Three World Wars: Fiscal-Monetary Consequences

George J. Hall[1] Thomas J. Sargent[2]

Monetary and Financial History Workshop
Federal Reserve Bank of Atlanta
May 23-24, 2022

Tactics

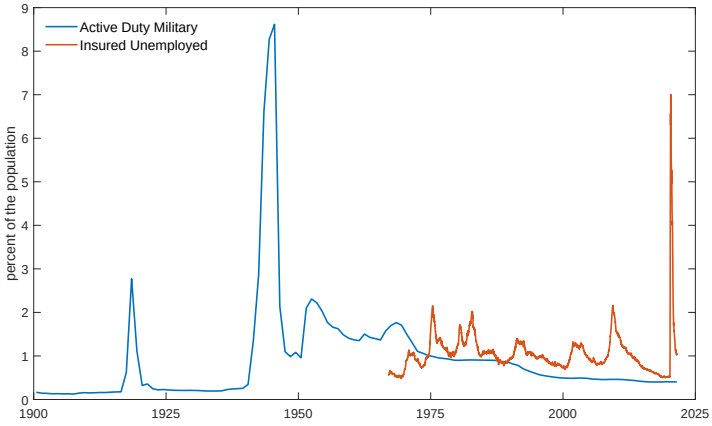
- "What a government spends, the public pays for." J. M. Keynes, 1923.
- Budget constraints alone put restrictions on behaviors and outcomes. Gary Becker, *JPE*, 1962.

Patterns: Private Sector

The US "War on COVID-19" shares these features with World Wars I and II:

- An adverse world-wide shock
- Negative labor supply shocks, in the form of sequestering soldiers away from civilian employment during the two World Wars, and in the forms of lockdown mandates that diverted workers into unemployment and voluntary withdrawals from the labor force during the COVID-19 pandemic
- Extensive government restrictions on domestic and international travel and trade

The Shock: Active Duty Military and Persons Receiving Unemployment Insurance

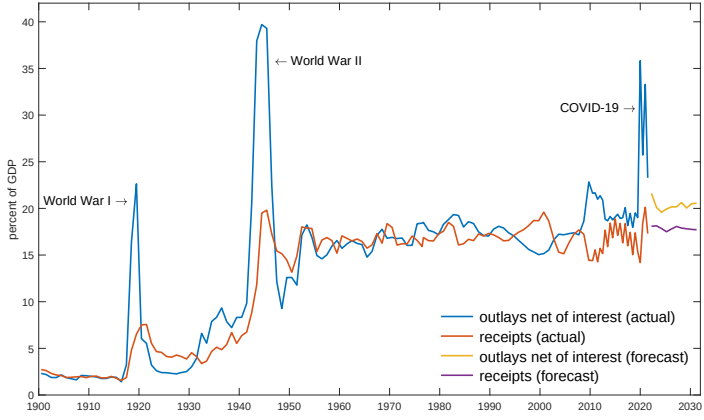


Active Duty Military: 1800-1900

Patterns: Public Sector

- Government outlays spiked during World War I, World War II, and COVID-19.
  - largely financed by issuing interest bearing debt and base money
- After World War I and World War II tax revenues remained elevated, so that the government ran primary surpluses for many years.
  - Permanent increases in federal expenditures as fractions of GDP followed both wars.
- As fractions of GDP, the federal government's responses to the Great Recession of 2008 and the Great Depression of the 1930s were similar.
- The Federal Reserve System supported federal bond prices and expanded its balance sheet

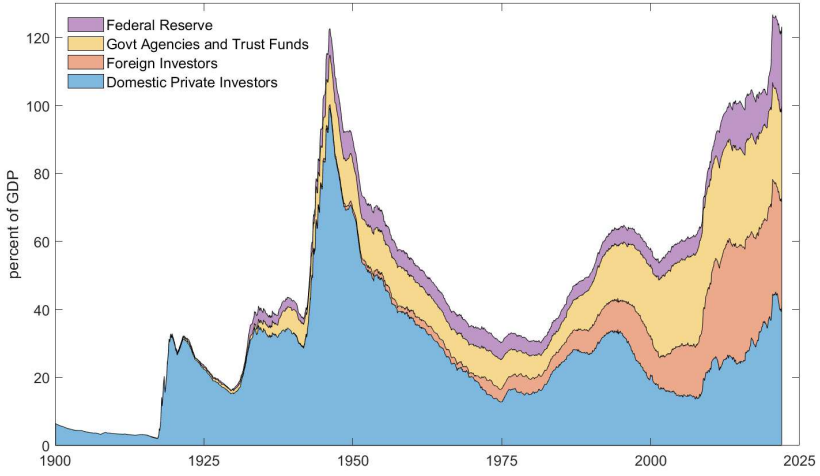
U.S. Federal Government Expenditures and Receipts: 1900-2031



Outlays are net of official interest payments. 1900-2010 annual by fiscal year; 2011-present monthly data aggregated to 6-month periods.

Expenditures and Receipts: 1775-1900

Par Value of U.S. Treasury Debt by Ownership as Percents of GDP: 1900 to 2021



Treasury Debt Ownership at Starts and Ends of Wars

	World War I		World War II		COVID-19	
	1914:5	1918:12	1939:9	1945:12	2019:12	2021:12
Federal Reserve	$0	$0.3115	$2.80	$19.41	$2,303.5	$5,580.0
	+0.312		+16.61		+3,276.5	
Gov't Agencies and Trust Funds	0	0.1070	6.55	31.88	6,030.9	6,473.5
	+0.107		+25.33		+442.6	
Foreign Investors	–	–	–	2.40	6,844.2	7,739.4
					+895.2	
Domestic Private Investors	1.1893	20.6574	31.51	224.42	8,045.2	9,824.3
	+19.468		+192.91		+1,779.1	
Total	$1.1893	$21.0759	$40.86	$278.11	$23,223.8	$29,617.2
	+19.887		+237.25		+6,393.4	

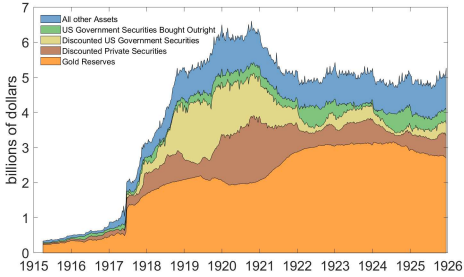
in billions of nominal dollars

Treasury Debt Ownership at Starts and Ends of Wars

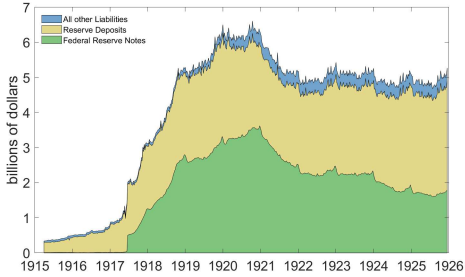
	World War I		World War II		COVID-19	
	1914:5	1918:12	1939:9	1945:12	2019:12	2021:12
Federal Reserve	$0	$0.3115	$2.80	$19.41	$2,303.5	$5,580.0
	+0.312		+16.61		+3,276.5	
Gov't Agencies and Trust Funds	0	0.1070	6.55	31.88	6,030.9	6,473.5
	+0.107		+25.33		+442.6	
Foreign Investors	–	–	–	2.40	6,844.2	7,739.4
					+895.2	
Domestic Private Investors	1.1893	20.6574	31.51	224.42	8,045.2	9,824.3
	+19.468		+192.91		+1,779.1	
Total	$1.1893	$21.0759	$40.86	$278.11	$23,223.8	$29,617.2
	+19.887		+237.25		+6,393.4	

