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REEXAMINING THE NATIONAL DEBT: A THEORETICAL FRAMEWORK FOR MANAGEMENT

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Abstract

It is well known that when government debt as a percentage of GDP exceeds a critical point, it becomes disastrous (Checherita and Rother, 2010). The national debt has reached a nearly unbelievable level, leaving policymakers, government officials, and the general public worried. The United States has only ran a surplus 4 years- 1998 to 2001- which has allowed for quite the compounding of debt. As the national debt per capita increases, the probability of the government defaulting on its debt service obligation does as well. This in turn mandates a higher yield on newer bonds. As the rates go up, government spending is shifted from other sources- such as domestic welfare programs- to paying interest and makes borrowing more difficult. This paper thoroughly analyzes the current national debt, the methods for management, and provides a theoretical framework for future reduction based on previous years' data. The equations and functions derived in the theoretical framework reveal that implementing alternative methods could possibly be more successful than current methods, both short and long term.
Keywords: Debt, Debt Management, Economic Growth, Econometric models (single equation), Government Bonds, National Debt, Sovereign Debt, Sovereign Debt Default, Treasury Securities

I. INTRODUCTION

Nowadays, an essential issue to be analyzed in depth is the current U.S. national debt and the potential benefits associated with its reduction. The current U.S. national debt is 21 Trillion dollars. This figure is rapidly increasing and shows no sign of slowing down. Many different factors contribute to this astronomical number, however, one of the most significant is the sale of securities. Other factors that contribute to the rising debt include: healthcare programs (including Medicare & Medicaid), social security program/pensions, defense budget expenses, transportation, veteran benefits, international affairs, education and training, etc.

There is a negative effect of debt ratio and financial crisis on economic growth. This is proven by combining the results of Kumar & Jaejoon (2010), Reinhart & Rogoff (2010, 2011), and Afonso & Jalles (2013). In Kourtellos et al. (2013), a structural threshold regression method was used to determine the effects of public debt on economic growth. The authors found evidence of an inverse relationship between growth and degree of democracy.

The aim of this paper is to analyze the current debt and provide a theoretical framework which allows for alternative methods to those in place today.
The rest of the paper is organized as follows. In the second section, I will provide additional context and statistical information necessary to understand current deficit/surplus conditions. In the third section, I introduce my theoretical framework on the basis of producing sustainable debt reduction through alternatives, as well as arguing against current methods. In the final section, I will present my conclusion.

II. CURRENT NATIONAL DEBT CONDITIONS

The Federal Debt Summarized

The following statistical data is largely comprised of the March 2018 Bureau of the Fiscal Service report; it provides a fundamental background in understanding the debt, using the most updated figures.
Table 1.1 presents the roughly consistent level of daily trading volume of the treasury securities from 2000 to 20161. There is a diverse spectrum of the owners of U.S. securities (treasury bills, treasury bonds, treasury notes, and U.S. savings bonds) which is illustrated in Figure 1.12.

Average daily trading volume of the treasury securities in the United States	
Year	Volume ($B)
2000	206.5
2005	554.5
2010	528.2
2012	518.9
2013	545.4
2014	504.2
2015	490.1
2016	514.2

Table 1.1

Table FD-1 summarizes the Federal debt by listing public debt and agency securities held by the public, including the Federal Reserve. It also includes debt held by Federal agencies, largely by the Social Security and other Federal retirement trust funds. The net unamortized premium and discount also are listed by total Federal securities, securities held by Government accounts and securities held by the public. The difference between the outstanding face value of the Federal debt and the net unamortized premium and discount is classified as the accrual amount. (For greater detail on holdings of Federal securities by particular classes of investors, see the ownership tables, OFS-1 and OFS-2.)

