Is Devaluation Risk Contractionary? Evidence from U.S. Silver Coinage Agitation, 1878-1900

Colin Weiss*

August 9, 2017

Abstract

I identify the real effects of devaluation risk on interest rates and output by studying changes in silver coinage policy in the U.S. between 1878 and 1900. “Silver agitation” heightened fears that the U.S would abandon the gold standard and depreciate the dollar relative to gold. Since silver policy was set by Congress rather than a central bank, the exact timing of silver policy news is more likely to be uncorrelated with other economic news. Using a high-frequency event study of corporate credit spreads, I show that silver news altered corporate credit spreads by 30 basis points per event day. This effect increases to 50 basis points when examining only events after the Panic of 1893. I focus on credit spreads because bonds with greater credit risk were more exposed to the effects of silver coinage. To obtain my results, I build a series of silver coinage policy news shocks at the daily level and hand-collect daily corporate bond yield data that I separate by credit risk using newly-collected earnings and balance sheet data. Finally, I exploit these daily credit spread changes as shocks to estimate monthly impulse response functions for the dollar-gold interest differential and industrial production. A 25-basis point increase in the speculative-safe spread due to an increased likelihood of future silver coinage raised the dollar-gold interest spread 80 percent relative to its mean and lowered industrial production by 3.19 percent at a trough of 12 months.

*Division of International Finance, Board of Governors of the Federal Reserve. E-mail: colin.r.weiss@frb.gov. I am deeply grateful to Dora Costa for her unyielding support and guidance. I also thank Leah Boustan for detailed feedback on this paper. Andy Atkeson, François Geerolf, Eric Hilt, and Francis Longstaff also provided comments which greatly improved this paper. For helpful comments at an earlier stage of this project I thank Michael Bordo, Gary Gorton, Alan Taylor, François Velde, and Marc Weidenmier. Yuqing Wu and Peter Fuzhe Zhang provided outstanding research assistance. The views expressed in this paper are solely those of the author and do not reflect those of the Board of Governors of the Federal Reserve. All errors are my own.
1 Introduction

Currency risk—including the risk of large fluctuations for floating exchange rates or sudden devaluations for fixed exchange rates—affects many developing economies today and potentially lowers their output (Gupta et al., 2007; Mitchener and Weidenmier, 2015; Schmuckler and Serven, 2002). Assessing the real effects of currency risk in a modern setting is an empirical challenge for a number of reasons. First, fluctuations in devaluation risk are often caused by shocks to other economic variables, such as output or asset prices, making it difficult to identify devaluation risk effects. Second, many changes in currency risk are quickly followed by actual exchange rate devaluations, again raising identification challenges.

I exploit the unique historical and institutional features of the U.S. monetary system at the end of the 19th century to estimate the effects of currency risk between 1878 and 1900 on economic activity. In the time period I study, the U.S. was on a gold standard (i.e. the dollar was convertible to a fixed amount of gold at the mint) but a political coalition of farmers and miners pressed for the additional convertibility of dollars to a fixed amount of silver. The preferred policy of this “Free Silver” movement would have resulted in a 50 percent depreciation of the dollar against gold.\footnote{The Free Silver movement advocated a mint convertibility ratio of 16 ounces of silver for one ounce of gold at a time when the market prices of silver and gold fluctuated between 20 and 32 ounces of silver per ounce of gold. This would exhaust the Treasury’s gold reserves and force it to suspend gold convertibility, leading to a 50 percent depreciation of the dollar against gold.}

My paper consists of two distinct, but complementary, analyses. I first identify the effects of silver coinage news on corporate bond credit risk, a key component of private borrowing costs, by using a high-frequency event study approach. This approach relies on a new series of silver coinage policy news shocks at the daily level that I constructed using information from the historical financial press and a series of daily bond yields around event days. I then aggregate my daily credit risk premia changes from silver policy shocks to the monthly level to study how industrial production and the dollar-gold interest rate spread reacted to changes in expected future silver coinage.\footnote{High-frequency methods are often used to identify the effects of monetary policy shocks. See G"urkaynak}
There are several advantages to the time period I study for understanding the real effects of currency risk. Shocks to devaluation risk were due to political rather than economic factors, making endogeneity less of an issue. I also use the narrative record to verify that no economic news occurred on silver policy news days to further alleviate endogeneity concerns. Additionally, the U.S. never abandoned the gold standard between 1878 and 1900, despite the persistent threat posed by Free Silver, so I do not have to separate the effects of currency risk from the effects of an actual currency crisis. Finally, many companies were exposed to exchange rate risk on their balance sheets because devaluation would have raised the real debt burden. Seventy percent of corporate debt was payable in “gold coin” rather than dollars and was primarily issued by companies in the non-tradable sector.

My analysis uses the differential changes in safe versus speculative-grade bonds to capture changes in the credit risk premium. Speculative bonds are more likely to be affected by silver coinage risk for three main reasons. First, although data limitations prevent a direct comparison of gold- and dollar-denominated bonds, the change in the gold debt burden due to devaluation was greater for speculative bonds than safe bonds. Second, devaluation fears weakened the financial system (through withdrawals of deposits), leading to contractions in credit and production, lowering corporate earnings. Speculative bond values respond more to fluctuations in earnings than safe bond values. Finally, since silver coinage affected the health of the financial system, news about silver coinage likely impacted speculators’ ability and willingness to hold risky corporate bonds.

I find that silver coinage news changed the spread between safe and speculative corporate bonds and had its largest effect on bond yields after the Panic of 1893, when the Treasury likely lacked the gold reserves to withstand a run on gold. I obtain these results using daily corporate bond yield data from over 100 firms that I hand-collected and then separate by credit risk using information from earnings reports and balance sheets which et al. (2005) and Krishnamurty and Vissing-Jorgensen (2011) for examples. Similarly to this paper, Gertler and Karadi (2015) use high-frequency shocks to help identify lower frequency effects on industrial production.

This is a case of currency mismatch, i.e., assets are denominated in one currency and liabilities in another. For an example of its relevance today, see Ranciere et al. (2010).
were available to investors at the time. Silver news after the Panic of 1893 caused speculative yields to change by an additional 50 basis points. Additionally, my evidence suggests that differences in the gold debt burden between safe and speculative bonds can explain a large portion of the differential response of speculative bonds on event days, while overall credit conditions changed little on event days.

In the second part of the paper, I find that greater silver coinage risk immediately leads to a substantial increase in the interest rate differential between dollar and gold-denominated assets—which I call the currency risk premium—relative to its mean, and this effect persists for several months. Industrial production also falls by a statistically significant amount due to higher silver coinage risk, reaching a trough at 12 months after the shock. My results are based on estimates of monthly impulse response functions to silver news. My estimated response of industrial production to silver coinage news is consistent with the qualitative evidence I present from the financial press. Devaluation risk had real effects because it raised expected default costs and contracted the supply of credit by worsening bank balance sheets through gold hoarding; I support these mechanisms with suggestive evidence.

My work addresses several issues in contemporary macroeconomics related to currency mismatch, exchange rate regimes, as well as the real effects of policy uncertainty. Relative to the existing work, I study the effects of devaluation risk rather than actual currency crises on bond yields and output; in this regard, I relate to broader work studying the impact of political and economic uncertainty on aggregate output and firm outcomes (e.g. Baker et al., 2016; Caldera et al., 2016; Ludvigson et al., 2016). My identification strategy, most closely

---

4 According to uncovered interest rate parity (UIP), this differential represents expected changes in the dollar-gold exchange rate. Some of the dollar-gold interest spread may also represent a risk premium, hence the name.

5 Previous work on devaluations and currency mismatch has focused on identifying firm-level effects (Aguiar, 2005; Calomiris, 2007; Kalemli-Ozcan et al., 2015; Kim et al., 2015) or on studying cross-country variation in currency mismatch and economic activity after currency crises (Domaç and Peria, 2003; Gupta et al., 2007; Bordo et al., 2010). Other authors have also argued that exchange rate expectations are priced into assets during both modern and historical time periods (Schmuckler and Serven, 2002; Powell and Sturzenegger, 2003; Bailey and Bhaopichitr, 2004; Bordo et al., 2009; Mitchener and Weidenmier, 2015). This work has primarily focused on interest rate differentials for government bonds (with the exception of Bailey and Bhaopichitr, 2004).
resembles that of Baker and Bloom (2013). Additionally, I focus on how exchange rate expectations influence corporate bond yields and credit risk (in part through currency mismatch on firm balance sheets), while prior work has emphasized changes in government bond yields; and I connect changes in exchange rate risk to fluctuations in industrial production.

My results also have implications for historical work on silver coinage in the U.S. and the broader impact of gold standard expectations on economic activity. Economic historians have argued that silver coinage created expectations that the U.S. would leave the gold standard, raising interest rates and increasing price level uncertainty (see Friedman and Schwartz, 1963; Calomiris, 1993; and Hallwood et al., 2000). I present well-identified effects of silver coinage on borrowing costs and go beyond the existing literature by linking these changes in credit spreads to output changes, as has been done for the current time period. Previous work linking expectations about the gold standard to output has focused on the Great Depression, but due to the bevy of policy changes during this time period, it is nearly impossible to systematically study how gold standard uncertainty contributed to output fluctuations in the U.S.

The rest of the paper is organized as follows: Section 2 reviews the monetary institutions in the U.S. during the latter half of the 19th century; Section 3 describes the potential mechanisms linking devaluation risk, interest rates, and output; Section 4 discusses the methodology and results of the daily-level empirical analysis; Section 5 does the same for the monthly impulse response functions; Section 6 describes narrative evidence on silver coinage and industrial production; Section 7 concludes.

---

6. A more recent study by Fulford and Schwartzman (2017) uses the 1896 U.S. presidential election to show how enhancing gold standard credibility increased bank leverage.

7. Philippon (2009) and Gilchrist and Zakrajšek (2012) are examples of this literature. Krishnamurthy and Muir (2016) and Lopez-Salido et al. (2016) study the effect of credit spreads using longer time series.

8. There are certainly individual episodes during the Great Depression that can be studied, but characterizing the response of output to all news about the gold standard is fraught with identification issues. See work by Temin and Wigmore (1990), Romer (1992), Edwards, Longstaff, and Marin (2015), Jalil and Rua (2016), Sumner (2015).
The Gold Standard and Silver Coinage in the U.S.

Prior to the Civil War (1861-1865), the U.S. operated under a bimetallic system where paper currency could be exchanged for a fixed amount of either gold or silver at the U.S. treasury. Under a bimetallic system, both metals are treated as money so long as the mint convertibility ratio approximates the market convertibility ratio. When these two ratios are not equal, the metal undervalued at the mint ceases to circulate as money and is used only for private purposes. After the suspension of metallic convertibility during the Civil War, the Coinage Act of 1873 restored the fixed dollar-gold exchange rate at its historical level of $20.67 per ounce of gold, and the Resumption Act of 1875 set the date at which convertibility would resume at January 1, 1879. The Coinage Act omitted mention of silver coinage, essentially demonetizing silver and pushing the U.S. to a monometallic gold standard.

Silver regained some of its previous monetary status through two legislative acts that allowed a limited amount of currency to be convertible to silver. The first, occurring in 1878, was the Bland-Allison Act. This law required the Treasury to purchase between $2 and $4 million worth of silver bullion each month and convert it to currency. The second act was the Sherman Silver Purchase Act of 1890, which set a fixed weight (4.5 million ounces) of silver to be purchased at the market price and coined each month. At the time of its passage, the Bland-Allison Act’s minimum monthly requirement would have added roughly 1.2 percent annually to the total money stock in 1879, ceteris paribus. Silver purchases under the Sherman Act equaled approximately $5 million a month, which would have increased the 1890 money stock by 1.44 percent, ceteris paribus.

The deflation required to return to pre-war gold parity, as well as continued deflation under the gold standard, led a coalition of farmers and miners to push for a return of

---

9This number represents an upper bound on the increase in the money supply. As Timberlake (1978) points out, the Treasury could avoid circulating silver if tax revenues were sufficient to cover the cost of purchasing silver.
bimetallism at the antebellum mint ratio of 16 ounces of silver to one ounce of gold. They hoped the additional money created would raise the overall price level, easing their debt burden and boosting their exports by depreciating the dollar. The two silver purchase acts described above were compromise capitulations to the Free Silver movement. The controversial aspect of the bimetallism advocated by the Free Silver was the 16:1 mint ratio. Relative to the market price ratio of silver to gold between 1880 and 1896, this mint ratio would have overvalued silver—by the end of this time period the market ratio was closer to 32:1. Gold would thus have ceased to circulate as money and the dollar would have been devalued by up to 50 percent relative to gold.

