# A European History Lesson for Today's Central Bankers*

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Treasury bonds provide money-like services, while other bonds do not. These money-like services, which include safety and liquidity, are valued more during financial crises, reducing the substitutability of actual Treasuries and synthetic Treasuries—other types of bonds that yield the same cash flows. Large equilibrium yield spreads between actual and synthetic Treasuries result. During the recent U.S. financial crisis, large-scale asset purchases by the Federal Reserve may have widened these spreads. To avoid policy-induced instability in bond markets, monetary authorities may have to stand ready to exchange actual and synthetic Treasuries at fixed exchange rates. These recent episodes of instability in the bond markets are analogous to the occasional large depreciations of small coins experienced by economies that used commodity money during periods of perceived shortages of small coins. This source of monetary instability was eventually eliminated by fixing the exchange rate of different coins (Sargent and Velde 2002).

JEL Codes: E43, E44.

## 1. Introduction

In the era of commodity money, many economies struggled with occasional, large depreciations of small coins. Sargent and Velde (2002) trace these episodes back to a failure on the part of authorities to fully understand the value that money derives from its role

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as a medium of exchange. In this paper, I explain how the dramatic widening of yield spreads during the recent U.S. financial crisis bears some resemblance to these earlier episodes of monetary instability, and how the solution to that earlier problem might be relevant even today.

During the recent U.S. financial crisis that started in 2008, the U.S. Federal Reserve broadly interpreted its dual mandate and aggressively lowered the federal funds rate. When the federal funds rate approached the zero lower bound, the Federal Reserve switched to large-scale asset purchases to further lower yields at the far end of the maturity spectrum. Initially, the Federal Reserve concentrated on buying mortgages, but eventually it started to purchase longer-term Treasury bonds in massive quantities in the second and third round of quantitative easing (QE). If different types of bonds that yield the same cash flows are good substitutes, as in the neoclassical paradigm, these purchases could reasonably be expected to pull down the yield curve for all bonds. However, the increased demand for the safety and liquidity of actual Treasuries reduced the substitutability of different bonds. As a result, the Treasury purchases may not actually have increased the prices of other bonds. This was confirmed in a careful event study of the first two rounds of quantitative easing by Krishnamurthy and Vissing-Jorgensen (2011).

Today's central bankers may not fully account for the additional value that Treasuries derive from their safety and liquidity role when designing policy.[1] As a result, the large-scale asset purchases may have exacerbated instability in the bond markets not only by creating additional scarcity in the Treasury markets but also by dissuading potential arbitrageurs who do not value safety and liquidity from shorting Treasuries.

To provide some context, I would like to draw a historical analogy between the current challenges faced by central bankers and a much older challenge that predates the arrival of fiat money. Today coins and currency do not derive their value from the metal and paper they are made of. Instead their value is derived from the goods and services that can be bought with these currencies. The relative

[1]Lagos (2011) sets up a formal model that derives optimal monetary policy in an environment in which assets deliver liquidity services.

prices of different coins are fixed. The Treasury stands ready to convert coins at fixed exchange rates (say, e.g., twenty nickels into a dollar). However, for hundreds of years, before the arrival of fiat money, there were no fixed exchange rates for different coins. In those days, there was a recurring problem with commodity money. Small-denomination coins occasionally experienced large depreciations against large-denomination coins. These episodes have been carefully documented in a recent book by Sargent and Velde (2002) on the topic. Cipolla (1956) labeled this the "big problem of small change." Interestingly, these episodes tended to coincide with shortages of small-denomination coins. By the middle of the nineteenth century, the ingredients for a sound system were well understood. This system was based on coins with a commodity value lower than their face value. These smaller coins were convertible into gold at fixed exchange rates, thus anchoring the currency to commodity, but not for each coin separately. These economies had finally settled the big problem of small change: they had found the right monetary technology.

The behavior of U.S. Treasury bond yields during the recent financial crisis bears some resemblance to that of small coins during these shortages. During the crisis, there was a shortage of nominal Treasury bonds at all maturities. As a result, yields on these bonds were driven to unprecedented lows relative to the yields on other bonds with similar credit and liquidity. This is the modern-day equivalent of the depreciation of small coins. The market resolves the shortage of Treasury bonds by driving down expected returns on these assets. They have to be dominated in rate of return by other assets.