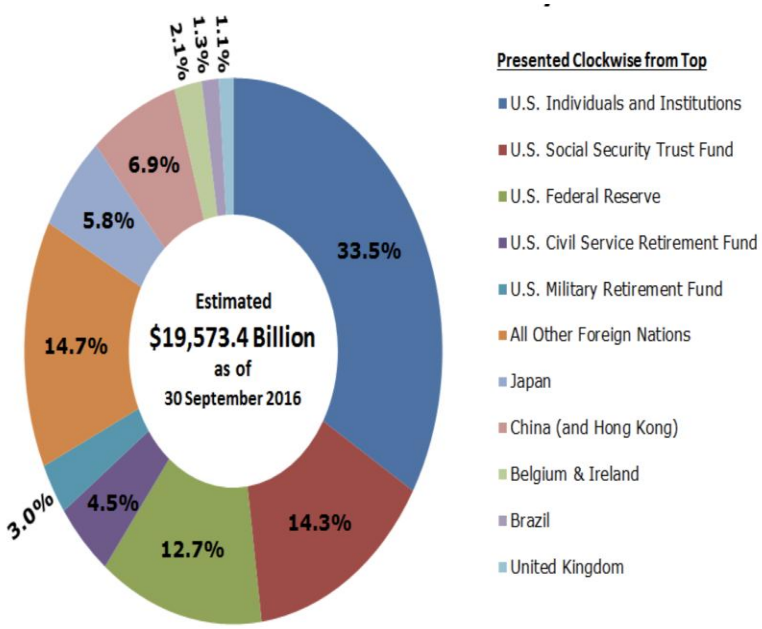

Figure 1.1

Table FD-2 categorizes by type, that is, marketable and non marketable, the total public debt securities outstanding that are held by the public.

1 Based on the Federal Budget 2016 Total Outlay Figures.
2 Figure 1.1 is from 2016, however, the data is still relevant as it shows the breakdown of debt ownership.

In table FD-3, non marketable Treasury securities held by U.S. Government accounts are summarized by issues to particular funds within Government. Many of the funds invest in par

value special series unmarketable at interest rates determined by law. Others invest in market-based special Treasury securities whose terms mirror those of marketable securities.

Table FD-4 presents interest-bearing securities issued by Government agencies. Federal agency borrowing has declined in recent years, in part because the Federal Financing Bank has provided financing to other Federal agencies. (Federal agency borrowing from Treasury is presented in the "Monthly Treasury Statement of Receipts and Outlays of the United States Government.")

Table FD-5 illustrates the average length of marketable interest-bearing public debt held by private investors and the maturity distribution of that debt.

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TABLE FD-1—Summary of Federal Debt

[In millions of dollars. Source: "Monthly Treasury Statement of Receipts and Outlays of the United States Government"]

End of fiscal year or month	Amount outstanding			Securities held by					
				Government accounts			The public		
	Total (1)	Public debt securities (2)	Agency securities (3)	Total (4)	Public debt securities (5)	Agency securities (6)	Total (7)	Public debt securities (8)	Agency securities (9)
2013	16,763,286	16,738,183	25,103	4,757,211	4,757,205	5	12,006,076	11,980,978	25,098
2014	17,847,931	17,824,071	23,860	5,039,265	5,039,262	3	12,808,666	12,784,809	23,857
2015	18,174,718	18,150,618	24,100	5,026,867	5,026,862	5	13,147,851	13,123,756	24,095
2016	19,597,812	19,573,445	24,367	5,395,699	5,395,695	4	14,202,113	14,177,750	24,363
2017	20,269,269	20,244,900	24,369	5,563,074	5,563,073	1	14,706,195	14,681,827	24,368
2016 - Dec	20,001,290	19,976,827	24,463	5,537,501	5,537,501	4	14,463,789	14,439,326	24,459
2017 - Jan	19,961,760	19,937,261	24,499	5,556,549	5,556,549	4	14,405,211	14,380,712	24,495
Feb	19,983,859	19,959,594	24,265	5,543,497	5,543,497	4	14,440,362	14,416,097	24,261
Mar	19,870,651	19,846,420	24,231	5,471,966	5,471,963	3	14,398,685	14,374,457	24,228
Apr	19,870,348	19,846,129	24,219	5,548,161	5,548,158	3	14,322,187	14,297,971	24,216
May	19,870,301	19,845,942	24,359	5,542,298	5,542,295	3	14,328,003	14,303,647	24,356
June	19,868,948	19,844,554	24,394	5,473,659	5,473,656	3	14,395,289	14,370,898	24,391
July	19,869,273	19,844,909	24,364	5,479,502	5,479,500	3	14,389,771	14,365,409	24,361
Aug	19,868,627	19,844,533	24,094	5,454,504	5,454,502	1	14,414,123	14,390,031	24,093
Sept	20,269,269	20,244,900	24,369	5,563,074	5,563,073	1	14,706,195	14,681,827	24,368
Oct	20,466,827	20,442,474	24,353	5,682,713	5,682,712	1	14,784,114	14,759,762	24,352
Nov	20,614,878	20,590,392	24,486	5,663,451	5,663,450	1	14,951,427	14,926,942	24,485
Dec	20,517,143	20,492,747	24,396	5,669,642	5,669,641	1	14,847,501	14,823,106	24,395