in billions of nominal dollars

Federal Reserve Balance Sheet: 1915-1925

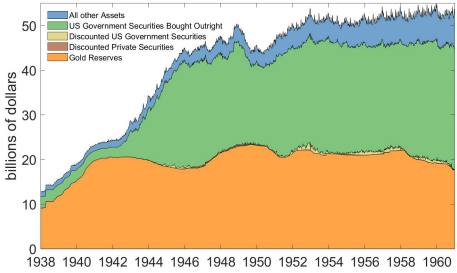


(a) Assets

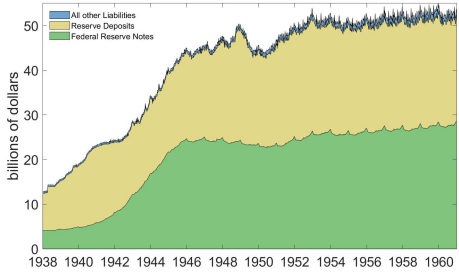


(b) Liabilities

Federal Reserve Balance Sheet: 1938-1960

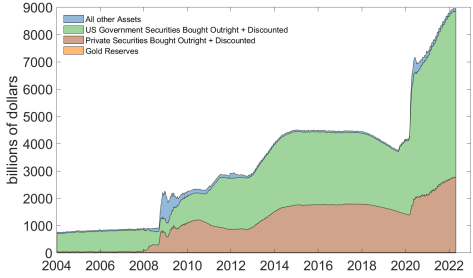


(a) Assets

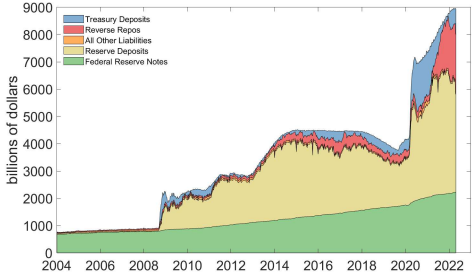


(b) Liabilities

Federal Reserve Balance Sheet: 2004-2022

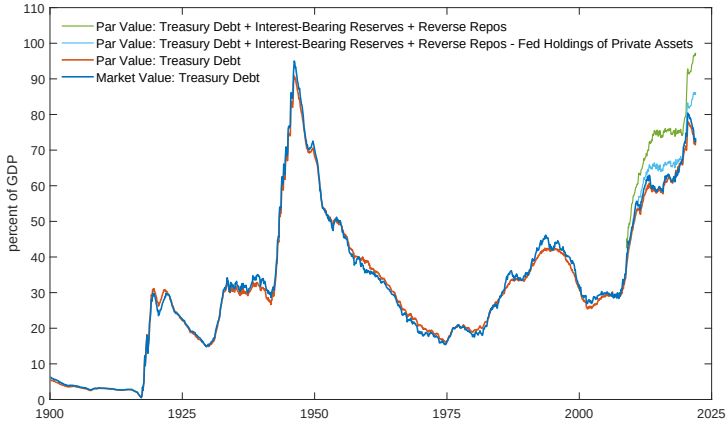


(a) Assets



(b) Liabilities

Par and Market Values of Treasury Debt Held by Private Investors



Par and Market Value of Debt: 1775-1900

Consolidated Government Budget Constraint

$$G_t + r^B_{t-1,t} B_{t-1} + (A_t - A_{t-1}) = T_t + (B_t - B_{t-1}) + r^A_{t-1,t} A_{t-1} + (M_t - M_{t-1}) + OM_t$$

where

G_t	=	Government purchases
B_{t-1}	=	Nominal market value of interest bearing government debt held by private investors
$r^B_{t-1,t}$	=	Nominal value-weighted holding period return on government debt between $t-1$ and t
A_t	=	Private assets purchased by the Federal Reserve
$r^A_{t-1,t}$	=	Nominal holding period return on Fed-held private assets between $t-1$ and t
T_t	=	Taxes
M_t	=	Federal Reserve credit
OM_t	=	Funding by Other Means

Consolidated Government Budget Constraint

$$G_t + r^B_{t-1,t} B_{t-1} + (A_t - A_{t-1}) = T_t + (B_t - B_{t-1}) + r^A_{t-1,t} A_{t-1} + (M_t - M_{t-1}) + OM_t$$

where

G_t	=	Government purchases
B_{t-1}	=	Nominal market value of interest bearing government debt held by private investors
$r^B_{t-1,t}$	=	Nominal value-weighted holding period return on government debt between $t-1$ and t
A_t	=	Private assets purchased by the Federal Reserve
$r^A_{t-1,t}$	=	Nominal holding period return on Fed-held private assets between $t-1$ and t
T_t	=	Taxes
M_t	=	Federal Reserve credit
OM_t	=	Funding by Other Means

Consolidated Government Budget Constraint

$$G_t + r^B_{t-1,t} B_{t-1} + (A_t - A_{t-1}) = T_t + (B_t - B_{t-1}) + r^A_{t-1,t} A_{t-1} + (M_t - M_{t-1}) + OM_t$$

where

G_t	=	Government purchases
B_{t-1}	=	Nominal market value of interest bearing government debt held by private investors
$r^B_{t-1,t}$	=	Nominal value-weighted holding period return on government debt between $t-1$ and t
A_t	=	Private assets purchased by the Federal Reserve
$r^A_{t-1,t}$	=	Nominal holding period return on Fed-held private assets between $t-1$ and t
T_t	=	Taxes
M_t	=	Federal Reserve credit
OM_t	=	Funding by Other Means

Consolidated Government Budget Constraint

$$G_t + r^B_{t-1,t} B_{t-1} + (A_t - A_{t-1}) = T_t + (B_t - B_{t-1}) + r^A_{t-1,t} A_{t-1} + (M_t - M_{t-1}) + OM_t$$

where

G_t	=	Government purchases
B_{t-1}	=	Nominal market value of interest bearing government debt held by private investors
$r^B_{t-1,t}$	=	Nominal value-weighted holding period return on government debt between $t-1$ and t
A_t	=	Private assets purchased by the Federal Reserve
$r^A_{t-1,t}$	=	Nominal holding period return on Fed-held private assets between $t-1$ and t
T_t	=	Taxes
M_t	=	Federal Reserve credit
OM_t	=	Funding by Other Means

Consolidated Government Budget Constraint

$$G_t + r^B_{t-1,t} B_{t-1} + (A_t - A_{t-1}) = T_t + (B_t - B_{t-1}) + r^A_{t-1,t} A_{t-1} + (M_t - M_{t-1}) + OM_t$$

where

G_t	=	Government purchases
B_{t-1}	=	Nominal market value of interest bearing government debt held by private investors
$r^B_{t-1,t}$	=	Nominal value-weighted holding period return on government debt between $t-1$ and t
A_t	=	Private assets purchased by the Federal Reserve
$r^A_{t-1,t}$	=	Nominal holding period return on Fed-held private assets between $t-1$ and t
T_t	=	Taxes
M_t	=	Federal Reserve credit
OM_t	=	Funding by Other Means

Consolidated Government Budget Constraint

$$G_t + r^B_{t-1,t} B_{t-1} + (A_t - A_{t-1}) = T_t + (B_t - B_{t-1}) + r^A_{t-1,t} A_{t-1} + (M_t - M_{t-1}) + OM_t$$

where

G_t	=	Government purchases
B_{t-1}	=	Nominal market value of interest bearing government debt held by private investors
$r^B_{t-1,t}$	=	Nominal value-weighted holding period return on government debt between $t-1$ and t
A_t	=	Private assets purchased by the Federal Reserve
$r^A_{t-1,t}$	=	Nominal holding period return on Fed-held private assets between $t-1$ and t
T_t	=	Taxes
M_t	=	Federal Reserve credit
OM_t	=	Funding by Other Means

Consolidated Government Budget Constraint

$$G_t + r^B_{t-1,t} B_{t-1} + (A_t - A_{t-1}) = T_t + (B_t - B_{t-1}) + r^A_{t-1,t} A_{t-1} + (M_t - M_{t-1}) + OM_t$$

where

G_t	=	Government purchases
B_{t-1}	=	Nominal market value of interest bearing government debt held by private investors
$r^B_{t-1,t}$	=	Nominal value-weighted holding period return on government debt between $t-1$ and t
A_t	=	Private assets purchased by the Federal Reserve
$r^A_{t-1,t}$	=	Nominal holding period return on Fed-held private assets between $t-1$ and t
T_t	=	Taxes
M_t	=	Federal Reserve credit
OM_t	=	Funding by Other Means

Consolidated Government Budget Constraint

$$G_t + r^B_{t-1,t} B_{t-1} + (A_t - A_{t-1}) = T_t + (B_t - B_{t-1}) + r^A_{t-1,t} A_{t-1} + (M_t - M_{t-1}) + OM_t$$

where

G_t	=	Government purchases
B_{t-1}	=	Nominal market value of interest bearing government debt held by private investors
$r^B_{t-1,t}$	=	Nominal value-weighted holding period return on government debt between $t-1$ and t
A_t	=	Private assets purchased by the Federal Reserve
$r^A_{t-1,t}$	=	Nominal holding period return on Fed-held private assets between $t-1$ and t
T_t	=	Taxes
M_t	=	Federal Reserve credit
OM_t	=	Funding by Other Means