Even these limited amounts of silver coinage created doubts about U.S. commitment to the gold standard, leading to gold outflows and negating the inflationary effect of the silver money injections. These fears of a gold standard exit were at their highest in the aftermath of the Panic of 1893, as the gold drain had pushed the Treasury’s gold reserves to historic lows. The business community largely blamed the Sherman Act for the devastating Panic of 1893, and President Grover Cleveland signed its repeal into law in November of 1893 (Friedman and Schwartz, 1963; Jalil, 2015). Although the election of 1896 is widely seen as the unofficial end of the silver threat, this era of “limping” bimetallism ended for good with the passage of the Gold Standard Act of 1900 (Timberlake, 1978).[10] This law established gold as the only metal for which dollars could be exchanged at the Treasury.

**Bond Markets and Financial Institutions**

Here I review several pertinent features of the market for corporate bonds in the U.S., as well as the role of financial institutions in the operation of these markets. These details will become important when discussing the channels through which silver coinage risk affected bond yields.

By the end of the 19th century, the U.S. had a burgeoning market for long-term

---

[10] The use of “limping” refers to the inability to freely convert dollars to silver.
corporate debt. The primary sector issuing traded bonds were the railroads, but utility and industrial companies made significant inroads during the 1890s. Most railroad bonds were mortgages against the companies’ property, particularly the lines of track, and were denominated in gold rather than dollars. There was significant variation in the liens these bonds had on the property. Some bonds were first or second liens on the main line of the company, while others, though liens on the entirety of the property, were junior to all other claims (often numerous) on the property. Additionally, other junior debt was unsecured or backed only by other issues of stocks and bonds. Most industrial and utilities debt was also not mortgaged against any property, making the safety of their bonds much more dependent on their earning capacity.

Financial institutions were both directly and indirectly involved in the trading of corporate securities. Their direct role as investors of bonds and stocks was small relative to the size of the market (they only owned about 3.5 percent of all corporate securities.\textsuperscript{11} Rather, the greater importance of the financial sector was in financing the purchase of stocks and bonds on credit, particularly for Wall Street traders. By 1910, one-third of all national and state bank loans were issued against stock and bond collateral (Pratt, 1912). If banks called in these loans and the borrower was unable to pay, the banks became owners of the securities, free to buy and sell these assets on the stock exchanges.

3 Devaluation Risk and the Real Economy: Transmission Mechanisms

Nominal devaluation risk can raise bond yields and lower real economic output through the provision of credit. In models of fixed exchange rate devaluations, when foreign investors

\textsuperscript{11}This is likely due in part to state and federal regulations. For instance, savings banks in New York could only hold first mortgage bonds of a railroad system or “part of a system” that was “controlled by a New York corporation which for five years has not defaulted and has paid four percent or higher dividends on its stock” (Selden, 1919).
believe that a country’s exchange rate peg will not be maintained they begin withdrawing capital from that country. This decreases savings in the economy, raising borrowing costs and lowering investment.

Under the gold standard, this outflow of foreign money often took the form of gold outflows, producing deflation and thus contracting the economy. Deflation can raise the number of non-performing loans on bank balance sheets, lowering banks’ net worth, leading to a decrease in credit. Further, if individuals respond to the fall in the banking sector’s net worth by withdrawing deposits this will lead to a second round of contracting credit. Additionally, if the dollar is expected to depreciate relative to gold, individuals may choose to hold more of their wealth in gold rather than bank deposits, also lowering bank reserves. If these two forces are strong enough, they can lead to bank runs. The U.S. indeed experienced large reversals in capital and gold flows in the time period I study: the average annual net purchase of American securities by foreigners of $200-300 million from 1885-1889 changed to an average annual net sale of American securities by foreigners of $60 million from 1890-1894 (Friedman and Schwartz, 1963). Additionally, the Panic of 1893 has been largely blamed (at least indirectly) on the uncertainty surrounding the gold standard in the U.S. (Friedman and Schwartz, 1963).

This financial distress could specifically impact bond spreads in several ways. If the speculators that disproportionately held riskier bonds had a greater need for gold, the mass sale of speculative bonds would result in a widening of the safe-speculative spread. Similarly, as individuals withdrew reserves from the banking system, this would increase banks’ demand for liquidity, forcing them to call in loans, many of which had stocks and bonds as collateral. If the loans were not repaid, the banks took ownership of the securities, which they would then try and sell for gold. If more of the collateral was in speculative bonds, this would cause speculative yields to rise by more than safe yields. Indeed, in his chronology of the Panic of 1893, Sprague (1910) notes that the contraction of bank loans in New York City in

---

12 Obstfeld (1995) is an example of a model where fear of devaluation leads to a run on a country’s currency.
13 See Gertler and Kiyotaki (2011) for a model with this type of effect.
the months before the Panic “involved loss to holders of securities, especially those of the more speculative variety” (p. 164).

In addition to reductions in intermediated credit, devaluation risk can lead to loss of direct credit due to currency mismatch on borrowers’ balance sheets.\(^\text{14}\) When a borrower’s liabilities are denominated in a foreign currency, but their assets are in the domestic currency, a devaluation raises the borrower’s real debt burden, making it more likely they will default on their debt. This effect is exacerbated for firms that produce non-tradable goods and services, as they do not receive the main benefit of a devaluation: increased export competitiveness. As firms go out of business, this lowers production. In the time period I study, a substantial fraction of corporate debt was payable in gold rather than dollars and over 90 percent of the debt was issued by railroad companies, with a substantial portion of the remaining fraction coming from utilities providers, essentially firms providing non-tradable goods and services.\(^\text{15}\) Depending on the year examined, 65 to 70 percent of the corporate debt in my bond dataset had interest or principal (or both) denominated in gold. These “gold clauses” in bond covenants were often necessary for bonds to be traded on the London Stock Exchange.\(^\text{16}\) Most companies did not match their gold debt with holdings of gold-denominated assets.

### 4 Daily-Level Event Study

Since devaluation risk can exacerbate financial frictions and increase real debt burdens, devaluation risk should affect firm borrowing costs. My empirical work first uses a daily-frequency event study to analyze the corporate bond market reaction to silver news. My primary regression compares yield changes between groups of bonds with different exposure to the effects of silver coinage. I later use these daily events as plausibly exogenous shocks to

---

\(^\text{14}\) See Cespedes et al. (2004) as an example.

\(^\text{15}\) For the empirical analysis, it is difficult to find a large enough sample of securities for tradables to conduct a quantitative analysis, though I am still exploring this possibility.

\(^\text{16}\) I thank Michael Bordo for pointing this fact out to me.
estimate monthly impulse response functions for the currency risk premium and industrial production. I describe the methodology used to estimate these impulse response functions at the beginning of Section 5.

To construct a series of events related to silver coinage policy, I employ the narrative approach most prominently used by Romer and Romer (1989, 2004) to study modern U.S. monetary policy. I look for mentions of silver coinage policy news in the “Financial Affairs” section of the *New York Times* and the “Bankers Gazette” in *The Commercial and Financial Chronicle* between 1878 and 1890. Importantly, I drop events where there is other economic news released on the same day to avoid biasing my quantitative estimates.

The empirical analysis below uses a set of 21 news shocks related to silver coinage. These events occur over a span of 29 days, and the narrative record indicates that some news events affected financial markets across multiple days. Table 1 contains a brief description of each event, as well as a (+) or (-). These symbols indicate whether or not the news appeared to increase (+) or decrease (-) expected future silver coinage. Events essentially fall into one of two categories: legislative action, such as the introduction of a bill to repeal the Sherman Act in December 1892, or executive branch positioning, like the election of the pro-Gold William McKinley in November 1896.

**Preliminary Analysis**

I establish whether silver coinage news is associated with greater bond yield movements using two different methods. First, following Kuttner and Posen (2010), I test whether silver policy news contained additional information for bond yields relative to days without news. Essentially, I test the null hypothesis that there was no additional variance on days with silver news. I begin by constructing bootstrap estimates of the 5th and 95th percentiles for

---

17 For a detailed description about the event selection procedure see the Appendix.  
18 The agreement of Republicans from the House and Senate on a new silver bill in July, 1890 is difficult to classify. I mark it as (+) because actual silver coinage did increase, but it is unclear if silver coinage increased by as much as people expected it to before the Sherman Bill passed. Subsequent results do not depend on the classification of this event, however.
the distribution of yield changes on non-event days. Non-event days in my dataset are one, five, and ten days before each event, as well as a six month period in 1891 with no silver coinage news. I count the number of event dates which have average yield changes that are either above the 95th percentile or below the 5th percentile estimated from the non-event dates. I compare this number to a critical value from the binomial distribution. If the actual count exceeds the critical value, then one rejects the null hypothesis that the variance is the same for the two groups.

My second method uses a simple regression to test whether days with news about silver coinage are associated with greater changes in bond yields:

\[ y_t = \alpha + \beta Silver_t + x_t'\gamma + \varepsilon_t \]  

where \( y_t \) is the average yield change in corporate bonds traded on date \( t \); \( Silver_t \) is a variable taking one of three values: zero for days with no silver news, one on days where expected future silver coinage decreases, and negative one on days when expected future silver coinage rises; \( x_t \) is a vector of month-year indicator variables, meant to control for the average level of bond yield volatility in a given month in a given year.

Average yield change data are based on daily closing price data for corporate bonds traded on the New York Stock Exchange (NYSE) I hand-collected from the *New York Times* and *Wall Street Journal*. For each event day, I record the closing price for each bond sold on the NYSE that day, as well as the last price at which each bond sold before the event date. I repeat this process for each of the non-event days in my dataset.

Eleven out of 29 event dates exceed the percentile bounds found using the Kuttner and Posen tail-based tests. Since the probability of seeing this many event dates in excess of the bounds under the null hypothesis is approximately 0.005 percent, I can easily reject the null hypothesis that average yield changes have the same volatility on days with silver coinage news when compared to days without silver coinage news. I repeat the above process using

\[ ^{19} \text{This last part is necessary to calculate the change in yield.} \]
absolute values of the average daily change as an additional test and again reject the null hypothesis.

Estimates of Equation 1 confirm the finding that yields systematically changed by more on event days. Column (1) of Table 2 reports the coefficients on the silver event variable when the dependent variable is the average daily corporate bond yield change. The silver event variable is negative and statistically significant at the 1 percent level. The negative sign and magnitude of the coefficient imply that news that lowered expected future silver coinage lowered corporate bond yields by roughly nine basis points on average.

To gauge the magnitude of this estimated effect, I compare it to two other news shocks in 1895 that likely raised uncertainty. The first event was a series of financial market panics in Europe due to political unrest and the failure of a South African mining company on November 8, 1895. On this day, the average U.S. corporate bond yield rose by about 5.7 basis points. The other event was a message from President Cleveland to Congress regarding a border dispute in South America between the U.S. and the U.K., which occurred on December 17, 1895. Over the next two days, corporate bond yields rose an average of 6.5 basis points per day. I therefore interpret the effect of silver news on corporate bond yields as economically significant.

The effect of silver news differs across time, and I argue below that this time-varying effect reflects changes in the ability of the U.S. to maintain the gold standard. All 11 event dates exceeding the bootstrapped percentile bounds occurred after the Panic of 1893 began in May of that year. Figure 1 plots the absolute value of the average yield changes separated by whether they occur before or after of the Panic of 1893. The horizontal line is the bootstrapped 90th-percentile of the non-event day distribution. It is readily apparent that the post-Panic events saw much larger changes in corporate bond yields when compared to the average for events before the Panic of 1893. Column (2) of Table 2 reports coefficients for regressions that include an additional dummy that takes a value of one when a silver event

20 These items both received mention as the dominant current event in their respective months in the Commercial and Financial Chronicle’s recap of the entire year.
occurs after the Panic of 1893. The value of the post-Panic dummy shows that silver news after the Panic of 1893 is associated with average yields changing by an additional 16.27 basis points, while events prior to the Panic have no effect on the average yield change.

This variation in the bond market response to silver news across time is likely due to changes in the ability of the U.S. government to maintain the gold standard. As mentioned in Section 2, the external drain of gold brought about by silver coinage (particularly under the Sherman Act) dwindled the Treasury’s gold reserves, and these reserves were at their lowest in the years after the Panic of 1893. With the Treasury unable to withstand any serious run on gold, continued silver coinage was much more likely to force an end to gold convertibility during these low-reserve times.

Figure 2 shows the increase in yield changes for post-Panic silver events as well as the persistently low gold reserves after the Panic. In the figure, I plot the monthly time series of the average daily absolute change in yields due to silver news and a 12-month lagged moving average of the Treasury’s gold reserves. The vertical line at May 1893 marks the start of the Panic of 1893. Once the average gold reserves over the past 12 months are either just above $100 million or below it, there is a large jump in the yield changes on event days. This $100 million reserve threshold was important because it was the legal minimum necessary for the Treasury to continue issuing gold certificates.

