US Monetary, Financial, and Fiscal Priorities*

Preliminary Draft

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Abstract

US federal governments have confronted trade-offs among lowering borrowing costs, maintaining price stability, and maintaining financial stability. During the gold standard era, successive administrations prioritized decreasing government borrowing costs and keeping trend inflation low. Starting with FDR, the government prioritized financial and business cycle stability and was willing to use inflation taxes to lower its debt obligations and redistribute wealth between nominal creditors and debtors. Towards the end of the twentieth century, the government embraced financial deregulation and aggressive inflation targeting. We use our estimates for historical yields and inflation processes to indicate how those changing policy priorities affected or coincided with key macroeconomic correlations. The slope of both the US federal debt yield curve and the "Phillips curve" has changed signs as government priorities have changed.

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KEY WORDS: Gold standard, monetary policy, fiscal policy, financial regulation.

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1 Introduction

Which macroeconomic relationships reflect enduring economic forces and which reflect how different governments prioritize policy trade-offs? We shed light on this question by studying historical times series data for US federal yields and prices. Different US institutional arrangements embody different choices about balancing trade-offs between lowering federal borrowing costs, price stability, and financial stability. We find that objects that macroeconomists sometimes treat as time-invariant, such as the slope of the yield curve and the Phillips curve, vary significantly across institutional eras and so potentially should be considered part of government policy.

Payne et al. (2023b) estimated yield curves on US federal debt going back to 1790. In this paper, we use a non-linear state space model with stochastic volatility to infer the evolving dynamics of inflation. We combine these estimates to approximate ex-ante real yield curves from 1791-2020. We use our results to examine key macroeconomic relationships across different institutional arrangements.

We first consider currency creation and inflation. Although we find that long run inflation expectations were anchored around zero before the 1890s,[1] this did not necessarily foster a "stable currency." Before the Civil War the federal government issued only gold and silver coins and left the heterogeneously regulated state chartered banks to issue bank notes that were incompletely backed by gold and state government bonds.[2] Through this period, our inflation model points to persistent deflation and high, counter-cyclical inflation volatility with peaks during major bank crises and wars. These findings suggest that money was scarce and that the market value of broad money was volatile. The Civil War brought major changes to monetary and banking systems. Early in the war, Congress introduced a paper currency called "greenbacks" that was initially not convertible into gold and that traded at a volatile discount to gold during the war. In addition, during 1862-66, Congress passed four National Bank Acts that constructed a system of federally chartered banks that could issue *standardized* bank notes backed by long-term U.S. government debt. Coinciding with these changes, inflation volatility dropped by two-thirds and stabilized at a lower level after the 1870s. We find no evidence of

[1] So that gold denominated yields closely approximated real yields over this period.

[2] In the early 19th century, the First (1791-1811) and Second (1816-36) Banks of the US operated nationally and had some indirect control over state bank money and credit creation. After the non-renewal of the Second Bank of the US, state governments progressively deregulated entry into the banking sector, creating the so-called "free banking era" from 1837 to 1863.

trend deflation in the gold to goods price after the Civil War, in the sense that an estimated permanent component of inflation stays near zero.

We next consider the slope of the yield curve. A positive pre-FDR correlation between output growth and inflation indicates that investors regarded gold-paying government bonds as an inflation hedge. We present evidence that the change from a downward-sloping yield curve slope to an upward-sloping yield curve during the 1870s reflected changes in the inflation risks that investors wanted to hedge. The inflation process shifted from being nearly i.i.d. before 1880 to a persistent, less volatile process with a higher long-run mean after 1880. Thus, in the first part of our 1790-1933 sample, the major inflation risks were at long horizons, so that long-term bonds acted as a relatively better inflation hedge, while in the later part short-term inflation risks became more important, making short-term bonds a better hedge. The yield curve reflected inflation dynamics: a positive slope endured under monetary policy arrangements that predated the Fed's using a short-term interest rate as its policy instrument.

Finally, we consider the "Phillips curve". We find a strong positive correlation between per capita output growth and inflation during 1790-1933[3] and a strong negative correlation from the late 1930s until 2000. This change in the "Phillips curve" coincided with FDR's decision to abandon the gold standard and reorganize the financial sector. Before FDR, business cycle downturns had often coincided with bank crises in which households wanted to convert their state or national bank notes into gold, forcing banks to liquidate securities to acquire enough gold to honor their notes. Consequently, gold appreciated and the price level declined during recessions. FDR's New Deal reforms changed monetary mechanics by prohibiting households from holding gold and having the Federal Deposit Insurance Corporation insure the dollar value of bank deposits. A post-FDR "Phillip's curve" appears at least partly to have been the outcome of efforts to alleviate difficulties that pre-FDR governments had experienced in stabilizing the banking sector under a gold standard in which sources of gold, i.e., banks' "reserve" asset, namely, were beyond its control.

