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ABSTRACT

The question of price level versus inflation targeting remains controversial. Disagreement concerns, not so much the desirability of price stability, but rather the means of achieving it. Irving Fisher argued for a commodity dollar standard where the purchasing power of money was fixed by indexing it to a basket of commodities. We show that movements in the price of silver closely track the movements in overall prices during the classical gold standard era. The one-to-one relationship between paper and silver bonds suggests that a simple “silver rule" could have sufficed to fix the purchasing power of money.

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> The price level will not stand still unless we hitch it. It never has; and now, of all times, with the vast conflicting forces ahead, we shall be foolish if we expect complete equilibrium. On the contrary, we are probably destined to see, in the next generation, important price movements, perhaps more erratic than those in the past. (Fisher 1920, p. 120)

I. INTRODUCTION

While inflation targeting has been widely adopted in recent years, the alternative price-level targeting strategy long advocated by Irving Fisher offers a potentially superior alternative. In committing to reverse any under- or over-shooting of inflation targets, such a policy could potentially not only eliminate average inflation bias and lower short-run inflation variability (Svensson 1999), but also help minimize fluctuations in nominal interest rates and ameliorate the effects of both deflationary and inflationary shocks (Gaspar, Smets and Vestin 2010). In the midst of the very low inflation rates prevailing since the onset of the global financial crisis, a price-level target could help ward off expectations of deflation. Mishkin and Schmidt-Hebbel (2007, p. 431) suggest that:

> "activating a price-level target to induce expectations of reflation of the economy would not only make it less likely that nominal interest rates would hit a floor of zero, but would also ... lower real interest rates, thereby stimulating the economy, and would help induce a rise in the price level, which would repair balance sheets."

A price-level target could also offer a means of signaling the policymaker's commitment to lowering real interest rates even after nominal interest rates have already been cut to zero, as argued by Federal Reserve Bank of Chicago President Charles Evans in his October 2010 call for the imposition of a price-level target in the United States (Evans 2010). Some support for this perspective arises from Leigh's (2010) finding that price-level targeting could have significantly

ameliorated Japan's "Lost Decade," whereas simply raising the inflation target alone would not have had much impact on macroeconomic performance. Although no central bank has yet made the switch to a price level target, the Bank of Canada has been seriously considering the case for price-level targets in preparation for its next policy agreement with the government in 2011 (Kahn 2009).

Today's proposals for price-level targeting have a rich heritage from the gold standard era. In 1898 Swedish economist Knut Wicksell made a path-breaking case for price-level stabilization via a form of interest-rate targeting.[1] As noted by Jonung (1979), his proposal could not be implemented under the gold standard as it required independent control of the money supply in order to adjust interest rates to their non-inflationary level. After Sweden left the gold standard for good on September 27, 1931, however, "the norm that Wicksell presented at the turn of the century became, some thirty years later, the official foundation for Swedish monetary policy" (Jonung 1979, p. 468).[2] Irving Fisher was a contemporary admirer of the new Swedish policy and, in Fisher's (1934, p. 331) view, the ensuing stability of the internal purchasing power of the Swedish krona in conjunction with this new stabilization policy "stand out as among the remarkable facts of the depression." Fisher (1913a, 1913b, 1920) had previously proposed maintaining price stability using an index approach that, unlike Wicksell's proposal, could have been implemented within the gold standard world prevailing at the time. Fisher's called for an adjustable commodity-based dollar that would automatically offset any upward or downward pressure on its purchasing power. Whenever prices fell below target by 1%, for example, the dollar value of the resource unit would be raised by 1% – at the same time automatically lowering the number of resource units in the

[1] The English translation of his 1898 address to Sweden's *Nationalekonomiska Förening* is provided in Wicksell (1958, pp.67-89).
[2] See also Berg and Jonung (1999) and Fregert and Jonung (2004) on this path-breaking episode.

dollar.

Fisher (1913b) suggested that his proposal could be spearheaded by Austria, which was not a formal member of the gold bloc but had been keeping its paper currency at par with gold by the sale of exchange on the London market following the second renewal of the "Compromise of 1867" with Hungary in August 1892. According to Fisher (1913b, p. 342):

> "Austria might maintain a par, not with a fixed weight of gold, but with such a weight of gold as should have a fixed purchasing power, and could do this by buying and selling gold at these adjusted prices, selling gold bullion for gulden to contract the currency, and buying gold bullion for gulden to expand the currency. All other countries could maintain their par with Austria."[3]