I modify Equation 1 to include the Treasury’s gold reserves and its interaction with the silver event variable and find that higher gold reserves weaken the bond market response to silver coinage news. This is evidenced by the statistically significant interaction terms reported in column (3) of Table 2. In column (4), I use the average of the Treasury’s gold reserves over the past 12 months instead of the actual reserves of that month. In both cases, the sign of the coefficient indicates that the average bond yield changed by less on silver event days as gold reserves—and therefore the Treasury’s abilities to maintain the gold standard—increased. Using the coefficient from column (4) implies that going from the average gold

\[21\] The gold reserves data are taken from the 1897 Treasurer’s Report.

\[22\] Certificates entitled holders to a fixed value of gold.
reserves over the past 12 months in July 1890 ($186.3 million), when the Sherman Act was passed, to those when a compromise repeal measure failed in the Senate in October 1893 ($105.365 million), increases the magnitude of the bond market response to silver news by approximately 12.23 basis points, or 50 percent of the actual difference in average yield change for these two events.\(^{23}\)

**Difference-in-difference: Safe Versus Speculative Bonds**

To further establish plausibility that silver coinage news drives yield changes on event days, I compare yield changes between groups of bonds with different exposure to the effects of silver coinage on silver news days and non-event days. Bonds with greater credit risk should have seen a larger change in their yields in response to silver coinage news.\(^{24}\) Safe bonds (those with low risk of default) would see smaller increases in their probability of default as the expected gold debt burden increased relative to bonds with higher default risk. The Appendix provides a simple credit risk model where this is true under plausible assumptions. Further, safe bonds had greater earnings cushions to withstand the contraction in earnings resulting from a lowering of the credit supply due to devaluation risk. Finally, since silver coinage likely weakened the aggregate economy and raised the demand for gold, investors would demand a higher risk premium for holding speculative bonds as expected silver coinage increased.

I separate bonds into different credit risk categories using statistics outlined in the first edition of Moody’s Manual (1909) that I calculate using annual earnings and balance sheet data that I collected from Poor’s Manual of Railroads, which were available to investors at the time.\(^{25}\) All analysis relying on safe-speculative yield spreads uses only the events

---

\(^{23}\) I repeat the four specifications discussed above using the absolute value of the average yield change as the dependent variable and report the results in the Appendix.

\(^{24}\) Given my emphasis on credit spreads, I would ideally compare riskier corporate bonds to safer U.S. government bonds, but public debt was small during this time period (less than 15 percent of GDP), and regulations limited trading in government bonds.

\(^{25}\) Data limitations and using multiple bonds issued by the same firm dissuade me from using a structural credit risk model to quantitatively estimate default risk.
from 1890 onwards because of a lack of availability of *Poor’s Manual of Railroads* for 1880s events. The Appendix provides the exact details of the statistics used to determine credit risk. Essentially, I examine differential effects between safe, typically senior bonds whose interest obligations were easily met with historical earnings and riskier, often junior bonds, where earnings were barely enough to cover their interest.26

My regression analysis compares yield changes between two groups across time, thus following a standard difference-in-difference approach:

\[
\Delta y_{i,t} = \alpha + \gamma Spec_i + \beta_1 Silver_t + \beta_2 (Silver_t \times Spec_i) + x_t' \eta_1 + (Spec_i \times x_t') \eta_2 + \varepsilon_{it} \tag{2}
\]

where the outcome variable, \(\Delta y\), is the log-change of the average yield for bonds in rating group \(i\) traded at date \(t\)27. To construct this variable, I average yields across all safe or speculative bonds sold on date \(t\), find each bond’s previous sale price and calculate their previous yields, average the previous yields across rating group, and take the difference in logs for each rating group’s average. There were typically 25-30 safe bonds and 10-15 speculative bonds traded per day. I use changes in logs in order to dampen the heteroskedasticity in yields across credit risk groups (Gilchrist and Zakrjašek, 2012).28 The variable \(Spec_i\) is a dummy that takes a value of one when the average yield change is for speculative bonds. \(Silver_t\) takes one of three values: one on event days with news lowering expected silver coinage, negative one when the news increases expected silver coinage, and zero for non-event days. The coefficient, \(\beta_2\), therefore captures the differential effect of silver news on speculative-grade corporate bonds relative to safe corporate bonds. I expect to see a negative and statistically significant value of \(\beta_2\) if silver coinage news is driving yield changes on event days. The last main term in Equation 1 is \(x_t\), a set of monthly and daily controls. Depending

---

26 Based on a comparison of yields over the Panic of 1893 and 2008-9 Financial Crisis, speculative bonds are probably closest to B-rated bonds in the modern setting.

27 My model for yield changes is a variant of the “constant-mean” model of expected returns used in event studies.

28 As credit risk increases, the variance in yields also increases. Therefore, as bonds’ credit risks change with the business cycle, their yield spreads and volatility are also likely to change. Using log changes helps control for changes in yield spreads simply correlated with the business cycle.
on the exact specification, these include a month-year dummy, 12-month realized volatility of an index of all common stock values, the monthly return on this index, the Treasury’s monthly gold reserves, and the average term length of the bonds sold for each day.\textsuperscript{29}

I control for differential effects between safe and speculative bonds on event days due to term structure differences using Edwards, Longstaff, and Marin (2015)’s weighting procedure. This procedure adjusts the weights in the speculative rating category such that the average term length of the speculative-grade bonds traded on date \( t \) matches the average term of length of the safe bonds traded on date \( t \). These weights are then used when calculating the average yield change for speculative-grade bonds.

Before discussing quantitative estimates, I will first present some rough evidence supporting this identification strategy. Figure 3 plots 1-standard error bands around the mean of the absolute log-change in spreads for 10, five, and one day before each post-Panic of 1893 silver event as well as on the day of silver coinage news. The horizontal line at 1.38 represents the average absolute change in spreads on non-event days. In the figure, note that only the mean spread change on event days is more than one standard error away from the average across all non-event days. This suggests that there is no underlying trend driving differential changes in yields around silver news events.

My estimates of Equation 2 in Table 3 confirm that silver news caused speculative-grade bond yields to change by more than safe yields on event days. Since the dependent variable is the log change in yield, estimates reflect percent changes relative to the raw yield. Column (1) simply regresses average log-yield change on \( Spec_i, Silver_t \), their interaction, and a constant, while Column (2) adds the vector of controls. The Event-Speculative interaction coefficients for these two columns show that news that lowered silver coinage risk lowered the safe-speculative spread by 1.58-1.74 percent of the total spread. Columns (3) and (4) repeat (1) and (2) using only event days after the Panic of 1893. The effect increases in magnitude to roughly 2.2 percent of the total spread when considering only events occurring after the

\textsuperscript{29}The common stock price index is available through the NBER Macrohistory database (series m11025a).
Panic of 1893. For easier interpretation of the coefficients, I re-run the regressions using the average yield change in levels rather than logs and report the full results in the Appendix. Here, it suffices to note that when I use all events, the implied spread change due to silver news is 32.68 basis points, with the effect increasing to 52.48 basis points when using only Post-Panic of 1893 event days.

The economic significance of my estimated effects on yield spreads is substantial. Returning to the financial market panic in Europe on November 8, 1895, the weighted credit spread change on that day is 26 basis points, slightly less than the estimated effect of silver coinage news. My estimated effect is also sizable compared to monthly changes in the spread between safe and speculative bonds after the U.S. abandoned the gold standard in 1933, an event which economic historians have highlighted as leading to rapid economic recovery.\footnote{Between March 1933, when Roosevelt suspended the gold standard, and June 1933, before the introduction of the NIRA, industrial production recovered 57 percent of its prior decline during the Depression. Jalil and Rua (2015), Sumner (2015), and Hausman, Rhode, Weiland (2016) are examples of the literature studying this episode.} I calculate the change in the spread between junk bonds and Aaa-rated corporate bonds in the month after the U.S. abandoned gold in 1933.\footnote{The junk bond yields are taken from Basile et al. (2015), and the Aaa yields are available through the NBER Macrohistory database.} The differential change from April to May of 1933 is 483 basis points. For events after the Panic of 1893, the estimated average daily change due to silver coinage news is 52.48 basis points, over 10 percent of the entire monthly change after the U.S. abandoned gold during the Depression.\footnote{This comparison is merely suggestive since depending on the persistence of credit spreads–mean reversion within the month may be an issue.}

As an additional check, I also perform a regression using only speculative bond yields as the dependent variable and including safe bond yield changes as a regressor:

$$SpecYield_t = \alpha + \beta Silver_t + \gamma SafeYield_t + x'_t \delta_t + \varepsilon_t$$  \hspace{1cm} (3)$$

where $SpecYield_t$ is the average speculative bond natural logarithm yield change on date $t$; $Silver_t$ is again the $\{-1, 0, 1\}$ variable corresponding to days with increased future silver
coinage, no silver news, and lower future silver coinage, respectively; SafeYield_t is the average safe bond natural logarithm yield change, and \( \mathbf{x}_t \) is the same set of controls as in Equation 2. The inclusion of SafeYield as a control variable is inspired by the “market return model” sometimes used to calculated expected returns in event studies. Here, I use the average safe bond yield change as a regressor to further rule out the possibility that speculative bonds always move by some factor relative to safe bonds.

Silver news remains an important determinant of speculative bond yield changes when I estimate Equation 3. The coefficient on silver coinage news is nearly identical in columns (1)-(4) to the silver event-speculative interaction term in columns (1)-(4) of Table 4. Here the silver event coefficients imply that news of lower silver coinage risk lowered speculative yields an additional 1.78-2.5 percent of their total yields. Regardless of how one might measure the “expected” speculative yield change on a given day, silver news has a statistically and economically significant effect on speculative bond yields.

The Appendix reports results for Equations 2 and 3 using the absolute values of the dependent variables. This is done to help mitigate mean reversion concerns, particularly when month-year fixed effects are included in the regression. It may be the case that yields were moving sharply in one direction prior to a silver event, and any news that would tend to move yields in the opposite direction ends up moving yields sharply simply due to reversion to the mean. Fortunately, although the magnitudes fall by about 50 percent, they are still significantly different than zero in every case.

A final issue is whether these changes to credit spreads from silver news disappeared after a few days. There is not a good monthly index for safe and speculative bond yields during my time period, so I construct some rough indices for 1893 and the first six months of 1894 and repeat for slightly different sets of bonds in 1895 and 1896. I plot these monthly yield spreads in Figures 4 and 5, respectively. The vertical lines mark months with silver coinage news. In Figure 4 the spread peaks around 15 percent in August 1893 when the House repeals the Sherman Silver Act and remains several percent lower for the next six
months. Similarly, Figure 5 shows the spread peaking just under 15 percent in August 1896, when Bryan delivers his failed speech on Wall Street and early state election results favor pro-gold candidates. The spread reaches its trough in November 1896, when Bryan is defeated, and remains close to this level for the next four months.

**Silver Coinage and Default Risk Premia: Mechanisms**

While the above results are certainly consistent with the proposed mechanisms through which silver coinage alters corporate borrowing costs, they cannot separate which channels mattered for yields on event days. I try to disentangle the different mechanisms affecting bond credit risk premia in several ways.

I first focus on the cross-sections of yields on event days in order to see whether more direct measures of a bond’s exposure to dollar devaluation are correlated with yield changes on event days by running the following regression:

\[
y_{i,t} = \alpha + \beta_1 \text{Principal}_{i,t} + \beta_2 \text{EarningsDepreciation}_{i,t} + \beta_3 \text{EarningsChange}_{i,t} + \beta_4 \text{Default}_{i,t} + \text{Event}_t'\gamma + \varepsilon_{i,t}
\]

where \( y_{i,t} \) is the total yield change of bond \( i \) for each event Post-Panic of 1893 event, \( \text{Principal} \) is the amount of the bond outstanding (in millions of dollars), \( \text{EarningsDepreciation} \) is the proportional change in the available earnings for bond \( i \)’s interest after a hypothetical dollar devaluation against gold; \( \text{EarningsChange} \) is the change in bond \( i \)’s available earnings from the year prior; \( \text{Default} \) is a dummy taking a value of one if bond \( i \) is in default; \( \text{Event} \) is a vector of dummies for each of the events after the Panic of 1893. When the bond is sold on an event where silver coinage risk decreases the yield is multiplied by negative one.\(^{33}\) All right-hand variables are based on information in Poor’s Manual of Railroads and the Commercial and Financial Chronicle.

\( \text{Principal} \) is used as a proxy for a bond’s liquidity. If illiquidity risk mattered for

\(^{33}\)For events that occur over multiple days, I sum the yield changes across each day of the event.