We argue that comovements among macro variables varied over time in ways that reflected how successive administrations traded off between lowering federal borrowing costs, targeting the price level, and stabilizing the financial system. During the gold standard era, the government prioritized minimizing costs of financing its expenditures and keeping trend inflation low. The government surrendered con-

[3]Except for the Civil War when the two series were virtually uncorrelated.

trol of the reserve asset by delegating price level targeting to the gold standard and foreign monetary authorities: it let US commercial banks create currency backed by banks' holdings of particular long-term US federal bonds, while excepting as beyond its control the consequences of those arrangements for financial stability. After FDR, the government put more weight on attaining financial and business cycle stability and less weight on price level targeting, so the government became willing to use the inflation tax to finance its expenditures. To do that it abandoned the gold standard, replaced it with a system in which the government controlled the supply of the bank-reserve asset, and fostered markets for federal securities in which liquidity premia move over the business cycle.

Related Work We present a narrative history supported by data and statistics, in the spirit of Friedman and Schwartz (1963).[4] There has been recent work compiling international historical interest rate series and examining long-term trends (e.g., Shiller (2015), Hamilton et al. (2016), Jordà et al. (2019), Schmelzing (2020), Officer and Williamson (2021), Chen et al. (2022)). Our non-linear state space model for inflation with drifting parameters and stochastic volatility builds on Cogley and Sargent (2005, 2015).

Outline Section 2 describes data and provides historical context. Section 3 outlines how we estimate the inflation process. Section 4 discusses statistical inferences about price processes. Section 5 examines the relationship between the yield curve slope and the inflation process. Section 6 shows the evolution of the cost of financing wars. Section 7 discusses the historical Phillips curve. Section 8 how the macroeconomic relationships reflect changing government priorities.

2 Historical Context

1791-1862: Bimetallism, Banks of the US, and State Banks. Between April 1792 and February 1862, the US dollar was defined in terms of gold and silver (a "bimetallic" system).[5] The federal government minted gold and silver coins but not paper

[4]Our interpretations are shaped by a statistical model that we regard as an auxiliary model in the sense of Gallant and Tauchen (1996) in terms of how it would connect to an explicit structural model cast in terms of parameters that describe preferences, constraints, and information flows of purposeful agents inside the model.

[5]Prior to 1792, a dollar referred to a Spanish silver coin.

notes. Instead, paper notes were created by the banking sector. Throughout the period, state legislatures charted state banks, which could issue their own bank notes. Initially, the First (1791-1811) and Second (1816-1836) Banks of the United States operated at the national level. These banks were privately owned and undertook commercial operations similar to those of the state banks. However, they also had the special privileges of acting as the banker for the federal government (depositing tax revenue and making loans) and operating across state boundaries. Because tax revenues could be paid in state bank notes and were deposited in the First and Second Banks of the US, these banks effectively acted as a lender to the state banking system. This meant that the First and Second Bank of the US could influence state bank note and credit creation by setting the rate at which they redeemed their state bank notes into gold.[6]

The rechartering of the Second Bank of the US turned into a political struggle during the Presidency of Andrew Jackson (1829-1837). Andrew Jackson vetoed a bill to recharter the bank in 1832, removed federal deposits from the bank in 1833, and ultimately allowed the bank's charter to expire in 1836. In the subsequent decades (1837-1862), states expanded their banking sectors by allowing the automatic chartering of banks without requiring explicit approval from the state legislature. This "free banking era" was perceived to be characterized by high bank risk taking and discounted state bank notes.

1862-1913: Greenbacks, Gold Standard, and the National Banking System. The outbreak of the Civil War in 1861 put significant strain on the monetary and financial systems, leading to major policy changes. In January 1862, state banks stopped honoring their legal obligation to convert their notes into specie (they "suspended" convertibility). On February 25, 1862, Congress passed a Legal Tender Act that authorized the Treasury to issue 150 million dollars of a paper currency known as greenbacks that the government did not promise immediately to exchange for gold dollars. Subsequent acts authorized the Treasury to issue more notes, eventually totalling 450 million dollars. Investors could use greenbacks to purchase bonds from the federal government at their par values. Gold dollars continued to be used to settle international transactions and to pay US tariffs. From 1862 to December 31, 1878 paper notes ("greenbacks" or "lawful money") traded at discounts relative to

[6]See Hammond (1947) for a discussion of the operations of the First and Second Bank of the US.

gold dollars ("gold" or "coin"). The greenback depreciated substantially during the Civil War and did not attain parity with gold until January 1, 1879, when the US Treasury started converting greenbacks into gold dollars one-for-one.

In addition, between 1863-6, Congress passed a collection of National Banking Acts, which established a system of nationally charted banks and the Office of the Comptroller of the Currency. National banks faced restrictions on what loans they could make and were allowed to issue bank notes up to 90% of the minimum of the par and market value of qualifying US federal bonds.[7] These national bank notes were intended to replace the state bank notes as a standardised currency that could be used across the country. In order to achieve this, Congress imposed a 10% annual tax on state bank notes, which was significantly greater than the 1% annual tax on national bank notes.