Consolidated Government Budget Constraint

$$G_t + r^B_{t-1,t} B_{t-1} + (A_t - A_{t-1}) = T_t + (B_t - B_{t-1}) + r^A_{t-1,t} A_{t-1} + (M_t - M_{t-1}) + OM_t$$

where

G_t	=	Government purchases
B_{t-1}	=	Nominal market value of interest bearing government debt held by private investors
$r^B_{t-1,t}$	=	Nominal value-weighted holding period return on government debt between $t-1$ and t
A_t	=	Private assets purchased by the Federal Reserve
$r^A_{t-1,t}$	=	Nominal holding period return on Fed-held private assets between $t-1$ and t
T_t	=	Taxes
M_t	=	Federal Reserve credit
OM_t	=	Funding by Other Means

Consolidated Budget Constraint Components as Shares of GDP

Dividing each term by nominal GDP, Y_t, and rearranging yields

$$\underbrace{\frac{G_t}{Y_t}}_{\text{government spending}} + \underbrace{\left(r^B_{t-1,t}\frac{B_{t-1}}{Y_{t-1}} - r^A_{t-1,t}\frac{A_{t-1}}{Y_{t-1}}\right)}_{\text{net interest payments}} + \underbrace{\left(\frac{A_t}{Y_t} - \frac{A_{t-1}}{Y_{t-1}}\right)}_{\text{asset purchases}} = \underbrace{\frac{T_t}{Y_t}}_{\text{tax revenue}} + \underbrace{\left(\frac{B_t}{Y_t} - \frac{B_{t-1}}{Y_{t-1}}\right)}_{\text{debt growth}}$$

$$+ \underbrace{\frac{M_t - M_{t-1}}{Y_t}}_{\text{money growth}} + \underbrace{\frac{OM_t}{Y_t}}_{\text{other means}}$$

$$+ \underbrace{g_{t-1,t}\frac{B_{t-1} - A_{t-1}}{Y_{t-1}}}_{\text{debt dilution via real GDP growth}} + \underbrace{\pi_{t-1,t}\frac{B_{t-1} - A_{t-1}}{Y_{t-1}}}_{\text{debt default via inflation}}$$

$$+ \underbrace{(\pi_{t-1,t} + g_{t-1,t})\left(r^B_{t-1,t}\frac{B_{t-1}}{Y_{t-1}} - r^A_{t-1,t}\frac{A_{t-1}}{Y_{t-1}}\right)}_{\text{cross-term}}$$

Consolidated Budget Constraint Components as Shares of GDP

Dividing each term by nominal GDP, Y_t, and rearranging yields

$$\underbrace{\frac{G_t}{Y_t}}_{\text{government spending}} + \underbrace{\left(r^B_{t-1,t}\frac{B_{t-1}}{Y_{t-1}} - r^A_{t-1,t}\frac{A_{t-1}}{Y_{t-1}}\right)}_{\text{net interest payments}} + \underbrace{\left(\frac{A_t}{Y_t} - \frac{A_{t-1}}{Y_{t-1}}\right)}_{\text{asset purchases}} = \underbrace{\frac{T_t}{Y_t}}_{\text{tax revenue}} + \underbrace{\left(\frac{B_t}{Y_t} - \frac{B_{t-1}}{Y_{t-1}}\right)}_{\text{debt growth}}$$

$$+ \underbrace{\frac{M_t - M_{t-1}}{Y_t}}_{\text{money growth}} + \underbrace{\frac{OM_t}{Y_t}}_{\text{other means}}$$

$$+ \underbrace{g_{t-1,t}\frac{B_{t-1} - A_{t-1}}{Y_{t-1}}}_{\text{debt dilution via real GDP growth}} + \underbrace{\pi_{t-1,t}\frac{B_{t-1} - A_{t-1}}{Y_{t-1}}}_{\text{debt default via inflation}}$$

$$+ \underbrace{(\pi_{t-1,t} + g_{t-1,t})\left(r^B_{t-1,t}\frac{B_{t-1}}{Y_{t-1}} - r^A_{t-1,t}\frac{A_{t-1}}{Y_{t-1}}\right)}_{\text{cross-term}}$$

Consolidated Budget Constraint Components as Shares of GDP

Dividing each term by nominal GDP, Y_t, and rearranging yields

$$\underbrace{\frac{G_t}{Y_t}}_{\text{government spending}} + \underbrace{\left(r^B_{t-1,t}\frac{B_{t-1}}{Y_{t-1}} - r^A_{t-1,t}\frac{A_{t-1}}{Y_{t-1}}\right)}_{\text{net interest payments}} + \underbrace{\left(\frac{A_t}{Y_t} - \frac{A_{t-1}}{Y_{t-1}}\right)}_{\text{asset purchases}} = \underbrace{\frac{T_t}{Y_t}}_{\text{tax revenue}} + \underbrace{\left(\frac{B_t}{Y_t} - \frac{B_{t-1}}{Y_{t-1}}\right)}_{\text{debt growth}}$$

$$+ \underbrace{\frac{M_t - M_{t-1}}{Y_t}}_{\text{money growth}} + \underbrace{\frac{OM_t}{Y_t}}_{\text{other means}}$$

$$+ \underbrace{g_{t-1,t}\frac{B_{t-1} - A_{t-1}}{Y_{t-1}}}_{\text{debt dilution via real GDP growth}} + \underbrace{\pi_{t-1,t}\frac{B_{t-1} - A_{t-1}}{Y_{t-1}}}_{\text{debt default via inflation}}$$

$$+ \underbrace{(\pi_{t-1,t} + g_{t-1,t})\left(r^B_{t-1,t}\frac{B_{t-1}}{Y_{t-1}} - r^A_{t-1,t}\frac{A_{t-1}}{Y_{t-1}}\right)}_{\text{cross-term}}$$

Consolidated Budget Constraint Components as Shares of GDP

Dividing each term by nominal GDP, Y_t, and rearranging yields

$$\underbrace{\frac{G_t}{Y_t}}_{\text{government spending}} + \underbrace{\left(r^B_{t-1,t}\frac{B_{t-1}}{Y_{t-1}} - r^A_{t-1,t}\frac{A_{t-1}}{Y_{t-1}}\right)}_{\text{net interest payments}} + \underbrace{\left(\frac{A_t}{Y_t} - \frac{A_{t-1}}{Y_{t-1}}\right)}_{\text{asset purchases}} = \underbrace{\frac{T_t}{Y_t}}_{\text{tax revenue}} + \underbrace{\left(\frac{B_t}{Y_t} - \frac{B_{t-1}}{Y_{t-1}}\right)}_{\text{debt growth}}$$

$$+ \underbrace{\frac{M_t - M_{t-1}}{Y_t}}_{\text{money growth}} + \underbrace{\frac{OM_t}{Y_t}}_{\text{other means}}$$

$$+ \underbrace{g_{t-1,t}\frac{B_{t-1} - A_{t-1}}{Y_{t-1}}}_{\text{debt dilution via real GDP growth}} + \underbrace{\pi_{t-1,t}\frac{B_{t-1} - A_{t-1}}{Y_{t-1}}}_{\text{debt default via inflation}}$$

$$+ \underbrace{(\pi_{t-1,t} + g_{t-1,t})\left(r^B_{t-1,t}\frac{B_{t-1}}{Y_{t-1}} - r^A_{t-1,t}\frac{A_{t-1}}{Y_{t-1}}\right)}_{\text{cross-term}}$$

Consolidated Budget Constraint Components as Shares of GDP

Dividing each term by nominal GDP, Y_t, and rearranging yields

$$\underbrace{\frac{G_t}{Y_t}}_{\text{government spending}} + \underbrace{\left(r^B_{t-1,t}\frac{B_{t-1}}{Y_{t-1}} - r^A_{t-1,t}\frac{A_{t-1}}{Y_{t-1}}\right)}_{\text{net interest payments}} + \underbrace{\left(\frac{A_t}{Y_t} - \frac{A_{t-1}}{Y_{t-1}}\right)}_{\text{asset purchases}} = \underbrace{\frac{T_t}{Y_t}}_{\text{tax revenue}} + \underbrace{\left(\frac{B_t}{Y_t} - \frac{B_{t-1}}{Y_{t-1}}\right)}_{\text{debt growth}}$$

$$+ \underbrace{\frac{M_t - M_{t-1}}{Y_t}}_{\text{money growth}} + \underbrace{\frac{OM_t}{Y_t}}_{\text{other means}}$$

$$+ \underbrace{g_{t-1,t}\frac{B_{t-1} - A_{t-1}}{Y_{t-1}}}_{\text{debt dilution via real GDP growth}} + \underbrace{\pi_{t-1,t}\frac{B_{t-1} - A_{t-1}}{Y_{t-1}}}_{\text{debt default via inflation}}$$

$$+ \underbrace{(\pi_{t-1,t} + g_{t-1,t})\left(r^B_{t-1,t}\frac{B_{t-1}}{Y_{t-1}} - r^A_{t-1,t}\frac{A_{t-1}}{Y_{t-1}}\right)}_{\text{cross-term}}$$