\(^{34}\)This is done to allow for the pooling of good and bad news events as well as for ease of interpretation.
yield changes on event days, the amount outstanding should be negatively correlated with
the magnitude of a bond’s yield change on a day with silver news. \textit{EarningsDepreciation}
captures the role of the gold debt burden.\footnote{In its August 3, 1896 issue, the \textit{Wall
Street Journal} performs a similar calculation for the Chicago, Milwaukee, and St Paul railroad to
demonstrate the effect of dollar devaluation. They show how the company’s total profits change in
response to dollar devaluation and a change in the gold debt burden.} It measures how much the
earnings available to pay bond \( i \)’s interest would change if the dollar value of more senior
gold debt changed due to devaluation and therefore ate up more dollar earnings.\footnote{The change in the dollar-gold exchange rate in this hypothetical devaluation is based on the average market silver-gold ratio in the year of the event and is taken from Bordo et al. (2009).}

\textit{EarningsChange} measures the responsiveness of credit risk due to general equilibrium
effects at the bond level by calculating changes in available earnings during two periods of
silver policy uncertainty (June-August 1893, June-August 1896). Firms that were particu-
larly affected by an economic slowdown (say, because of higher currency hoarding in the
location of the railroad) would see their earning decline the most during these sensitive pe-
riods. The summer of 1893 was plagued by continued silver coinage and low gold reserves,
with business recovering after the repeal of the Sherman Act. The summer of 1896 was
marked by renewed currency risk with the nomination of Bryan as a Free Silver candidate.
To address seasonality, I calculate earnings changes in these periods relative to the previous
summer (1892 or 1895).

The bond default indicator is included for two reasons. First, since silver coinage was
viewed as harmful to the economy, this meant that holders of defaulted bonds likely had a
lower recovery rate as silver coinage risk increased. Second, investors would demand a higher
risk premium on defaulted bonds because the aggregate economy was likely to contract under
increased silver coinage.

I find that all exposure measures, except the change in earnings, are statistically sig-
nificant when entered individually in the regression (columns (1)-(4) in Table 5), but the
amount outstanding coefficient has the opposite sign relative to that predicted. Larger is-
issues of bonds (in terms of face value) have greater yield changes, which is at odds with
the illiquidity risk channel of transmission. The same variables are statistically significant when all regressors are included. Again, the signs on their coefficients are consistent with the suggested transmission mechanisms except for the amount outstanding. The coefficients in Column (5) imply that going from the average percentage decrease in earnings available after dollar depreciation (~6.8 percent) for safe bonds to that of speculative bonds (~130 percent) results in an additional 36.5 basis points in yield change. Similarly, going from the average value of the default indicator for safe bonds (zero) to that of speculative bonds (0.74) adds an additional 24.96 basis points to a bond’s yield change. Together, this additional 62 basis points is roughly 75 percent of the average spread change between safe and speculative bonds.

The results of the regressions suggest that while default risk mattered for the spread changes on event days, illiquidity risk and risk premia were less important. Further evidence in support of this conclusion can be found by looking at the response of the money market on silver event days. If financing and liquidity constraints are important, the money market rates should have seen large changes in the same direction as the credit spread. Figure 6 plots the change in the safe-speculative spread on post-Panic of 1893 event days against the change in the average call loan rate on those days. While there are a few days with large declines in the call rate and the safe-speculative spread, there is generally no relationship between money market and bond market changes. Similarly, looking at the relationship between credit spread changes and changes in the amount of loans on New York City banks’ balance sheets, as is done in Figure 7, also shows a lack of correlation between spread changes and financial conditions in a tight window around silver coinage events.

One final piece of evidence in favor of the default risk channel comes from the narrative at the time this silver news occurred. The financial press stresses the role of the railroads’ gold debt when discussing bond price movements, but does not mention any sort of liquidity

---

37 The average call loan rate is simply the sum of the quoted high and low rates divided by two.
38 A simple regression of the spread change on the average call loan rate change and a constant produces a coefficient on call rate changes with a t-statistic 0.76.
or financing constraint for investors. After the repeal of the Sherman Silver Act in the House in August, 1893, the *Commercial and Financial Chronicle* wrote: “The question as to bonds is a very simple one—there is a great fear...for some months past that our railroads might soon be compelled to take their earnings in depreciated silver...and they would consequently be unable to meet their gold obligations. Now, as this fear is partly dispelled, the prices of bonds rise sharply from this late depression,” (Vol. 57, p. 366).

Similarly, after the nomination of William Jennings Bryan as the Democratic presidential candidate, the *Wall Street Journal* ran several articles discussing railways’ gold debts and the impact of a potential Free Silver victory. In one, they discuss that the “danger of free silver” could be met by holding gold bonds *only* “if it were certain that roads could meet their interest in gold” and that, if the dollar devalued too much relative to gold, “it would be impossible for corporations which have only a small surplus above fixed charges to meet their interest in gold.”

While one cannot draw definite conclusions from the above evidence, it strongly suggests that credit spread changes on event days were due more to changes in default risk rather than risk premia based on investor demand changes.

## 5 Monthly Impulse Response Functions

The daily bond yield data show that financial markets responded to silver coinage risk; In this section of the paper, I estimate impulse response functions with monthly data on exchange rate expectations and industrial production to investigate whether these responses were justified.

### Methodology

I investigate the impact of silver coinage risk on exchange rate expectations and industrial production using the local projection technique pioneered by Jordà (2005) in which impulse
response functions are computed through a series of OLS regressions at different forecast horizons. This approach offers more flexibility when compared to a traditional vector autoregression (VAR) technique in estimating the effect of the shock further and further into the future.

In this study, I compute impulses responses from 0 to 24 months after the initial shock, using two different measures of a shock to silver coinage risk. In the first series, the shock is the monthly change in the safe-speculative credit spread due to silver coinage news. For each horizon, \( h \in [0, 24] \), and outcome variable, \( z \), I estimate the following regression:\(^{39}\)

\[
z_{t+h} = \alpha + \beta_h \text{Event}_t \text{Spread}_t + \sum_{k=1}^{6} \left[ \rho_k \text{DollarRisk}_{t-k} + \theta_k \ln(\text{IndProd}_{t-k}) \right] + \phi_k \ln(\text{PriceLevel}_{t-k}) + \psi t + \varepsilon_{t+h}
\]

(5)

where \( z \) is either industrial production or the currency risk premium; \( \text{Event}_t \text{Spread}_t \) is the change in the actual, unweighted safe-speculative credit spread on silver coinage news days aggregated to the monthly frequency then divided by the total number of days with silver news in the month; \( \text{DollarRisk} \) is the dollar-gold 60-day interest spread; \( \text{IndProd} \) is the Miron-Romer seasonally-adjusted index of industrial production; and \( \text{PriceLevel} \) is the general index of the overall price level (NBER Macrohistory series m04051). The dollar-gold interest spread is my measure of the currency risk premium and expands Calomiris’ (1993) series for 1893-1896 to cover my entire time period.\(^{40}\) I then use the resulting estimates for the \( \beta_h \) to calculate the impulse response functions.

My second approach for measuring the impact of silver coinage risk on industrial production is to use an external instruments method.\(^{41}\) I use silver credit spread shocks

---

\(^{39}\)Depending on the information/selection criterion, the optimal lag length varies from 2 to 11 lags. I choose to use a lag length of 6, selected by the HQIC, but my findings are generally robust to the number of lags.

\(^{40}\)This series takes the interest rate differential between the 60-day commercial paper rate in New York City, which was payable in dollars, and the implied gold interest rate from 60-day and “sight” (spot) bankers’ bills of exchange to capture the currency risk premium. These data are available through the National Monetary Commission’s Statistics for the United States, 1867-1909 and the Commercial and Financial Chronicle.

\(^{41}\)See Mertens and Ravn (2013) and Gertler and Karadi (2015) for examples in the context of fiscal and
as an instrument for dollar devaluation risk shocks and estimate the impulse response of industrial production to the instrumented value of the dollar devaluation risk premium. An advantage of this method is that dollar devaluation risk is arguably the true policy indicator because the transmission mechanism for silver coinage was primarily through exchange rate expectations. This method also alleviates concerns that the short window for measuring the shock may produce underestimates of the overall effect. I then estimate the following set of local projections for horizons \( h \in [0, 24] \):

\[
IndProd_{t+h} = \alpha + \beta_h DollarRisk_t + \sum_{k=1}^{2} \left[ \rho_k \ln(DollarRisk_{t-k}) + \theta_k \ln(IndProd_{t-k}) + \phi_k \ln(PriceLevel_{t-k}) \right] + \psi_t + \varepsilon_{t+h}
\]

where I instrument for \( DollarRisk_t \) with \( Event_Spread_t \). The first-stage regressions also include a constant, two lags of the currency risk premium, industrial production, and the price level, as well as a time trend.

To help solidify that my silver events are not driven by shocks to other variables, I test whether industrial production, the price level, and the currency risk premium Granger cause my \( Event_Spread \) variable. Specifically, I look at whether this is true in a VAR specification with six lags of each of the four variables. Following Mertens and Ravn (2013), I use first differences of industrial production and the price level in the VAR because I cannot reject the null hypothesis of a unit root in either case. The null hypothesis is that industrial production, the price level, and the currency risk premium do not Granger cause \( Event_Spread \).

**Impulse Response Function Estimates**

I begin by showing the raw time series for the currency risk premium and the spread changes on event days, as these form the basis for the currency risk impulse response and the “first stage” of the external instruments impulse response. Figure 8 shows that these shocks monetary policy respectively.
correlate to large changes in the 60-day dollar-gold interest spread. It is also apparent that
the currency risk premium was fairly small over this entire time period, never reaching
more than two percent.\textsuperscript{42} Dollar devaluation was likely perceived to be a tail event: a
low-probability but very large shock.

My impulse is simply the estimated daily causal effect of 1.75 percent of the total
spread. Given the raw values of the safe-speculative yield spread over the time period I
study, this corresponds to approximately a 25 basis point increase in the spread in levels.
Since an increase in future silver coinage risk corresponded to an increase the safe-speculative
spread, I will refer to a positive realization of my shock as an increase in expected future
silver coinage. The dashed lines around my impulse responses represent 90 percent confidence
bands, which are estimated using Newey-West standard errors. The usage of these standard
errors for local projection impulse response functions follows from Jordà (2005).

An increase in expected future silver coinage immediately raises the dollar-gold interest
spread by a statistically significant 13.33 basis points, as seen in Figure 9. Further, the
increase in currency risk appears to be persistent, with peak effects coming one and five
months after the initial shock. At one month out, the implied effect is 16.73 basis points,
or 80 percent of the average currency risk premium during the time period. The five-month
peak is 17.44 basis points or close to 90 percent of the average risk premium. The estimated
impulse response function for this interest rate differential therefore supports the Friedman
and Schwartz hypothesis that silver coinage in the U.S. raised expectations that the U.S.
would abandon gold and depreciate the dollar.

Figure 10 displays the contractionary effect of increased expected silver coinage on
industrial production. The negative effect of increasing the risk of future silver coinage
on industrial production confirms the belief of the contemporary financial community about
silver’s impact. The impact reaches a trough at 12 months after the shock and stays negative

\textsuperscript{42}This would suggest that the second moment effect of a silver news shock was greater than the first-
moment effect. Consider the case where the decision to leave the gold standard is a Bernoulli random
variable. The expected value of this variable is $p$, while the variance is $p(1-p)$. When $p$ is small, as appears
to be the case in this setting, the variance is larger than the expected value.
and significantly different from zero for several months after the trough. Further, the delayed response (it takes eight months to achieve statistical significance) is similar to that found in studies of modern monetary policy (Ramey, 2016). Industrial production drops 3.19 percent at the trough of 12 months and is still around one percent lower 18 months after the silver coinage news. The trough effect is roughly 40 percent of the standard deviation of the 12-month change in industrial production during this period. The estimated 12-month effect also captures about 35 percent of the fall in production from 1892 to 1893 (the onset of the Panic). Additional evidence of the contractionary effect of silver coinage can be found in the Appendix, which reports impulse response functions for monthly railroad earnings and bank clearings as well. Both measures decline more quickly than industrial production after an increase in gold standard uncertainty but reach a trough around 12 months after the initial shock as well.

I find a similarly harmful effect of silver coinage risk on industrial production using the external instruments methodology. Figure 11 plots the response of industrial production to a 16.75 basis point increase in the currency risk premium. The F-statistic on the credit spread instrument ranges from 9.5-9.8 depending on the horizon $h$, very close to the accepted weak instrument threshold. Similar to when the credit spread shocks were used directly, the effect of an increase in currency risk has a statistically significant negative impact after nine months, with the trough effect again reached at 12 months after the initial shock. At the trough, industrial production is 3.77 percent lower than it otherwise would have been. The shape of the impulse response using the external instruments approach also matches that when industrial production was regressed directly on the credit spread change on silver event days.

