

Gold's Grip: How the Fed Broke the Link

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October 2026

Abstract

Before the United States had a central bank, gold flows were its monetary policy. We ask whether the founding of the Federal Reserve changed how external gold shocks reached the domestic economy. We identify gold shocks in a Bayesian structural VAR on monthly data from 1890 to 1927, using only the impact restrictions implied by a model of the gold-standard money market together with narrative restrictions drawn from documented inflow and outflow episodes on both sides of the founding. Although the restrictions bind only on impact, the identified shock produces the persistent liquidity effect and the delayed rise in the price level that the model predicts. Transmission changed sharply with the arrival of the Fed. Before it, a gold inflow of about 33 million dollars lowered the call money rate by about one percentage point, raised equity prices by almost three percent, and lifted industrial production and the price level by 1.6 and 0.7 percent within six months. After it, the call rate moved by a tenth as much, and output and prices barely responded. The pattern matches the comparative statics of a central bank that offsets gold flows and smooths interest rates.

JEL C32, E42, E52, E58, F33, N11, N21. **Keywords** gold standard, Federal Reserve, monetary transmission, sterilization, narrative sign restrictions, structural VAR.

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1 Introduction

Gold is money. Everything else is credit.

— John Pierpont Morgan

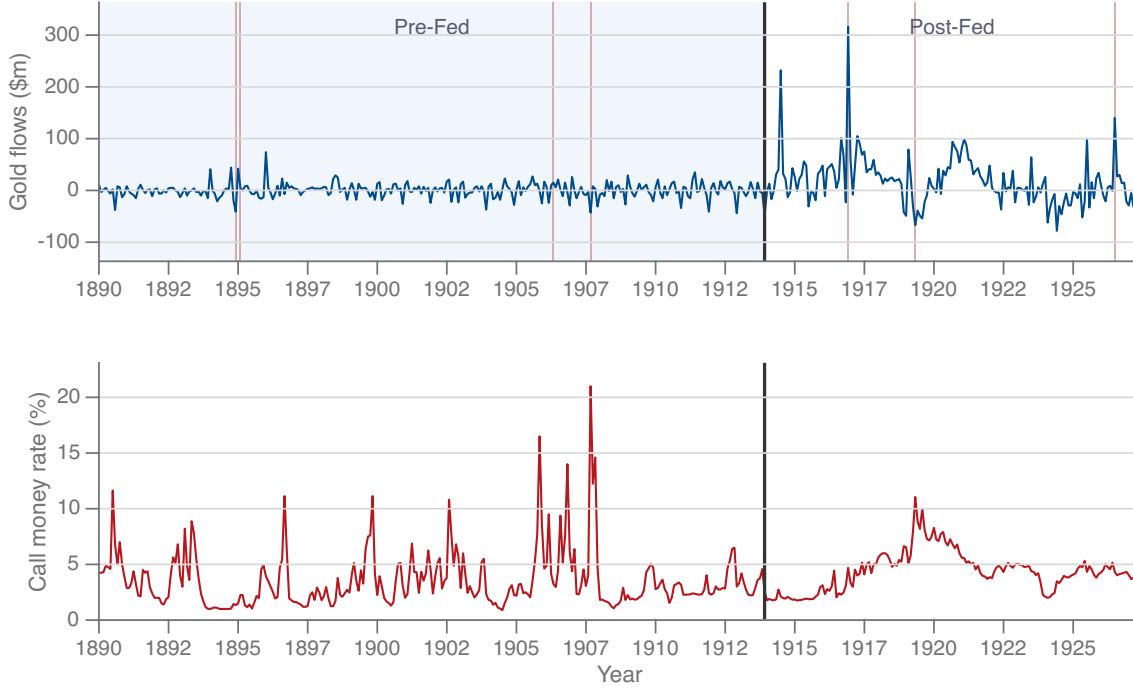
For most of the classical gold standard the United States had no central bank, and gold flows set its monetary conditions. A shipment of gold from London added to bank reserves and eased the New York money market. A shipment the other way drained reserves and tightened it. Nobody decided anything. In December 1913 the Federal Reserve Act placed an institution with a balance sheet between the gold flow and the money market. This paper asks whether that institution changed how external gold shocks were transmitted to the American economy, by how much, and through which channels.

The question reaches beyond its period. Whether a central bank can insulate domestic conditions from external monetary forces under a fixed exchange rate is the core of the international trilemma (Obstfeld et al., 2005), and the evidence that global financial conditions reach even countries with flexible exchange rates has made it newly contested (Rey, 2013). Modern settings rarely offer a clean before and after. The United States around 1913 comes close. It was the largest economy in the world, it stayed on gold throughout, it was hit by large and well documented gold shocks on both sides of the break, and it acquired a central bank in the middle of the period. The European central banks that the literature on the rules of the game studies existed throughout, so their behavior can be measured but not switched off. The American case lets us compare transmission with and without a central bank in the same economy.

The raw data suggest that something changed. Figure 1 plots the monthly change in U.S. official gold holdings and the New York call money rate from 1890 to 1927. Gold movements did not shrink after 1913. The largest flows in the sample, driven by Allied wartime payments, came after the Fed opened. Yet the call money rate, which before 1913 lurched repeatedly into double digits and reached twenty-one percent in the Panic of 1907, is calm afterward. Figure 2 makes the point in one line. The slope of a rolling regression of the change in the call rate on the gold flow is large and unstable before 1913 and close to zero after.

Two obstacles stand between these pictures and an answer. The first is reverse causality. Under the gold standard a rise in domestic interest rates itself drew gold in, so gold flows and interest rates move together for reasons unrelated to transmission. We show below that a gold surprise built from a reduced-form forecast error carries the wrong sign for the call money rate for exactly this reason. The second obstacle is that the Federal Reserve did not arrive alone. Its founding coincided with the First World War, a wartime embargo on gold exports, the suspension of sterling convertibility, and the transformation of the United

Figure 1: Gold flows and the money market, 1890 to 1927

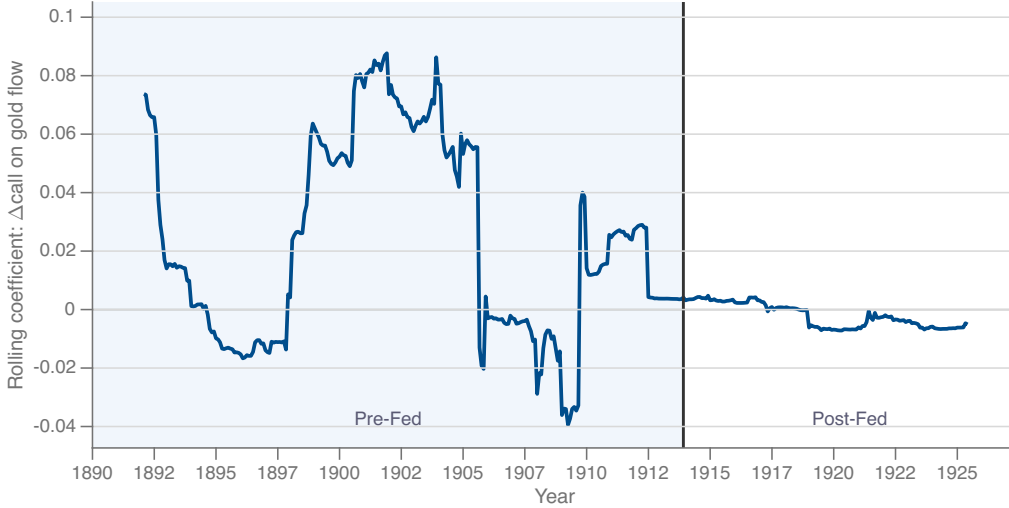


Notes. The top panel plots the monthly change in gold held by the U.S. Treasury and, from 1914, the Federal Reserve Banks, in millions of dollars. The bottom panel plots the New York call money rate in percent. Thin vertical lines mark the eight episodes of Table 1. The heavy vertical line marks the Federal Reserve Act of December 1913, and shading marks the pre-Fed period.

States into a creditor nation, and the change in the behavior of interest rates around 1914 was visible well beyond the United States (Barsky et al., 1988). An answer has to isolate exogenous gold movements and be explicit about what a comparison across 1913 can and cannot attribute to the Fed.

We meet the first obstacle with a structural vector autoregression identified from economic theory and from the historical record. We begin from a compact model of the gold-standard money market in which a central bank, when one exists, can offset a gold flow and smooth the interest rate. The model delivers three impact signs and two impact zeros for a gold shock, and these are all we impose. We add narrative sign restrictions in the manner of Antolín-Díaz and Rubio-Ramírez (2018) at eight documented episodes, four before the Fed and four after, with two inflows and two outflows in each period. The identification binds only on impact. Everything the model says about the path of the economy after impact is left free, so the dynamic responses test the model rather than assume it. We meet the second obstacle by estimating three objects that answer different questions, an average gold

Figure 2: The sensitivity of the money market to gold flows over time



Notes. The line is the slope from a rolling regression of the monthly change in the call money rate on the gold flow over a centered forty-eight-month window. This is a reduced-form correlation. Its sign is not identified, for the reasons given in the text.

shock on the full sample, separate gold shocks on the pre-Fed and post-Fed samples, and episode-specific responses on local windows, and by reading the historical decompositions of individual episodes to see where a gold-driven impulse went.

Three results stand out. First, the identified gold shock behaves as the model predicts even though only its impact is restricted. A one standard deviation inflow, about 33 million dollars, lowers the call money rate by about half a percentage point on impact, and the rate stays below baseline for the next two months. Equity prices rise by about one and a half percent, and the price level rises gradually to about half a percent after a year, with a credible band that excludes zero. Output and the dollar price of sterling move in the predicted direction but are imprecisely estimated.

Second, transmission collapsed after the founding of the Fed. Estimated on the pre-Fed sample, a gold inflow lowers the call rate by about one percentage point on impact, raises equity prices by about 2.7 percent, and lifts industrial production and the price level by 1.6 and 0.7 percent within six months. Estimated on the post-Fed sample, the same shock moves the call rate by about a tenth as much, raises equity prices by half a percent, and leaves output and the price level essentially unchanged after six months. The posterior probability that the pre-Fed impact on the call rate is the larger of the two is 0.93. The contrast holds event by event. Each of the four pre-Fed episodes, estimated on its own window, shows a liquidity effect between 0.6 and 2.6 percentage points, and each of the four post-Fed episodes

shows one of about a tenth of a point.

Third, the decompositions show where the gold impulse went. In the Panic of 1907 the gold shock accounts for essentially all of the September drain but for only about seven percent of the jump in the call rate, so the rate spike was the panic and not the gold. In December 1916 a gold inflow of about three hundred million dollars, two thirds of it attributed to the gold shock, pushed the call rate down by about two thirds of a point, yet the observed rate rose by more than two points. The easing impulse arrived and was absorbed.

The model reads these results through two policy parameters, one governing how much of a gold flow is offset and one governing how strongly the interest rate is smoothed. Both raise the denominator, or lower the numerator, of the liquidity effect, and every response in the model shrinks as either rises. That is the pattern in the data. The impact response of the call rate, which the model ties most directly to the policy parameters, falls by a factor of about nine. Holding the other parameters fixed, a fall of that size means that offsetting and smoothing together absorbed close to nine tenths of the liquidity effect of a gold flow. The equity response, which the model makes a pure discount-rate effect on impact, falls by a similar order of magnitude, and the responses of output and the price level, which we never restrict across periods, shrink as well. The one variable that moves more after 1913 is the exchange rate, which the model, built for an economy inside the gold points, does not speak to once sterling left gold.

We are careful about what the comparison can attribute to the Fed. The post-Fed sample spans the war, the postwar boom and deflation, and the restored gold standard, any of which could change the dynamics. Three pieces of evidence point toward the Fed nonetheless. The muted response appears in a wartime inflow, a postwar outflow, and two episodes of the restored standard, which differ in nearly everything except the presence of the central bank. The 1916 decomposition shows the easing impulse arriving and being absorbed, which is what offsetting means. And Barsky et al. (1988) attribute the worldwide change in interest-rate behavior in 1914 to the founding of the Fed rather than to the suspension of the gold standard. We nonetheless rest on the ordering of the responses across periods rather than on the exact ratio.

Related literature. The paper joins four literatures. The first asks whether the founding of the Fed changed the American money market. Miron (1986) shows that the seasonal swings in interest rates that marked the National Banking Era largely vanish after 1914, Mankiw et al. (1987) show that short-term rates became far more persistent and that the term structure adjusted accordingly, Canova (1991) compares the incidence of panics before and after the Fed, and Bernstein et al. (2010) find that call money rate volatility in the

seasonally stressed autumn months fell by more than seventy percent. These papers study the unconditional behavior of rates. We study the transmission of an identified external monetary shock, which maps directly into the central bank’s capacity to offset, and we trace it beyond the money market to equities, output, and prices.

The second literature asks whether central banks under the gold standard followed the rules of the game. [Bloomfield \(1959\)](#) and [Nurkse \(1944\)](#) found that central banks routinely moved domestic assets against gold flows, [Bordo and MacDonald \(2005\)](#) show that credible target zones gave core countries some room for independent policy, and [Bazot et al. \(2016\)](#) and [Bazot et al. \(2022\)](#) document that the Bank of France and other central banks of the first globalization absorbed external shocks through their balance sheets. These studies measure sterilization by banks that existed throughout. We measure its macroeconomic consequence by comparing an economy before and after it acquired a central bank. The two-way tie between gold and interest rates that underlies our identification problem goes back to [Neuburger and Stokes \(1979\)](#), and the arbitrage bounds within which the exchange rate moved are set out by [Officer \(1996\)](#).

The third literature studies gold shocks and the American economy directly. [Tallman and Moen \(1998\)](#) document a short-run liquidity effect of gold on interest rates in the National Banking Era with data that stop in 1909, [Romer \(1992\)](#) shows that largely unsterilized gold inflows drove the monetary expansion behind the recovery from the Great Depression, [Hanes and Rhode \(2013\)](#) link harvest fluctuations to the timing of financial crises under the gold standard, and [Odell and Weidenmier \(2004\)](#) and [Rodgers and Payne \(2014\)](#) trace individual gold movements around the Panic of 1907. We carry the analysis across the founding of the Fed, so that one shock is measured on both sides of the break, and we use outflows as well as inflows, since offsetting should damp transmission in both directions.

The fourth literature concerns identification. We build on the narrative approach of [Romer and Romer \(1989\)](#), the sign-restriction approach of [Uhlig \(2005\)](#), the inference methods of [Rubio-Ramírez et al. \(2010\)](#) and [Arias et al. \(2018\)](#), the narrative sign restrictions of [Antolín-Díaz and Rubio-Ramírez \(2018\)](#), and the hierarchical prior of [Giannone et al. \(2015\)](#). Narrative restrictions suit historical work, because they use the episodes for which the record is strongest without requiring a continuous proxy series whose relevance and exogeneity would have to be defended month by month.