These yield differences are effectively inefficiency wedges which adversely impact the intertemporal allocation of resources in this economy. Making these smaller and less volatile should be an overriding objective of monetary and fiscal policymakers.

The rest of this paper is organized as follows. Section 2 describes the historical analogy between the recent instances of instability in the bond markets and the "big problem of small change" in medieval Europe based on the work of Sargent and Velde (2002). Shortages of small coins cause a breakdown of the quantity theory of money. Section 3 describes the modern version of the "big problem of small change" in today's bond markets. Finally, section 4 concludes.

## 2. Big Problem of Small Change

As beautifully described by Sargent and Velde (2002), these episodes of depreciation pose a challenge to the standard quantity of money. I will use "pennies" to describe small coins and "dollars" to describe larger coins.

### *2.1 Quantity Theory of Money Breaks Down*

This theory, which describes an aggregate demand function for money, only works if all of the coins are perfect substitutes. But of course they were not. Pennies could be used for purchases that dollars could not be used for! Furthermore, there were costs associated with turning dollars into pennies. Whenever there was a shortage of pennies, the pennies would depreciate relative to the dollar, thus lowering the expected return on holding pennies, and restoring equilibrium. These inflationary episodes were viewed as highly undesirable.

### *2.2 Cash-in-Advance Model*

Sargent and Velde (2002) formalize this intuition in a cash-in-advance model with two different cash-in-advance constraints, in an extension of the model proposed by Lucas and Stokey (1987), one for pennies and one for dollars. Pennies can be used for some transactions that dollars cannot be used for. In other words, pennies deliver additional transaction services. As a result, in equilibrium, they can be dominated in rate of return. This will happen when the cash-in-advance constraint on pennies is binding, that is, if there is a shortage of pennies.

In this model, the quantity theory of money, which describes a relation between the stock of all coins and the price level, holds only when the pennies constraint does not bind. At other times, it breaks down altogether.

### *2.3 The Right Monetary Technology*

Authorities learned to control the supply of small change to avoid these episodes. Small coins became tokens, worth more than their intrinsic value, exchangeable against larger denominations at a fixed

exchange rate. That solved the big problem of small change. They had stumbled upon the right monetary technology. This required a major intellectual leap: understanding that money derives its value from its role as a medium of exchange.

## 3. A Modern-Day Version of the Big Problem of Small Change

QE I (2008–09) consisted of purchases of Treasuries and other long-term securities. Mortgages accounted for the bulk of these purchases. The total amount was $1.5 trillion. On the other hand, QE II (2010–11) consisted exclusively of purchases of Treasuries. The total amount was $600 billion. To understand the rationale behind these interventions, we need to consider significant departures from the standard neoclassical finance paradigm.

### *3.1 The Effects of Quantitative Easing*

In the standard neoclassical finance paradigm, there is no effect. There is a pricing kernel, and these purchases do nothing to affect that pricing kernel. Demand for bonds is perfectly elastic. However, there are deviations from the standard paradigm under which these purchases would have an effect.

There are several candidate mechanisms that can rationalize large-scale asset purchases as a means of lowering long-term yields. Krishnamurthy and Vissing-Jorgensen (2011) provide an overview. The most prominent one is the duration risk channel. Duration risk is priced if markets are segmented and a small pool of investors is forced to absorb duration risk (see Greenwood and Vayanos 2010). This is the framework adopted by Li and Wei (2013). By purchasing long-term assets, the Federal Reserve removes duration risk from the economy and thus lowers the market premium for duration risk on all bonds, regardless of their issuer. In this view of bond markets, duration risk is a key determinant of yield differences. A second possibility is that the Federal Reserve signals its intentions about the future. These purchases signal a commitment to keep interest rates low in the future (if not, the central bank would incur large losses).