1913-1933: Establishment of Federal Reserve Bank. Bank runs and stock market crashes were a common feature of all different monetary and banking policy arrangements during the nineteenth century. There were country wide bank panics in 1819, 1827, 1857, 1873, 1893, and 1907 as well as many other local bank panics in New York and other financial hubs. In response, the 1913 Federal Reserve Act created a system of Federal Reserve Banks to act as reserve money creators of last resort. Convertibility between gold and US notes at par prevailed through World War I and the 1929 stock market crash until 1933 when Franklin D. Roosevelt increased the paper price of gold and prohibited private US citizens from holding gold coins. For the purposes of this paper, we consider this the end of the gold standard in the US.

3 State-Space Model of Inflation Expectations

We estimate inflation expectations between 1794-2020 by applying a univariate state-space model with drifting coefficients and stochastic volatility. When gold and greenback dollars coexisted at a floating exchange rate from 1862 to 1878, the

[7]National banks could only operate one branch. They were restricted from making mortgages unless they were operating in rural areas, where they could make a limited range of loans collateralized by agricultural land. Initially, qualifying bonds were United States government registered bonds bearing interest in coupons of 5% or more. In addition to needing to hold federal bonds, the National Banks also needed a minimum quantity of equity capital that depended on the population in the town where they operated.

General Price Level Index expresses greenback inflation, so we converted it into gold inflation by using the gold/greenback exchange rate P_t. Our estimates here are based on quarterly inflation. However, key findings are robust to estimating the model using monthly or annual inflation.

Let π_{t+1} denote the logarithm of quarterly price change between period t and $t+1$. We use the following state-space model that has stochastic volatility, changing long-run mean and (infrequently) changing persistence parameter:

Assumption 1. Quarterly inflation π_t obeys a state-space model:

$$\begin{aligned} \pi_{t+1} &= \alpha_t + x_t^{\pi} + \sigma_{\pi,t}\varepsilon_{\pi,t+1} \\ x_{t+1}^{\pi} &= \rho_t x_t^{\pi} + \sigma_x \varepsilon_{\pi,t+1} \end{aligned} \qquad \varepsilon_{\pi,t+1} \sim \mathcal{N}(\mathbf{0}, 1), \ \forall t \geq 0 \tag{3.1}$$

where x_t^{π} is a hidden state with a given initial x_0. Parameters α_t and $\sigma_{\pi,t}$ follow random walks:

$$\begin{aligned} \alpha_{t+1} &= \alpha_t + \sigma_\alpha \varepsilon_{\alpha,t+1} & \varepsilon_{\alpha,t+1} &\sim \mathcal{N}(\mathbf{0}, 1) \\ \log \sigma_{\pi,t+1} &= \log \sigma_{\pi,t} + \sigma_{\sigma_\pi} \varepsilon_{\sigma_\pi,t+1} & \varepsilon_{\sigma_\pi,t+1} &\sim \mathcal{N}(\mathbf{0}, 1) \end{aligned}$$

while the persistence parameter ρ_t follows a random walk with infrequent shocks:

$$\rho_{t+1} = \begin{cases} \rho_t + \sigma_\rho \varepsilon_{\rho,t+1} & \varepsilon_{\rho,t+1} \sim \mathcal{N}(\mathbf{0}, 1) \quad \text{if } \ t = k\Delta \quad \text{for } k \in \mathbb{N} \\ \rho_t & \text{otherwise} \end{cases}.$$

Our baseline estimates set $\Delta = 4$, so that the persistence of quarterly inflation can change once every year. Model (3.1) posits that j-period ahead logged inflation, $\sum_{i=1}^{j} \pi_{t+i}$, is a normal random variable, implying that j-period ahead gross inflation, $\Pi_t^{(j,n)}$, is log-normal. Using the model-implied conditional mean and variance of $\sum_{i=1}^{j} \pi_{t+i}$, one can derive an estimate for $\mathbb{E}_t\left[\exp\left(-\pi_t^{(j,n)}\right)\right]$ that goes into formula (**??**). We estimate this model using the same HMC-NUTS sampler that we use in Payne et al. (2023b) and Payne et al. (2023a).

Priors: We use independent Gaussian priors for σ_x and the initial parameters α_0 and ρ_0:

$$\sigma_x \sim \mathcal{N}(0, 0.5), \qquad \alpha_0 \sim \mathcal{N}(0, 1), \qquad \rho_0 \sim \mathcal{N}(0, 0.5)$$

For the initial standard deviation $\sigma_{\pi,0}$, we use a log-normal prior $\sigma_{\pi,0} \sim \log \mathcal{N}(0.015,\ 0.01)$. For each of the standard deviations σ_α, σ_{σ_π}, and σ_ρ, we use the same exponential prior with the rate parameter tuned so that *a priori* the probability that $\sigma_i > 0.3$ is lower than 5%. The prior mean is 0.1.