The paper proceeds as follows. Section 2 describes the money market before and after the Fed and the eight episodes. Section 3 develops the model. Section 4 sets out the empirical strategy. Section 5 presents the results, and Section 6 concludes.

2 Gold, Panics, and Central Banking

2.1 The money market without a central bank

Under the National Banking System the American currency was inelastic. National bank notes were tied to bank holdings of government bonds, so the supply of currency could not expand with the demand for it. Reserves pyramided toward New York, where country banks kept balances that the city banks lent on call to the stock market, and the autumn demand for cash to move the crops drained the city every year ([Sprague, 1910](#); [Timberlake, 1993](#); [Wicker, 2000](#)). Gold flows fed straight into this structure. An import added to bank reserves in New York and to the funds available on call, and an export removed them. The call money rate was the price at which that margin cleared, which is why we measure transmission there.

There was no lender of last resort. In panics the New York Clearing House issued loan certificates and banks restricted the convertibility of deposits into cash. The Treasury intervened at times, most actively under Secretary Leslie Shaw between 1902 and 1907, by moving government deposits into banks, but it had no systematic instrument for offsetting gold flows ([Timberlake, 1993](#)). The Aldrich-Vreeland Act of 1908 allowed emergency currency in a crisis, a stopgap that was used only once, in 1914. In the language of the model in [Section 3](#), the capacity to offset a gold flow before 1914 was small.

2.2 What the Federal Reserve Act changed

The Federal Reserve Act of December 1913, with the Reserve Banks open from November 1914, changed this in three ways that bear directly on gold. It created an elastic currency. Federal Reserve notes could be issued against eligible commercial paper with a fractional gold cover, and from 1917 member-bank reserves were held at the Reserve Banks, so the base was no longer tied one for one to the gold in the banking system. It created a discount window whose rate could be set with domestic conditions in view. And it gave the Reserve Banks a balance sheet that could move against gold flows. By the early 1920s the System was buying and selling government securities and bankers' acceptances, and the record of the decade shows gold inflows being offset by reductions in Reserve Bank credit ([Friedman and Schwartz, 1963](#); [Meltzer, 2003](#); [Wheelock, 1991](#)). Each of these tools allows a gold flow to be absorbed rather than passed straight into the money market. The wartime and postwar setting in which the System first operated is described by [Meltzer \(2003\)](#) and, for the closure of the markets in 1914, by [Silber \(2007\)](#). The international cooperation of the 1920s is the subject of [Chandler \(1958\)](#) and [Clarke \(1967\)](#), and the broader reading of the gold standard as a commitment device and of its interwar fragility is developed by [Bordo and Kydland](#)

(1995) and [Eichengreen \(1992\)](#).

2.3 The eight episodes

Our narrative restrictions rest on the claim that at eight specific dates the sign of the gold shock, and its dominance in the movement of gold, are not in serious historical doubt. The claim is only as strong as the stories behind it.

The Treasury reserve crisis and the Morgan-Belmont syndicate, 1894 and 1895.

The first pre-Fed outflow and inflow are two halves of one story. Doubts about the country's commitment to gold, raised by the Sherman Silver Purchase Act of 1890 and not dispelled by its repeal in 1893, drained gold from the Treasury and pushed its free gold reserve below the closely watched hundred-million-dollar mark and toward exhaustion by the winter of 1894 ([Friedman and Schwartz, 1963](#); [Timberlake, 1993](#)). December 1894 records one of the largest single-month outflows in the pre-Fed sample. The crisis broke in February 1895, when a syndicate led by J.P. Morgan and August Belmont agreed to supply the Treasury with gold, much of it from abroad, in return for bonds. The episode is usually read as private finance standing in for a missing lender of last resort ([Friedman and Schwartz, 1963](#)). We use the December 1894 drain as a pre-Fed outflow and the syndicate's inflow as a pre-Fed inflow.

The San Francisco earthquake, 1906. The April 1906 earthquake and fire destroyed much of the capital stock of a major city and triggered large insurance payments, a good share owed by British insurers. [Odell and Weidenmier \(2004\)](#) show that the resulting gold shipments from London over the following months tightened British conditions and helped set in motion the chain of events that ended in the Panic of 1907. The episode is close to ideal for our purpose. It is an inflow of gold whose source lies in a natural disaster abroad rather than in American financial conditions. We use the spring 1906 inflow as a pre-Fed inflow.

The Panic of 1907. The Panic of 1907 is the central pre-Fed episode. It began with the failed corner of United Copper and the runs on the Knickerbocker Trust and other trust companies, and it produced a scramble for cash, a restriction of convertibility, and a call rate of twenty-one percent ([Sprague, 1910](#); [Andrew, 1908](#); [Moen and Tallman, 1992](#); [Wicker, 2000](#)). Two gold movements bracket the panic. Gold drained from New York as strain built, and we use the September 1907 drain as a pre-Fed outflow. [Rodgers and Payne \(2014\)](#) then show that the Bank of France's November decision to release gold against discounted

commercial paper was an outside increase in the supply of gold to the American banking system that helped end the panic. Because the autumn of 1907 saw both a domestic drain and an outside inflow within a short span, we date the outflow to September, ahead of the French shipments, so that the two do not fall in the same window.

Allied wartime payments, 1916. The first post-Fed episode is the flood of gold that came with Allied purchases of American munitions, food, and raw materials during the First World War. December 1916 records the largest monthly inflow in the sample ([Friedman and Schwartz, 1963](#); [Meltzer, 2003](#)). The inflow came under a working Federal Reserve that could respond to it. Because the raw shock was so large, it is the sharpest test of the offsetting mechanism.

The lifting of the gold-export embargo, 1919. During the war the United States held back gold exports. The embargo came off in June 1919 ([Meltzer, 2003](#); [Eichengreen, 1992](#)), and sizable outflows followed as gold was again free to settle foreign accounts. The episode is a post-Fed outflow triggered by a policy change rather than by domestic credit conditions.

The restored gold standard, 1926 and 1927. The last two episodes belong to the restored gold standard. With sterling back on gold from 1925 and the system rebuilt as a gold-exchange standard, gold moved in and out of New York in large amounts as it adjusted ([Eichengreen, 1992](#); [Clarke, 1967](#); [Chandler, 1958](#)). We use the July 1926 influx as a post-Fed inflow. For the post-Fed outflow we use May 1927, in the period of the understanding between Benjamin Strong and Montagu Norman under which the Federal Reserve eased in part to relieve pressure on sterling. May 1927 records the largest monthly outflow in the sample ([Chandler, 1958](#); [Clarke, 1967](#)). That the Federal Reserve was by then using domestic policy to manage the external gold account is itself the phenomenon this paper measures.

3 A Simple Model of Gold Flow Transmission

We set out a compact monthly model that links an outside gold flow to the monetary base, the call money rate, activity, prices, the exchange rate, and equities. It uses accounting identities and linear behavioral relations so that it maps into the six series we estimate, and it keeps the high-frequency mechanism stressed by contemporaries and by the literature ([Friedman and Schwartz, 1963](#); [Eichengreen, 1992](#); [Bordo and Kydland, 1995](#); [Tallman and Moen, 1998](#)). The model has two jobs. It delivers the three impact signs and two impact zeros

that we impose in Section 4, and it delivers a set of dynamic and cross-period predictions that we leave free and test. It is not estimated.

3.1 The monetary base, cover, and offsetting

Let G_t be the nominal gold stock and M_t the monetary base. Under the gold standard the base is tied to gold through a cover relation,

$$M_t = \mu_t G_t, \quad \mu_t \equiv \theta_t^{-1} v_t \in (0, \infty), \quad (1)$$

where θ_t is the gold cover ratio and v_t captures reserve preferences and the note-to-deposit mix. Gold flows are persistent,

$$\Delta G_t = \rho_g \Delta G_{t-1} + \varepsilon_t^g, \quad \rho_g \in (0, 1), \quad \mathbb{E}_{t-1} \varepsilon_t^g = 0, \quad (2)$$

so the monthly base innovation is $\Delta M_t = \mu_t \varepsilon_t^g + G_{t-1} \Delta \mu_t$. The feature that drives the paper is that a monetary authority, when one exists, can offset a gold flow and lean against movements in the call rate,

$$\Delta \mu_t = -\phi_\mu \varepsilon_t^g + \psi_r (r_t - \bar{r}) + \eta_t, \quad \phi_\mu, \psi_r \geq 0. \quad (3)$$

The parameter ϕ_μ measures state-contingent offsetting of the gold flow, and ψ_r measures rate smoothing, the withdrawal of base money when the rate falls below its normal level $\bar{r}$ and its injection when the rate rises above it. Before the Federal Reserve there was no institution to set either, and we take $(\phi_\mu, \psi_r) \approx (0, 0)$. With a central bank in place both can be strictly positive. Substituting (3) into the base identity, the effect of a gold shock on the base is

$$\frac{\partial \Delta M_t}{\partial \varepsilon_t^g} = \mu_t - G_{t-1} \phi_\mu + G_{t-1} \psi_r \frac{\partial r_t}{\partial \varepsilon_t^g}. \quad (4)$$

3.2 Money demand and the liquidity effect

Money demand is $M_t = P_t L(y_t, r_t; \xi_t^m)$. Linearized around a steady state, money-market clearing reads $M_t = \bar{L} P_t + \lambda y_t - \sigma r_t + \xi_t^m$, where $\bar{L}$ is steady-state real balances, $\lambda > 0$, and $\sigma > 0$ is the slope of money demand in the interest rate.

Lemma 1 (Liquidity effect). *Under (1) through (3), money-market clearing as above, and output and the price level predetermined within the month, the impact response of the call*

money rate to a gold shock is

$$\frac{\partial r_t}{\partial \varepsilon_t^g} = -\frac{\mu_t - G_{t-1}\phi_\mu}{\sigma + G_{t-1}\psi_r}. \quad (5)$$

It is strictly negative whenever $\mu_t > G_{t-1}\phi_\mu$, and its size falls in both ϕ_μ and ψ_r .

Proof. With y_t and P_t predetermined (Section 3.3) and ξ_t^m given, differentiating the clearing condition gives $\sigma \partial r_t / \partial \varepsilon_t^g = -\partial \Delta M_t / \partial \varepsilon_t^g$. Substituting (4) and solving gives (5). The numerator is positive under $\mu_t > G_{t-1}\phi_\mu$ and the denominator is positive, so the response is negative. Its absolute value is decreasing in ϕ_μ through the numerator and in ψ_r through the denominator. $\square$

Offsetting and rate smoothing both shrink the liquidity effect. If $\phi_\mu \geq \mu_t / G_{t-1}$ the effect vanishes or flips. The sign restriction (12) below rules out the flip for the identified shock while leaving its size free to shrink toward zero.

3.3 Timing, predetermined output and prices

At a monthly frequency it is not plausible that real output and posted prices respond within the month to a gold shock. Output in month t reflects input orders, labor contracts, and mill schedules set in month $t - 1$, and much of the price level in this era consisted of list or contract prices reset at intervals. We therefore make industrial production predetermined,

$$\Delta IP_t = \chi_y \Delta y_{t-1} - \chi_r (r_{t-1} - r_{t-1}^*) + \nu_t^m, \quad \chi_y, \chi_r > 0, \quad (6)$$

and prices set one period ahead in the manner of Fischer and Taylor,

$$p_t = \mathbb{E}_{t-1}[p_t^*], \quad p_t^* = p_{t-1} + \beta \mathbb{E}_t \pi_{t+1} + \kappa y_t + u_t, \quad \beta \in (0, 1), \kappa > 0. \quad (7)$$

Iterating the demand relation $y_t = \mathbb{E}_t y_{t+1} - \phi(r_t - \mathbb{E}_t \pi_{t+1} - r_t^*) + \varepsilon_t^y$ forward shows that expected offsetting and smoothing, higher ϕ_μ and ψ_r , raise the expected path of real rates after a gold inflow and so damp the output response at every horizon.

3.4 Exchange rate and equities

Let s_t be the log dollar price of sterling, the USD/GBP rate we observe, so that a rise in s_t is a depreciation of the dollar. Inside the gold points the exchange rate responds to the interest differential, $\Delta s_t = -\gamma(r_t - r_t^*) + \nu_t$ with $\gamma > 0$, so the lower American rate after an inflow weakens the dollar until the gap closes. Shipments bind, and feed back into G_t , only when the rate reaches a gold point (Officer, 1996). A linear dividend-discount

relation, $\Delta q_t = \zeta_y \Delta IP_t - \zeta_r(r_t - r_t^*) + \xi_t^q$ with $\zeta_y, \zeta_r > 0$, closes the model. Because ΔIP_t is predetermined, the impact equity response runs entirely through the discount rate.

3.5 Comparative statics across periods

For a variable that enters in log changes, write its level response as the cumulated response, so that $\partial IP_{t+h}/\partial \varepsilon_t^g = \sum_{j=0}^h \partial \Delta IP_{t+j}/\partial \varepsilon_t^g$, and similarly for p , q , and s .