### *3.2 Money-Like Services Provided by Treasuries*

Bonds and money are very different, but some bonds have some money-like features. In a modern financial system, bonds do not exclusively derive value from the future cash flows that are promised by the issuer. Instead, at least for some bonds, part of the value is derived from the transaction services that are provided by the bond. Bonds can be used as collateral in a wide variety of transactions, like repos and derivative transactions (e.g., writing a credit default swap, or CDS).

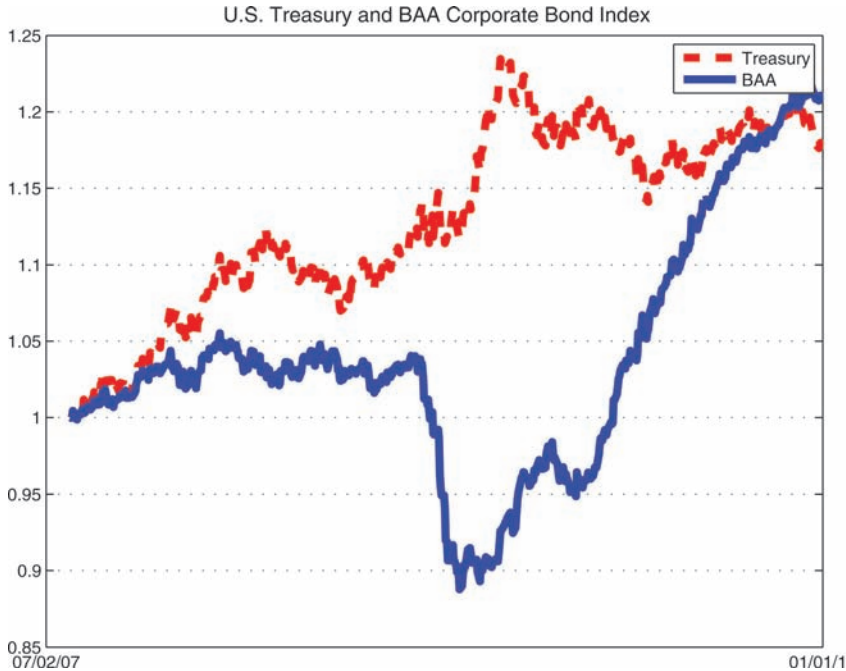
In addition, some of these bonds provide additional safety and liquidity services that are valued by a large segment of bond investors. Krishnamurthy and Vissing-Jorgensen (2012) quantify the size of liquidity and safety demand for U.S. Treasuries by demonstrating large supply effects on Treasury yields. According to their estimates, on average, Treasury yields are lowered by 73 basis points as a result of liquidity and safety demands. So, Treasury bonds do have some money-like attributes that significantly lower their average returns.

During the financial crisis, there was a large increase in the safety and liquidity demand for Treasuries. Figure 1 plots the Barclays Treasury index during the U.S. financial crisis against the BAA corporate Barclays index. The sharp divergence between these two indexes cannot be rationalized by increases in credit risk. In many ways it is similar to the depreciation of those pennies. The divergence signals a shortage of Treasuries, as perceived by the market. Arguably, the valuation of Treasuries should be of concern to policymakers, more so than the valuation of these corporate bonds.

### *3.3 Manufacturing Synthetic Treasuries*

Especially during crises, we have seen mounting evidence that other characteristics drive wedges between the valuation of claims to otherwise identical cash flows in bond markets. To check whether the law of one price holds in bond markets, we can manufacture synthetic Treasuries out of other bonds by using derivatives. We look at synthetic Treasuries constructed from agency bonds, Treasury Inflation-Protected Securities (TIPS), as well as corporate bonds.