Consolidated Budget Constraint Components as Shares of GDP

Dividing each term by nominal GDP, Y_t, and rearranging yields

$$\underbrace{\frac{G_t}{Y_t}}_{\text{government spending}} + \underbrace{\left(r^B_{t-1,t}\frac{B_{t-1}}{Y_{t-1}} - r^A_{t-1,t}\frac{A_{t-1}}{Y_{t-1}}\right)}_{\text{net interest payments}} + \underbrace{\left(\frac{A_t}{Y_t} - \frac{A_{t-1}}{Y_{t-1}}\right)}_{\text{asset purchases}} = \underbrace{\frac{T_t}{Y_t}}_{\text{tax revenue}} + \underbrace{\left(\frac{B_t}{Y_t} - \frac{B_{t-1}}{Y_{t-1}}\right)}_{\text{debt growth}}$$

$$+ \underbrace{\frac{M_t - M_{t-1}}{Y_t}}_{\text{money growth}} + \underbrace{\frac{OM_t}{Y_t}}_{\text{other means}}$$

$$+ \underbrace{g_{t-1,t}\frac{B_{t-1} - A_{t-1}}{Y_{t-1}}}_{\text{debt dilution via real GDP growth}} + \underbrace{\pi_{t-1,t}\frac{B_{t-1} - A_{t-1}}{Y_{t-1}}}_{\text{debt default via inflation}}$$

$$+ \underbrace{(\pi_{t-1,t} + g_{t-1,t})\left(r^B_{t-1,t}\frac{B_{t-1}}{Y_{t-1}} - r^A_{t-1,t}\frac{A_{t-1}}{Y_{t-1}}\right)}_{\text{cross-term}}$$

Consolidated Budget Constraint Components as Shares of GDP

Dividing each term by nominal GDP, Y_t, and rearranging yields

$$\underbrace{\frac{G_t}{Y_t}}_{\text{government spending}} + \underbrace{\left(r^B_{t-1,t}\frac{B_{t-1}}{Y_{t-1}} - r^A_{t-1,t}\frac{A_{t-1}}{Y_{t-1}}\right)}_{\text{net interest payments}} + \underbrace{\left(\frac{A_t}{Y_t} - \frac{A_{t-1}}{Y_{t-1}}\right)}_{\text{asset purchases}} = \underbrace{\frac{T_t}{Y_t}}_{\text{tax revenue}} + \underbrace{\left(\frac{B_t}{Y_t} - \frac{B_{t-1}}{Y_{t-1}}\right)}_{\text{debt growth}}$$

$$+ \underbrace{\frac{M_t - M_{t-1}}{Y_t}}_{\text{money growth}} + \underbrace{\frac{OM_t}{Y_t}}_{\text{other means}}$$

$$+ \underbrace{g_{t-1,t}\frac{B_{t-1} - A_{t-1}}{Y_{t-1}}}_{\text{debt dilution via real GDP growth}} + \underbrace{\pi_{t-1,t}\frac{B_{t-1} - A_{t-1}}{Y_{t-1}}}_{\text{debt default via inflation}}$$

$$+ \underbrace{(\pi_{t-1,t} + g_{t-1,t})\left(r^B_{t-1,t}\frac{B_{t-1}}{Y_{t-1}} - r^A_{t-1,t}\frac{A_{t-1}}{Y_{t-1}}\right)}_{\text{cross-term}}$$

Consolidated Budget Constraint Components as Shares of GDP

Dividing each term by nominal GDP, Y_t, and rearranging yields

$$\underbrace{\frac{G_t}{Y_t}}_{\text{government spending}} + \underbrace{\left(r^B_{t-1,t}\frac{B_{t-1}}{Y_{t-1}} - r^A_{t-1,t}\frac{A_{t-1}}{Y_{t-1}}\right)}_{\text{net interest payments}} + \underbrace{\left(\frac{A_t}{Y_t} - \frac{A_{t-1}}{Y_{t-1}}\right)}_{\text{asset purchases}} = \underbrace{\frac{T_t}{Y_t}}_{\text{tax revenue}} + \underbrace{\left(\frac{B_t}{Y_t} - \frac{B_{t-1}}{Y_{t-1}}\right)}_{\text{debt growth}}$$

$$+ \underbrace{\frac{M_t - M_{t-1}}{Y_t}}_{\text{money growth}} + \underbrace{\frac{OM_t}{Y_t}}_{\text{other means}}$$

$$+ \underbrace{g_{t-1,t}\frac{B_{t-1} - A_{t-1}}{Y_{t-1}}}_{\text{debt dilution via real GDP growth}} + \underbrace{\pi_{t-1,t}\frac{B_{t-1} - A_{t-1}}{Y_{t-1}}}_{\text{debt default via inflation}}$$

$$+ \underbrace{(\pi_{t-1,t} + g_{t-1,t})\left(r^B_{t-1,t}\frac{B_{t-1}}{Y_{t-1}} - r^A_{t-1,t}\frac{A_{t-1}}{Y_{t-1}}\right)}_{\text{cross-term}}$$

Consolidated Budget Constraint Components as Shares of GDP

Dividing each term by nominal GDP, Y_t, and rearranging yields

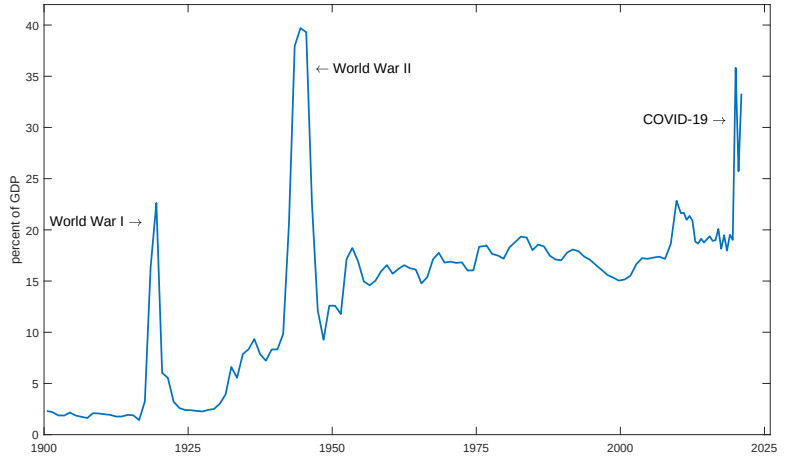
$$\underbrace{\frac{G_t}{Y_t}}_{\text{government spending}} + \underbrace{\left(r^B_{t-1,t}\frac{B_{t-1}}{Y_{t-1}} - r^A_{t-1,t}\frac{A_{t-1}}{Y_{t-1}}\right)}_{\text{net interest payments}} + \underbrace{\left(\frac{A_t}{Y_t} - \frac{A_{t-1}}{Y_{t-1}}\right)}_{\text{asset purchases}} = \underbrace{\frac{T_t}{Y_t}}_{\text{tax revenue}} + \underbrace{\left(\frac{B_t}{Y_t} - \frac{B_{t-1}}{Y_{t-1}}\right)}_{\text{debt growth}}$$

$$+ \underbrace{\frac{M_t - M_{t-1}}{Y_t}}_{\text{money growth}} + \underbrace{\frac{OM_t}{Y_t}}_{\text{other means}}$$