My estimated response of industrial production is slightly smaller than the estimated

---

43 This magnitude is derived from the first-stage estimation of the response of the currency risk premium to an average monthly silver credit spread shock.

44 Adding more lags to the regressions significantly reduces the first stage F-statistic, but the resulting impulse response for industrial production is virtually identical to one estimated with fewer lags.

45 I again use Newey-West standard errors to calculate confidence bands.
one-year response of output to twin banking and currency crises reported in Cerra and Saxena (2008). Given that my sample includes the Panic of 1893, it would be inappropriate to compare my measured effect of devaluation risk to the response solely coming from a currency crisis.\footnote{The trough effect when excluding events occurring less than six months prior to the start of the Panic in 1893 is around 1.86 percent.} Depending on the subsample of countries used in estimation they find output is between four and six percent lower one year after the onset of the twin financial crises.

Returning to the potential question of whether silver events are simply correlated with shocks to other economic variables, I cannot reject that changes in industrial production and the price level do not Granger cause silver news. I can reject the null hypothesis for the currency risk premium. Table 6 reports the p-values for each of these variables in the first column. If changes to industrial production or prices are causing the currency risk premium to change, then this still may be an issue. I discuss below how I work around this problem.

I estimate paths for industrial production that are qualitatively similar to those in Figures 10 and 11 using only events that were unlikely to be strongly correlated with prior economic conditions as a robustness check. Figure 12 plots the response of industrial production under three scenarios: estimated using the original data, estimated setting the spread changes for the four summer of 1893 months to zero, and estimated dropping the summer of 1893 events and the August and November 1896 events.\footnote{These last two specifications have only 10 and eight non-zero months respectively.} In their paper on modern U.S. monetary policy shocks, Romer and Romer (2004) follow a similar procedure for the months of nonborrowed reserve targeting in the U.S. between 1979 and 1981. Despite changing the values in my shocks series, the estimated paths are fairly similar. They all show silver coinage risk leading to a contraction in output, with the trough effect occurring between 12 and 16 months in all cases. It is especially reassuring to see that dropping the events with the largest changes in credit spreads does not undo the initial finding of a negative effect of silver risk on output.
Silver Coinage Risk and Output: Transmission Channels

In Section 3, I argued that devaluation risk mainly affects output by reducing the supply of credit available to firms and individuals. Credit contracts because banks lose net worth as the deflation wrought by devaluation risk leads to loan defaults. Additionally, imminent risk of devaluation leads to gold and currency hoarding, sometimes leading to bank runs, again hurting credit supply. Here I present evidence from the U.S. consistent with this story.

The first stage in the transmission of devaluation risk to real activity is gold outflows that contract the money supply, which did indeed occur in the U.S. in the 1890s. I collect monthly data on U.S. gold flows from the Bureau of Statistics published in the *Commercial and Financial Chronicle* for 1880-1898. I then regress net gold inflows on 11 of its lagged values, the silver event credit spread change used in the impulse response analysis, and a set of month dummies to account for seasonality. The coefficient on silver event credit spread changes in this regression is negative and statistically significant, indicating that greater silver risk is associated with gold outflows. An average increase in the safe-speculative spread from higher silver coinage risk was associated with a $3.93 million reduction in gold inflows.

Next, I examine whether prices fell and credit contracted as a result of increased gold standard uncertainty. The impulse response function for the price level (based on eq 5 with the inclusion of month dummies) shows an immediate and statistically significant fall in prices after an increase in silver coinage risk. For three to 10 months after the initial shock, prices are still lower, but not statistically significant different from zero. Credit, measured as the total volume of loans and discount in National (commercial) banks and plotted in Figure 13, also tends to change after months with silver coinage news. Since loan data are reported at irregular intervals, time series analysis cannot be applied. What is readily apparent in

---

48 I focus on contemporaneous gold flows only rather than presenting a full impulse response function because the gold outflow from higher devaluation would likely be an immediate result of the foreign sale of U.S. stocks and bonds in exchange for gold.
49 The median monthly gold flow was a $19600 inflow.
50 The inclusion of month dummies is because the original price level data is not seasonally adjusted.
51 The plotted data are the sum of three series available through the NBER Macrohistory database.
Figure 14 however, is that after two major events that raised gold standard uncertainty, loans fell drastically and only began increasing a few months after news that reversed this uncertainty.

Finally, additional suggestive evidence points gold standard uncertainty leading to gold and currency hoarding. Again, the availability of data limits a quantitative analysis, but a rough estimate of the currency-deposit ratio corroborates this story. I use total currency outside the treasury and individual deposits in national banks to approximate the true currency-deposit ratio. As can be seen in Figure 14 when Congress is unable to repeal the Sherman Act in the spring of 1893 this ratio rises and only reverses in late summer/early fall when Congress overturns the Sherman Act. Similarly, in 1896, hoarding increases after the nomination of Bryan and subsides after McKinley’s election. This mirrors the changes in loans around gold standard events discussed above.

6 Silver Coinage and Output: the Narrative Record

Narrative accounts from the financial and business press highlight the importance of silver coinage policy for production decisions and credit provision. Specifically, newspapers and trade publications tracked business climate changes in response to two silver events: the repeal of the Sherman Silver Act in November, 1893, and the election of President McKinley in 1896. Regarding the former, the press emphasize the renewed ability of companies to borrow both short- and long-term after its occurrence. One week after the Sherman Repeal was signed into law, the November 10, 1893 issue of the Railroad Gazette notes that several railroad companies have recently secured new loans or successfully issued new stocks and bonds. Two of the railroad companies that saw the largest changes in their bond yields on the Sherman Repeal event days, the Missouri, Kansas, and Texas and the New York, Lake Erie, and Western, were among the companies selling new securities. It was a marked

52These data are available through the NBER Macrohistory database, and the total deposits are the sum of three different series.
change from previous months where companies had trouble selling securities to meet their short-term obligations.

The economic repercussions of the defeat of the Free Silver movement in the election of 1896 also received considerable attention in the media. The *Railway Age* sent a survey to railroad and industrial companies specifically asking how the businesses adjusted their activity in response to the pro-gold victory. Some companies reported increases in hours and employment for car shops or orders for new equipment since the results of the election became known. Often, the responses note that it is the first time in years the shop has worked this many hours. A majority of companies also reported plans to further shed workers and decrease purchases of equipment if Bryan had won the election. Clearly, the risk of abandoning the gold standard mattered for economic decisions.

7 Concluding Remarks

This paper studies the impact of currency risk on interest rates and output using the historical experience of the U.S. with silver coinage and the gold standard. I find that increases in expected future silver coinage raised dollar devaluation expectations and bond credit spreads while lowering industrial production. I argue that these contractionary effects emerge through two mechanisms: the increase in the gold debt burden that would result from dollar depreciation and the disruption of financial intermediation brought about by the contraction in the money supply. Both channels cause credit costs to increase and spending to decrease, lowering aggregate demand and output. Since actual devaluations contract output through similar channels, it may be unsurprising that I find that non-trivial devaluation risk has only slightly smaller output effects than those estimated for currency and banking crises in the previous literature.

My findings have implications for current policymakers. One of the largest macroeconomic questions today is the future of the Euro. Greece, in particular, has come close to
dropping out of the Euro and adopting a new, depreciated currency, while all of its debt would still be payable in Euros. Additionally, many developing and middle-income countries have adopted de facto dollar pegs while also borrowing heavily in dollars. In many instances, these countries face vastly different economic shocks than the United States, undermining the credibility of their dollar peg. My work suggests that this exchange rate uncertainty has produced harmful economic effects independent of any other economic policies. Further, given new work highlighting the economic expansion that occurred once the U.S. actually devalued the dollar against gold during the Great Depression, my results imply that these countries are doing more harm by trying to maintain their exchange rate pegs (Hausman et al., 2016; Jalil and Rua, 2016).

References


35


---

**Figure 1:**

![Graph](image)

Horizontal line is bootstrapped 90th percentile for non-event days.
Figure 2:

Gold Reserves and Event Yield Change, 1884-1897

Vertical Line is beginning of Panic of 1893.

Figure 3:

Credit Spreads in Month Before Silver Event

Horizontal line is average absolute value log-change in safe-speculative spread.
Figure 4:

Vertical lines are months with Post-Panic of 1893 silver news.

Figure 5:

Vertical lines are months with Post-Panic of 1893 silver news.
Figure 6:

Credit Spread & Money Market Changes, Post-Panic of 1893 Event Days

Figure 7:

Credit Spread and Bank Loan Changes, Post-Panic of 1893 Silver Event Weeks
Figure 8:

Silver Coinage Shocks and the Currency Risk Premium

Date
Credit Spread Changes from Silver News (Log Points)
60-Day Dollar-Gold Interest Differential (Percent)

Figure 9:

Impulse Response Function: 60-Day Dollar Risk Premium

Impulse is a 1.75 log point increase in the safe-speculative bond log spread due to silver coinage news. Results based on estimating Equation 5 for currency risk premium. Shaded area is 90% confidence interval constructed using Newey-West standard errors.
Figure 10:

Impulse is a 1.75 log point increase in the safe-speculative bond log spread due to silver coinage news. Results based on estimating Equation 5 for industrial production. Shaded area is 90% confidence interval constructed using Newey-West standard errors.

Figure 11:

Impulse is a 16.75 basis point increase in the currency risk premium. Results based on estimating Equation 6. Shaded area is 90% confidence interval constructed using Newey-West standard errors. First-stage F-statistic: 9.5-9.8.
Impulse is a 2.92 log point increase in the safe-speculative bond log spread due to silver coinage news.

Results based on estimating Equation 5 for the price level, month dummies added to correct for seasonality. Shaded area is 90% confidence interval constructed using Newey-West standard errors.
Figure 14:

National Bank Loans and Currency-Deposit Ratio, 1889-1900

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 4, 1884</td>
<td><em>Juilliard v. Greenman</em> Legal Tender Case Decision (+)</td>
</tr>
<tr>
<td>February 27, 1885</td>
<td>Repeal of Bland-Allison Voted Down (+)</td>
</tr>
<tr>
<td>December 9, 1885</td>
<td>Pres. Cleveland calls for repeal of Bland-Allison in 1st message to Congress (-)</td>
</tr>
<tr>
<td>December 22, 1885</td>
<td>Senator Beck delivers speech shooting down B-A repeal (+)</td>
</tr>
<tr>
<td>June 9, 1890</td>
<td>Compromise silver purchase measure passes House (-)</td>
</tr>
<tr>
<td>June 18, 1890</td>
<td>Senate passes free silver measure (+)</td>
</tr>
<tr>
<td>July 8, 1890</td>
<td>New silver bill agreed upon by Republican conferrees of House and Senate (+)</td>
</tr>
<tr>
<td>January 15, 1891</td>
<td>Free silver bill passes Senate (+)</td>
</tr>
<tr>
<td>February 20, 1891</td>
<td>House Coinage committee votes against Senate silver bill (-)</td>
</tr>
<tr>
<td>July 5, 1892</td>
<td>Free silver bill passes Senate (+)</td>
</tr>
<tr>
<td>July 13-14, 1892</td>
<td>Free silver rejected in House (-)</td>
</tr>
<tr>
<td>December 7, 1892</td>
<td>Introduction of Sherman Act repeal (-)</td>
</tr>
<tr>
<td>February 9-10, 1893</td>
<td>House refuses to consider act repealing Sherman Act (+)</td>
</tr>
<tr>
<td>June 30-July 1, 1893</td>
<td>Pres. Cleveland orders emergency session of Congress to repeal Sherman Act in August (-)</td>
</tr>
<tr>
<td>August 26, 28-29, 1893</td>
<td>House repeals Sherman Act by 2-1 majority (-)</td>
</tr>
<tr>
<td>September 28, 1893</td>
<td>Pres. Cleveland writes letter stating he will only accept unconditional repeal of Sherman Act (-)</td>
</tr>
<tr>
<td>October 24, 1893</td>
<td>Compromise repeal fails to pass Senate (-)</td>
</tr>
<tr>
<td>June 13, 15-16, 1896</td>
<td>Republicans announce campaign platform for gold standard (-)</td>
</tr>
<tr>
<td>July 1, 1896</td>
<td>Free silver Democrats to control presidential nomination (+)</td>
</tr>
<tr>
<td>August 13, 1896</td>
<td>William Jennings Bryan speech on Wall St disappoints (-)</td>
</tr>
<tr>
<td>November 2 &amp; November 4, 1896</td>
<td>Election of Republican candidate William McKinley (-)</td>
</tr>
<tr>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td>------------------</td>
<td>---------</td>
</tr>
<tr>
<td>Silver Event</td>
<td>-9.147 ***</td>
</tr>
<tr>
<td></td>
<td>(1.84)</td>
</tr>
<tr>
<td>Post- Panic of 1893 Event</td>
<td>-16.27 ***</td>
</tr>
<tr>
<td></td>
<td>(3.61)</td>
</tr>
<tr>
<td>Treasury Gold Reserves</td>
<td>-0.32</td>
</tr>
<tr>
<td></td>
<td>(0.36)</td>
</tr>
<tr>
<td>Treasury Gold Reserves (Moving Average)</td>
<td>1.047</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Event x Gold Reserves</td>
<td>0.149 ***</td>
</tr>
<tr>
<td></td>
<td>(0.04)</td>
</tr>
<tr>
<td>Event x Gold Reserves (Moving Average)</td>
<td>0.151 ***</td>
</tr>
<tr>
<td></td>
<td>(0.04)</td>
</tr>
</tbody>
</table>