Proposition 1 (Comparison across periods). *Under (1) through (7), the exchange-rate and equity relations above, $\mu_t > G_{t-1}\phi_\mu$, and gradual price adjustment in the sense that κ is small relative to σ , a gold inflow $\varepsilon_t^g > 0$ implies the following.*

- (i) *On impact, $\partial \Delta G_t/\partial \varepsilon_t^g > 0$, $\partial r_t/\partial \varepsilon_t^g < 0$, $\partial q_t/\partial \varepsilon_t^g > 0$, and $\partial IP_t/\partial \varepsilon_t^g = \partial p_t/\partial \varepsilon_t^g = 0$.*
- (ii) *In the short run, $h = 1, 2, 3$, $\partial r_{t+h}/\partial \varepsilon_t^g < 0$, $\partial q_{t+h}/\partial \varepsilon_t^g > 0$, and $\partial s_{t+h}/\partial \varepsilon_t^g > 0$.*
- (iii) *In the medium run, $h = 6, 12$, $\partial IP_{t+h}/\partial \varepsilon_t^g > 0$ and $\partial p_{t+h}/\partial \varepsilon_t^g > 0$.*
- (iv) *Every non-zero response in (i) through (iii) is weakly smaller in absolute value in (ϕ_μ, ψ_r) , strictly so whenever either is positive. Transmission is therefore strictly stronger without a central bank.*

Proof. The impact signs of ΔG , r , and q follow from (2), Lemma 1, and the discount-rate channel, and the impact zeros from the predetermination in (6) and (7). For $h \geq 1$ the cumulated inflow keeps the gold stock above baseline, since $\partial G_{t+h}/\partial \varepsilon_t^g = \sum_{j=0}^h \rho_g^j > 0$, while the price level moves only through the reset term, whose slope is κ . With κ small relative to σ , real balances stay above baseline over the first quarter, and money-market clearing keeps r_{t+h} below its baseline for $h = 1, 2, 3$. The exchange-rate relation carries this sign to s and the discount-rate term carries it to q . In the medium run, (6) turns the lagged rate gaps into positive output growth, so the level of output is above baseline, and the reset term in (7) passes the higher output into the price level. For part (iv), Lemma 1 shows that $|\partial r_t/\partial \varepsilon_t^g|$ falls in (ϕ_μ, ψ_r) , and offsetting scales down the base path at every horizon. The model is linear and every other non-zero response is driven by the path of the base and the rate, directly through s and the discount-rate term in q and through the real-rate path in IP and p , so each inherits the same monotonicity. $\square$

Corollary 1 (The impact zeros carry no cross-period content). *The impact restrictions $\partial IP_t/\partial \varepsilon_t^g = 0$ and $\partial p_t/\partial \varepsilon_t^g = 0$ hold for any (ϕ_μ, ψ_r) and so say nothing about the change in transmission.*

Proof. Both derivatives are zero by (6) and (7), which do not involve the policy parameters at horizon zero. $\square$

Corollary 1 shapes the empirical design. The impact zeros are timing restrictions, not period restrictions, so the cross-period content of Proposition 1 lies in the impact responses of r and q and in the whole path from $h = 1$ onward. That is why the comparison in Section 5.2 rests on separately estimated subsamples, and why the output and price responses there, which are never restricted after impact, are informative about the change. By symmetry every statement holds with the signs reversed for an outflow, which raises the call rate, lowers equities, activity, and prices, and strengthens the dollar, with sizes again weakly decreasing in (ϕ_μ, ψ_r) . The outflow episodes are therefore a second test of the same mechanism.

3.6 The predictions we take to the data

Proposition 1(i) gives the restrictions we impose, the signs on gold flows, the call rate, and equities and the zeros on output and prices. Parts (ii) and (iii) give a path,

$$\begin{aligned} \theta_{r,g}(h) < 0 \text{ and } \theta_{s,g}(h) > 0 \quad (h = 1, 2, 3), \\ \theta_{IP,g}(h) > 0 \quad (h = 3, 6, 12), \quad \theta_{p,g}(h) > 0 \quad (h = 6, 12), \end{aligned} \tag{8}$$

stated for the levels of output, prices, and the exchange rate, which we do *not* impose. Part (iv) gives the cross-period ranking, which we also do not impose. Section 4 explains why, and Section 5 confronts both with the estimates.

4 Empirical Strategy

We estimate a Bayesian structural vector autoregression identified by sign, zero, and narrative restrictions. Inference follows Arias et al. (2018), adjusted for the reweighting of Antolín-Díaz and Rubio-Ramírez (2018), under the prior of Giannone et al. (2015).

4.1 Data and specification

Let y_t denote the vector of six monthly variables

$$y_t = [\Delta IP_t, r_t^{\text{call}}, \Delta q_t, \Delta s_t, \Delta p_t, \Delta G_t]',$$

where ΔIP_t is the monthly log change of the industrial production index of Miron and Romer (1990), r_t^{call} is the New York call money rate, Δq_t is the monthly log change of a stock price

index, Δs_t is the monthly log change of the dollar price of sterling, Δp_t is monthly inflation in the general price index, and ΔG_t is the monthly change in gold held by the Treasury and, from 1914, the Federal Reserve Banks, in millions of dollars. The call rate is constructed from *daily* New York call money quotations as in Fohlin (2025), rather than taken from the monthly averages in the NBER Macroeconomy database. The distinction matters for episodes such as the Panic of 1907, when the rate moved violently within the month and a monthly average understates both the level and the timing of the strain. The gold series measures official holdings rather than shipments. It records international movements together with transfers of gold between the public, the banks, and the official holders, including the concentration of gold in the Reserve Banks after 1914. The contribution restrictions in (16) address this in each episode window by requiring that the identified gold shock, and not some other force, be the main driver of the series there. 1927:06, so $T = 450$. Appendix A lists the sources and reports descriptive statistics.

The structural VAR is

$$y'_t A_0 = \sum_{l=1}^p y'_{t-l} A_l + c + \varepsilon'_t, \quad t = 1, \dots, T, \quad (9)$$

where $A_l \in \mathbb{R}^{n \times n}$, A_0 has full rank, c is a $1 \times n$ vector of constants, and ε_t is i.i.d. $N(0, I_n)$ given initial conditions. Collecting $A'_+ = [A'_1 \ \dots \ A'_p \ c']$ and $x'_t = [y'_{t-1} \ \dots \ y'_{t-p} \ 1]$, the reduced form is

$$y'_t = x'_t B + u'_t, \quad B = A_+ A_0^{-1}, \quad u'_t = \varepsilon'_t A_0^{-1}, \quad (10)$$

with $\Sigma \equiv \mathbb{E}[u_t u'_t] = (A_0 A'_0)^{-1}$. Letting Θ collect (A_0, A_+) , the structural shocks are $\varepsilon'_t(\Theta) = y'_t A_0 - x'_t A_+$. The impulse response matrices $\{\Theta_h\}_{h \geq 0}$ have (k, j) element $\theta_{kj}(h)$, the response of variable k at horizon h to shock j , with $\Theta_0 = A_0^{-1}$. For the four variables that enter in log changes we report level responses, the cumulated sums of $\theta_{kj}(h)$, which is the object in (8). Responses are scaled to a gold inflow of one standard deviation of the gold-flow series, about 33 million dollars. Output, equity prices, the exchange rate, and prices are in percent, the call rate in percentage points, and gold flows in millions of dollars.

Information criteria on a common sample select short lags. The Akaike criterion selects $p = 3$ and the Hannan-Quinn and Schwarz criteria select $p = 1$, which reflects the fact that five of the six series are growth rates or returns close to white noise. A first-order system cannot generate the delayed responses that the model predicts and that we test, so we set $p = 6$, in line with monthly practice. Results at $p = 3$ are similar in sign and slightly less persistent.

4.2 Identification by sign and zero restrictions

We name one structural shock the gold shock and leave the others unrestricted. We impose three impact sign restrictions,

$$\theta_{\Delta G,g}(0) > 0, \quad (\text{gold flows rise}) \quad (11)$$

$$\theta_{r,g}(0) < 0, \quad (\text{the call rate falls}) \quad (12)$$

$$\theta_{\Delta q,g}(0) > 0, \quad (\text{equity prices rise}) \quad (13)$$

and two zero restrictions that rule out a same-month response of output and prices,

$$\theta_{\Delta IP,g}(0) = 0, \quad \theta_{\Delta p,g}(0) = 0. \quad (14)$$

These are Proposition 1(i), and (14) comes from the timing assumptions of Section 3.3 rather than from convenience. That is the whole of the identification. About thirteen percent of candidate rotations satisfy it.

We stop at impact on purpose. Imposing the path in (8) would force every accepted draw into nearly the same shape, would make the estimated responses look alike across samples by construction, and would understate the uncertainty in the bands. Leaving the path free turns the model’s dynamic predictions into a test. It also means that any difference between the pre-Fed and post-Fed responses after impact, and any difference in the size of the impact responses, comes from the data rather than from the restrictions, which are identical in the two samples.

The identification is what separates transmission from reverse causality. Under the gold standard a higher domestic rate attracts gold, so a reduced-form gold surprise, the forecast error of the gold flow on the past of the system, is contaminated by the rate. In our data such a surprise is associated with a *higher* call rate, the reverse of the liquidity effect. The sign restrictions select the rotation in which gold raises the base and lowers the rate, and the narrative restrictions tie that rotation to dates on which the source of the gold movement is known.

4.3 Identification by narrative sign restrictions

We add the two kinds of narrative restriction in Antolín-Díaz and Rubio-Ramírez (2018). The first fixes the sign of the gold shock at the event date t^* ,

$$\varepsilon_{g,t^*} \geq 0 \quad (\text{inflow}), \quad \varepsilon_{g,t^*} < 0 \quad (\text{outflow}). \quad (15)$$

The second requires that over a window $[t^*, t^{**}]$ the gold shock be the largest contributor to the observed movement in gold flows,

$$|H_{\Delta G, g, t^*, t^{**}}| - \max_{j \neq g} |H_{\Delta G, j, t^*, t^{**}}| > 0, \quad (16)$$

where H denotes the historical decomposition. Draws that satisfy (15) and (16) are kept and reweighted by importance sampling, so that conditioning on the narrative does not distort the posterior. The restrictions use the historical record without a proxy series and so avoid the measurement error and exogeneity concerns that come with a constructed instrument.

4.4 Prior and computation

We use the prior of [Giannone et al. \(2015\)](#), with Minnesota, sum-of-coefficients, and single-unit-root components and hyperparameters chosen by maximizing the marginal likelihood. With six variables and six lags each equation has thirty-six slope coefficients, and without shrinkage the estimates fit high-frequency features of the lag structure that carry no economic content and produce jagged responses. We sample (B, Σ) from the Normal-Inverse-Wishart posterior, draw an orthogonal rotation, check the sign and zero restrictions, form the importance weight from the volume elements as in [Arias et al. \(2018\)](#), and then check the narrative restrictions and reweight as in [Antolín-Díaz and Rubio-Ramírez \(2018\)](#).

4.5 Three samples, three questions

We estimate on three kinds of sample, each answering a different question. The full 1890 to 1927 sample, with sign and zero restrictions only, gives the response to the average gold shock in Section 5.1. The pre-Fed sample, 1890:01 to 1913:12, and the post-Fed sample, 1914:01 to 1927:06, estimated separately under identical restrictions, give the change in transmission in Section 5.2. And a local window of about seven years on either side of each episode, clamped to the sample and to the episode’s own period, gives the episode responses and decompositions in Sections 5.3 and 5.4, with each episode carrying its own reduced-form dynamics. The windows are short, so the episode bands are wide, which is the price of letting each event speak for itself.

Table 1 lists the episodes. The design is balanced. Four come before the Federal Reserve Act and four after the Reserve Banks opened, and within each period two are inflows and two are outflows. All pre-Fed episodes fall in or before 1907 and all post-Fed episodes in or after 1916, so none sits near the break.

Table 1: Narrative episodes

Period	Episode	Direction	Shock month	Contribution window
Pre-Fed	Treasury Gold-Reserve Crisis	Outflow	Dec 1894	Nov to Dec 1894
Pre-Fed	Morgan-Belmont Syndicate	Inflow	Feb 1895	Jan to Apr 1895
Pre-Fed	San Francisco Earthquake	Inflow	May 1906	Apr to Jul 1906
Pre-Fed	Panic of 1907 (drain)	Outflow	Sep 1907	Aug to Sep 1907
Post-Fed	Allied Wartime Payments	Inflow	Dec 1916	Oct 1916 to Jan 1917
Post-Fed	WWI Gold-Export Embargo Lift	Outflow	May 1919	Apr to Jul 1919
Post-Fed	Restored Gold-Standard Influx	Inflow	Jul 1926	Jun to Aug 1926
Post-Fed	Strong-Norman Accord	Outflow	May 1927	Apr to Jun 1927

5 Results

We report the results in six steps. We begin with the average gold shock on the full sample, turn to the central comparison of the two periods, check it episode by episode, read the historical decompositions of two episodes, interpret the pattern through the model, and close with a local projection check.

5.1 The gold shock

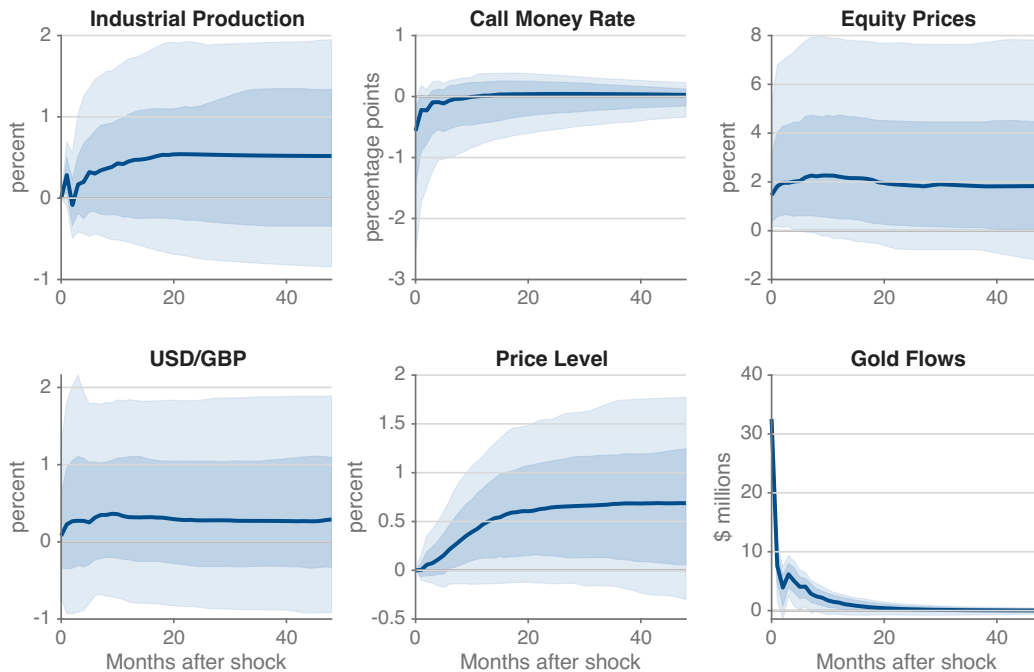
Figure 3 reports the response to the identified gold shock on the full sample. Because the identification binds only on impact, every later horizon is left to the data, and the figure is a test of the path in (8).

The impact responses come out as restricted. A one standard deviation gold inflow lowers the call money rate by about 0.56 percentage points, with a 68 percent band from -1.46 to -0.16 , and raises equity prices by about 1.5 percent. What follows is not imposed. The call rate stays below baseline for the next two months, at about -0.2 points, with a band that excludes zero in the second month, and it returns to baseline within about half a year. Equity prices settle about two percent higher. Industrial production rises in the month after the shock, by about 0.3 percent with a band above zero, and is about 0.3 and 0.45 percent higher after six and twelve months, although the bands at those horizons include zero. The price level does not move for a quarter and then rises steadily, to about 0.2 percent after six months and 0.5 percent after a year, with bands that exclude zero at both horizons. The dollar weakens slightly against sterling, by about a quarter of a percent over the first quarter, as the model predicts, but that response is imprecise.