4 Inflation Anchor Before 1880

Figure 1 depicts posterior distributions of conditional moments for the inflation process. The top panel shows conditional inflation expectations: color grey refers to long-term expectations (permanent component of inflation), color blue represents inflation expectations one year ahead. The grey line in the bottom panel depicts the posterior median estimate for the model implied 5-year ahead conditional inflation volatility. Figure 1 plots an annualized conditional volatility defined as

$$\sigma_{\pi,t}^{(j)} := \sqrt{\frac{1}{j}\left(\mathbb{E}_t\left[\exp\left(2\pi_t^{(j)}\right)\right] - \mathbb{E}_t\left[\exp\left(\pi_t^{(j)}\right)\right]^2\right)}.$$

The purple line in the bottom panel depicts the posterior median estimate for the 5-year-ahead smoothed conditional root mean square statistic. This is the measure of the conditional second moment of inflation that Cogley and Sargent (2015) used to quantify 'price instability' as distinguished from 'unpredictability'. The conditional root mean square statistic can be written as

$$crms_{\pi,t}^{(j)} := \sqrt{\frac{1}{j}\mathbb{E}_t\left[\exp\left(2\pi_t^{(j)}\right)\right]}.$$

Throughout most of the 19th century, gold inflation expectations were anchored around zero or negative rates (especially between 1810 and 1850). Wars, recessions, and panics brought sharp temporary increases in inflation volatility. The story started to change in the 1880s when long-run gold inflation expectations became positive and inflation volatility dropped: those recurrent large but temporary inflation shocks ended and were succeeded by shocks that mostly hit the permanent component, implying an increase in inflation persistence.[8]

Sources of the elimination of deflation and the decrease in inflation volatility

[8]These findings are broadly consistent with Barro (1979, 1982) and the empirical results of Benati (2008) who shows that whenever a monetary regime has a clearly defined nominal anchor inflation is only weakly persistent.

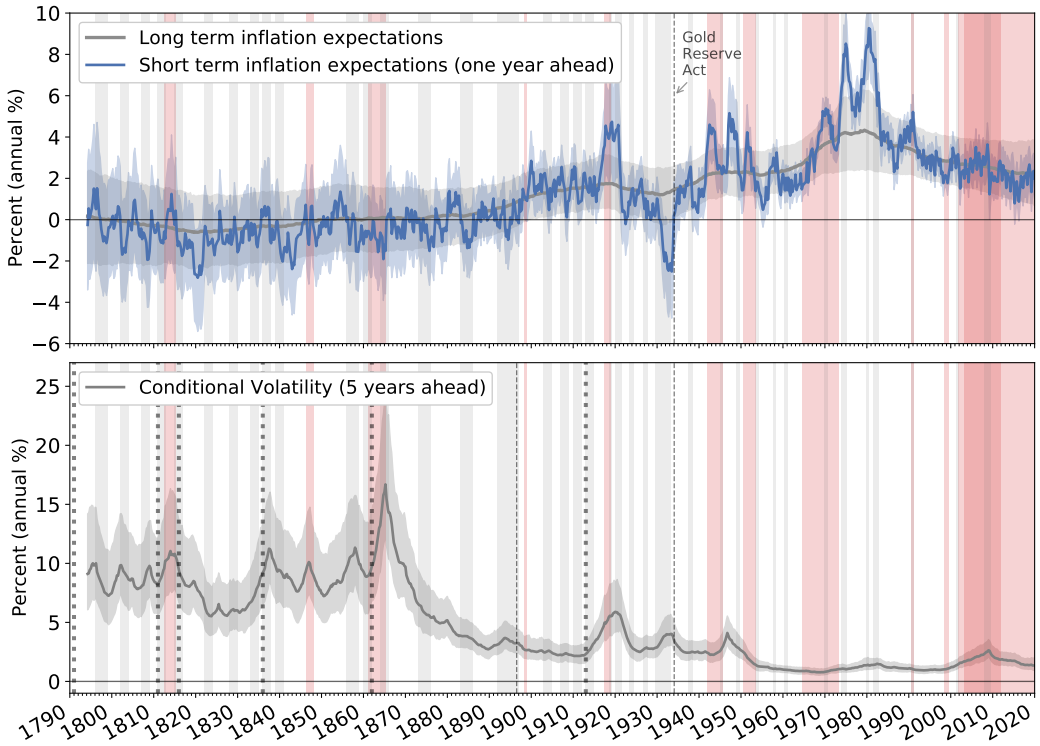

Figure 1: Smoothed Conditional Moments of Inflation

Top panel: The solid grey line depicts the posterior median estimate for the permanent component of inflation. The solid blue line depicts the posterior median estimate for one-year-ahead inflation expectations implied by our statistical model. *Bottom panel:* The solid grey line depicts the posterior median estimate for the smoothed, annualized conditional inflation volatility 5 years ahead.

might have included four National Banking Acts during 1863-6 that created a steady supply of national bank notes backed by federal government debt that after 1879 promised gold dollars. The pre-Civil War period was characterized by a patchwork of restrictions on quantities and qualities of bank supplied money. The 1848-1855 California gold rush significantly increased the supply of gold in the US. A likely source of the increase in long-run inflation expectations in the late 19th century was sentiment among elements of both major political parties to reinstate a bimetallic gold-silver standard at a mint price ratio of 16-1 after the market price ratio had become much higher. Prospects of a return to bimetallism at an exchange rate that overvalued silver relative to market prices naturally made investors fear inflation

(See Friedman (1990a), Friedman (1990b), Velde and Weber (2000), Weiss (2020), and Fulford and Schwartzman (2020)).[9] The Witwatersrand (1886) and Klondike (1896) gold rushes increased the supply of gold (See Friedman and Schwartz (1963) and Bordo et al. (2004)).