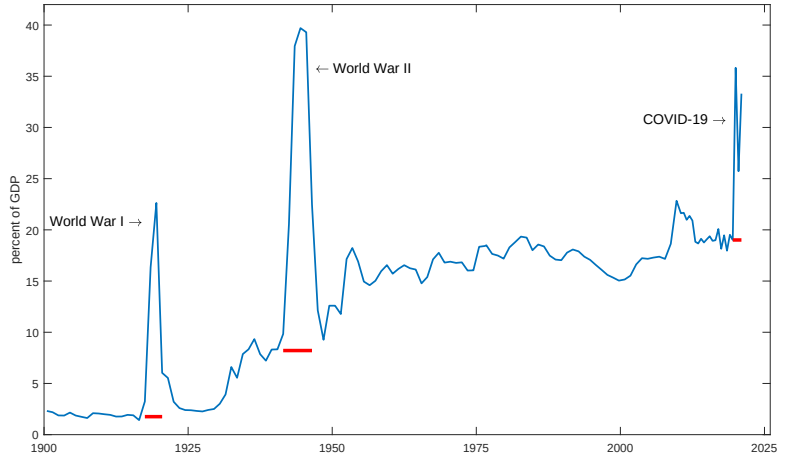
$$+ \underbrace{g_{t-1,t}\frac{B_{t-1} - A_{t-1}}{Y_{t-1}}}_{\text{debt dilution via real GDP growth}} + \underbrace{\pi_{t-1,t}\frac{B_{t-1} - A_{t-1}}{Y_{t-1}}}_{\text{debt default via inflation}}$$

$$+ \underbrace{(\pi_{t-1,t} + g_{t-1,t})\left(r^B_{t-1,t}\frac{B_{t-1}}{Y_{t-1}} - r^A_{t-1,t}\frac{A_{t-1}}{Y_{t-1}}\right)}_{\text{cross-term}}$$

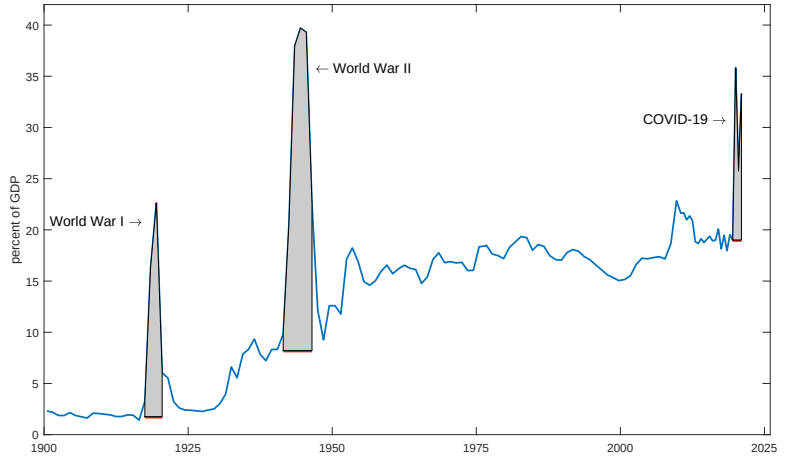
G/Y


percent of GDP
World War I →
← World War II
COVID-19 →
0
5
10
15
20
25
30
35
40
1900
1925
1950
1975
2000
2025

Baseline G/Y: a 5-Year Pre-War Average



Wartime Surges in G/Y: Add Up Spending in Excess of Baseline



Decomposition of Wartime Revenues

War Start - End	(1) government spending	(2) payouts on net debt	(3) asset purchases	(4) (1)+(2) +(3)	(5) tax revenue	(6) debt growth	(7) money growth	(8) GDP growth	(9) inflation	(10) Other
World War I										
1917:4 - 1918:11	36.93	0.30	0.16	37.39	7.76	27.79	2.59	0.03	0.68	-1.46
					20.8	74.3	6.9	0.1	1.8	-3.9
World War II										
1941:12 - 1945:8	116.48	2.00	–	118.48	35.80	54.53	11.96	8.99	6.05	1.14
					30.2	46.0	10.1	7.6	5.1	1.0
COVID-19										
2020:1 - 2021:12	21.37	0.22	5.85	27.45	0.95	-0.59	25.16	1.02	3.03	-2.12
reserves $\subset M$					3.5	-2.2	91.7	3.7	11.0	-7.7
2020:1 - 2021:12	21.37	0.17	5.85	27.40	0.95	18.36	5.07	1.48	3.99	-2.45
reserves $\subset B$					3.5	67.0	18.5	5.4	14.6	-8.9

Decomposition of Wartime Revenues

War Start - End	(1) government spending	(2) payouts on net debt	(3) asset purchases	(4) (1)+(2) +(3)	(5) tax revenue	(6) debt growth	(7) money growth	(8) GDP growth	(9) inflation	(10) Other
World War I										
1917:4 - 1918:11	36.93	0.30	0.16	37.39	7.76	27.79	2.59	0.03	0.68	-1.46
					20.8	74.3	6.9	0.1	1.8	-3.9
World War II										
1941:12 - 1945:8	116.48	2.00	–	118.48	35.80	54.53	11.96	8.99	6.05	1.14
					30.2	46.0	10.1	7.6	5.1	1.0
COVID-19										
2020:1 - 2021:12	21.37	0.22	5.85	27.45	0.95	-0.59	25.16	1.02	3.03	-2.12
reserves $\subset M$					3.5	-2.2	91.7	3.7	11.0	-7.7
2020:1 - 2021:12	21.37	0.17	5.85	27.40	0.95	18.36	5.07	1.48	3.99	-2.45
reserves $\subset B$					3.5	67.0	18.5	5.4	14.6	-8.9

Decomposition of Wartime Revenues

War Start - End	(1) government spending	(2) payouts on net debt	(3) asset purchases	(4) (1)+(2) +(3)	(5) tax revenue	(6) debt growth	(7) money growth	(8) GDP growth	(9) inflation	(10) Other
World War I										
1917:4 - 1918:11	36.93	0.30	0.16	37.39	7.76	27.79	2.59	0.03	0.68	-1.46
					20.8	74.3	6.9	0.1	1.8	-3.9
World War II										
1941:12 - 1945:8	116.48	2.00	–	118.48	35.80	54.53	11.96	8.99	6.05	1.14
					30.2	46.0	10.1	7.6	5.1	1.0
COVID-19										
2020:1 - 2021:12	21.37	0.22	5.85	27.45	0.95	-0.59	25.16	1.02	3.03	-2.12
reserves $\subset M$					3.5	-2.2	91.7	3.7	11.0	-7.7
2020:1 - 2021:12	21.37	0.17	5.85	27.40	0.95	18.36	5.07	1.48	3.99	-2.45
reserves $\subset B$					3.5	67.0	18.5	5.4	14.6	-8.9

Decomposition of Wartime Revenues

War Start - End	(1) government spending	(2) payouts on net debt	(3) asset purchases	(4) (1)+(2) +(3)	(5) tax revenue	(6) debt growth	(7) money growth	(8) GDP growth	(9) inflation	(10) Other
World War I										
1917:4 - 1918:11	36.93	0.30	0.16	37.39	7.76	27.79	2.59	0.03	0.68	-1.46
					20.8	74.3	6.9	0.1	1.8	-3.9
World War II										
1941:12 - 1945:8	116.48	2.00	–	118.48	35.80	54.53	11.96	8.99	6.05	1.14
					30.2	46.0	10.1	7.6	5.1	1.0
COVID-19										
2020:1 - 2021:12	21.37	0.22	5.85	27.45	0.95	-0.59	25.16	1.02	3.03	-2.12
reserves $\subset M$					3.5	-2.2	91.7	3.7	11.0	-7.7
2020:1 - 2021:12	21.37	0.17	5.85	27.40	0.95	18.36	5.07	1.48	3.99	-2.45
reserves $\subset B$					3.5	67.0	18.5	5.4	14.6	-8.9