End of fiscal year or month	Federal debt securities			Securities held by Government accounts			Securities held by the public		
	Amount outstanding face value (10)	Net unamortized premium and discount (11)	Accrual amount (12)	Amount outstanding face value (13)	Net unamortized premium and discount (14)	Accrual amount (15)	Amount outstanding face value (16)	Net unamortized premium and discount (17)	Accrual amount (18)
2013	16,763,286	46,496	16,716,791	4,757,211	22,292	4,734,919	12,006,076	24,203	11,981,872
2014	17,847,931	55,907	17,792,023	5,039,265	26,678	5,012,587	12,808,666	29,229	12,779,436
2015	18,174,718	56,852	18,117,866	5,026,867	25,603	5,001,264	13,147,851	31,249	13,116,602
2016	19,597,812	60,393	19,537,417	5,395,699	26,706	5,368,993	14,202,113	33,687	14,168,425
2017	20,269,269	65,378	20,203,891	5,563,074	25,909	5,537,165	14,706,195	39,469	14,666,725
2016 - Dec	20,001,290	62,673	19,938,616	5,537,501	26,577	5,510,924	14,463,789	36,096	14,427,692
2017 - Jan	19,961,760	63,651	19,898,108	5,556,549	26,500	5,530,049	14,405,211	37,151	14,368,059
Feb	19,983,859	63,978	19,919,881	5,543,497	26,480	5,517,017	14,440,362	37,498	14,402,863
Mar	19,870,651	65,545	19,805,105	5,471,966	26,462	5,445,504	14,398,685	39,083	14,359,601
Apr	19,870,348	65,022	19,805,326	5,548,161	26,192	5,521,969	14,322,187	38,830	14,283,357
May	19,870,301	65,617	19,804,682	5,542,298	26,106	5,516,192	14,328,003	39,511	14,288,491
June	19,868,948	65,367	19,803,580	5,473,659	26,022	5,447,637	14,395,289	39,345	14,355,943
July	19,869,273	65,006	19,804,266	5,479,502	25,942	5,453,560	14,389,771	39,064	14,350,707
Aug	19,868,627	65,601	19,803,025	5,454,504	25,982	5,428,521	14,414,123	39,619	14,374,504
Sept	20,269,269	65,378	20,203,891	5,563,074	25,909	5,537,165	14,706,195	39,469	14,666,725
Oct	20,466,827	66,975	20,399,851	5,682,713	27,037	5,655,676	14,784,114	39,938	14,744,176
Nov	20,614,878	68,036	20,546,842	5,663,451	27,103	5,636,348	14,951,427	40,933	14,910,493
Dec	20,517,141	68,451	20,448,690	5,669,641	27,132	5,642,509	14,847,499	41,319	14,806,180

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TABLE FD-2—Debt Held by the Public

[In millions of dollars. Source: "Monthly Statement of the Public Debt of the United States"]

End of fiscal year or month	Total public debt securities outstanding (1)	Marketable						Non-marketable Total (8)
		Total (2)	Bills (3)	Notes (4)	Bonds (5)	Treasury inflation-protected securities (6)	Floating rate notes (7)	
2013	11,976,279	11,577,400	1,527,909	7,750,336	1,363,114	936,041	-	398,879
2014	12,784,971	12,271,552	1,409,628	8,160,196	1,534,069	1,044,676	122,985	513,419
2015	13,123,847	12,831,867	1,355,231	8,366,026	1,688,208	1,135,363	287,039	291,980
2016	14,173,424	13,638,303	1,644,759	8,624,253	1,825,338	1,209,814	334,139	535,120
2017	14,673,429	14,175,677	1,799,570	8,798,940	1,948,414	1,286,124	342,630	497,752
2016 - Dec	14,434,842	13,898,806	1,815,667	8,652,238	1,848,817	1,247,054	335,030	536,035
2017 - Jan	14,376,139	13,841,231	1,759,619	8,671,704	1,861,477	1,238,451	309,980	534,908
Feb	14,411,381	13,876,477	1,750,698	8,677,837	1,878,200	1,246,760	322,983	534,904
Mar	14,369,682	13,944,290	1,754,818	8,695,552	1,890,158	1,266,181	337,580	425,392
Apr	14,293,345	13,928,045	1,739,875	8,709,935	1,902,275	1,238,391	337,570	365,299
May	14,298,976	13,960,583	1,745,789	8,729,403	1,906,667	1,252,191	326,533	338,394
June	14,366,186	13,988,972	1,715,829	8,751,868	1,918,661	1,261,485	341,128	377,215
July	14,360,944	14,039,901	1,756,005	8,775,867	1,930,928	1,260,445	316,656	321,044
Aug	14,381,562	14,069,265	1,745,509	8,781,810	1,936,400	1,275,905	329,641	312,297
Sept	14,673,429	14,175,677	1,799,570	8,798,940	1,948,414	1,286,124	342,630	497,752
Oct	14,751,446	14,249,596	1,853,165	8,823,959	1,960,410	1,295,052	317,010	501,851
Nov	14,918,736	14,413,466	1,967,577	8,825,124	1,977,263	1,313,480	330,022	505,270
Dec	14,814,721	14,456,067	1,952,521	8,844,128	1,989,231	1,327,160	343,027	358,654