Short-run inflation expectations peaked at over 4% per annum during World War I but stabilized at around 1% per annum soon afterward. Meanwhile, long-term inflation expectations stayed near 1-1.5%. That pattern may reflect that the US was one of the few Western countries not to have abandoned the gold standard during World War I. The next major change came in 1933 when Roosevelt signed the Gold Reserve Act that effectively took the US off the gold standard, at least for US citizens. Short-term inflation expectations immediately increased by approximately 3 percentage points and remained positive throughout the rest of the 20th century.

5 Yield Curve Slope Inversion and Inflation Volatility

The top panel in Figure 2 depicts the 10-year gold dollar yield minus the 2-year yield, which we refer to as the term spread. A positive term spread indicates an upward-sloping yield curve (i.e., longer maturity bonds have higher rates), while a negative term spread indicates an "inverted" yield curve (i.e., shorter maturity bonds have higher rates). The term spread was typically negative before the Civil War and positive afterward, with major declines during the War of 1812, the Mexican-American War, and the Civil War.

A possible explanation for the sign switch is related to a remarkable change in the inflation dynamics. The green solid line in the bottom panel in Figure 2 shows changes in relative forecastabilities of inflation at long and short horizons, as measured by the difference between the 10- and 2-year ahead conditional inflation volatility.[10] Positive values indicate that it was more difficult to predict inflation at the 10-year horizon than at the 2-year horizon. Negative values indicate the opposite. Evidently long-term inflation became relatively easier to predict following

[9] Also see Silber (2019) for an acccount of the "free silver" movement that advocated that the US return to a bimetallic standard at a mint ratio of 16 to 1. William Jennings Bryan made the case for silver coinage in his *Cross of Gold speech* at the Democratic National Convention in 1896. The Democratic Party made free silver central to its 1896 presidential campaign but ultimately lost the election. The Gold Standard Act was passed in 1900.

[10] More precisely, we plot the posterior distribution of the statistic $\sigma^{(10)}_{\pi,t} - \sigma^{(2)}_{\pi,t}$. Apart from the difficulty of predicting inflation, the wide posterior band reflects the significant parameter uncertainty underlying our estimates.

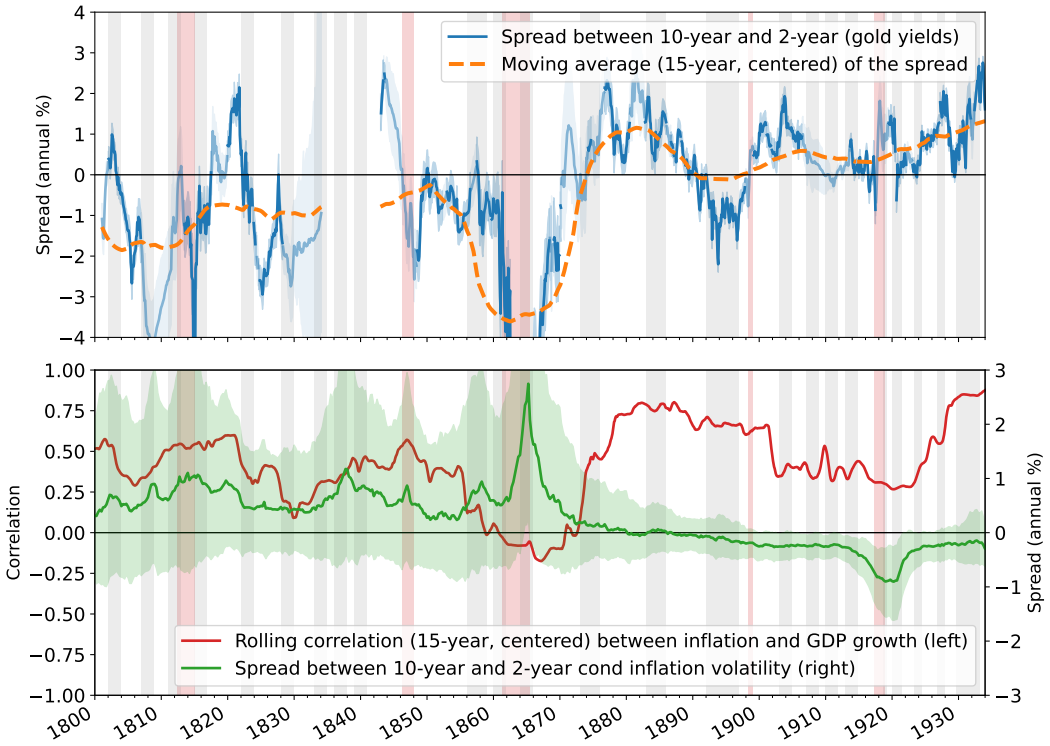

Figure 2: Term Spread and Inflation Risk

Top panel: The solid blue line depicts the posterior median for the yield on 10-year, gold denominated, zero coupon US government bonds minus the yield on 2-year bonds. The orange dashed line depicts the 15-year centered moving average spread. *Bottom panel:* The green solid line (right axis) depicts the posterior median for the difference between the 10-year ahead (smoothed) annualized conditional inflation volatility and the 2-year ahead inflation volatility. The red solid line (left axis) depicts 15-year centered rolling correlation between inflation and GDP per capita.