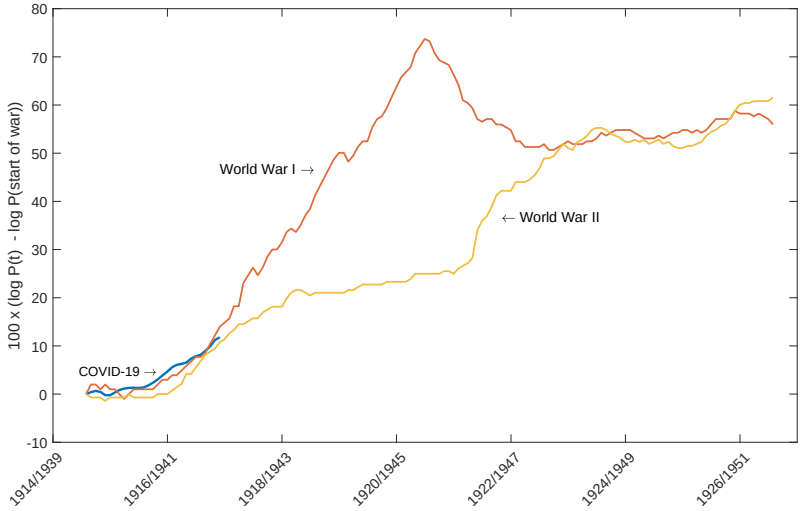
Decomposition of Wartime Revenues

War Start - End	(1) government spending	(2) payouts on net debt	(3) asset purchases	(4) (1)+(2) +(3)	(5) tax revenue	(6) debt growth	(7) money growth	(8) GDP growth	(9) inflation	(10) Other
World War I										
1917:4 - 1918:11	36.93	0.30	0.16	37.39	7.76	27.79	2.59	0.03	0.68	-1.46
					20.8	74.3	6.9	0.1	1.8	-3.9
World War II										
1941:12 - 1945:8	116.48	2.00	–	118.48	35.80	54.53	11.96	8.99	6.05	1.14
					30.2	46.0	10.1	7.6	5.1	1.0
COVID-19										
2020:1 - 2021:12	21.37	0.22	5.85	27.45	0.95	-0.59	25.16	1.02	3.03	-2.12
reserves $\subset M$					3.5	-2.2	91.7	3.7	11.0	-7.7
2020:1 - 2021:12	21.37	0.17	5.85	27.40	0.95	18.36	5.07	1.48	3.99	-2.45
reserves $\subset B$					3.5	67.0	18.5	5.4	14.6	-8.9

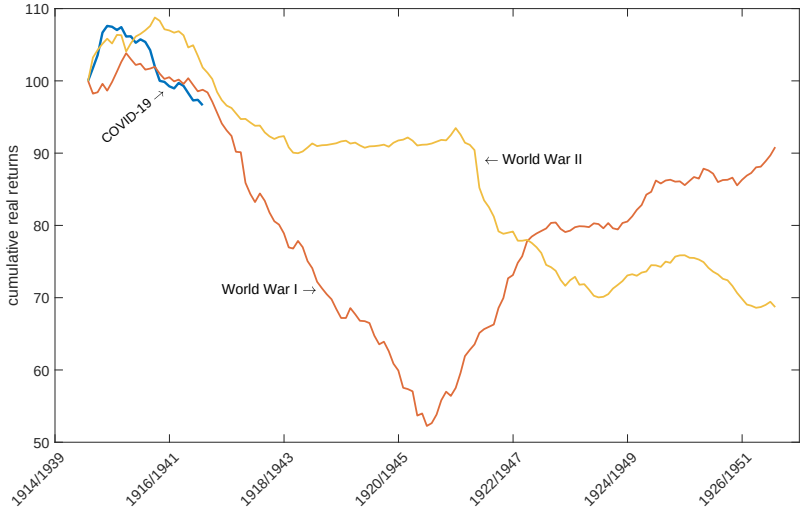
Decomposition of Wartime Revenues

War Start - End	(1) government spending	(2) payouts on net debt	(3) asset purchases	(4) (1)+(2) +(3)	(5) tax revenue	(6) debt growth	(7) money growth	(8) GDP growth	(9) inflation	(10) Other
World War I										
1917:4 - 1918:11	36.93	0.30	0.16	37.39	7.76	27.79	2.59	0.03	0.68	-1.46
					20.8	74.3	6.9	0.1	1.8	-3.9
World War II										
1941:12 - 1945:8	116.48	2.00	–	118.48	35.80	54.53	11.96	8.99	6.05	1.14
					30.2	46.0	10.1	7.6	5.1	1.0
COVID-19										
2020:1 - 2021:12	21.37	0.22	5.85	27.45	0.95	-0.59	25.16	1.02	3.03	-2.12
reserves $\subset M$					3.5	-2.2	91.7	3.7	11.0	-7.7
2020:1 - 2021:12	21.37	0.17	5.85	27.40	0.95	18.36	5.07	1.48	3.99	-2.45
reserves $\subset B$					3.5	67.0	18.5	5.4	14.6	-8.9

Natural Log of Consumer Price Index During and After Wars



Real Value of $100 Portfolio of Treasury Securities Invested at Starts of Wars



How US paid for three wars

	taxes	bonds	money
World War I	20.8	74.6	7.0
World War II	30.2	46.0	10.1
COVID-19	3.5	67.0	18.5

As percentages of total revenues.

Summary Five Wars

Backup Slides

Pre versus post 1900

- Net international debtor status
- Role of gold standard
  - (Or was it a "gold-exchange standard" a la David Ricardo (1816)?)
- Money versus bonds
  - Paying interest on "money"?
  - Price discrimation
- Delegating and Coordinating Monetary and Fiscal Policies
  - Two Banks of the United States
  - Andrew Jackson and 100% reserve regime
  - Independent Treasury
  - Congress as Consolidator and Coordinator
- Reputation poisoning or building or sustaining?

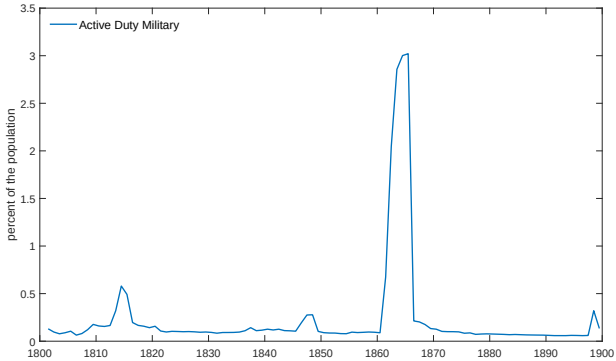
Three Pre-1900 US Wars

- Independence (1775-1783)
- 1812 (1812-1815)
- Civil War (1861-1865)

Cast of Characters

- Alexander Hamilton
- James Madison
- Andrew Jackson
- Andrew Johnson
- Ulysses S. Grant

Active Duty Military as Percent of the Population: 1800-1900

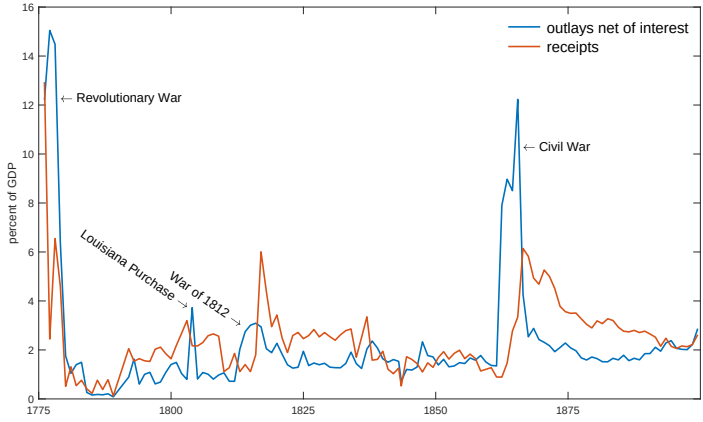


Total population, including free and enslaved. During Civil War, population includes Confederacy. Population in Confederacy was 42% of Union population.

Active duty military is total personnel in Army, Navy and Marine Corps. During Civil War, numbers include only Union forces. Confederate forces were roughly half the size of the Union forces.

Active Duty Military: 1900-2021

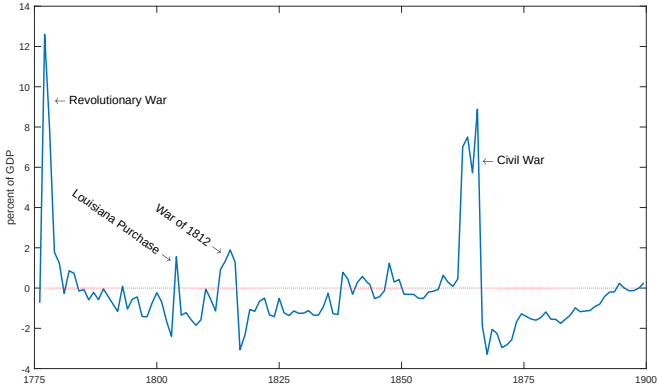
U.S. Federal Government Expenditures and Receipts: 1775-1900



Outlays are net of official interest payments. During Civil War, GDP includes the Confederacy.