End of fiscal year or month	Nonmarketable, continued						
	U.S. savings securities (9)	Depositary compensation securities (10)	Foreign series (11)	Government account series (12)	State and local government series (13)	Domestic series (14)	Other (15)
2013	180,022	-	2,986	60,445	124,079	29,995	1,353
2014	176,762	-	2,986	196,520	105,668	29,995	1,489
2015	172,826	-	264	9,138	78,115	29,995	1,642
2016	167,524	-	264	226,349	109,211	29,995	1,777
2017	161,705	-	264	223,787	80,359	29,995	1,641
2016 - Dec	165,853	-	264	228,406	109,779	29,995	1,737
2017 - Jan	165,155	-	264	230,097	107,675	29,995	1,721
Feb	164,792	-	264	232,204	105,935	29,995	1,713
Mar	164,286	-	264	122,864	106,229	29,995	1,754
Apr	163,818	-	264	66,759	102,784	29,995	1,679
May	163,368	-	264	43,638	99,516	29,995	1,612
June	162,895	-	264	90,919	91,463	29,995	1,678
July	162,608	-	264	41,718	84,800	29,995	1,658
Aug	162,022	-	264	37,596	80,752	29,995	1,668
Sept	161,705	-	264	223,787	80,359	29,995	1,641
Oct	161,189	-	264	226,578	82,149	29,995	1,674
Nov	160,902	-	264	227,451	85,018	29,995	1,639
Dec	160,476	-	264	73,658	92,447	29,995	1,813

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TABLE FD-3—Government Account Series

[In millions of dollars. Source: "Monthly Statement of the Public Debt of the United States"]

End of fiscal year or month	Total (1)	Airport and Airway Trust Fund (2)	Deposit Insurance Fund (3)	Employees Life Insurance Fund (4)	Exchange Stabili-zation Fund (5)	Federal Disability Insurance Trust Fund (6)	Federal employees retirement funds (7)	Federal Hospital Insurance Trust Fund (8)	Federal Housing Administration (9)
2013	4,803,100	11,808	36,864	41,951	22,669	100,791	731,125	206,010	3
2014	5,212,466	12,759	48,750	43,213	22,649	70,113	861,349	202,207	-
2015	5,013,530	12,716	60,096	43,958	20,773	41,638	737,096	195,458	-
2016	5,604,069	13,400	71,524	45,167	22,680	45,880	874,141	192,209	36,441
2017	5,771,144	13,404	78,486	45,680	22,090	69,669	912,438	197,835	30,879
2016 - Dec	5,747,933	13,878	70,900	45,273	22,014	46,481	893,862	198,806	39,398
2017 - Jan	5,768,690	13,652	74,295	45,352	22,023	50,646	889,876	204,770	40,387
Feb	5,757,968	13,871	75,098	45,271	22,021	51,724	885,603	199,959	41,450
Mar	5,577,222	13,483	78,191	45,247	22,033	54,047	854,151	187,316	42,213
Apr	5,597,243	13,749	76,766	45,230	22,046	59,730	854,102	210,154	43,103
May	5,568,532	13,764	75,740	45,232	22,045	61,133	854,055	204,532	43,978
June	5,548,842	13,744	78,021	45,267	22,061	66,114	786,104	204,497	28,404
July	5,505,410	13,712	77,889	45,309	22,078	67,201	770,814	208,365	28,875
Aug	5,476,269	13,737	78,012	45,622	22,073	67,928	770,778	200,601	29,861
Sept	5,771,144	13,404	78,486	45,680	22,090	69,669	912,438	197,835	30,879
Oct	5,893,523	13,717	80,448	45,737	22,110	69,745	907,895	202,220	31,782
Nov	5,875,032	13,825	81,786	45,799	22,106	70,453	903,618	199,293	32,442
Dec	5,727,513	13,604	83,172	45,867	22,127	71,624	891,604	201,781	33,003