the Civil War,[11] a change that coincides with the slope of the yield curve switching from negative to positive. This suggests that term spreads becoming positive could reflect a decrease in long run "inflation risk." That would be consistent with asset pricing theory if the inflation risk premium were negative because federal gold bonds provided a good hedge against inflation. The red line in the bottom panel, which depicts a rolling correlation between inflation and real GDP growth per capita, provides evidence that this was indeed the case. The correlation between GDP growth and inflation appears to be positive in the gold era which is consistent with inflation risk premium being negative.

6 Cost of Financing Wars

An outcome of 19th century reforms was that, by the early twentieth century, the US federal government could finance large deficits at low or negative real yields. See Figure 3, which plots our estimates of 5-year *ex ante* real yields on US Treasuries, our estimates of 5-year nominal zero-coupon yields on US Treasuries, and US surpluses as percentages of GDP.[12] Evidently, large deficits during the War of 1812 and the Civil War coincided with high real yields. That pattern stands in stark contrast to the US experience during the twentieth century when it financed large deficits during WW1, WW2, the Depression, and the Great Recession at low real yields.

This figure sheds light on a historical contest between two founding fathers: Alexander Hamilton and Thomas Jefferson. During the late 18th and early 19th centuries, the UK serviced high debt-GDP ratios at low interest rates. US statesmen disagreed about whether the US could and should foster a similar outcome. One of Hamilton's motivations for his reform "program" was to ensure the US could on occasions run large deficits to finance wars and build infrastructures. By contrast, Jefferson advocated low federal taxes and spending and a limited federal borrowing capacity, partly to prevent the US from supporting a standing army and becoming entangled in foreign adventures. Figure 3 assesses the success of both Hamilton and Jefferson as advocates and prophets. Hamilton's hopes of low interest rate deficit

[11] Mechanically, this comes from the stunning fact that the persistence and long-run mean of inflation increased while inflation volatility fell *simultaneously* after Resumption. Because gross inflation $\exp(\pi_t^j)$ is modeled as a *log*-normal random variable, finding the exact source of the change is difficult, but inflation becoming more persistent is certainly a key factor.

[12] We combine our nominal yield curve estimates for 1790-1947 with the zero-coupon yield estimates of McCulloch and Kwon (1993) covering the period 1947 - 1961 and the estimates of Gürkaynak et al. (2007), which is available since 1961.