N 233 233 233 233

Notes: Results based on estimating Equation 1. All specifications include month-year dummies. In last two columns “Treasury’s Gold Reserves” is average of Treasury’s gold reserves over last 12 months. Heteroskedastic standard errors in parentheses. *p<0.1, **p<0.05, ***p<0.01.
Table 3: Event Study: Speculative vs. Safe Corporate Bond Yield Changes

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silver Event</td>
<td>−0.241**</td>
<td>−0.329**</td>
<td>−0.365**</td>
<td>−0.541*</td>
</tr>
<tr>
<td></td>
<td>(0.10)</td>
<td>(0.14)</td>
<td>(0.16)</td>
<td>(0.29)</td>
</tr>
<tr>
<td>Event x Speculative</td>
<td>−1.737***</td>
<td>−1.578***</td>
<td>−2.257***</td>
<td>−2.167***</td>
</tr>
<tr>
<td></td>
<td>(0.31)</td>
<td>(0.30)</td>
<td>(0.46)</td>
<td>(0.51)</td>
</tr>
<tr>
<td>Speculative</td>
<td>0.209*</td>
<td>268.2</td>
<td>0.233*</td>
<td>281.7</td>
</tr>
<tr>
<td></td>
<td>(0.12)</td>
<td>(178.83)</td>
<td>(0.13)</td>
<td>(179.80)</td>
</tr>
<tr>
<td>Month-Year Dummies?</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Additional Controls?</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Post-Panic Events Only?</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>N</td>
<td>448</td>
<td>448</td>
<td>426</td>
<td>426</td>
</tr>
</tbody>
</table>

Notes: Results based on estimating Equation 2. Additional controls include 12-month average of Treasury’s gold reserves, common stock index 12-month realized volatility, common stock index monthly holding period return, and average term length of bonds traded. All specifications include a constant term. Heteroskedastic-robust standard errors in parentheses. *p<0.1, **p<0.05, ***p<0.01.
### Table 4: Event Study: Speculative Yield Changes

<table>
<thead>
<tr>
<th>Speculative Yield Changes</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silver Event</td>
<td>-1.812***</td>
<td>-1.777***</td>
<td>-2.377***</td>
<td>-2.511***</td>
</tr>
<tr>
<td></td>
<td>(0.25)</td>
<td>(0.26)</td>
<td>(0.36)</td>
<td>(0.41)</td>
</tr>
<tr>
<td>Safe Change</td>
<td>0.687***</td>
<td>0.394*</td>
<td>0.672***</td>
<td>0.367</td>
</tr>
<tr>
<td></td>
<td>(0.19)</td>
<td>(0.22)</td>
<td>(0.19)</td>
<td>(0.23)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.164</td>
<td>38.65**</td>
<td>0.190</td>
<td>42.92**</td>
</tr>
<tr>
<td></td>
<td>(0.12)</td>
<td>(21.3)</td>
<td>(0.12)</td>
<td>(21.76)</td>
</tr>
</tbody>
</table>

#### Month-Year Dummies?
- N, Y, N, Y

#### Additional Controls?
- N, Y, N, Y

#### Post-Panic Events Only?
- N, N, Y, Y

#### N
- 224, 224, 213, 213

Notes: Dependent variable is the weighted average change in the natural logarithm of the yield of all speculative-grade corporate bonds traded each day. Speculative bond average weighted so average term length matches average term length of safe bonds traded. Results based on estimating Equation 3. Additional controls include 12-month average of Treasury’s gold reserves, common stock index 12-month realized volatility, common stock index monthly holding period return, and average term length of bonds traded. Heteroskedastic-robust standard errors in parentheses. *p < 0.1, **p < 0.05, ***p < 0.01.

### Table 5: Post-Panic Event Yield Changes and Bond Characteristics

<table>
<thead>
<tr>
<th>Amount Outstanding</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.310*</td>
<td></td>
<td></td>
<td></td>
<td>0.202**</td>
</tr>
<tr>
<td>Earnings after Depreciation</td>
<td></td>
<td>-30.739***</td>
<td></td>
<td></td>
<td>-29.631***</td>
</tr>
<tr>
<td></td>
<td>(0.18)</td>
<td></td>
<td></td>
<td></td>
<td>(0.91)</td>
</tr>
<tr>
<td>Change in Earnings</td>
<td></td>
<td>-92.465</td>
<td></td>
<td>-45.430</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(57.45)</td>
<td></td>
<td>(47.71)</td>
<td></td>
</tr>
<tr>
<td>Default</td>
<td></td>
<td>61.01***</td>
<td>33.734**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(22.08)</td>
<td>(16.81)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>757</td>
<td>756</td>
<td>504</td>
<td>795</td>
<td>504</td>
</tr>
<tr>
<td>R²</td>
<td>0.0447</td>
<td>0.2061</td>
<td>0.0463</td>
<td>0.113</td>
<td>0.2748</td>
</tr>
</tbody>
</table>

Notes: Dependent Variable is YTM change in basis points of corporate bonds traded on event days multiplied by negative one on (-) event days (see Table 1). Results based on estimating Equation 4. All columns include event fixed effects. Standard errors clustered at the firm level in parentheses. **p < 0.01, ***p < 0.05, *p < 0.1.
Table 6: Granger Causality Test P-Values

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial Production</td>
<td>0.975</td>
<td>0.991</td>
<td>0.908</td>
<td>0.955</td>
</tr>
<tr>
<td>Price Level</td>
<td>0.618</td>
<td>0.952</td>
<td>0.633</td>
<td>0.829</td>
</tr>
<tr>
<td>Currency Risk Premium</td>
<td>0.000</td>
<td>0.266</td>
<td>0.02</td>
<td>0.414</td>
</tr>
</tbody>
</table>

Notes: Reported p-values are for null hypothesis each variable does not Granger cause the silver event credit spread shock. Actual tests use first difference of industrial production and price level. Column (1) contains original series of credit spread changes, Column (2) gives summer of 1893 events a value of zero, Column (3) drops events occurring in the summer of 1893, and Column (4) drops August and November 1896 events as well.

A Appendix

Event Selection Procedure

This section details how I construct my series of silver coinage policy news events. I begin by searching two phrases in the *New York Times* archives on ProQuest: “silver bill” and “silver,” “gold,” “currency” between June 1878 and December 1899. I look for large observations in the monthly counts of articles containing these phrases and explore the returned articles in these months. Figure A1 below plots the monthly article counts for these two search terms. When an article mentions a new potential change to silver coinage policy, I initially mark the date as an event. To be considered a “new” potential change, it has to be the first time the public learns of it. For instance, when a July 16 article discusses a bill that was proposed on July 8 and first mentioned in the *Times* on July 9 but provides no new information about the bill, I only include July 9 as an event date.

After this initial search, I find 35 events related to silver coinage policy. I next remove events if they are not mentioned in the “Financial Affairs”/“Financial Markets” section of the *New York Times* or the weekly recap in the Bankers’ Gazette of *The Commercial and Financial Chronicle*. I use this qualification as a means of eliminating “events” that do not
actually contain new or relevant information regarding silver coinage policy. Sometimes, the newspapers report potential changes to silver coinage policy that do not actually change expected future silver coinage. I use financial market participants to gauge whether expected future silver coinage changed as a result of silver news because they had strong economic incentives to update their information set regarding silver coinage policy. For example, on September 24, 1885, the *Times* ran an article mentioning a new silver bill Senator Warner plans to submit to Congress; however, there is no description of this event in the “Financial Affairs” section. Further, I find no later articles mentioning this bill, so I drop this event, since it fails to receive any attention on Wall Street and no additional coverage in the media.

Additionally, sometimes silver news is discussed in the financial section of the *New York Times*, but I drop these events for other reasons. This is most prominent for a series of events in 1894 after the repeal of the Sherman Silver Act where Free Silver proponents in Congress attempted to pass legislation implementing the policy. President Cleveland’s strong anti-silver stance had been known for a decade by this point and his refusal to accept anything but an unconditional repeal of the Sherman Act was also well-publicized. By the time he actually vetoed the Free Silver bill on March 29, 1894, “it had little or no influence on the stock market” because it was “so confidently anticipated” (*New York Times*, 3/30/1894). Prior to the veto, when the Senate passed the silver bill to send it to President Cleveland, prices initially fell upon learning of the Senate’s actions, but “those who recalled how steadfastly Mr. Cleveland has stood for right principles in the past...checked the decline and brought about the closing recovery” (*New York Times*, 3/16/1894). This muted the earlier market response to the news about the silver bill. Given my inability to track within-day changes, I also drop this date from my list.

Finally, I remove dates where there is other economy-wide news discussed on the same day as the silver event. The latter criterion is added to ensure that the market response is solely due to silver coinage news and is not contaminated by some other aggregate shock. There is one main event violating this rule: President Cleveland’s announcement of his
intention to call an extra session of Congress in September 1893 to repeal the Sherman Act (June 6, 1893). As he did this, the Midwest, particularly Chicago, was experiencing a banking panic, which in turn was affecting New York City banks.

I also check whether my event list is comprehensive over the time period I study. I cross-reference dates on my list with two other sources documenting the political battles over silver coinage: Timberlake (1978) and Frieden (1997). I find no silver coinage events in Timberlake (1978) or Frieden (1997) that is not in my initial set of 35 events. Table A1 lists the eliminated event dates, a brief description, and why they were removed from the final event set.

Figure A1:
Table A1: Eliminated Event Dates

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Why Removed</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 1, 1879</td>
<td>House makes silver bill special order for next day</td>
<td>No mention in “Financial Affairs”</td>
</tr>
<tr>
<td>Sept. 23, 1885</td>
<td>Sen Warner plans to introduce new silver bill</td>
<td>No mention in “Financial Affairs”</td>
</tr>
<tr>
<td>Jan. 28, 1886</td>
<td>Sen Sherman introduces new silver bill</td>
<td>No mention in “Financial Affairs”</td>
</tr>
<tr>
<td>April 8, 1886</td>
<td>Free silver bill voted down in house</td>
<td>No mention in “Financial Affairs”</td>
</tr>
<tr>
<td>April 5, 1888</td>
<td>Silver “scheme” added to Senate bond purchasing bill</td>
<td>No mention in “Financial Affairs,” railroad</td>
</tr>
<tr>
<td>April 24, 1890</td>
<td>Republicans of House and Senate agree on compromise silver bill</td>
<td>No mention in “Financial Affairs”</td>
</tr>
<tr>
<td>May 19, 1890</td>
<td>Pres. Harrison declares he will not accept free coinage bill</td>
<td>No mention in “Financial Affairs,”</td>
</tr>
<tr>
<td>June 6, 1893</td>
<td>Pres. Cleveland plans to call extra session of Congress in Sept to repeal Sherman</td>
<td>Banking panic in mid-west</td>
</tr>
<tr>
<td>Mar 15, 1894</td>
<td>Bland free silver bill passes Senate</td>
<td>Within day changes, markets ultimately care little</td>
</tr>
<tr>
<td>Mar 28, 1894</td>
<td>Pres. Cleveland vetoes Bland bill</td>
<td>Discounted by markets (not seen as news)</td>
</tr>
<tr>
<td>April 4, 1894</td>
<td>House refuses to override Cleveland veto</td>
<td>No mention in “Financial Markets”</td>
</tr>
<tr>
<td>Feb 1, 1896</td>
<td>Senate passes free silver bill</td>
<td>Passage seen as “foregone conclusion” by financial markets</td>
</tr>
<tr>
<td>Feb 14, 1896</td>
<td>House rejects Senate silver bill</td>
<td>No mention in “Financial Markets”</td>
</tr>
</tbody>
</table>

Bond Rating Criteria

The rating procedure relies on similar earnings and balance sheet data and calculations to that used in Moody (1909). The data are taken from various issues of Poor’s Manual of Railroads. The process begins by collecting firm-level data for the ten years prior to that when the bond was traded. To make the variables comparable across railroad companies of different sizes, everything is calculated in per-mile terms. Therefore, I first record the average annual railway mileage for each company. Next, I gather the following variables:
Net Income : The sum of net earnings from operations and miscellaneous income that typically comes from trackage rentals, equipment leases, and dividends and interest from stocks and bonds of other companies. Net earnings takes gross earnings and subtracts “operating expenses.” These expenses include maintenance costs and general costs for “conducting transportation.”