Fisher envisaged a whole new international monetary standard based on Austrian authorities buying and selling gold at an official price that was to be fixed based on the aggregate price level. For example, a 1% rise in aggregate prices would be neutralized by fixing the official price of gold at a level 1% below the then-prevailing market price of gold. This would, in turn, give the public an incentive to exchange currency for gold at the relatively cheap government price, thereby automatically contracting the currency and acting to restore overall price stability. In case of deflation, a policy of setting the official gold price above the prevailing market level would be used to induce the public to exchange gold for currency and boost the money in circulation. Other gold bloc countries need then only maintain their currencies at par with the Austrian currency in order to import the benefits arising from varying the currency's gold content to offset any fluctuations in its purchasing power. The resulting system would seemingly have had much in common with the Bretton Woods exchange rate system that was set up in 1945, with the critical distinction being that Fisher's scheme offered a clear means of ensuring stable purchasing power

[3] The "gulden" currency referred to by Fisher (1913b) was actually Austria's old monetary unit, with the switch to the krone having been made in 1892. Unlike the gulden, the krone's gold value was kept stable even though formal convertibility was never established.

for the core currency – a property that increasingly failed to be met by the weakening and over-issued U.S. dollar in the period leading up to the break up of Bretton Woods in 1971.

Although Fisher's scheme was, in reality, never formally adopted by Austria or any other country, his proposition did receive serious consideration in policy circles. Fisher's presentation of his compensated dollar proposal at the *Fifth International Congress of Chambers of Commerce* in 1912 was followed by that body's unanimous approval for convening an International Congress on prices and the cost of living. Investigations into this question had already begun in a number of countries, including Austria, and the Hungarian National Commercial Association submitted its own report calling for the uniform compilation of statistics on prices. Early critics of his proposal pointed to such issues as the difficulty in computing appropriate index numbers and uncertainty as to exactly which commodities to include, however, as well as the potential implementation costs, the impact on gold prices, and the question of whether it could really be undertaken by one country alone without an international agreement among the leading nations (see, for example, Clark 1913; Murray et al. 1913; Taussig 1913).[4] Cagan (1982) further emphasizes the potential for over-reaction given that the monetary response required to maintain the current value of the commodity-based dollar would have additional future consequences owing to lags, leading to a need for compensating adjustments in the other direction later on.[5]

[4] In responding to questions raised by critics of his plan, Fisher (1912) acknowledged that, while "the plan could be worked if adopted by one nation without the concurrence of others, its benefits would be best secured through its adoption by a number of nations." There were many positive reactions as well as criticisms, however, and Laidler (1991, p. 178) notes that it received favorable commentary in England. For example, Keynes (1911, p. 398) states that "Fisher's admirable proposal ... deserve[d] very careful consideration, and if he can revive general interest in such proposals he will have done a great service to the progress of monetary reform."

[5] There is also the question of whether adjustments in the dollar's gold content could keep pace with the information available to speculators, who might recognize upward pressure on prices, say, and "convert the standard or foreign currencies into dollars just before the adjustment and reverse the transaction just after, for a dollar profit" (Cagan 1982, p. 22). This would likely be less of an issue today with data updating potentially allowing for near-continuous adjustment in the standard (as seen in the Chilean example discussed below), but likely would have posed problems at the time when Fisher first made his proposal.

While we do not seek to assess the viability of the new international monetary system envisaged by Fisher, our analysis suggests that a stripped-down form of Fisher's idea could have helped Austria maintain price stability during the gold standard era. Based on comparative data from Austrian silver and paper bonds, we find that stable purchasing power could, in practice, have been maintained without resorting to the full, wide-ranging commodity bundle envisaged by Fisher. We show that yields on Austrian paper bonds and silver bonds moved together during 1880-1913. When increased scarcity of gold produced lower goods prices under the classical gold standard, Austrian data imply that investors saw silver prices moving on a one-to-one basis with the aggregate price level when the central European power bought and sold gold on the London market to target their exchange rate. These findings suggest that a silver peg could potentially have allowed for inflation-targeting with this one commodity used as a proxy for overall prices. This approach would have alleviated the need for Fisher or government agencies to produce high-quality data on a shifting, broad-based commodity bundle in order to stabilize prices.