End of fiscal year or month	Federal Old-Age and Survivors Insurance Trust Fund (10)	Federal Savings and Loan Corporation, Resolution Fund (11)	Federal Supplementary Medical Insurance Trust Fund (12)	Highway Trust Fund (13)	National Service Life Insurance Fund (14)	Postal Service Fund (15)	Railroad Retirement Account (16)	Unemploy-ment Trust Fund (17)	Other (18)
2013	2,655,599	825	67,385	1,957	6,256	2,860	788	29,478	886,731
2014	2,712,805	827	68,391	10,696	5,611	5,450	803	35,919	1,110,924
2015	2,766,649	828	66,128	7,667	4,903	7,163	874	44,368	1,003,215
2016	2,796,712	828	63,336	64,629	4,246	8,527	685	53,776	1,309,888
2017	2,820,200	839	70,589	52,332	3,604	10,965	419	60,711	1,381,004
2016 - Dec	2,801,406	831	95,642	61,696	4,141	8,871	424	51,571	1,392,739
2017 - Jan	2,811,101	835	96,964	61,852	4,082	8,856	621	49,957	1,393,421
Feb	2,801,126	836	97,539	63,095	4,016	9,289	679	52,028	1,394,363
Mar	2,796,253	836	80,264	62,236	3,935	9,908	771	47,354	1,278,984
Apr	2,813,234	836	98,507	62,251	3,872	10,285	701	48,116	1,234,561
May	2,803,765	837	96,321	61,244	3,795	10,845	609	61,906	1,208,731
June	2,845,621	838	78,586	58,604	3,803	10,171	753	59,899	1,246,355
July	2,841,024	838	97,082	57,469	3,740	10,171	671	59,373	1,200,799
Aug	2,828,008	839	92,530	53,667	3,674	10,611	574	62,583	1,195,171
Sept	2,820,200	839	70,589	52,332	3,604	10,965	419	60,711	1,381,004
Oct	2,810,934	840	93,047	50,492	3,547	10,585	621	59,653	1,490,150
Nov	2,796,854	841	86,412	50,555	3,494	11,443	474	61,722	1,493,915
Dec	2,820,369	842	87,369	49,311	3,502	11,001	438	59,896	1,332,003

Note—Detail may not add to totals due to rounding.

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TABLE FD-4—Interest-Bearing Securities Issued by Government Agencies

[In millions of dollars. Source: "Monthly Treasury Statement of Receipts and Outlays of the United States Government"]

End of fiscal year or month	Total outstanding (1)	Department of Housing and Urban Development Federal Housing Administration (2)	Architect of the Capitol (3)	Other independent Tennessee Valley Authority (4)	National Archives and Records Administration (5)	Other/Federal Communications Commission (6)
2013	25,103	19	130	24,821	134	*
2014	23,860	19	105	23,620	116	*
2015	24,100	19	107	23,878	96	*
2016	24,367	19	98	24,175	75	*
2017	24,369	19	89	24,209	52	*
2016 - Dec	24,463	19	101	24,268	75	*
2017 - Jan	24,499	19	101	24,303	75	*
Feb	24,265	19	93	24,089	64	*
Mar	24,231	19	94	24,055	64	*
Apr	24,219	19	95	24,042	64	*
May	24,359	19	95	24,181	64	*
June	24,394	19	96	24,215	64	*
July	24,364	19	97	24,185	64	*
Aug	24,094	19	89	23,934	52	*
Sept	24,369	19	89	24,209	52	*
Oct	24,353	19	90	24,192	52	*
Nov	24,486	19	91	24,325	52	*
Dec	24,396	19	91	24,233	52	*

Note—Detail may not add to totals due to rounding.

* Less than $500,000.