Margin of Safety : This variable is the ratio of profits to net income per mile. Profits are calculated by taking net income per mile and subtracting off interest payments, taxes, and rental fees.

Stocks Outstanding : The sum of all common and preferred stock reported on the company’s balance sheet. This is the book value of equity.

Bonds Outstanding : The sum of all bonds outstanding (book value). This is typically listed as “funded debt” on a company’s balance sheet.

Rentals Capitalized at 5% : This takes the total annual rentals paid by the company and multiplies it by 20. Essentially, this gives a sense of the total liabilities of the rental companies for which the lessee is responsible. The 5 percent capitalization rate was used by Moody (1909) since the exact interest or dividend rate for the lessor’s bonds and stocks may not be publicly available.

Stocks and Bonds Owned by Company : The sum of the book value of all equity and debt held by the company as reported on the asset side of the balance sheet. Sometimes the individual stocks or bonds are listed, but often they are listed under the umbrella category of “stocks and bonds owned.” I also included the book value of “securities held at the Treasury” as reported on the balance sheet as part of stocks and bonds owned.

Net Capitalization : I calculate this by summing stocks and bonds outstanding and
rentals capitalized at 5 percent and then subtract stocks and bonds held by the company.

**Net Income on Net Capital** : As the name implies, this is the annual net income divided by the net capitalization in that year.

I then take the 10-year average of all these variables. The limited availability of some volumes of *Poor’s Manual of Railroads* prevents me from having the data for the entire 10-year period for most companies. In these cases, I simply average across the years for which I do have data.

The next step is to calculate three bond-level variables for each of the bonds in my dataset. The key for determining the values of the variables defined below is knowledge of each bond’s place in the capital structure (e.g. senior versus junior debt). When possible, I follow the ordering presented in Moody (1909). Otherwise, I try to best extrapolate his system for the capital structures in my years. Fortunately, each company’s report in *Poor’s Manual of Railroads* typically includes information on every bond, such as what it is secured against and what lien it has on the property. Moody’s procedure is not an exact science, so in many cases I have to make judgment calls. Even if the precise ordering is not correct, I am still broadly correct in characterizing debt as senior or junior.

Bonds with the highest seniority are the prior liabilities outstanding for companies that have merged or been reorganized. For example, the Cleveland, Cincinnati, Chicago, and St. Louis formed in 1889 as the consolidation of three smaller railroads: the Cincinnati, Indianapolis, St. Louis, and Chicago; the Cleveland, Columbus, Cincinnati, and Indianapolis; and the Indianapolis and St. Louis. The outstanding bonds of these smaller companies would get first claim to income before *any* debt issued by the consolidated company.

Next in the capital structure are typically bonds with first lien to some or all of the railroad’s property. I treat bonds with first lien on different properties of a company as
having the same seniority, as long as the property already exists. For instance, some bonds are issued to back construction of new railway lines. These bonds are not subject to the same lien as bonds secured against track that has already been laid and is in use.

Following first-lien bonds in the capital structure are the second, third, fourth, etc. claims to property as well as bonds that have a general lien to the entire property subject to all prior liens. Unsecured bonds are the next-highest ranking group, followed by two special groups of bonds. First are income bonds, which pay interest only when there is enough net income left after all other bond interest and rental costs have been paid to meet the coupon obligations of the income bonds. In this manner, income bonds are similar to preferred stock, but they have a set maturity during which the principal is returned to the holder. The other group of bonds are those of rented companies whose income is not listed separately from the company they are leased to. Only income bonds have a lower claim to income. As an example of this type of situation, the Atchison, Colorado, and Pacific company is leased to the Central Branch of the Union Pacific. All Central Branch bond issues have seniority over the Atchison, Colorado, and Pacific debt.

Having discussed the general strategy behind determining the capital structure for each railroad company, I will now describe the bond-level variables used to help me rate the bonds. Again, variables are in per-mile terms when appropriate.

**Average Income Available**: This takes the average net income collected for each company and subtracts the interest payments for more senior bonds. Information on each bond’s coupon rate and amount outstanding is listed in the company reports in *Poor’s Manual of Railroads*.

**Interest Required**: This variable is simply the coupon rate of the bond multiplied by the amount outstanding, which is then divided by the average mileage of the railroad.
**Factor of Safety** : I calculate a bond’s factor of safety by subtracting its interest required as well the interest required for all bonds with the same claim to income from the average income available. This is then divided by the initial average income available.

In some cases, the use of the 10-year average mileage to transform the bond-level variables into per-mile figures is inappropriate because the company has undergone a large expansion in recent years and the bond itself was issued to cover that expansion. In this case, using the 10-year average would grossly underestimate the current capacity of the railroad company and overstate the level of indebtedness of the company relative to its earning potential. To deal with this issue, I also calculate the interest required per mile using the average mileage of the company in the year prior to the event date, and use this second version of interest required to calculate another factor of safety for the bond.

Moody (1909) initially had 10 ratings classifications for railroad bonds, and he lists the general qualifications for each category in this initial volume. I will summarize the general properties here. Bond ratings are based on several features: the earning power of the railroad, the profitability of the company, the indebtedness of the company relative to its earning capacity, the factor of safety of the individual bond, as well as the value of the property that the bond is secured against (if it is secured at all). In performing the ratings, Moody compared these factors amongst sub-groups of railroads based on geographic location of the company and the nature of its business, as statistics tend to vary by group. He lists the broad groups in his 1909 volume, and I try to follow this within-group comparison strategy.

Next I will discuss the types of bonds I assign each rating to:

**Aaa** : These are the safest bonds. Bonds receiving this rating typically are issued by large, historically profitable companies that are not overly capitalized relative to their major competitors. The bonds themselves have high factors of safety and often have first claim to income. Moody argues that these bonds value should not be impacted by minor changes in the company’s profitability or earnings, but only by changes in the time-value of money.
**Aa**: Similar to Aaa bonds, these bonds are also very safe. The lower ranking usually reflects a lesser claim to income or a smaller, less valuable property against which the bond is secured.

**A**: Although still relatively secure, these bonds have a higher potential for default than Aaa or Aa bonds. In my dataset, I typically assign an A rating to bonds with an average to above-average factor of safety, but whose issuing company is less financially secure. For example, several of the more senior issues of the Chesapeake and Ohio have factors of safety above 50 percent, but the company itself struggled to turn a profit in recent years.

**Baa**: Bonds with a Baa rating typically reflect bonds with average factors of safety that are fairly low in the payout hierarchy or those that are first liens of companies struggling to turn a profit. For instance, some of the junior debt of the Louisville and Nashville rates as Baa because, although the company’s property is large and its profits always positive, the company is heavily capitalized and so lower-ranked debt may be more in danger of defaulting.

**Ba and B**: I define these two both here because there are only slight differences between the two ratings. Bonds with either of these rating typically have factors of safety below 50 percent or are outranked by bonds with very low factors of safety, even if their own factors of safety are relatively high.

**Caa**: The first of the ratings which I categorize as a “junk” bond. Bonds with a Caa rating tend to have factors of safety below 15 percent. What tends to push their rating above a ‘C’ for example is if they have fewer bonds ranked ahead of them in the capital structure.

**Ca**: Few bonds receive a Ca rating specifically. They have similarly low factors of safety to Caa bonds but are typically outranked by other Caa bonds.
C: C bonds tend to have factors of safety that are zero or would be negative, and the company overall is heavily capitalized and struggles to make a profit. They are typically not secured against any valuable property, but may be secured against other bonds of the company. Most income bonds in my dataset have ‘C’ ratings, reflecting their low position in the payout chain and the overall weakness of the companies that issue income bonds.

D: The lowest possible rating. Bonds with ‘D’ rating include a company with a 3rd income bond series (meaning it is outranked by two other income bonds) and an income bond for which there was never enough profit to pay its interest over the preceding 10-year period.

As mentioned in Section 4, I use two broad rating categories in my empirical analysis: safe and speculative bonds. Safe bonds are those which initially receive a Aaa or Aa rating, while speculative bonds have a Caa rating or worse based on the above criteria. In part, I focus on these groups because I am most confident in my assignment of these ratings. Additionally, as highlighted in footnote 16, the spread between these two groups of bonds in the modern setting has been found to primarily reflect default risk compensation rather than between-group differences in some other factor.

Additional Results

This section presents additional results for the event study and other impulse response functions. First, I estimate equations 1, 2, and 3 using the absolute value of the average yield change as the dependent variable. In these regressions, the event variable becomes an indicator taking a value of one on days with silver coinage news. Next I show the results for estimation of equations 2 and 3 when the dependent variable is the yield change in levels, and repeat with absolute value of yield changes as well. These are shown in Tables A5-A8 and the estimated coefficients are consistent with the findings in the main text of the paper.
Finally, Figure A2 displays impulse response functions for four other variables: the log of the general price level, the log of aggregate railroad earnings, the log of bank clearings, and the yield on a “high-grade” railroad bond index constructed by Macaulay (1937). All of the estimated responses are consistent with increased silver risk having contracting aggregate demand and thus the aggregate economy.
Table A2: Event Study: Daily Absolute Average Corporate Bond Yield Change

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silver Event</td>
<td>3.136**</td>
<td>-0.394</td>
<td>9.173*</td>
<td>11.794**</td>
</tr>
<tr>
<td>Post-Panic of 1893 Event</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treasury Gold Reserves (Moving Average)</td>
<td>0.605</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Event x Gold Reserves</td>
<td></td>
<td>-0.057*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Event x Gold Reserves (Moving Average)</td>
<td></td>
<td>-0.072**</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

N 233 233 233 233

Notes: Results based on estimating Equation 1. Dependent variable is absolute value of the average daily change in corporate bond yields. Silver event is indicator variable taking value of 1 on news days. All specifications include month-year dummies. In last two columns “Treasury’s Gold Reserves” is average of Treasury’s gold reserves over last 12 months. Heteroskedastic standard errors in parentheses. *p<0.1, **p<0.05, ***p<0.01.
Table A3: Event Study: Speculative vs. Safe Corporate Bond Absolute Yield Changes

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Silver Event</strong></td>
<td>0.035</td>
<td>-0.076</td>
<td>0.210**</td>
<td>-0.091</td>
</tr>
<tr>
<td></td>
<td>(0.08)</td>
<td>(0.09)</td>
<td>(0.11)</td>
<td>(0.16)</td>
</tr>
<tr>
<td><strong>Event x Speculative</strong></td>
<td>0.666**</td>
<td>0.653***</td>
<td>1.077**</td>
<td>0.958**</td>
</tr>
<tr>
<td></td>
<td>(0.32)</td>
<td>(0.24)</td>
<td>(0.45)</td>
<td>(0.43)</td>
</tr>
<tr>
<td><strong>Speculative</strong></td>
<td>0.807***</td>
<td>-275.1*</td>
<td>0.807***</td>
<td>-221.9</td>
</tr>
<tr>
<td></td>
<td>(0.09)</td>
<td>(157.74)</td>
<td>(0.09)</td>
<td>(167.80)</td>
</tr>
<tr>
<td><strong>Month-Year Dummies?</strong></td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td><strong>Additional Controls?</strong></td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td><strong>Post-Panic Events Only?</strong></td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td><strong>N</strong></td>
<td>448</td>
<td>448</td>
<td>426</td>
<td>426</td>
</tr>
</tbody>
</table>

Results based on estimating Equation 2 with dependent variable replaced by absolute value of weighted average change by rating group. Additional controls include 12-month average of Treasury’s gold reserves, common stock index 12-month realized volatility, common stock index monthly holding period return, and average term length of bonds traded. All specifications include a constant term. Heteroskedastic-robust standard errors in parentheses. *p<0.1, **p<0.05, ***p<0.01.
Table A4: Event Study: Speculative Absolute Yield Changes

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silver Event</td>
<td>0.684**</td>
<td>0.588***</td>
<td>1.198***</td>
<td>0.882**</td>
</tr>
<tr>
<td></td>
<td>(0.283)</td>
<td>(0.23)</td>
<td>(0.39)</td>
<td>(0.38)</td>
</tr>
<tr>
<td>Safe Change</td>
<td>0.477**</td>
<td>0.147</td>
<td>0.423*</td>
<td>0.178</td>
</tr>
<tr>
<td></td>
<td>(0.23)</td>
<td>(0.21)</td>
<td>(0.22)</td>
<td>(0.21)</td>
</tr>
<tr>
<td>Constant</td>
<td>1.038***</td>
<td>−10.197**</td>
<td>1.062***</td>
<td>−8.594*</td>
</tr>
<tr>
<td></td>
<td>(0.12)</td>
<td>(4.24)</td>
<td>(0.12)</td>
<td>(4.50)</td>
</tr>
<tr>
<td>Month-Year Dummies?</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Additional Controls?</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Post-Panic Events Only?</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>N</td>
<td>224</td>
<td>224</td>
<td>213</td>
<td>213</td>
</tr>
</tbody>
</table>

Notes: Dependent variable is the absolute value of the weighted average change in the natural logarithm of the yield of all speculative-grade corporate bonds traded each day. Speculative bond average weighted so average term length matches average term length of safe bonds traded. Results based on estimating Equation 3. Additional controls include 12-month average of Treasury’s gold reserves, common stock index 12-month realized volatility, common stock index monthly holding period return, and average term length of bonds traded. Heteroskedastic-robust standard errors in parentheses. *p<0.1, **p<0.05, ***p<0.01.