II. FISHER'S PLAN AND ITS LEGACY TODAY

Irving Fisher sought a self-stabilizing money that could avoid the ups and downs in purchasing power seen in the late nineteenth and early twentieth centuries. The crux of Fisher's proposal was the replacement of a fixed-weight dollar with a new fixed purchasing power alternative:

> "When gold depreciates, its price should be reduced ... Reversely, when gold appreciates, its price should be raised ... The proposal here made is to authorize a raising or lowering of the sluice gates by which gold flows in or out, so as to keep our money lake at a uniform level. By increasing or decreasing the dollar's weight, we would thus be providing against either a flood or a drain." (Fisher 1920, pp. 106-107)

Fisher's index approach precludes bracket creep and, as Sumner (1990) points out, the basic tenets of Fisher's compensated dollar plan continue to be incorporated in many modern-day proposals for stabilizing the unit of account.[6] Fisher's proposal involved adjusting the resource content of the monetary unit in proportion to any deviations from the (fixed) target price level. Following Hall (2005, p. 95), we can write this relationship as:

$$x_t = 1 / (p_o r_t), \tag{1}$$

where x_t is the value of the currency expressed in resource units, r_t is the value of one unit of the resource relative to the cost-of-living bundle, and p_o is the target price level.

In the aftermath of the ongoing debate between Fisher and his critics in the economics profession, as well as the aforementioned resolution passed by the *Fifth International Congress of Chambers of Commerce* in 1912 but derailed by the outbreak of World War I, the U.S. House Committee on Banking and Currency in 1922 held hearings on a bill proposed by Congressman T. Alan Goldsborough that would have enacted a modified version of Fisher's compensated dollar plan (see Patinkin 1993, p. 19). Although neither this bill nor a 1924 revision ever made it out of committee, Hall (2005) points out that Chile later adopted a bank-issued bearer certificate that operates according to Fisher's principle of a self-stabilizing monetary unit. This Chilean monetary unit, the Unidad de Fomento (UF), has its peso content adjusted each day in line with the estimated cost of living so as to maintain its purchasing power. Hall (2005, p. 101) notes that, soon after its

[6] The hypothetical gains from an historical implementation of Fisher's compensated dollar are demonstrated by Bordo, Dittmar and Gavin (2007), who find significant reductions in price level and inflation uncertainty compared to the gold standard. Following the demise of the classical gold standard in 1914, many observers besides Fisher sought to arrive at a commodity bundle that would track the aggregate price level (see Burdekin 2007). Lewis (1925), for example, proposed including silver alongside wheat, cotton and iron. Nor did interest in this area entirely abate in the postwar era, with Hall (1982) concluding that a particular mix of ammonium nitrate, copper, aluminum and plywood would have closely tracked the overall US cost of living over the 1946-1980 period.

introduction in 1967, "essentially all forward contracts in Chile came to be written in UFs – the country achieved cost-of-living indexation painlessly."[7]

Fisher's (1920) concern with price fluctuations emphasized the uncertainty of these moves and the sluggishness of nominal contracts and wages in adjusting to unforeseen price movements. Bondholders and those on fixed incomes were especially hurt as the dollar's purchasing power fell, declining at a rate close to 25% per annum during 1915-1918 (Fisher 1920, p. 62). As shown by Friedman (1992, p. 26), sharp swings in real interest rates continued through the interwar era even as nominal bond yields remained relatively stable. The subsequent upward trend in nominal interest rates during the postwar era occurred only after inflation had become entrenched in the world economy. Not only did modern-day inflation targeting emerge in an environment where everyone had come to expect rising prices, but inflation targets of central banks built in positive rates of inflation. Irving Fisher's commodity dollar standard sought to minimize the price fluctuations that had plagued even the gold standard economies without permitting the upward drift in the price level that continued even after the widespread adoption of inflation targeting by central banks around the world.

III. THE CHANGING MONETARY ROLE OF SILVER

From 1880-1913, gold became the monetary standard for most of the world's economies. With the exception of India, which switched from silver to gold in 1893, silver standards were maintained only in China and the Far East by this time. The gold standard countries faced persistent deflationary pressures over most of the last two decades of the nineteenth century. Higher monetary usage of gold coupled with a paucity of new gold discoveries pushed gold prices

[7] Daily data on the UF resource content (x_t in equation 1 above) are available from http://www.uf.cl.

higher and goods prices lower, producing considerable discontent in the United States (see, for example, Fox 1897; Friedman 1992; Frieden 1997). Until 1873, the United States had combined monetary roles for both gold and silver under "bimetallism," whereby the mint coined both metals at a preset ratio. Abandonment of the old bimetallic standard also meant abandonment of the stabilizing effects deriving from the increased minting of the cheaper metal if shifts in demand and supply caused the other metal to appreciate.[8] Had the bimetallic standard not been removed in 1873, increased minting of silver would likely have significantly reduced, perhaps even eliminated the deflationary trend of the 1880s and 1890s (Drake 1985; Friedman 1992; Velde 2002). This automatic expansionary response would have occurred as the silver market price fell below its mint value based upon the old 16:1 ratio against gold. Calls for restoration of bimetallism persisted until deflationary pressures were alleviated by new gold production near the end of the century.[9]