Every median response thus has the sign the model predicts, without any of those signs being imposed after impact. The evidence is strongest for the persistence of the liquidity

effect and for the delayed rise in the price level, and weakest for output and the exchange rate. The bands are wide, which is an honest measure of what three impact signs and two impact zeros can pin down on their own.

Figure 3: The gold shock, full sample



Notes. Response to a gold inflow of one standard deviation (about 33 million dollars) on the full 1890 to 1927 sample, identified by the impact sign and zero restrictions of Section 4.2 without narrative conditioning. Industrial production, equity prices, USD/GBP, and the price level are cumulated from monthly log changes and shown as percent deviations of the level. The solid line is the posterior median, and shaded regions are 68 and 90 percent pointwise credible bands. Appendix Figure 9 shows the same responses in monthly growth rates.

5.2 Transmission before and after the Fed

The full-sample response averages across a structural break and so cannot show it. To let the dynamics differ, we estimate the model separately on the pre-Fed and post-Fed samples under identical sign and zero restrictions, without narrative conditioning, and scale every draw to a one standard deviation inflow. Figure 4 and Table 2 report the result. It is the central evidence of the paper.

Before the Fed, a gold inflow lowers the call rate by about 1.0 percentage point on impact, with a 68 percent band from -3.3 to -0.4 . After the Fed, the impact is about 0.1 point,

with a band from -0.33 to -0.04 . The two bands do not overlap, the ratio of the medians is about nine, and the posterior probability that the pre-Fed response is the larger is 0.93. The equity response falls from 2.7 to 0.5 percent. The largest change in levels, however, is beyond the money market. Six months after a pre-Fed inflow, industrial production is 1.6 percent higher and the price level 0.7 percent higher, both with bands well above zero. Six months after a post-Fed inflow, both are essentially unchanged, and their bands are centered on zero. A year out the post-Fed price level has risen by about 0.2 percent, so the Fed delayed and damped the pass-through to prices rather than eliminating it. Before 1914 a gold inflow moved the cost of credit, asset prices, activity, and the price level within a quarter. After 1914 it barely moved any of them.

Two features depart from a simple reading. The pre-Fed liquidity effect is large but brief. The median rate is back above baseline the following month, whereas the smaller post-Fed effect fades over several months. A sharp and quickly reversed response is consistent with a market that cleared through call loans and gold-point arbitrage, although the model, which predicts persistence in both periods, does not account for it. The second feature is the exchange rate, the one variable that moves more after 1914. Before the Fed the dollar price of sterling barely responds, as it should inside narrow gold points. After the Fed it rises by about half a percent. This is less a statement about the Fed than about sterling, which left gold in 1914, was pegged during the war, and floated from 1919 to 1925, so that external adjustment could run through the exchange rate rather than through domestic rates.

The comparison has a clear limit. It shows that a gold shock identified the same way in both samples fed into the domestic economy before 1914 and mostly did not afterward. It does not by itself show that offsetting by the Federal Reserve was the reason, since the post-Fed sample also spans the war, the postwar boom and deflation, and the restored gold standard. The pre-Fed impact is also loosely estimated, with a band spanning a factor of about eight, so we rest on the ordering of the responses rather than on the exact ratio. The next two subsections ask whether the ordering survives at the level of individual episodes and what the episodes reveal about where the gold impulse went.

5.3 Episode by episode

Table 3 reports the impact responses from estimating the model on a local window around each episode, with the narrative restrictions of Table 1. Each episode has its own reduced-form dynamics, so the responses are free to differ across events. Full responses are in Appendix C.

The ordering holds in every case. Each pre-Fed episode shows a sizable liquidity effect,

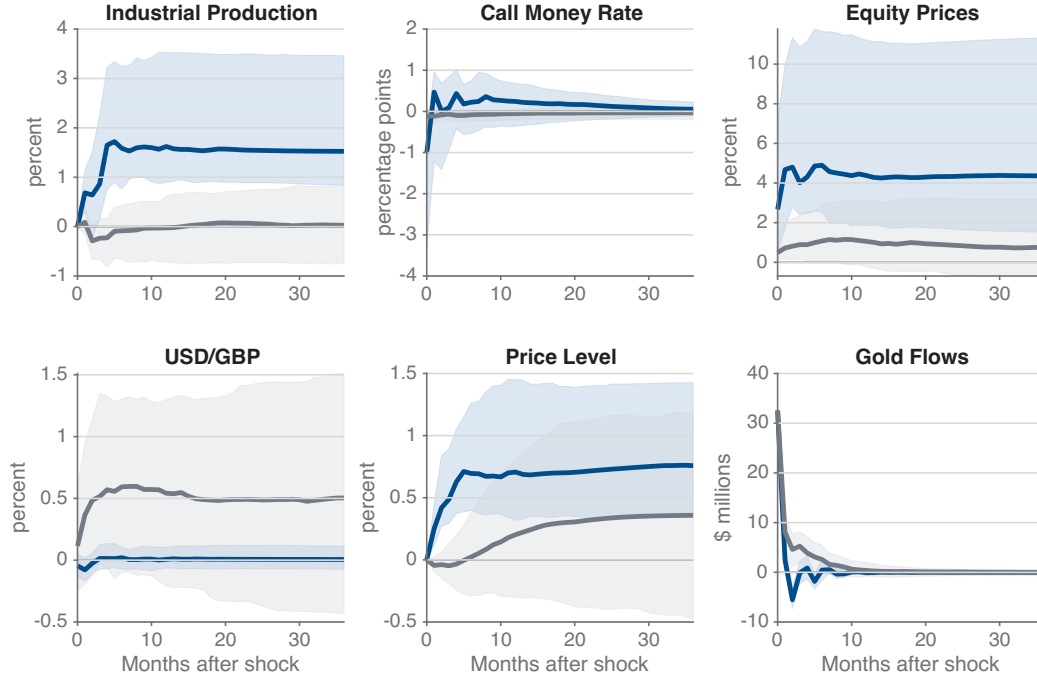
Table 2: Transmission of a gold inflow before and after the Fed

	Pre-Fed 1890 to 1913	Post-Fed 1914 to 1927	Posterior probability pre-Fed larger
<i>On impact</i>			
Call money rate (pp)	−1.02 [−3.29, −0.42]	−0.11 [−0.33, −0.04]	0.93
Equity prices (%)	2.67 [0.53, 7.03]	0.49 [0.12, 1.56]	0.83
<i>After six months</i>			
Industrial production (%)	1.59 [0.76, 3.25]	−0.08 [−0.66, 0.42]	0.89
Price level (%)	0.70 [0.40, 1.26]	0.02 [−0.29, 0.38]	0.88
<i>After twelve months</i>			
Industrial production (%)	1.62 [0.90, 3.52]	−0.02 [−0.72, 0.62]	0.88
Price level (%)	0.71 [0.32, 1.45]	0.20 [−0.30, 0.80]	0.72
USD/GBP, after three months (%)	0.01 [−0.07, 0.13]	0.52 [−0.03, 1.35]	0.07

Notes. Posterior medians with 68 percent bands in brackets, for a one standard deviation gold inflow. Each subsample is estimated separately with 2000 accepted draws under the impact sign and zero restrictions of Section 4.2, without narrative conditioning. Industrial production, equity prices, the price level, and USD/GBP are cumulated from monthly log changes. The last column is the posterior probability that the pre-Fed response is larger in absolute value, computed from independent draws of the two subsample posteriors.

from about -0.6 points in the Morgan-Belmont inflow to about -2.6 points in the San Francisco earthquake, with an equity response between three and five and a half percent. Each post-Fed episode is muted, with a call-rate response between -0.12 and -0.16 points and an equity response below one percent. The pre-Fed episodes also differ markedly from one another, which fits a money market whose response depended on the state of reserves and confidence at the moment the gold arrived. The post-Fed episodes look alike. Part of that similarity is mechanical, since the post-Fed windows overlap within a short sample, but part of it is the point. The four post-Fed episodes include a wartime inflow, a postwar outflow, and two movements under the restored standard, and the response to each is about a tenth of a point.

Figure 4: Response to a gold inflow by period, separate subsample VARs



Notes. Response to a one standard deviation gold inflow, estimated separately on the pre-Fed sample (1890 to 1913, blue) and the post-Fed sample (1914 to 1927, grey), with 68 percent bands. Industrial production, equity prices, USD/GBP, and the price level are cumulated from monthly log changes. Identification as in Section 4.2, without narrative conditioning. Appendix Figure 10 shows the same responses in monthly growth rates.

Table 3: Impact responses by episode, local-window estimates

Period	Episode	Call rate, impact (pp)	Equities, impact (%)
Pre-Fed	Treasury Gold-Reserve Crisis	-1.08	4.03
Pre-Fed	Morgan-Belmont Syndicate	-0.61	3.87
Pre-Fed	San Francisco Earthquake	-2.57	5.51
Pre-Fed	Panic of 1907	-1.29	3.01
Post-Fed	Allied Wartime Payments	-0.12	0.55
Post-Fed	Gold-Export Embargo Lift	-0.12	0.36
Post-Fed	Restored Gold-Standard Influx	-0.13	0.65
Post-Fed	Strong-Norman Accord	-0.16	0.65

Notes. Posterior medians of the impact response to a one standard deviation gold inflow, each estimated on a local window of about seven years around the event under the impact and narrative restrictions. Outflow episodes are normalized to an inflow for comparability.

5.4 Where the gold impulse went

Figures 5 and 6 report historical decompositions for the Panic of 1907 and the Allied wartime payments. Each panel plots the observed deviation from the deterministic baseline against the gold-shock contribution, under the sign-only and the narrative posteriors, over a year on either side of the episode. Appendix D reports the other six.

In 1907 the gold shock explains the drain but not the panic. The observed September outflow was about forty-three million dollars, and the narrative posterior attributes about forty-six million to the gold shock. The call rate rose by nearly seventeen points that month on its way to twenty-one percent, and the gold shock contributes about one and a quarter points of the rise, or roughly seven percent. The gold movement pushed the rate in the same direction as the panic, but the convulsion itself was the runs and the scramble for cash.

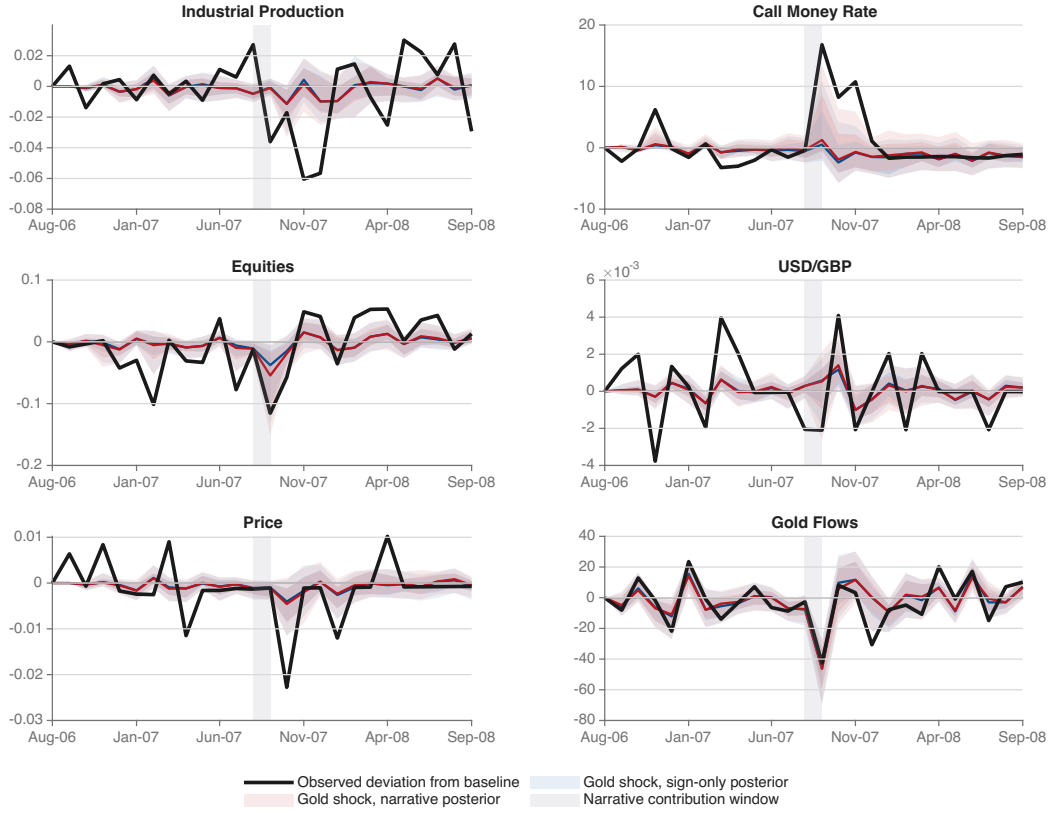
In 1916 the gold shock explains the inflow and the easing impulse, but the impulse never reached the market. The observed December inflow was about three hundred million dollars, two thirds of it attributed to the gold shock. The implied contribution of that shock to the call rate is an easing of about two thirds of a point. The observed rate that month rose by about two and a half points. The decomposition assigns the offsetting force to the other structural shocks, which in 1916 and 1917 include war finance and a surging demand for credit, so it cannot by itself label that force as Federal Reserve policy. What it does establish is the contrast. Before the Fed the gold impulse and the observed money-market move point the same way. After it, a large gold-driven easing impulse is absorbed without moving the observed rate.

5.5 Reading the results through the model

The model ties the change in transmission to two parameters, ϕ_μ for offsetting and ψ_r for rate smoothing, both near zero before the Fed and both able to turn positive after. Proposition 1(iv) predicts that every response shrinks when they do. The estimates bear this out on three margins.

The first is the impact response of the call rate, which Lemma 1 ties to the policy parameters most directly and which is free of the lag structure. Before the Fed, $(\phi_\mu, \psi_r) \approx (0, 0)$ and the response is $-\mu/\sigma$. After it, the response is $-(\mu - G\phi_\mu)/(\sigma + G\psi_r)$. A fall by a factor of about nine means, holding μ and σ fixed, that offsetting and smoothing together absorbed close to nine tenths of the liquidity effect of a gold flow. If the change ran entirely through offsetting, the post-Fed system neutralized close to nine tenths of the effect of a gold flow on the base. Holding μ fixed is, if anything, conservative. The fractional gold cover of the Federal Reserve Act raised the base that a dollar of gold could support, which on its

Figure 5: Historical decomposition, Panic of 1907



Notes. In each panel the black line is the observed deviation from the deterministic baseline, the blue band is the gold-shock contribution under the sign-only posterior, and the red band is the contribution under the narrative posterior, each with 68 and 90 percent bands. Shading marks the contribution window.