**Figure 1. Bond Index in U.S. Financial Crisis**

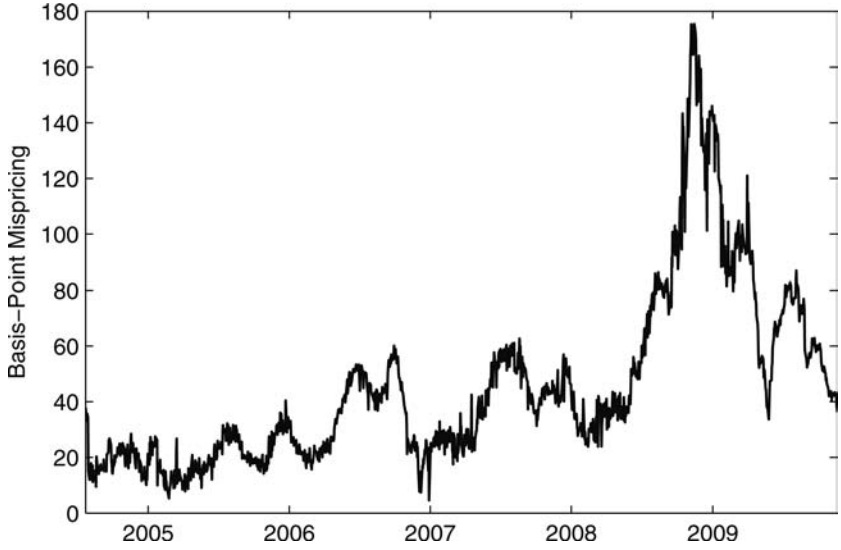



**Note:** This figure shows the Barclays Treasuries Index and Barclays BAA Corporate Index, daily data: 07/02/07–01/01/10.

Longstaff (2004) was one of the first to carefully document large yield differences between bonds that represent claims to identical cash flows. Longstaff compared Treasury bonds with bonds issued by Resolution Funding Corporation (Refcorp), a government agency created by the Financial Institutions Reform, Recovery, and Enforcement Act of 1989 (FIRREA). These bonds differ from other agency bonds because they have literally the same credit risk as other Treasury bonds. On average, these spreads were about 10 to 15 basis points, but occasionally the spreads blew up to 90 basis points.

In other cases, more work is need to create synthetic Treasuries that can be compared with the actual Treasuries. Recently, Fleckenstein, Longstaff, and Lustig (2013) compared the prices of synthetic Treasuries constructed from TIPS using inflation swaps with those of actual Treasuries. They found that TIPS are always cheap.

**Figure 2. Weighted Average TIPS–Treasury Mispricing in Basis Points**




**Source:** Fleckenstein, Longstaff, and Lustig (2013).
**Note:** The average is 54 basis points.

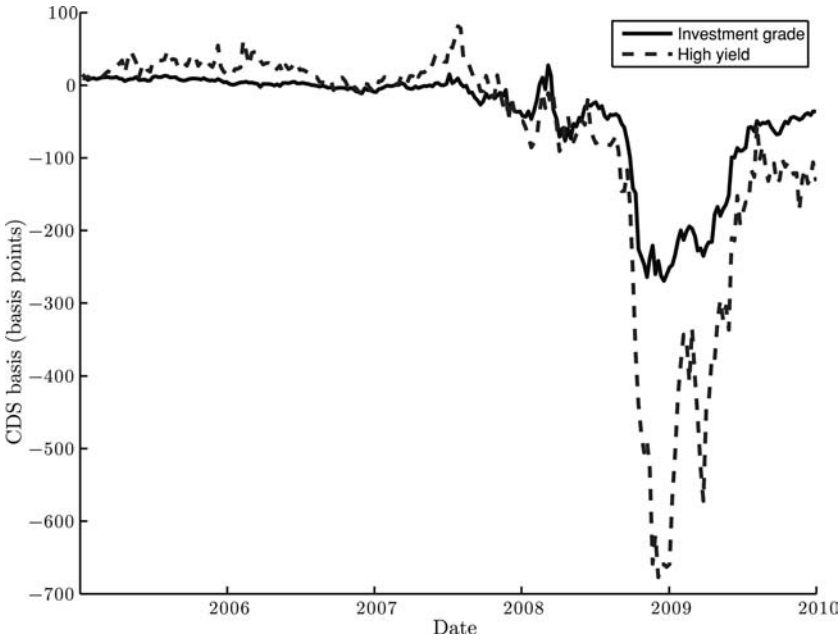
Figure 2 plots the weighted average mispricing of all outstanding TIPS against Treasuries. The average mispricing is 54 basis points in a sample from 2004 to 2009. This number peaks at 180 basis points in the financial crisis. Towards the end of 2008, some TIPS traded at a $20 discount.