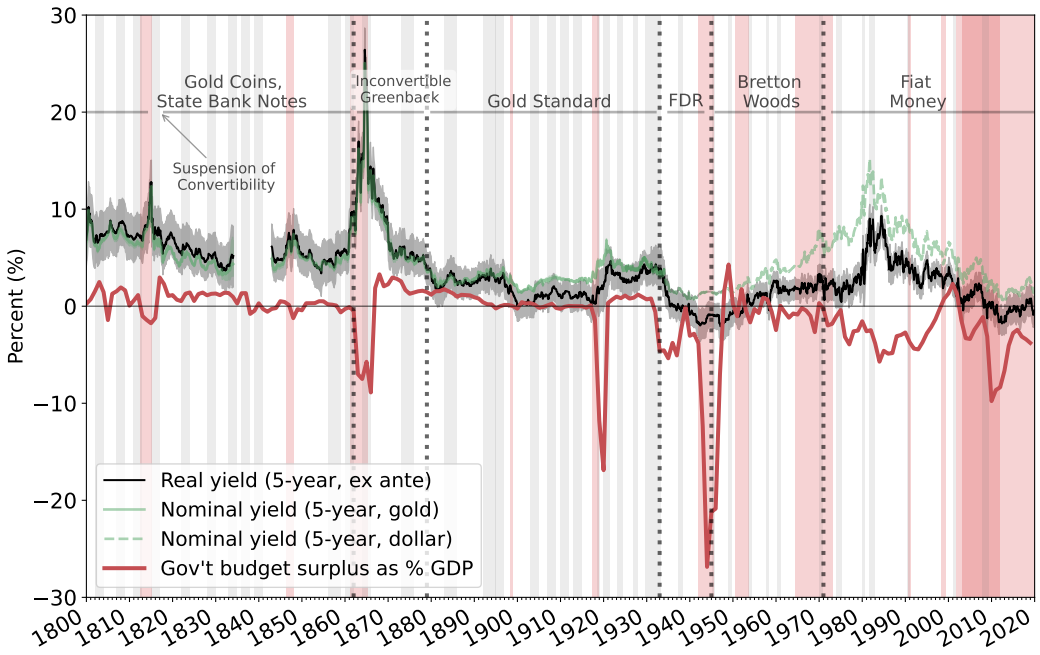

Figure 3: US Budget Surpluses and *ex ante* Real Bond Yields

The solid black line depicts the posterior median estimate for the 5-year, gold denominated, zero coupon yield. The grey bands around the posterior median depict the 90% interquantile range. The solid green line depicts the posterior median for the 5-year gold denominated yield. The dashed green line depicts the combination of our posterior median estimate for the 5-year dollar (post 1933) yield with the zero-coupon yield estimates of McCulloch and Kwon (1993) and Gürkaynak et al. (2007). The solid red line shows US surplus as a percentage of GDP. The light gray intervals depict recessions. The light red intervals depict wars.

financing were eventually realized in the early twentieth century. However, as Jefferson feared, the achievement of a low financing cost regime coincided with the nation's introducing a big standing army and more frequently waging foreign wars.

7 The Phillips Curve Slope Change After New Deal

A coincidence of output declines and deflationary pressures was a controversial topic after the 2007-9 financial crisis. To many contemporary researchers, the positive correlation between output growth and inflation seemed to be a historical anomaly. Figure 4 shows that a positive correlation was actually the historical norm until

World War II. The top panel of figure 4 shows that the rolling correlation between per capita output growth and inflation was positive from 1790 to 1933, except for the Civil War period when the two series became uncorrelated.[13] This relationship changed dramatically after World War II when the correlation became significantly negative due to a series of low inflation booms and the "stagflation" of the 1970s and 1980s. The figure shows the irony that a "Phillips curve" prevailed for approximately 150 years but then abruptly broke down just when economists discovered it in the late 1950s.

8 Evolving Purposes of Monetary Policy Makers

It is possible that these changes reflect how different administrations have balanced trade-offs between lowering borrowing costs, price stability, and financial stability. Before the Civil War, the government prioritized decreasing the cost of government financing and keeping trend inflation low. To do that it adhered to the gold standard and for two spells awarded monopoly powers over high powered money creation to the First and Second Banks of the US. The middle and bottom panels of Figure 4 show that these policies coincided with volatile inflation, long run deflation, and relatively frequent financial crises. This indicates an economy characterized by downturns with bank crises in which households demanded more gold by seeking to convert state bank notes into gold, which in turn forced state banks to demand more gold. As a result, gold appreciated and deflation occurred in the midst of recessions. So under the gold standard, frequent financial crises coincided with strong positive co-movement between output growth and inflation.

While the government had similar priorities after the Civil War, its new banking and regulatory institutions gave it more powerful tools for lowering inflation volatility. A key institution was the National Banking System, which allowed the government to earn a higher convenience yield on long term government debt and stabilize the market value of broad money. That the government accomplished those purposes is indicated by the evaporation of the spread between US and UK debt yields, the elimination of the "short rate disconnect," the substantial decrease in inflation volatility, and the stabilization of the trend price level. Although the 1863-66

[13]Figure 4 plots the 15-year rolling correlation, but our finding is robust to other horizons. In fact, one can easily spot the changing co-movement between inflation and output growth per capita by inspecting the raw series, which also appears in figure 4.