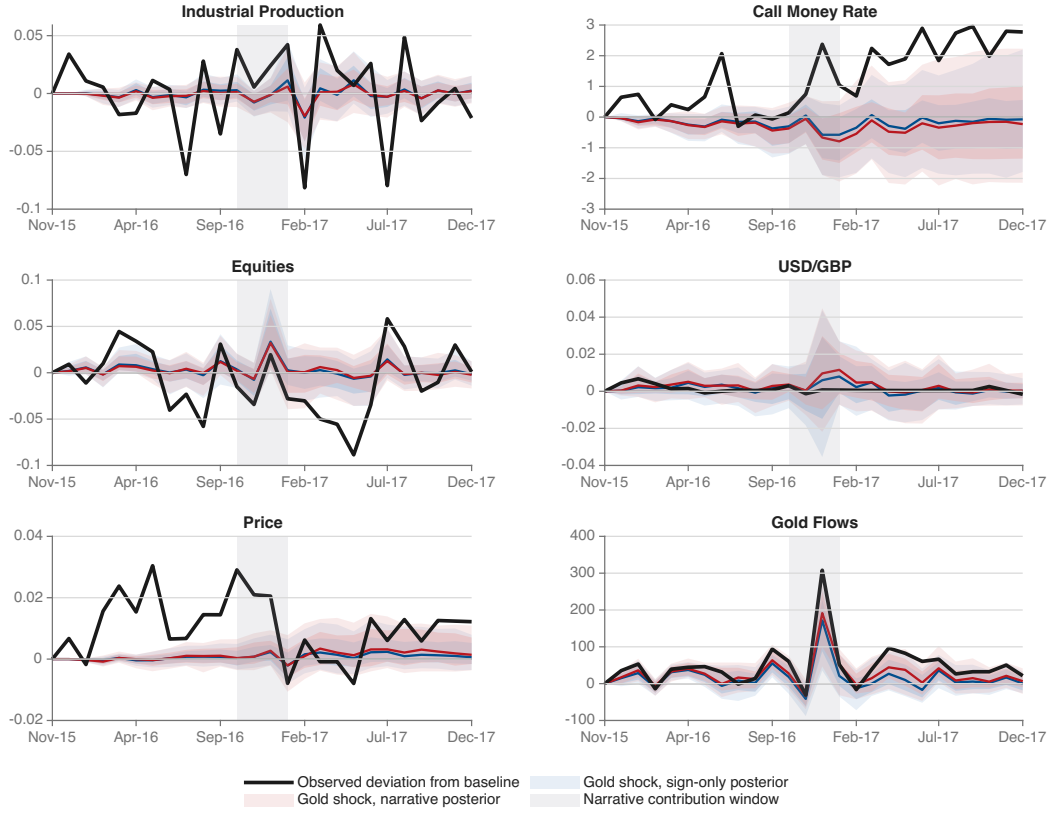
own would have strengthened the liquidity effect.

The second margin is equity prices. With output predetermined, the model makes the impact equity response a pure discount-rate effect, so it should shrink roughly in proportion to the rate response. It falls about five-fold against the rate's nine-fold, the same order of magnitude given the width of the bands.

The third margin is output and the price level, which are restricted only to be zero on impact. By Corollary 1 those restrictions carry no information about the policy parameters, so the large gap after impact, 1.6 against -0.1 percent for output and 0.7 against zero for prices after six months, comes from the unrestricted dynamics. It is the clearest sign that the change was not confined to the money market. The price gap narrows by a year, as the gradual adjustment in (7) implies when the impulse to real balances is smaller but not zero.

The exchange rate is the exception, and the model says why. Its exchange-rate block

Figure 6: Historical decomposition, Allied wartime payments (December 1916)



Notes. See the notes to Figure 5.

describes an economy inside the gold points, where a smaller rate response means a smaller exchange-rate response. After 1914 sterling was not on gold for most of the sample, and the larger exchange-rate response belongs to that change in the external regime rather than to the domestic mechanism.

5.6 Local projections

A natural concern is that the comparison is an artifact of the VAR, which ties the response at every horizon to one set of lag coefficients. Local projections estimate each horizon from a separate regression and impose no link across horizons (Jordà, 2005). In population the two estimate the same impulse responses (Plagborg-Møller and Wolf, 2021), so a large discrepancy would point to misspecification of the VAR's lag structure. We hold the identification fixed and free the propagation. Let $\hat{\varepsilon}_t^g$ be the posterior-median structural gold shock from the subsample VAR of Section 5.2, the median across retained draws of the first element of

$\varepsilon_t(\Theta) = y'_t A_0 - x'_t A_+$. For each outcome and each horizon $h = 0, 1, \dots, 24$, and separately on each subsample, we estimate

$$y_{t+h} = a_h + b_h \widehat{\varepsilon}_t^g + \sum_{l=1}^p \gamma'_{h,l} y_{t-l} + e_{t+h}, \quad (17)$$

with $p = 6$. The response at horizon h is b_h , scaled so that the impact response of gold flows equals one standard deviation of the gold-flow series, and the reported band is a 90 percent interval from Newey-West standard errors with bandwidth $h + 4$ (Newey and West, 1987). Because the regressor is a structural innovation, it is orthogonal to the past by construction, and the lagged controls serve only to absorb residual serial dependence. The regressor must be the identified shock. A reduced-form gold surprise carries the wrong sign for the call rate, for the reason given in Section 4.2.

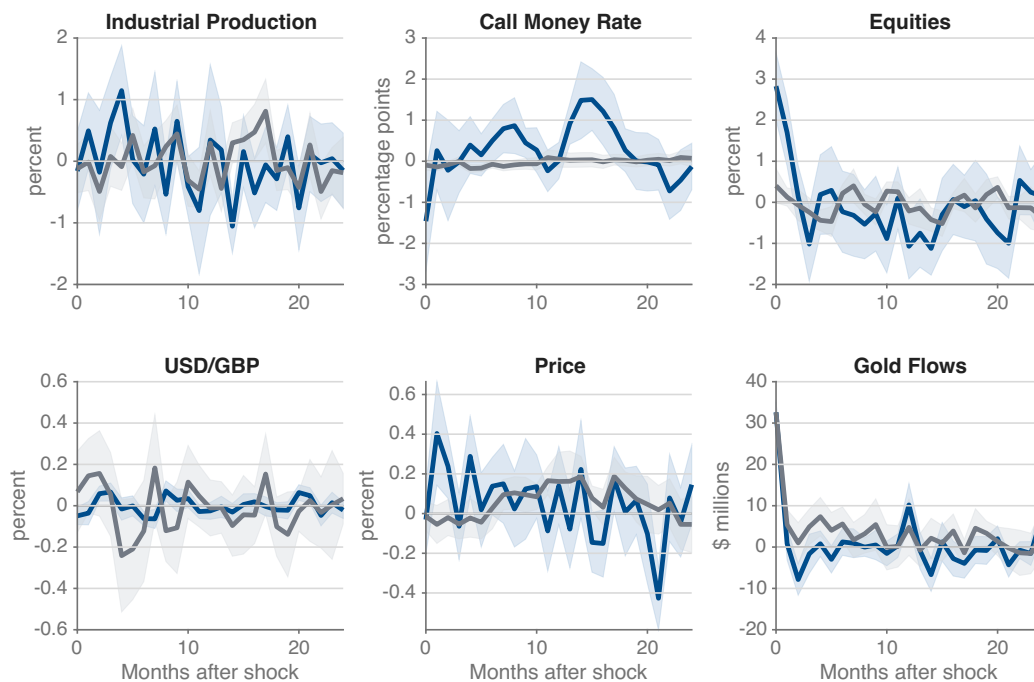
Figure 7 reports the result. Before the Fed the call rate falls by about 1.5 points on impact, with a Newey-West standard error near three quarters of a point, and returns toward zero over the first half year. After the Fed the impact response is about -0.1 point and is not different from zero at any horizon. The equity, output, and exchange-rate responses repeat the pattern. An estimator that shares none of the VAR's cross-horizon structure delivers impact magnitudes of the same order and the same gap across periods.

6 Conclusion

Before the Federal Reserve, gold was American monetary policy. A gold flow passed into bank reserves, the call money market, equity prices, output, and the price level within a few months, with no institution in between. We identify gold shocks using only the impact restrictions of a simple model and the historical record of documented episodes, and we find that this transmission was strong before the founding of the Fed and weak after it. Before 1914 a gold inflow lowered the call rate by about one percentage point and raised output by about 1.6 percent and the price level by about 0.7 percent within six months. Afterward the same inflow moved the call rate by a tenth as much and left output and prices essentially unchanged. The ordering holds in separately estimated subsamples, in each of eight episodes estimated on their own windows, and under local projections.

The model attributes the change to two policy parameters, offsetting and rate smoothing, and its comparative statics match the evidence. Every response shrinks, the money-market response by about nine-fold, and the responses of output and prices, which we never restrict after impact, shrink as well. The decomposition of the 1916 inflow shows a large easing impulse arriving and being absorbed, which is what offsetting looks like in the data.

Figure 7: Local projection responses to a gold inflow by period



Notes. Local projection responses to a one standard deviation gold inflow, estimated separately on the pre-Fed sample (1890 to 1913, blue) and the post-Fed sample (1914 to 1927, grey), with 90 percent Newey-West bands. The regressor is the posterior-median structural gold shock from the subsample VAR of Section 5.2. Outcomes are in the units in which they enter the VAR, so log-change variables are shown as monthly changes.

Several limits deserve emphasis. The post-Fed sample is short and spans the war, the postwar deflation, and the restored gold standard, so the comparison cannot cleanly separate the arrival of the Fed from everything else that changed after 1914. The sample ends in 1927, before the Great Depression reshaped both the gold standard and Federal Reserve doctrine. Narrative restrictions limit us to episodes the record can vouch for. And the pre-Fed estimates are imprecise, so it is the ordering across periods, rather than the exact ratio, on which we rest.

Three extensions follow naturally. The first is to measure offsetting directly, by bringing Reserve Bank balance sheets and discount operations to bear on the implied value of ϕ_μ . The second is to compare the American transition with economies that lacked a central bank for longer, such as Canada before 1935, which shared the shocks of the period without its institutional break. The third is to let transmission drift over time rather than impose a single break in 1913.

Gold kept its monetary power into the twentieth century mainly because nothing stood

in its way. The founding of the Federal Reserve did more than add a lender of last resort. It placed a balance sheet between external gold and the domestic economy. Morgan's maxim described a world in which gold set monetary conditions directly. By the 1920s that link ran through policy rather than around it.

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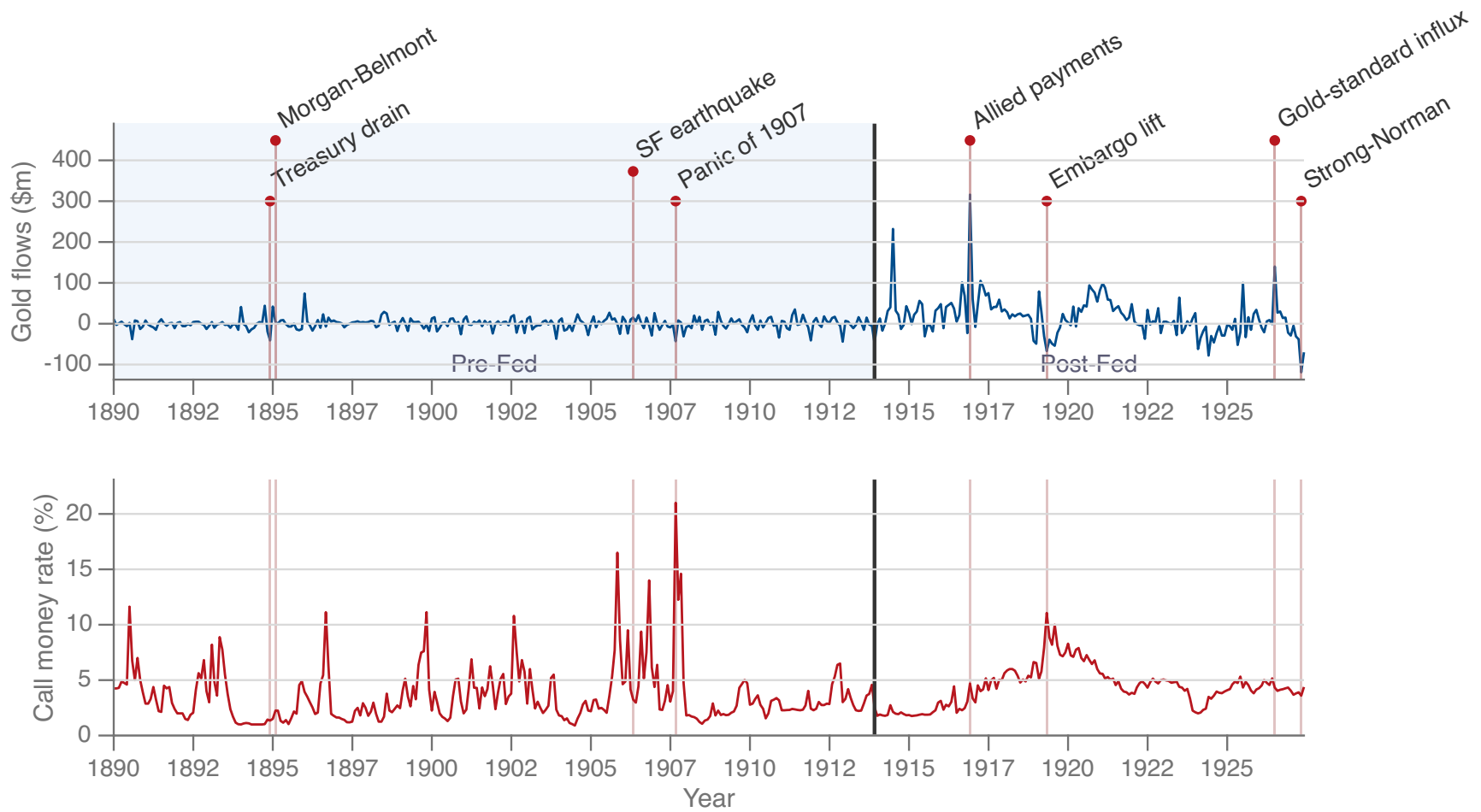
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A Data and Descriptive Statistics

Table 4 lists the six series and their sources, and Table 5 reports summary statistics over the estimation sample, 1890:01 to 1927:06. The call money rate and the gold flow are far from normal, with heavy right tails and high kurtosis, and the call rate includes the twenty-one percent reading of the Panic of 1907. The gold flow has a standard deviation of about 33 million dollars, the unit used to scale all responses. Figure 8 reproduces Figure 1 on a landscape page with each episode labeled.