Expenditures and Receipts: 1900-2031

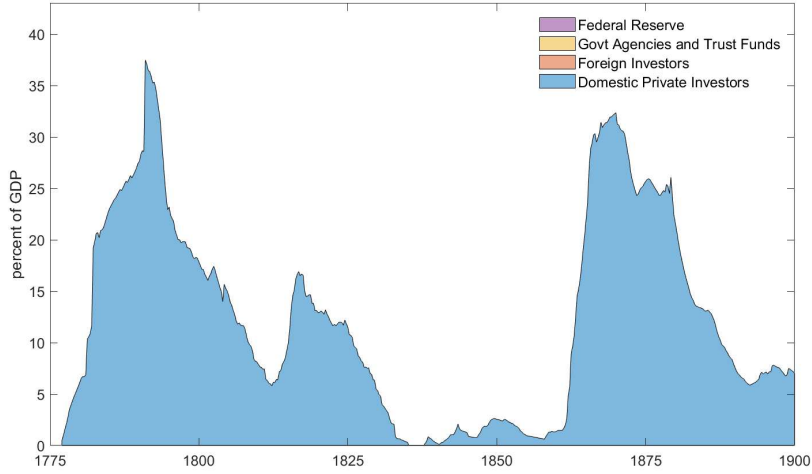
Primary Deficit: 1775-1900



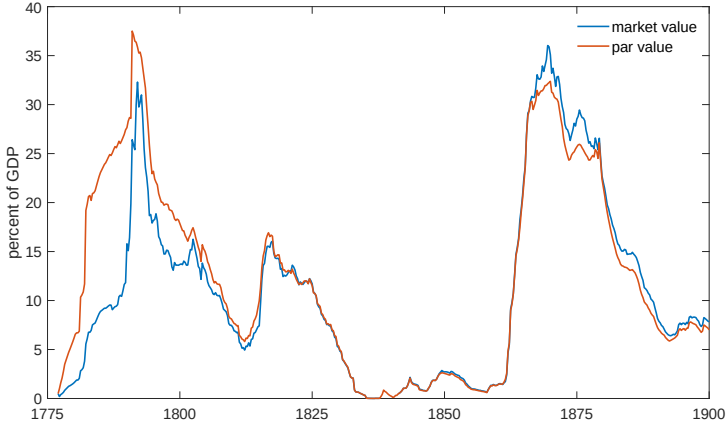
During the Civil War, GDP includes the Confederacy.

Deficits: 1900-2031

Par Value of U.S. Treasury Debt by Ownership as Percents of GDP: 1790 to 1900



Par and Market Values of Treasury Debt Held by Private Investors



Excludes bonds issued to Pacific Railway Companies.

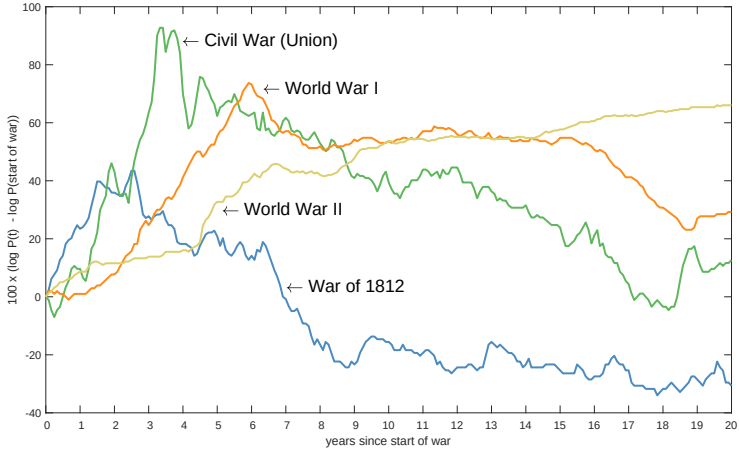
Par and Market Value of Debt: 1900-2021

Decomposition of Wartime Revenue

War Start - End	(1) gov't spending	(2) return on debt	(3) total spending	(4) tax revenue	(5) debt growth	(6) money growth	(7) GDP growth	(8) inflation	(9) other
War of 1812									
1812:6 - 1815:2	7.34	-0.20	7.14	-2.35	10.60	0.00	-0.16	0.06	-1.01
				-32.9	148.5	0.0	-2.2	0.8	-14.2
Civil War (Union)									
1861:4 - 1865:4	31.04	2.10	33.14	2.26	19.74	6.49	1.08	3.95	-0.37
				6.8	59.6	19.6	3.2	11.9	-1.1

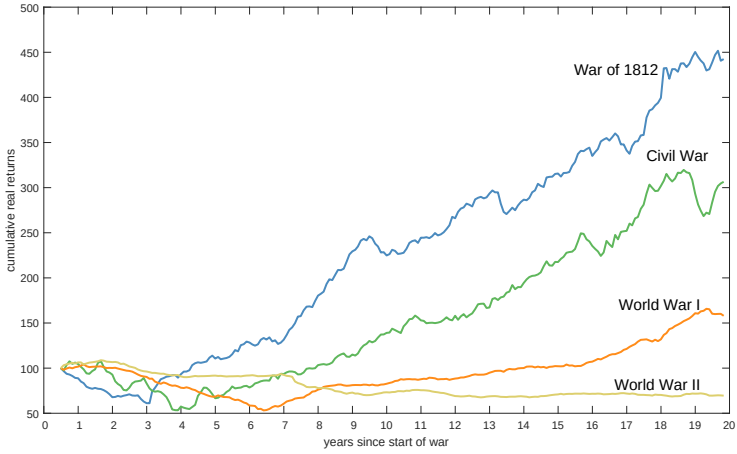
For each war, the elements in first row are percents of GDP. Columns (4)-(9) sum to column (3). The numbers in the second row are percentages of the sum of war-related government spending and returns to bondholders (column (3)) accounted for by each term in (4)-(9).
Peacetime baseline is the average value five years prior to the war.

Natural Log of Price Level

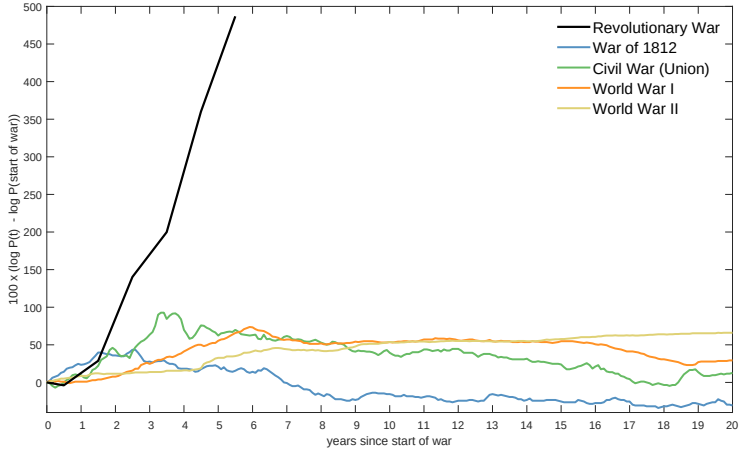


War of 1812 and Civil War: Warren-Pearson Index; WW-I and WW-II: BLS-CPI

Real Value of $100 Portfolio of Treasury Securities Invested at Starts of Wars



Natural Log of Price Level



Revolution War: Hoover-Taylor Index; War of 1812 and Civil War: Warren-Pearson Index; WW-I and WW-II: BLS-CPI

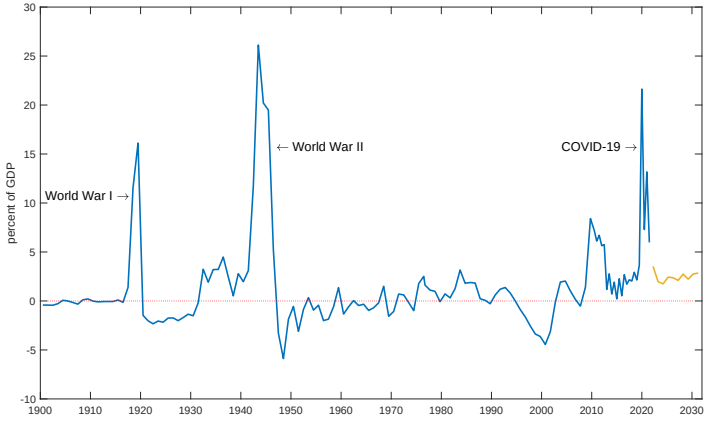
How US paid for five wars

	taxes	bonds	money
War of 1812	-32.9	148.5	0
Civil War	6.8	59.6	19.6
World War I	20.8	74.6	7.0
World War II	30.2	46.0	10.1
COVID-19	3.5	67.0	18.5

As percentages of total revenues.

