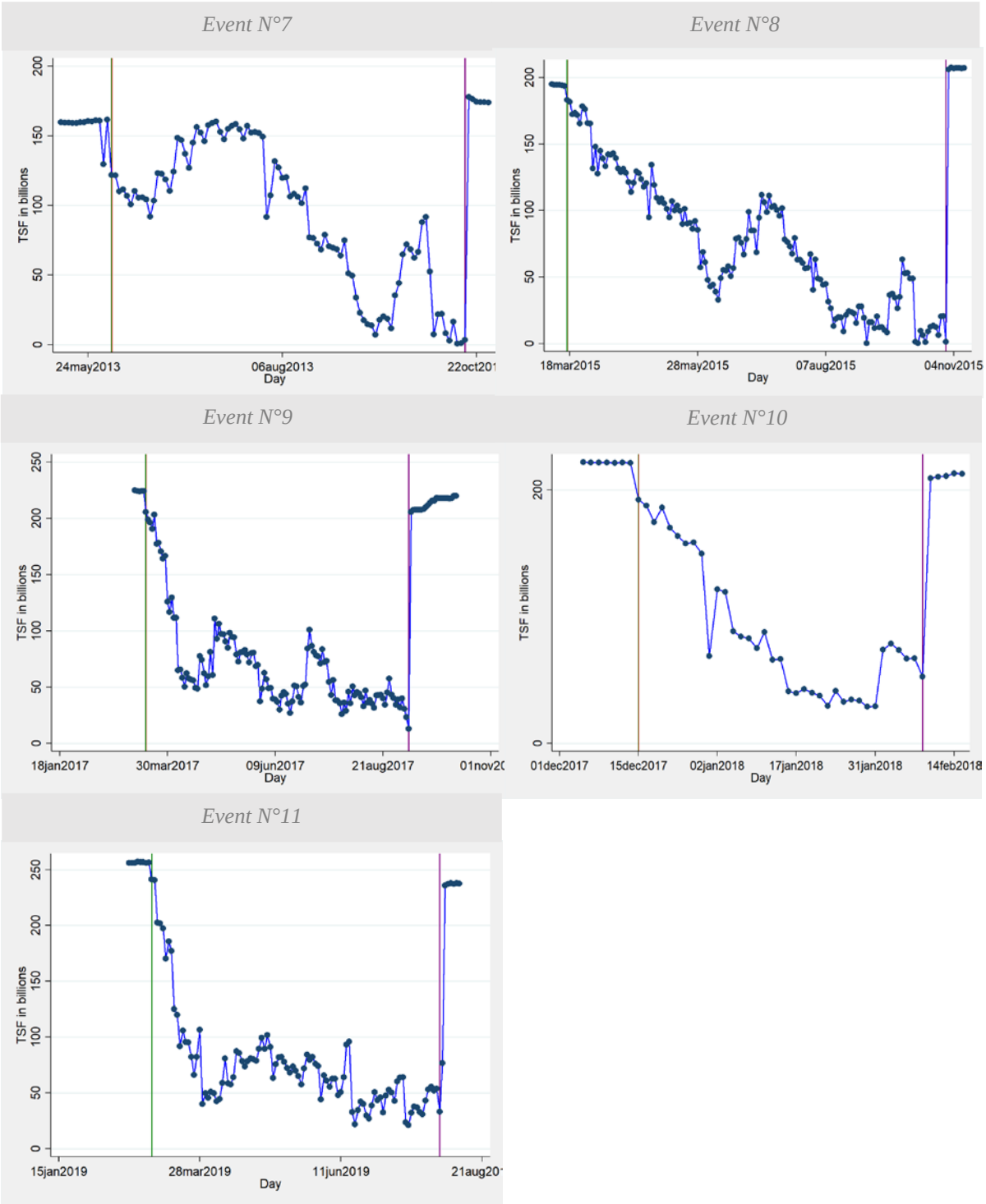
A4. Graphic illustration of the BP1 variable




Event N°7
TSF in billions
0
50
100
150
200
24may2013
06aug2013
22oct2013
Day
Event N°8
TSF in billions
0
50
100
150
200
18mar2015
28may2015
07aug2015
04nov2015
Day
Event N°9
TSF in billions
0
50
100
150
200
250
18jan2017
30mar2017
09jun2017
21aug2017
Day
Event N°10
TSF in billions
0
200
01dec2017
15dec2017
02jan2018
17jan2018
31jan2018
14feb2018
Day
Event N°11
TSF in billions
0
50
100
150
200
250
15jan2019
28mar2019
11jun2019
Day

A5. Graphic illustration of the BP2 variable




Event N°7
TSF in billions
0
50
100
150
200
24may2013
06aug2013
22oct201
Day
Event N°8
TSF in billions
0
50
100
150
200
18mar2015
28may2015
07aug2015
04nov2015
Day
Event N°9
TSF in billions
0
50
100
150
200
250
18jan2017
30mar2017
09jun2017
21aug2017
01nov20
Day
Event N°10
TSF in billions
0
200
01dec2017
15dec2017
02jan2018
17jan2018
31jan2018
14feb2018
Day
Event N°11
TSF in billions
0
50
100
150
200
250
15jan2019
28mar2019
11jun2019
21aug20
Day