Table A5: Event Study: Speculative vs. Safe Corporate Bond Yield Changes (Levels)

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silver Event</td>
<td>−1.095*</td>
<td>−1.443**</td>
<td>−1.676**</td>
<td>−2.333*</td>
</tr>
<tr>
<td></td>
<td>(0.45)</td>
<td>(0.60)</td>
<td>(0.74)</td>
<td>(1.28)</td>
</tr>
<tr>
<td>Event x Speculative</td>
<td>−32.417***</td>
<td>−32.679***</td>
<td>−46.532***</td>
<td>−52.488***</td>
</tr>
<tr>
<td></td>
<td>(5.58)</td>
<td>(6.05)</td>
<td>(7.85)</td>
<td>(10.21)</td>
</tr>
<tr>
<td>Speculative</td>
<td>1.626</td>
<td>82.9</td>
<td>2.416</td>
<td>125.860</td>
</tr>
<tr>
<td></td>
<td>(1.90)</td>
<td>(81.48)</td>
<td>(1.99)</td>
<td>(83.63)</td>
</tr>
<tr>
<td>Month-Year Dummies?</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Additional Controls?</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Post-Panic Events Only?</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>N</td>
<td>452</td>
<td>452</td>
<td>430</td>
<td>430</td>
</tr>
</tbody>
</table>

Notes: Results based on estimating Equation 2. Additional controls include 12-month average of Treasury’s gold reserves, common stock index 12-month realized volatility, common stock index monthly holding period return, and average term length of bonds traded. All specifications include a constant term. Heteroskedastic-robust standard errors in parentheses. *p<0.1, **p<0.05, ***p<0.01.
Table A6: Event Study: Speculative vs. Safe Absolute Yield Changes (Levels)

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silver Event</td>
<td>0.159</td>
<td>−0.247</td>
<td>0.989**</td>
<td>−0.138</td>
</tr>
<tr>
<td></td>
<td>(0.38)</td>
<td>(0.39)</td>
<td>(0.50)</td>
<td>(0.72)</td>
</tr>
<tr>
<td>Event x Speculative</td>
<td>13.789**</td>
<td>10.891***</td>
<td>26.539***</td>
<td>17.715**</td>
</tr>
<tr>
<td></td>
<td>(5.74)</td>
<td>(4.17)</td>
<td>(7.80)</td>
<td>(7.55)</td>
</tr>
<tr>
<td>Speculative</td>
<td>17.138***</td>
<td>−108.510</td>
<td>17.138***</td>
<td>−70.775</td>
</tr>
<tr>
<td></td>
<td>(1.50)</td>
<td>(157.74)</td>
<td>(71.45)</td>
<td>(80.18)</td>
</tr>
<tr>
<td>Month-Year Dummies?</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Additional Controls?</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Post-Panic Events Only?</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>N</td>
<td>452</td>
<td>452</td>
<td>430</td>
<td>430</td>
</tr>
</tbody>
</table>

Results based on estimating Equation 2 with dependent variable replaced by absolute value of weighted average change by rating group. Additional controls include 12-month average of Treasury’s gold reserves, common stock index 12-month realized volatility, common stock index monthly holding period return, and average term length of bonds traded. All specifications include a constant term. Heteroskedastic-robust standard errors in parentheses. *p<0.1, **p<0.05, ***p<0.01.

Table A7: Event Study: Speculative Yield Changes (Levels)

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silver Event</td>
<td>−29.972***</td>
<td>−30.557***</td>
<td>−42.939***</td>
<td>−49.439***</td>
</tr>
<tr>
<td></td>
<td>(4.65)</td>
<td>(5.23)</td>
<td>(6.23)</td>
<td>(8.75)</td>
</tr>
<tr>
<td>Safe Change</td>
<td>3.232***</td>
<td>2.47***</td>
<td>3.144***</td>
<td>2.307***</td>
</tr>
<tr>
<td></td>
<td>(0.73)</td>
<td>(0.86)</td>
<td>(0.71)</td>
<td>(0.21)</td>
</tr>
<tr>
<td>Constant</td>
<td>3.15*</td>
<td>90.678</td>
<td>3.765*</td>
<td>130.448*</td>
</tr>
<tr>
<td></td>
<td>(1.88)</td>
<td>(67.95)</td>
<td>(1.97)</td>
<td>(71.24)</td>
</tr>
<tr>
<td>Month-Year Dummies?</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Additional Controls?</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Post-Panic Events Only?</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>N</td>
<td>226</td>
<td>226</td>
<td>215</td>
<td>215</td>
</tr>
</tbody>
</table>

Notes: Dependent variable is the weighted average change in the yield of all speculative-grade corporate bonds traded each day. Speculative bond average weighted so average term length matches average term length of safe bonds traded. Results based on estimating Equation 3 Additional controls include 12-month average of Treasury’s gold reserves, common stock index 12-month realized volatility, common stock index monthly holding period return, and average term length of bonds traded. Heteroskedastic-robust standard errors in parentheses. *p<0.1, **p<0.05, ***p<0.01.
Table A8: Event Study: Speculative Absolute Yield Changes (Levels)

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silver Event</td>
<td>13.606***</td>
<td>10.845***</td>
<td>25.73***</td>
<td>17.701**</td>
</tr>
<tr>
<td></td>
<td>(5.14)</td>
<td>(4.10)</td>
<td>(7.06)</td>
<td>(7.27)</td>
</tr>
<tr>
<td>Safe Change</td>
<td>2.148**</td>
<td>0.814</td>
<td>1.821**</td>
<td>0.90</td>
</tr>
<tr>
<td></td>
<td>(0.90)</td>
<td>(0.77)</td>
<td>(0.86)</td>
<td>(0.78)</td>
</tr>
<tr>
<td>Constant</td>
<td>14.829***</td>
<td>−109.755*</td>
<td>15.487***</td>
<td>−71.337</td>
</tr>
<tr>
<td></td>
<td>(2.11)</td>
<td>(66.00)</td>
<td>(2.04)</td>
<td>(73.87)</td>
</tr>
<tr>
<td>Month-Year Dummies?</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Additional Controls?</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Post-Panic Events Only?</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>N</td>
<td>226</td>
<td>226</td>
<td>215</td>
<td>215</td>
</tr>
</tbody>
</table>

Notes: Dependent variable is the absolute value of the weighted average change in yield of all speculative-grade corporate bonds traded each day. Speculative bond average weighted so average term length matches average term length of safe bonds traded. Results based on estimating Equation 3. Additional controls include 12-month average of Treasury’s gold reserves, common stock index 12-month realized volatility, common stock index monthly holding period return, and average term length of bonds traded. Heteroskedastic-robust standard errors in parentheses. *p<0.1, **p<0.05, ***p<0.01.
Impulse is a 1.75 log-point increase in safe-speculative spread due to silver news. Shaded areas are 90-percent confidence intervals based on Newey-West standard errors.

**Default Risk and the Dollar-Gold Exchange Rate: Simple Model**

Here I describe a simple, illustrative model to show how changing the probability of dollar devaluation affects the probability a firm defaults on its debt, as well as how this differentially impacts firms already at greater risk of defaulting. There are two periods in this model. In period 1, firm $i$ has debt denominated in gold with a dollar value of $D_{i1}$ and the dollar value of the firm is $V_{i1}$. The firm’s debt consists of a zero-coupon bond. The period 2 value of firm $i$ is $V_{i2} = V_{i1} \varepsilon_{i2}$. $\varepsilon_{i2}$ has a log-normal cumulative distribution, $H$, with a mean of unity. The firm defaults in period 2 when the dollar value of its debt exceeds the dollar value of the firm, i.e. $D_{i2} < V_{i2}$ or $D_{i2} < V_{i1} \varepsilon_{i2}$. Hence there exists a cutoff value, $\varepsilon_{i2}^*$, such that for any $\varepsilon_{i2} < \varepsilon_{i2}^*$ the firm defaults on its debt in period 2. The dollar-gold exchange rate in period 2 is also uncertain. With probability $p$ the exchange rate is 1, while it is $1 + \gamma$ with probability
$1 - p$. Thus, we can write the probability the firm defaults in period 2 as:

$$pH \left( \frac{D_{i1}}{V_{i1}} \right) + (1 - p)H \left( \frac{(1 + \gamma)D_{i1}}{V_{i1}} \right)$$

From this, we see that $p < 1$ raises the probability of default.

The following is a numerical example designed to demonstrate that a decrease in the probability of the dollar-gold exchange rate remaining constant has a larger effect on the probability of default for firms already at greater risk of defaulting. Consider two firms: $i = s$ (for safe) and $i = j$ (for junk). Assume initially that $p = 1$ and the firms have the following cutoff values: $\varepsilon_{s2}^*$ and $\varepsilon_{j2}^*$ with $\varepsilon_{s2}^* < \varepsilon_{j2}^*$. Specifically, assume that firm $s$ has a default probability of 0.005 and firm $j$ has a default probability of 0.2. Additionally, note that the cumulative distribution function for $\varepsilon$ can be written as $\Phi \left( \frac{\ln(\varepsilon) - \mu}{\sigma_{\varepsilon}} \right)$, where $\mu$ and $\sigma_{\varepsilon}$ are the mean and standard deviation of $\ln(\varepsilon)$. For this example, suppose $\mu = -0.125$ and $\sigma_{\varepsilon} = 0.5$ (which implies a mean of 1 for $\varepsilon$). For each firm $i$ let $\tilde{\varepsilon}_{i2} \equiv \frac{\ln(\varepsilon_{i2}) - \mu}{\sigma_{\varepsilon}}$. With default probabilities of 0.005 and 0.2, $\tilde{\varepsilon}_{s2}^* = -2.58$ and $\tilde{\varepsilon}_{j2}^* = -0.84$ respectively. Now, let $\tilde{\varepsilon}_{i2}^{**}$ be the cutoff value for firm $i$ when the dollar-gold exchange rate is $1 + \gamma$. Under this scenario, $\tilde{\varepsilon}_{i2}^{**} = \frac{\ln(1 + \gamma)}{\sigma_{\varepsilon}} + \tilde{\varepsilon}_{i2}^*$. Letting $\gamma = 0.5$, this implies that $\tilde{\varepsilon}_{i2}^{**} \approx 0.811 + \tilde{\varepsilon}_{i2}^*$. The cutoff values for each firm under this exchange rate are $\tilde{\varepsilon}_{s2}^{**} \approx -1.77$ and $\tilde{\varepsilon}_{j2}^{**} \approx -0.03$. Thus firm $s$ defaults with probability 0.0384 and firm $j$ defaults with probability 0.488 under a dollar-gold exchange rate of $1 + \gamma$.

Next, suppose that $p$ decreases from 1 to 0.99. With a recovery rate of 0.5, this implies the yield on the bond for firm $s$ falls $-0.01 \times 0.005 \times 0.5 + 0.01 \times 0.0384 \times 0.5$ or 1.67 basis points. Likewise the yield on the bond for firm $j$ falls $-0.01 \times 0.2 \times 0.5 + 0.01 \times 0.488 \times 0.5$ or 23.4 basis points. Therefore, an increase in the probability of dollar devaluation raises the yield on a speculative bond by more than it raises a safe bond’s yield. The main empirical specification of this paper uses the log-change in yield, and it remains to be seen if this is greater for the junk bond in this example. To make this comparison, assume that the
risk-free yield is 4 percent and does not change as the devaluation probability of the dollar changes. Thus, the initial yields when $p = 1$ are 4.25% and 14% for the safe and junk bonds respectively. Finally, this means the log-change for the safe bond is 0.003992 while the log change for the junk bond is 0.016576. In other words, an increase in the probability of devaluation sees a larger increase in the log of the yield of the junk bond relative to the log of the yield of the safe bond.