Summary Three Wars

Primary Deficit: 1900-2031



1900-2010 annual by fiscal year; 2011-present monthly data aggregated to 6-month periods.

Deficits: 1775-1900

The Government Budget Constraint as Shares of GDP

Consider a "peacetime baseline"

$$\left(\frac{G}{Y}\right)^{base} + \left(r_{-1,0}\frac{B_{-1}}{Y_{-1}}\right)^{base} = \left(\frac{T}{Y}\right)^{base} + \left(\frac{B}{Y} - \frac{B_{-1}}{Y_{-1}}\right)^{base} + \left(\frac{M - M_{-1}}{Y_{-1}}\right)^{base} + \left(\frac{OM}{Y}\right)^{base}$$
$$+ \left(g_{-1,0}\frac{B_{-1}}{Y_{-1}}\right)^{base} + \left(\pi_{-1,0}\frac{B_{-1}}{Y_{-1}}\right)^{base}$$
$$+ \left(r_{-1,0}(\pi_{-1,0} + g_{-1,0})\frac{B_{-1}}{Y_{-1}}\right)^{base}.$$

Revenue Decomposition

For each war,

$$\underbrace{\sum_{t=T_1}^{T_2}\left[\frac{G_t}{Y_t}-\left(\frac{G}{Y}\right)^{base}\right]}_{\text{government spending}}+\underbrace{\sum_{t=T_1}^{T_2}\left[r_{t-1,t}\frac{B_{t-1}}{Y_{t-1}}-\left(r_{-1,0}\frac{B_{-1}}{Y_{-1}}\right)^{base}\right]}_{\text{nominal return on debt}}=\underbrace{\sum_{t=T_1}^{T_2}\left[\frac{T_t}{Y_t}-\left(\frac{T}{Y}\right)^{base}\right]}_{\text{explicit tax revenue}}$$

$$+\underbrace{\sum_{t=T_1}^{T_2}\left[\left(\frac{B_t}{Y_t}-\frac{B_{t-1}}{Y_{t-1}}\right)-\left(\frac{B}{Y}-\frac{B_{-1}}{Y_{-1}}\right)^{base}\right]}_{\text{interest-bearing debt growth}}+\underbrace{\sum_{t=T_1}^{T_2}\left[\frac{M_t-M_{t-1}}{Y_t}-\left(\frac{M-M_{-1}}{Y_{-1}}\right)^{base}\right]}_{\text{money growth}}$$

$$+\underbrace{\sum_{t=T_1}^{T_2}\left[g_{t-1,t}\frac{B_{t-1}}{Y_{t-1}}-\left(g_{-1,0}\frac{B_{-1}}{Y_{-1}}\right)^{base}\right]}_{\text{debt dilution via real GDP growth}}+\underbrace{\sum_{t=T_1}^{T_2}\left[\pi_{t-1,t}\frac{B_{t-1}}{Y_{t-1}}-\left(\pi_{-1,0}\frac{B_{-1}}{Y_{-1}}\right)^{base}\right]}_{\text{debt default via inflation}}$$

$$+\underbrace{\sum_{t=T_1}^{T_2}\left[\frac{OM_t}{Y_t}-\left(\frac{OM}{Y}\right)^{base}\right]}_{\text{other means}}+\underbrace{\sum_{t=T_1}^{T_2}\left[r_{t-1,t}(\pi_{t-1,t}+g_{t-1,t})\frac{B_{t-1}}{Y_{t-1}}-\left(r_{-1,0}(\pi_{-1,0}+g_{-1,0})\frac{B_{-1}}{Y_{-1}}\right)^{base}\right]}_{\text{cross-term}}$$

where T_1 is the first year of the war or the first year of US involvement, and T_2 is the final year of the war.

Decomposing Postwar Changes in Debt-GDP Ratios

We rearrange the government budget constraint

$$\begin{aligned}\frac{B_t}{Y_t} - \frac{B_{t-1}}{Y_{t-1}} &= r_{t-1,t}\frac{B_{t-1}}{Y_{t-1}} - g_{t-1,t}\frac{B_{t-1}}{Y_{t-1}} - \pi_{t-1,t}\frac{B_{t-1}}{Y_{t-1}} - r_{t-1,t}(\pi_{t-1,t} + g_{t-1,t})\frac{B_{t-1}}{Y_{t-1}} \\ &\quad + \frac{G_t - T_t}{Y_t} - \frac{M_t - M_{t-1}}{Y_t} \end{aligned} \tag{1}$$

Note that we have set $A_t = 0$.

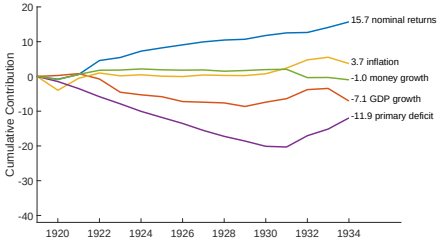
Decomposition of Post-War Changes in Debt/GDP Ratios

War post-war period	100 × Debt/GDP (1) end of war	 (2) 15 years postwar	 (3) change	Contributions (4) nominal payouts $r_t \frac{B_{t-1}}{Y_{t-1}}$	 (5) real gdp growth $g_t \frac{B_{t-1}}{Y_{t-1}}$	 (6) inflation $\pi_t \frac{B_{t-1}}{Y_{t-1}}$	 (7) primary deficit $\frac{G_t - T_t}{Y_t}$	 (8) money growth $\frac{M_t - M_{t-1}}{Y_t}$	 (9) other
World War I									
1919-1934	28.6	31.4	2.8	15.7	-7.1	3.7	-11.9	-1.0	3.4
World War II									
1945-1960	90.1	35.7	-54.4	14.3	-15.8	-38.9	-13.0	-0.3	-0.8

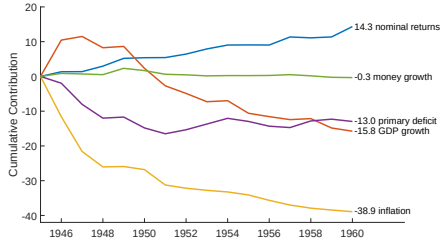
Decomposition of Post-War Changes in Debt/GDP Ratios

War post-war period	100 × Debt/GDP (1) end of war	 (2) 15 years postwar	 (3) change	Contributions (4) nominal payouts $r_t \frac{B_{t-1}}{Y_{t-1}}$	 (5) real gdp growth $g_t \frac{B_{t-1}}{Y_{t-1}}$	 (6) inflation $\pi_t \frac{B_{t-1}}{Y_{t-1}}$	 (7) primary deficit $\frac{G_t - T_t}{Y_t}$	 (8) money growth $\frac{M_t - M_{t-1}}{Y_t}$	 (9) other
World War I									
1919-1934	28.6	31.4	2.8	15.7	-7.1	3.7	-11.9	-1.0	3.4
World War II									
1945-1960	90.1	35.7	-54.4	14.3	-15.8	-38.9	-13.0	-0.3	-0.8

Cumulative Sums of Contributions to Postwar Debt-GDP Changes



(a) Post World War I

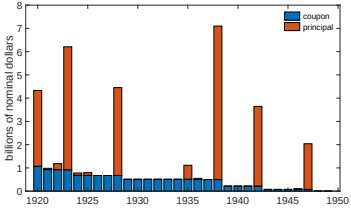


(b) Post World War II

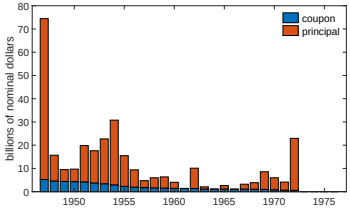
Distribution of Prospective Capital Losses

- After World War II, losses that the lifting of price controls and the subsequent inflation imposed on holders of federal bonds fell primarily on private investors.
- Today, a similar-sized inflation would probably hit the Fed's balance sheet and the Social Security Trust Fund much harder.

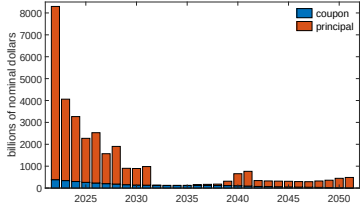
US Treasury Debt Service Profiles



(a) 1919



(b) 1946



(c) 2021