Finally, Mitchell and Pulvino (2012) computed the CDS-bond basis for an average of 491 investment-grade (204 high-yield) issues per week from January 2010 through December 2010. Figure 3 plots the CDS-bond basis. During the financial crisis, there was a negative basis in excess of 300 basis points (700 basis points). Clearly, synthetic Treasuries are typically cheap relative to actual Treasuries, but especially so during financial crises.

### *3.4 Shortage of Arbitrage Capital*

There are arbitrageurs who mainly value these securities for the actual payoffs, not for the perceived safety and liquidity services.

**Figure 3. The Corporate-Bond CDS Basis**




**Source:** Mitchell and Pulvino (2012).
**Note:** This figure shows the difference between the CDS rate and the associated par bond yield spread.

During the recent U.S. financial crisis, there was a global shortage of arbitrage capital. Many hedge funds had the knowledge capital to eliminate mispricing by putting on convergence trades, but were likely to face binding capital constraints. The "Relative Value" category in the Hedge Fund Research data suffered large losses during 2008–09. The assets under management in "Relative Value" hedge funds declined from $234 billion in January of 2008 to $161 billion in December of 2008 and even further to $141 billion in March of 2009. Fleckenstein (2012) finds direct evidence that negative returns experienced by these "Relative Value" hedge funds may have exacerbated mispricing in inflation-index markets, not only in the United States, but in other countries as well.

Furthermore, when the Federal Reserve announced its intention to purchase large volumes of Treasury securities, it obviously

may have discouraged some potential arbitrageurs from stepping in and shorting Treasuries. Instead, there is anecdotal evidence that market participants actively tried to front-run the Federal Reserve by guessing which securities they would buy. In fact, Fleckenstein (2012) finds that central bank interventions not only in the United States but also in other G7 countries tended to widen the spreads in inflation-linked bond markets.

### *3.5 Standard Asset-Pricing Theory Breaks Down*

All of these are instances of bonds with identical cash flows (at least in the absence of counterparty risk) with wildly different valuations. To explain these facts, we can amend Sargent and Velde (2002)'s model of cash-in-advance constraints. Let us assume that agents face an assets-in-advance constraint, either for collateral reasons or for transaction reasons. Suppose there is a separate constraint for actual Treasuries.[2] Actual Treasuries can be used for certain transactions, while synthetic Treasuries (other bonds) cannot.

Standard asset-pricing theory breaks down when the assets-in-advance constraint for Treasuries binds. As a result of the binding constraint, the expected returns on actual Treasuries has to decrease. Even if duration risk is priced, the tight link between the total quantity of duration risk and equilibrium yields is severed.

To restore this link, monetary authorities could commit to exchanging synthetic and actual Treasuries at a fixed exchange rate (preferably close to one), thus letting relative quantities adjust to eliminate these inefficiency wedges. Presumably, this would imply large increases in the supply of Treasuries and decreases in the supply of other bonds to the market. Having done so, the authorities could rely on a more stable link between the total supply of bonds and yields without distorting yield spreads.

## 4. Conclusion

During the crisis, the Treasury has benefited from extremely low yields. These low yields have helped the Treasury to stabilize

[2]This model is close to the model used by Bansal, Coleman, and Lundblad (2010).

government finances in the wake of the worst recession since the Great Depression. To the extent that these low Treasury yields are symptomatic of Treasury shortages, these are not a good yardstick to measure the effectiveness of U.S. monetary policy unless the main objective is to help the Treasury finance deficits. In fact, these low yields may be a measure of the distortions that are directly attributable to monetary policy.

Today's central bankers could learn from a careful reading of exactly how earlier monetary systems dealt with endemic instability by fixing the exchange rates between different coins. For example, the Federal Reserve could fix the "exchange rate" between synthetic and actual Treasuries by committing to exchanging these bonds at a fixed ratio. At the zero lower bound, the Federal Reserve could still control the total supply of bonds to impact yields on all bonds at various maturities, but without distorting relative yields.

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