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TABLE FD-5—Maturity Distribution and Average Length of Marketable Interest-Bearing Public Debt Held by Private Investors

[In millions of dollars. Source: Office of Debt Management, Office of the Under Secretary for Domestic Finance]

End of fiscal year or month	Amount outstanding privately held (1)	Maturity classes					Average length (months) (7)
		Within 1 year (2)	1-5 years (3)	5-10 years (4)	10-20 years (5)	20 years or more (6)	
2013	9,518,102	2,939,037	4,134,968	1,647,954	230,758	565,384	55
2014	9,828,787	2,931,581	4,216,746	1,813,563	223,276	643,620	56
2015	10,379,413	2,922,734	4,356,051	2,084,293	184,306	832,030	61
2016	11,184,046	3,321,283	4,478,458	2,219,048	167,666	997,590	63
2017	11,642,870	3,263,065	4,746,209	2,320,739	151,686	1,161,170	66
2016 - Dec	11,360,224	3,445,952	4,489,802	2,219,388	162,911	1,042,171	63
2017 - Jan	11,387,230	3,358,828	4,574,253	2,253,434	146,711	1,054,003	64
Feb	11,422,363	3,338,579	4,615,543	2,248,976	148,229	1,071,037	64
Mar	11,489,205	3,321,955	4,653,575	2,281,541	148,613	1,083,522	64
Apr	11,350,910	3,294,170	4,538,051	2,273,961	148,826	1,095,902	65
May	11,504,863	3,279,506	4,655,415	2,310,028	155,318	1,104,596	65
June	11,532,819	3,230,656	4,694,240	2,330,392	155,516	1,122,015	66
July	11,583,458	3,253,425	4,720,738	2,319,583	155,580	1,134,133	66
Aug	11,616,729	3,218,596	4,777,990	2,319,165	151,729	1,149,249	66
Sept	11,642,870	3,263,065	4,746,209	2,320,739	151,686	1,161,170	66
Oct	11,802,355	3,302,159	4,800,642	2,369,052	151,883	1,178,620	66
Nov	11,971,545	3,415,143	4,841,876	2,377,380	142,829	1,194,317	65
Dec	11,940,545	3,401,357	4,821,693	2,368,229	142,802	1,206,463	65

Note—Detail may not add to totals due to rounding.

III. THEORETICAL FRAMEWORK AND ANALYSIS

Analysis of Current Management Methods

There are two primary methods current being used to manage the debt. The first is refinancing, which occurs as follows: as portions of the public debt come due on maturing Treasury bills, notes, bonds each month, the government sells new bonds and uses the proceeds to pay the holders of the maturing bonds.

This method is fundamentally flawed, as essentially structured like a Ponzi scheme, and, eventually, will likely fail. To this point, the U.S. has been able to function successfully utilizing refinancing; however, consider this example: what if people stopped purchasing U.S. securities and began purchasing other countries' securities? The U.S. would need to keep borrowing at a higher interest rate, leading to more deficits, ultimately necessitating more borrowing at progressively higher interest rates. This creates a positive feedback loop, which will require cutting expenditures and slow growth. Taxes must then be raised, and a situation similar to what happened recently in Greece would occur.

Another reason why refinancing is not sustainable in eliminating debt is the way refinancing is structured. Consider the following example with small fund and some investors:

1. The fund takes the investors money, purchases some assets, and promises returns.
2. The assets mature; however, the fund's profits do not meet expectations, they cannot pay the investors, and their business is threatened.
3. Rather than default, the fund finds new investors and takes their money.
4. This new money is redistributed to the original group of investors, and the cycle continues.

The example I have just explained is easily recognized as a Ponzi Scheme. Moreover, compare the previous to the following:

1. The Government sells securities and promises returns.
2. The assets mature; however, the Government cannot pay.
3. The Government refinance the debt by selling new securities.
4. The profits from the new securities are redistributed to the holders of the original securities, and the cycle continues.

For the most part, the parallels between the two are undeniable.

Once the securities mature, the government repays lenders by issuing new securities. This cycle will continue to put the government further and further in debt. A significant contributor of what got the national debt to the current figure (21 Trillion) was the issuing of these financial instruments. I am going to put this in elementary terms: the solution to the problem is not what caused the problem in the first place. Granted, issuing treasury securities has many positives, it also poses noticeable future risk.

The second method is taxation/tariffs. These methods are politically unpopular; however, both are realistic ways of achieving sustainable debt reduction. While taxation may weaken

incentives to work and invest, the long term consequences of an increase in taxes are probably better than the long term consequences of prolonged refinancing. The other is increasing tariffs. This would have significantly negative repercussions though, as other countries would impose retaliatory tariffs, which allows me to arrive at the conclusion that progressively increased taxation is likely the preferable method in sustainably reducing the national debt.