Figure 8: Gold flows and the money market, 1890 to 1927, with episodes labeled



Notes. The top panel plots the monthly change in gold held by the Treasury and, from 1914, the Federal Reserve Banks, in millions of dollars, with the eight narrative episodes of Table 1 marked and labeled. The bottom panel plots the New York call money rate in percent. The heavy vertical line marks the Federal Reserve Act of December 1913, and shading marks the pre-Fed period.

Table 4: Variables and data sources

Variable	Description	Source
Industrial production	Monthly log change of the Miron-Romer index of industrial production, 1909 = 100	Miron and Romer (1990)
Call money rate	New York call money rate, percent, constructed from daily quotations	Fohlin (2025)
Equity prices	Monthly log change of a stock price index	NBER Macrohistory, M1125AUSM343NNBR
USD/GBP	Monthly log change of the dollar price of sterling	USUKFXUKM
Price level	Monthly log change of the general price index	NBER Macrohistory, M04051USM324NNBR
Gold flows	Monthly change in gold held in the Treasury and Federal Reserve Banks, millions of dollars	NBER Macrohistory, M1437AUSM144NNBR and M1437BUSM144NNBR

Notes. The gold series is the change in gold held in the Treasury (to 1914) and in the Treasury and Federal Reserve Banks (from 1914), including gold held as cover for gold certificates. It is not a series on gold imports and exports, so it reflects transfers of gold between the public, the banks, and the official holders as well as international movements. The two series are spliced at the end of 1914.

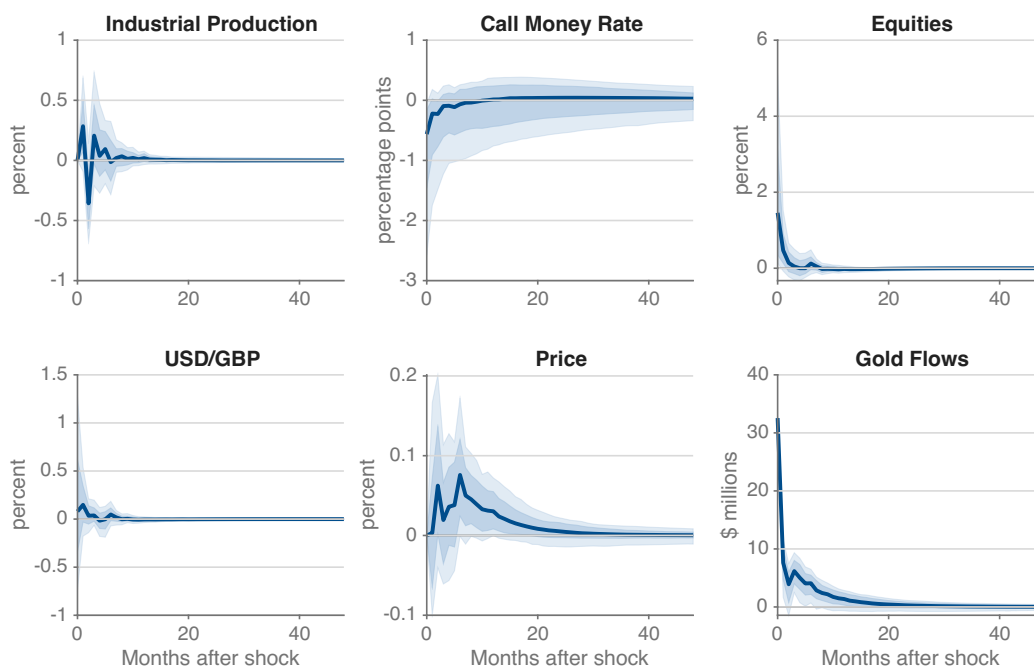
Table 5: Descriptive statistics, 1890:01 to 1927:06

Variable	Mean	Std. Dev.	Min	Max	Skewness	Kurtosis
Industrial production (% chg)	0.14	3.40	−9.39	15.32	0.00	3.98
Call money rate (%)	3.86	2.35	0.90	21.00	2.23	12.41
Equity prices (% chg)	0.26	3.40	−11.58	9.60	−0.34	3.32
USD/GBP (% chg)	0.00	1.18	−8.50	9.85	0.01	29.69
Price level (% chg)	0.18	0.91	−3.82	3.23	−0.19	4.46
Gold flows (\$ millions)	6.10	32.55	−119.00	316.00	3.03	26.67

B Responses in Monthly Growth Rates

The body reports level responses for the four variables that enter the VAR in log changes. Figures 9 and 10 report the same posterior draws as responses of the monthly growth rates themselves, which is the form in which the episode responses of Appendix C are shown. In growth rates the pre-Fed inflation response is concentrated in the first two months after the shock, which is why inflation six months out is similar in the two periods even though the price level six months out is not.

Figure 9: The gold shock, full sample, monthly growth rates



Notes. As Figure 3, with industrial production, equities, USD/GBP, and prices shown as monthly log changes in percent.

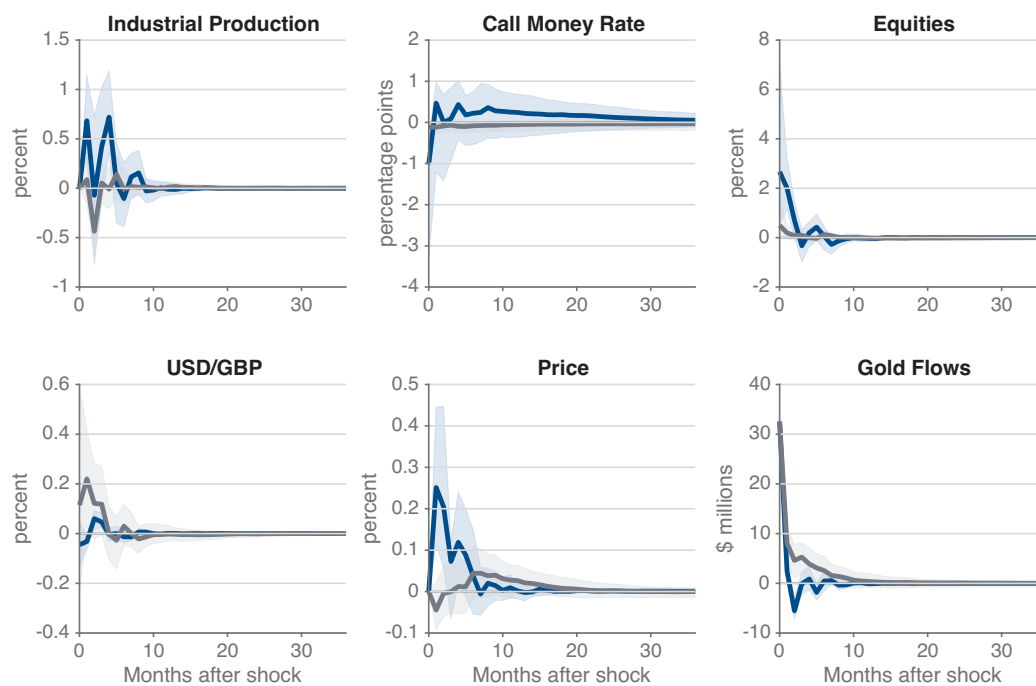
C Impulse Responses by Episode

Figures 11 through 18 report the responses conditioned on each of the eight episodes, discussed in Section 5.3. Each is estimated on a local window around the event, so the responses differ from one episode to the next. Each is scaled to a gold flow of one standard deviation, and outflow episodes are shown as outflows. Industrial production, equities, USD/GBP, and prices are shown as monthly log changes. Solid lines are posterior medians and shaded regions are 68 and 90 percent pointwise credible bands.

D Additional Historical Decompositions

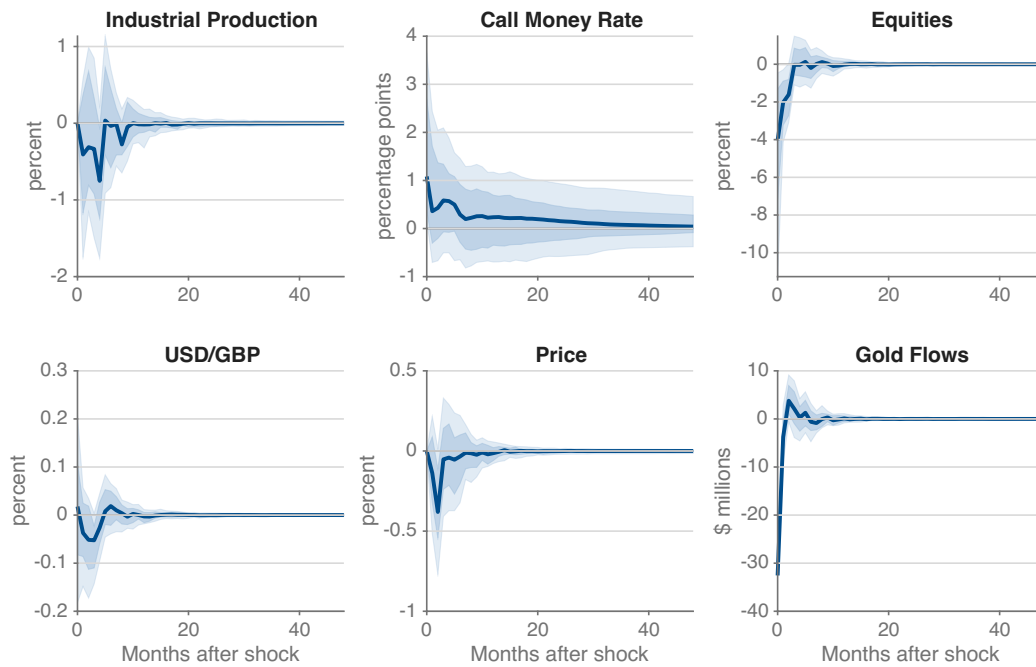
The body reports historical decompositions for the Panic of 1907 and the Allied wartime payments. Figures 19 through 24 report the remaining six. The black line is the observed deviation from the deterministic baseline, the blue band is the gold-shock contribution under the sign-only posterior, and the red band is the contribution under the narrative posterior, each with 68 and 90 percent bands. Shading marks the contribution window.

Figure 10: Response to a gold inflow by period, monthly growth rates



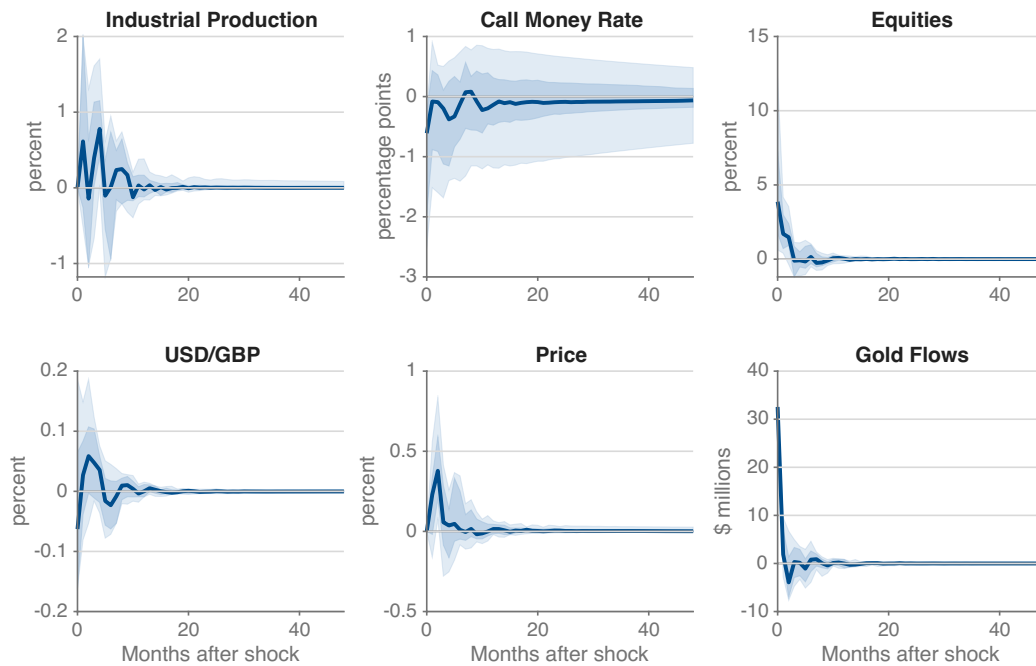
Notes. As Figure 4, with industrial production, equities, USD/GBP, and prices shown as monthly log changes in percent.

Figure 11: Impulse responses, Treasury gold-reserve crisis (December 1894), gold outflow



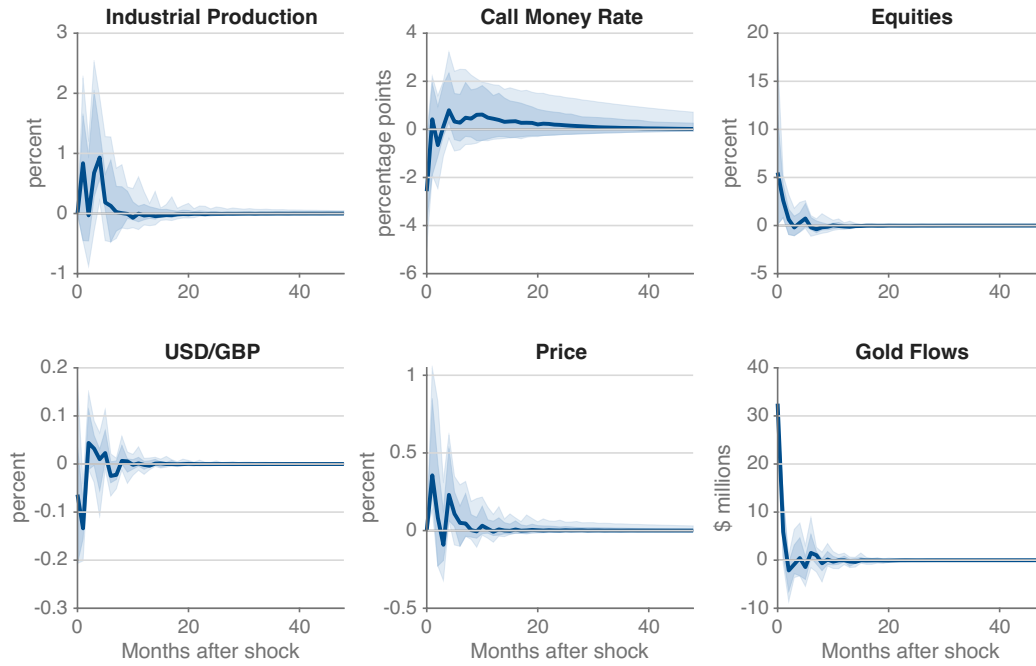
Notes. Response to a gold outflow of one standard deviation, with 68 and 90 percent bands.