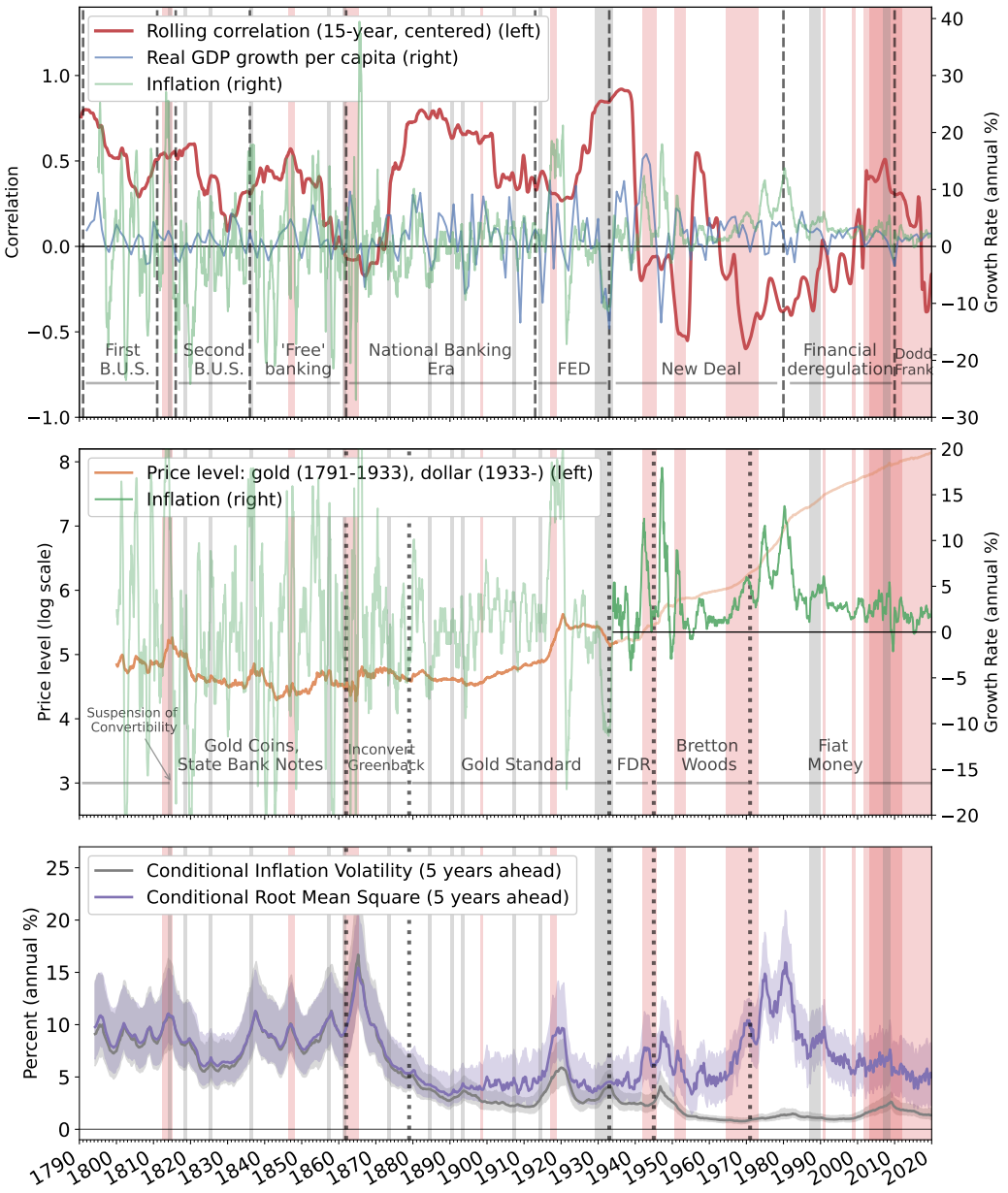

Figure 4: Output and Inflation.

Top panel: The pale blue line depicts annual real GDP growth per capita; the pale green line depicts our annual inflation series, both measured on the right axis. The red thick line shows the 15-year (centered) rolling correlation between the blue and green series, measured on the left axis. *Middle panel:* The orange line depicts our combined log price index (left axis). It measures the gold price of goods before 1933 and the price of goods in dollars after 1933. The green line shows the annual growth rates (inflation) of the orange line (right axis). *Bottom panel:* The solid grey line depicts the posterior median estimate for the 5-year-ahead smoothed, annualized conditional inflation volatility. The solid purple line depicts the posterior median estimate for the 5-year-ahead smoothed conditional root mean square statistic. The light gray intervals depict banking crises from Reinhart and Rogoff (2009)

National Banking Acts restricted bank lending, they did not create a government-run lender-of-last-resort backstop for the financial system. The system still experienced large financial crisis shocks and the positive relationship between output growth and inflation continued.

During the first half of the 20th century the government's priorities changed. Concerns about ensuring financial and business cycle stability increased while concerns about ensuring price stability decreased as the government used inflation taxes to lower its borrowing costs especially during wars. Institutional changes accompanied these shifting priorities. Created by the Federal Reserve Act of 1913 and beginning to operate in late 1914,[14] the Federal Reserve Bank was empowered to act as a lender-of-last-resort to member banks. During the 1930s, Franklin D. Roosevelt's New Deal devalued the dollar relative to gold, introduced national deposit insurance, passed the Glass-Steagall Banking Act of 1933, and established the Federal National Mortgage Association ("Fannie Mae") to insure a large fraction of bank issued mortgage loans. After World War II, the Fed focused more and more on taming business cycles. We see these changes reflected in the increase in long run inflation expectations and the relative stability of the financial sector from 1933 through to 2007.[15] A plausible explanation for the changed correlation between output growth and inflation during 1940-2000 was the government's decision to refocus away from price stability toward financial stability. The government's priorities changed again towards the end of the century when it embarks on a program of financial deregulation. During this period the correlation between inflation and output increased and eventually became positive again in the early decades of the twenty-first century.[16]

9 Concluding remarks

Our data and descriptive statistical models have helped us detect how coincident arrangements for regulating financial institutions and administering monetary and fiscal policies impinged on costs of government finance. To understand more about

[14] Silber (2007) described how Fed mostly sat out 1914 financial crisis.

[15] It is enlightening to compare frequencies of gray bands in Figure 4 before and after the New Deal.

[16] Calomiris and Haber (2015) provide a political- economic analysis of the coalitions that lobbied for different regulatory arrangements.

connections between arrangements and outcomes, we plan to construct structural macroeconomic models that make contact with our descriptive statistical model.

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