Theoretical Framework Implementation

This section presents an integrated approach which allows us to evaluate the different dimensions involved in the reduction of the national debt; (i) changes in the quantity refinanced, (ii) changes in taxation, and (iii) the monetary effect on the debt.

Given the current national debt of 21 trillion USD (as of March 30, 2018), and a growth rate of 5.5 billion per day 3, the function for the estimated national debt in USD can be modeled by □:

$$□ = 21,000,000,000,000 + 5,500,000,000□ \quad (1)$$

Where n= days after March 30, 2018

From (1) we obtain the first value necessary to determine an approximation the national debt in the future. The function □ will represent the amount in of USD the government increases its debt by each day when refinancing the debt through issuing new securities. The function □ will represent the same as □, however it will be the annual increase. From Table FD-2, it can be seen that from Dec. 2016 to Dec. 2017, the quantity of Marketable securities- Treasury bills, notes, bonds and Treasury Inflation-Protected Securities (TIPS)- increased from $13,898,806,000,000 to $14,456,067,000,000.

$$□ = \$14,456,067,000,000 - \$13,898,806,000,000 = \$557,261,000,00□ \quad (2)$$

This data was gathered from U.S. Treasury Department, U.S. Federal Reserve.
Therefore, from Dec. 2016 to Dec. 2017, increased $557,261,000,000. Using this number should provide a relatively accurate estimation for future annual increase in debt because of new securities. In order to model □, the 2016-2017 estimate will be used 4.

$$□ = \frac{□}{365.25} = \$1,525,697,467.49 \quad (3)$$

An integrated approach incorporating (1), (2), and (3) allow to determine the following: if refinancing was to stop, the estimated current debt for any number of days, x, after the issuing

of marketable securities ceased can be represented by the function □ = □ − □□. This would slow the current rate of debt growth, which would be a step in the right direction; nevertheless, even more significant progress would be made with gradual increases in taxes. Application of the □function for 2017 (from Jan. to Dec) is shown below.

Given that in 2017 the federal government took in $3,316,200,000,000 in federal taxes, if the government had increased taxes by 4 percent and refinancing stopped at the end of 2016, according to the □function:

□ = 21,000,000,000,000 + 5,500,000,000(−90) = $20,505,000,000,000 (estimated national debt at end of 20175)

□ = 1,525,697,467.49

□ = $20,505,000,000,000 − 1,525,697,467.49(365.25) = $19,947,739,000,000 (hypothetical debt if refinancing ceased)

Now considering the tax increase 6

$3,316,200,000,000 × 1.04 = $3,448,848,000,000

$3,448,848,000,000 − $3,316,200,000,000 = $132,648,000,000 (additional revenue from the 4 percent increase)

If refinancing was reduced and taxes increased at the beginning of 2017 by 4 percent, the cumulative result would've been an additional $689,909,000,000 in federal revenue. The fiscal deficit in 2017 was -$665,400,000,000. 2017 could have ended in a budget surplus, which would have been the fifth year in history that occured.

Functions □ and □ were derived using 2016 and 2017 data from Table FD-2; extrapolation of □and □ may yield inaccurate results.

The actual debt in Dec. 2017 was 20,492,750,000,000, which demonstrates the accuracy of the □ in predictions of debt.

Once the tax change is made, the □ function is no longer applicable, since it was derived with data during a time when refinancing was being used and new taxes had not been implemented.

IV. CONCLUDING REMARKS

To conclude, some interesting lessons can be extracted regarding the application of this approach. Firstly, it must be recognized that the theoretical analysis was based 2016/2017 data; therefore, the functions mustn't be extrapolated, as that would likely yield incorrect results. Secondly, the final results suggest that future policy changes in debt management strategies

could allow for sustainable reduction. The degree of implementation varies- for example, different percentage increases or the amount that refinancing is scaled back- regardless, both produce the same outcome.

I large concern with the theoretical framework is the negative effect of raising taxes 4 percent. While this may weaken incentives to work and invest, the long term consequences of an increase in taxes are likely better than the long term consequences of prolonged refinancing.

All in all, the national debt in the ensuing years will be determined by a many variables; nevertheless, the functions and equations provided in the framework will remain relevant and applicable (so long as significant changes do not alter economic conditions).

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