Figure 12: Impulse responses, Morgan-Belmont syndicate (February 1895), gold inflow



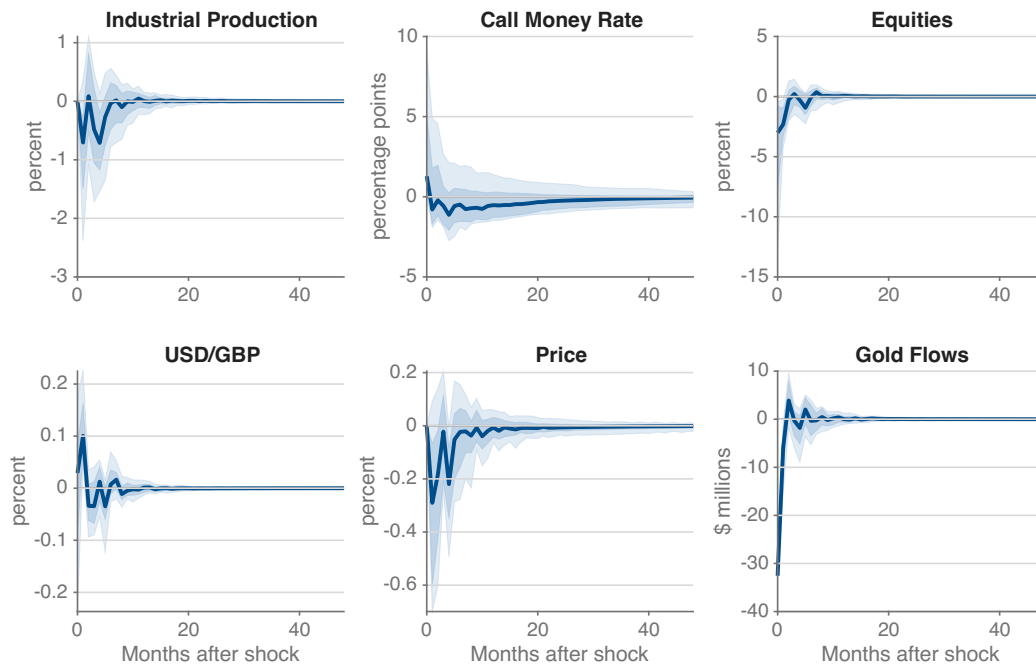
Notes. Response to a gold inflow of one standard deviation, with 68 and 90 percent bands.

Figure 13: Impulse responses, San Francisco earthquake (May 1906), gold inflow



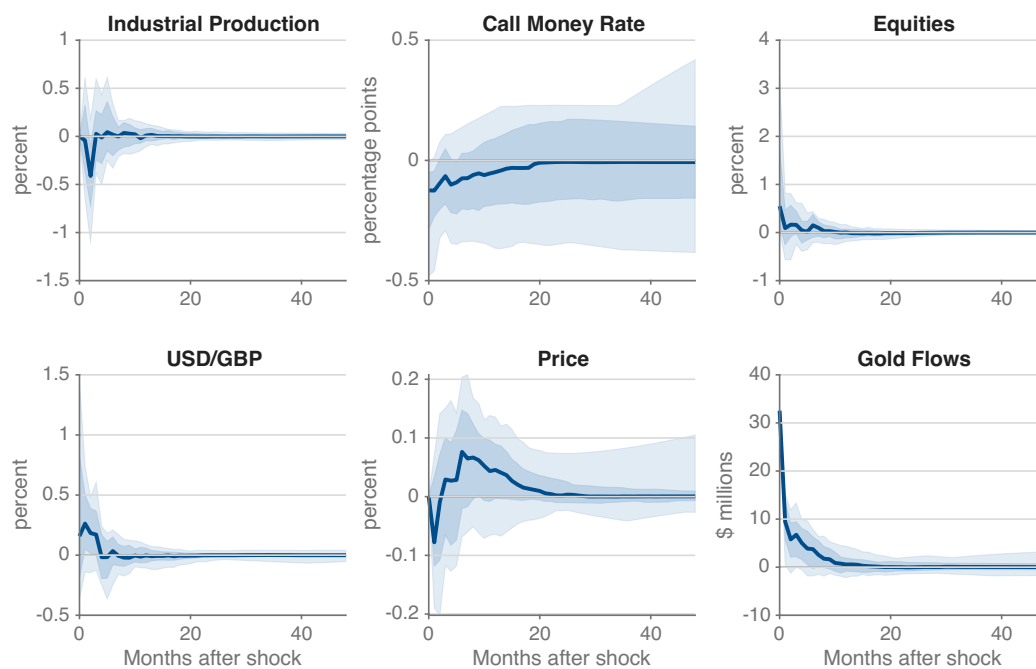
Notes. Response to a gold inflow of one standard deviation, with 68 and 90 percent bands.

Figure 14: Impulse responses, Panic of 1907 drain (September 1907), gold outflow



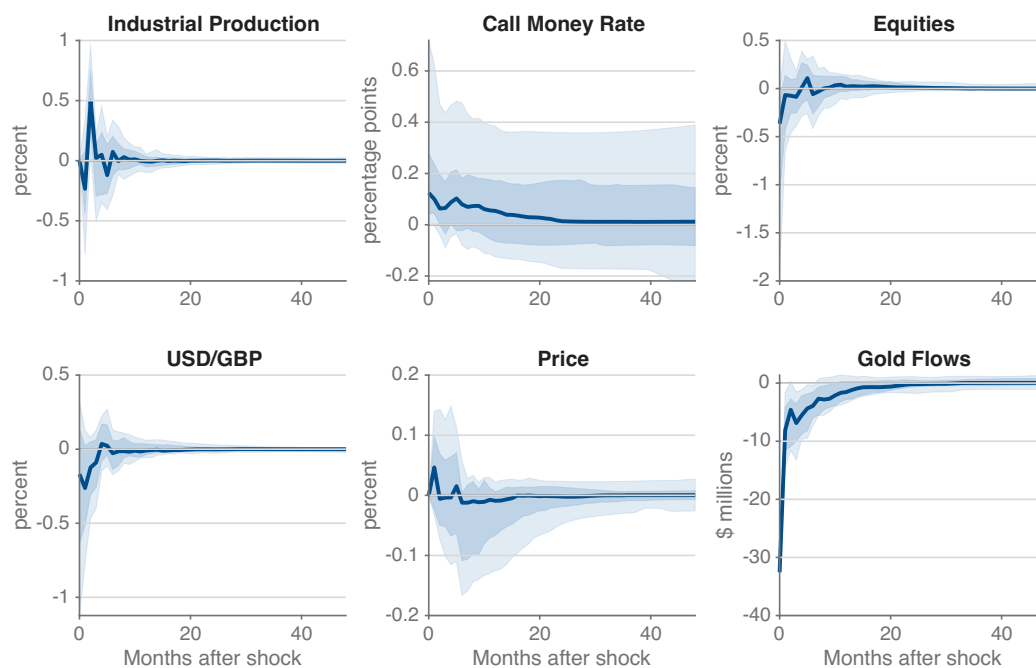
Notes. Response to a gold outflow of one standard deviation, with 68 and 90 percent bands.

Figure 15: Impulse responses, Allied wartime payments (December 1916), gold inflow



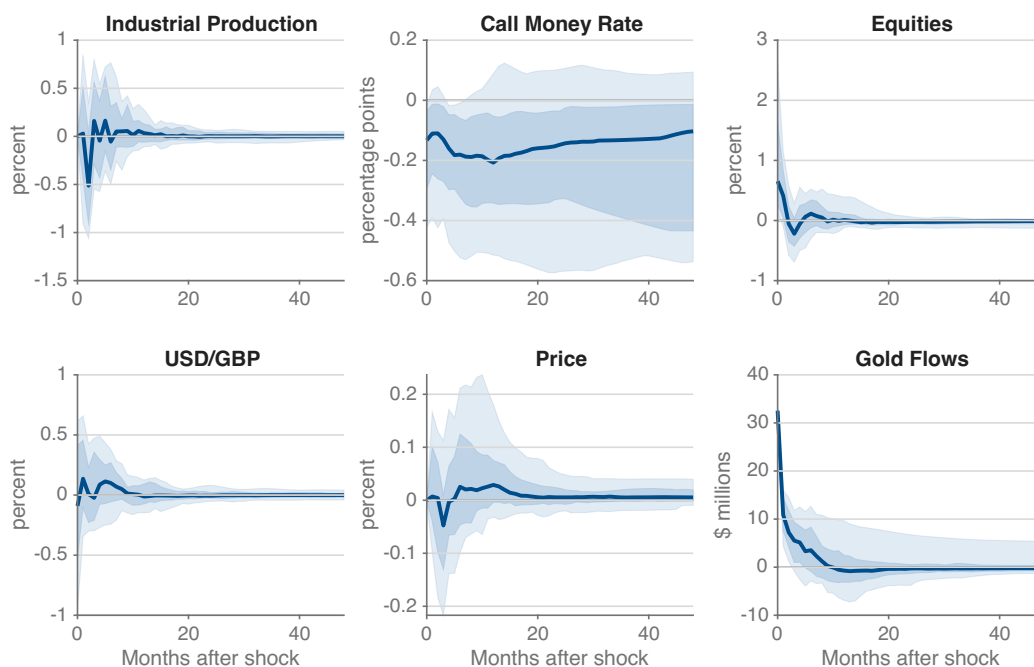
Notes. Response to a gold inflow of one standard deviation, with 68 and 90 percent bands.

Figure 16: Impulse responses, gold-export embargo lift (May 1919), gold outflow



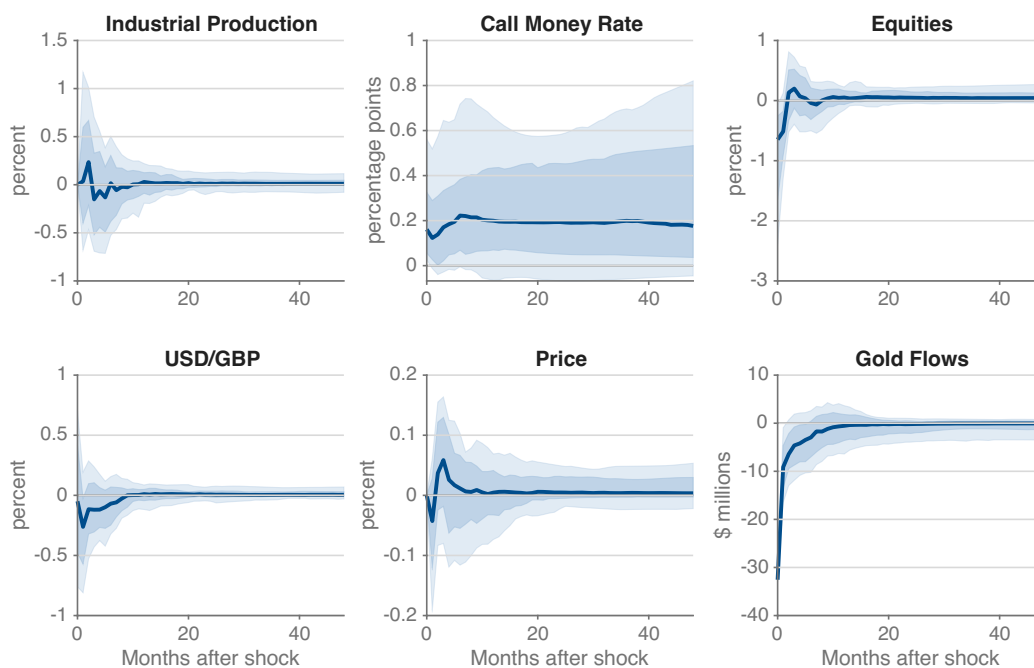
Notes. Response to a gold outflow of one standard deviation, with 68 and 90 percent bands.

Figure 17: Impulse responses, restored gold-standard influx (July 1926), gold inflow



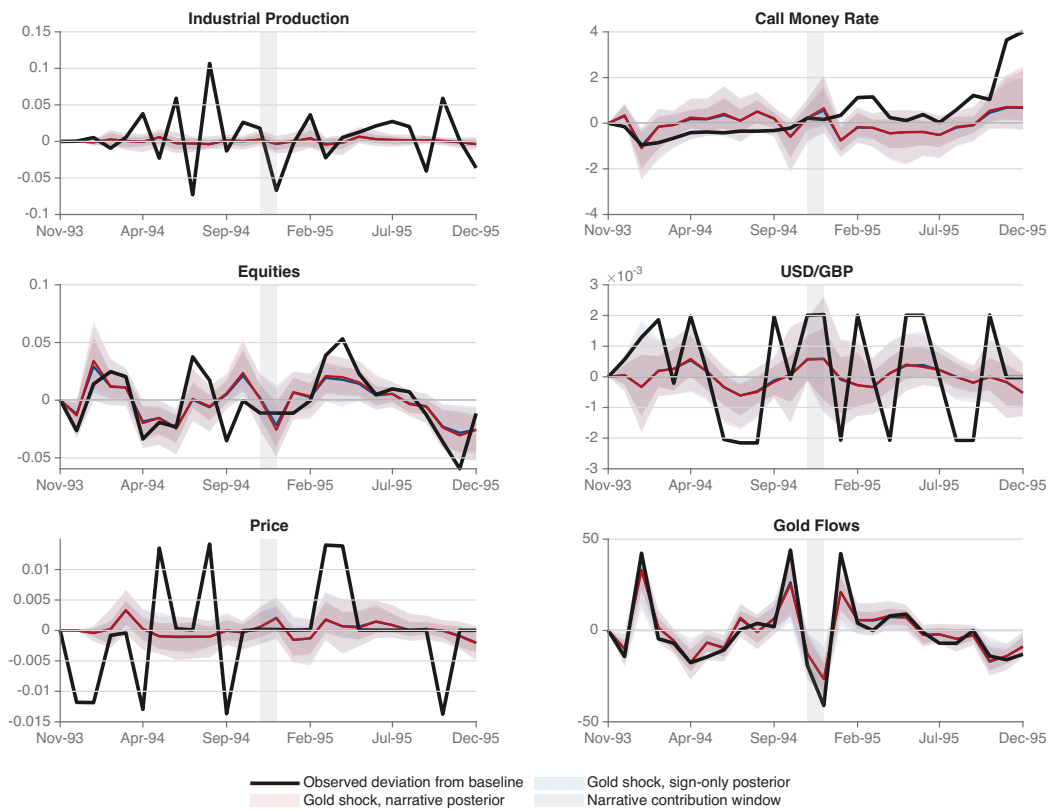
Notes. Response to a gold inflow of one standard deviation, with 68 and 90 percent bands.

Figure 18: Impulse responses, Strong-Norman episode (May 1927), gold outflow



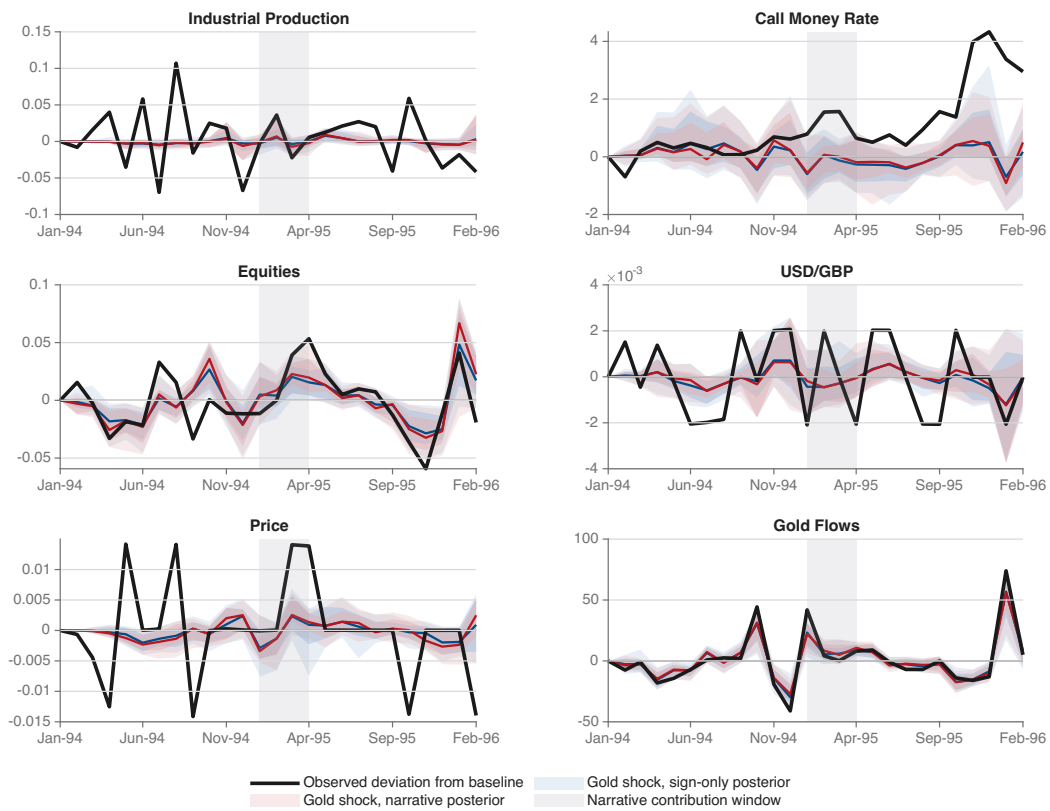
Notes. Response to a gold outflow of one standard deviation, with 68 and 90 percent bands.

Figure 19: Historical decomposition, Treasury gold-reserve crisis (December 1894)



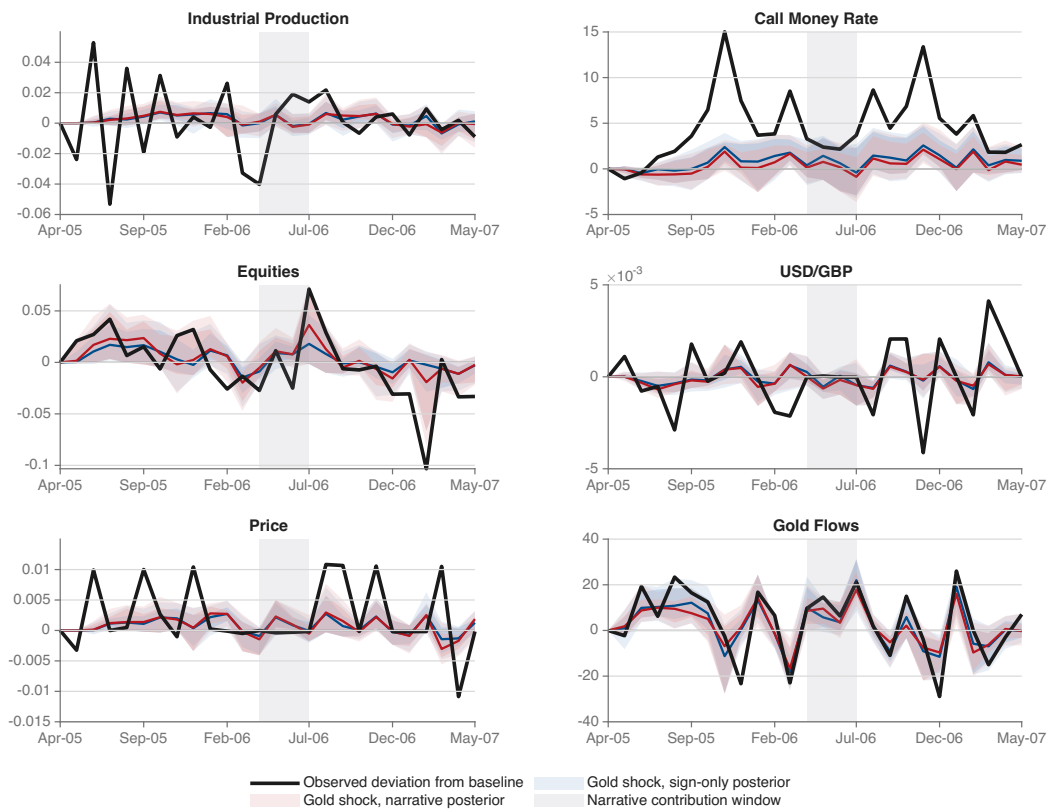
Notes. See the notes to Figure 5.

Figure 20: Historical decomposition, Morgan-Belmont syndicate (February 1895)



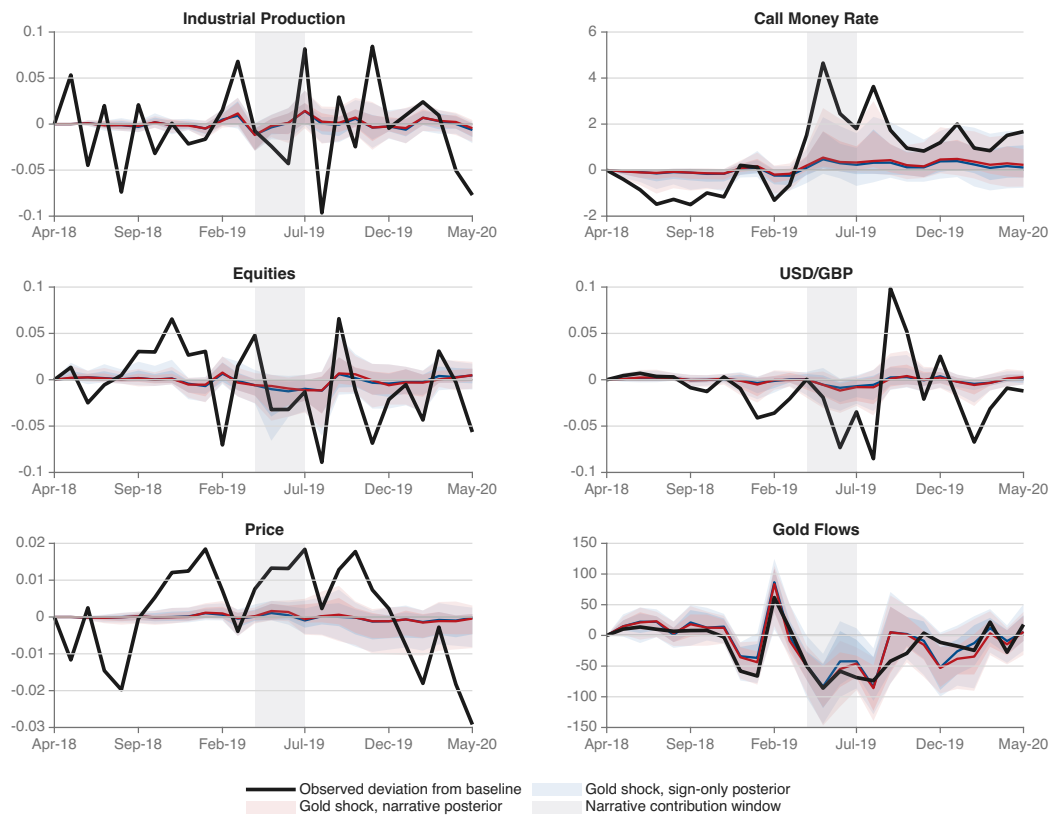
Notes. See the notes to Figure 5.

Figure 21: Historical decomposition, San Francisco earthquake (May 1906)



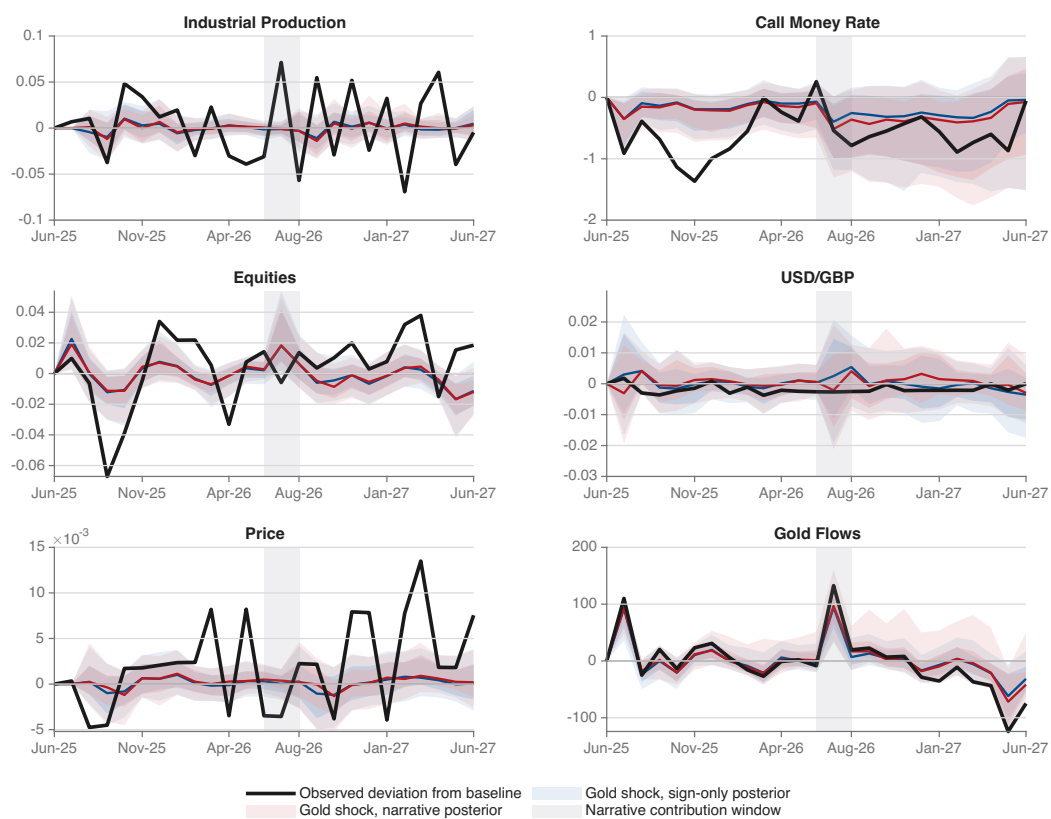
Notes. See the notes to Figure 5.

Figure 22: Historical decomposition, gold-export embargo lift (May 1919)



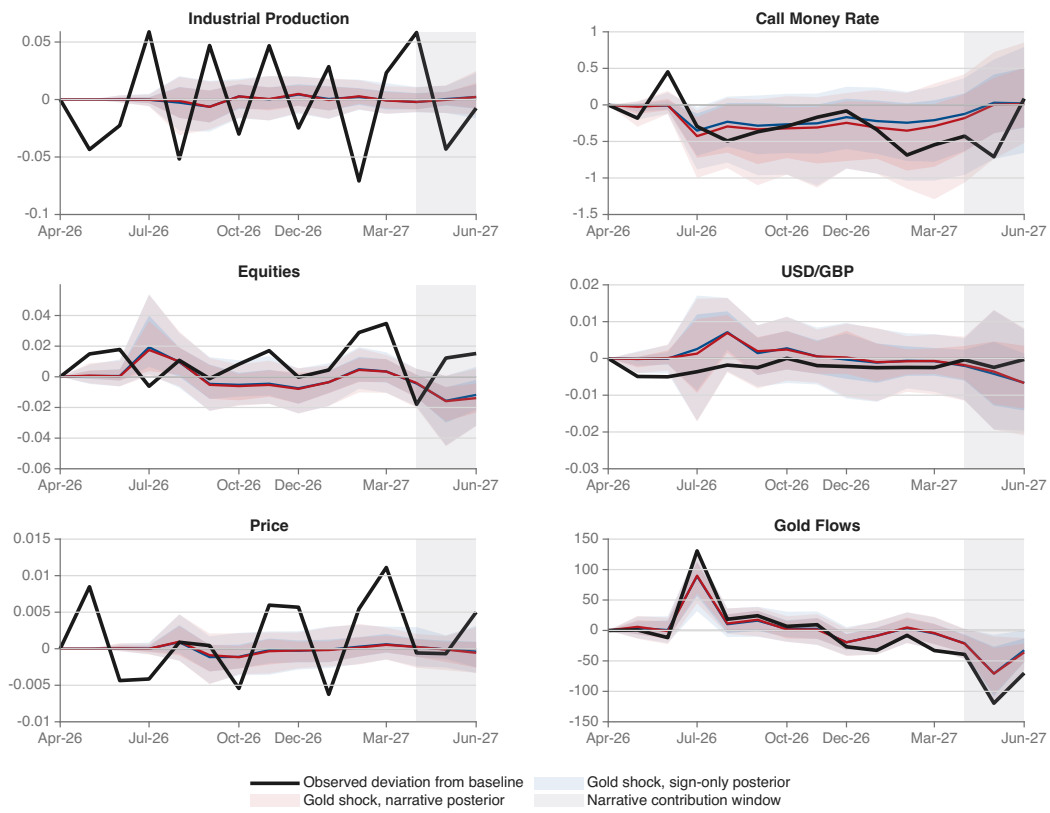
Notes. See the notes to Figure 5.

Figure 23: Historical decomposition, restored gold-standard influx (July 1926)



Notes. See the notes to Figure 5.

Figure 24: Historical decomposition, Strong-Norman episode (May 1927)



Notes. See the notes to Figure 5.