Decades after the demonetization of silver in the United Kingdom and United States, commentators lamented the additional depreciation of silver relative to gold that followed the closing of the Indian mints to the free coinage of silver in June 1893. Selby (1895, p. 86) goes so far as to argue that the widespread demonetization of silver had the effect of "grossly changing the relation between debtors and creditors throughout the world." Meanwhile, Bear (1896) emphasizes a link between the fall in the price of silver and declining wheat prices – with farm prices in the United States falling even more steeply than those in England. Most striking of all, however, is the fact that, notwithstanding the sharp drop in silver's value in terms of gold, silver's purchasing power over other commodities seemed to hold steady. In 1890, for example, contemporary observers noted that "the relationship between silver and other commodities

[8] See Dowd (1996) on the details of this mechanism.

[9] Large-scale silver purchases remained a key part of US attempts at monetary expansion even in the 1930s, however (Burdekin and Weidenmier 2009).

remains now about what it was before 1873" (*The Statist* 1890, p. 502), with silver and other commodities each falling against gold by approximately 30-35% over this period. This same issue was raised during the lead in to the U.S. presidential election of 1900, with Fox (1897, p. 95) bemoaning a 50% drop in the domestic mint price of silver being matched by a similar 50% drop in agricultural product prices.

Although the importance of silver, like bimetallism itself, was hotly debated at the time, there is no doubt that silver prices continued to be widely followed throughout the classical gold standard era. It was also widely believed that silver prices continued to track the overall price level even while the silver-gold ratio was skyrocketing in the late nineteenth century. This, in turn, raises the question of whether stabilization of silver prices might have offered a parsimonious means of achieving the overall stability in the currency unit so earnestly sought by Irving Fisher. We now use newly-collected data on sovereign bonds from the gold standard era to address this question empirically.

IV. EVIDENCE FROM THE SOVEREIGN BOND MARKET

A. Debt Issues and Price Movements in Austria

Our empirical analysis focuses on Austria for two reasons. First, Fisher (1913b) identified Austria as a potential lynchpin for a new, self-stabilizing monetary standard. Second, Austrian sovereign bond data allow us to examine whether silver could have been used to stabilize the price level. During the classical gold standard era, Austria was unique among the major European economies in that it issued sovereign bonds in gold, silver, and paper. All three types of issuances were actively traded, not only in Vienna, but also in the major external financial markets of

London, Paris, Amsterdam, and Berlin.[10] The terms of the three sets of bond issues were identical (perpetuity bonds) with the exception that the coupons on the paper and silver bonds were subject to a 16 percent tax. Austria broke from the silver standard in 1879, just before our data series begins in January 1880. In allowing its currency to float against silver, Austria avoided the currency inflation that would otherwise have occurred had owners of silver bullion been able to take advantage of free coinage into the gulden at a guaranteed fixed exchange rate (Yeager 1976, p. 298). Indeed, by the time free coinage of silver was ended, inflows into Austria and Hungary had already swelled the coinage of silver gulden from 16.5 million in 1877 to nearly 25 million in 1878 and over 64 million in 1879 (Wieser 1893, p. 384). After August 1892 the Austrian authorities pursued a gold exchange standard under which Austria's currency became closely tied to the gold bloc even though gold convertibility was never formally established in the pre-World War I era.[11] Austria's irredeemable paper currency was kept at par with gold through the interventions discussed by Fisher (1913b) and was considered to have become substantively integrated by 1896, aided by the liberal use of such modern instruments as foreign exchange forwards and repurchase contracts (Jobst 2009).

Fluctuations in the Austrian exchange rate relative to the major gold standard countries averaged 15% between 1876-1891 before dropping to 8% during 1892-1895 and no more than 2%

[10] The interest rates on the paper and silver bonds have been adjusted to account for the 16 percent tax in the figures and empirical analysis.

[11] Although the Austro-Hungarian Bank implemented a *de facto* gold standard with an effective cover ratio above 40%, political wrangling with the Austrian and Hungarian governments precluded any formal accession to the gold standard (Flandreau 2003). Contrary to Tullio and Wolters (2007), this remained true throughout the pre-World War I period (see also Flandreau and Komlos (2006, 2007). Austria's gold-exchange standard was similar to that adopted by India after 1899 and was spreading rapidly across Asia, Africa and Central America in the approach to World War I (Laidler 1991, p. 169). In Austria's case, formal convertibility may have made little difference at the time. Mises (1909, pp. 204-205) observes that the Austrian public had a preference for paper money such that "even were the bank compelled to exchange the notes for gold, people would prefer to use paper to gold, as is the case nowadays where the bank willingly pays notes in gold."

after 1896 (Flandreau and Komlos 2002).[12] Even prior to this convergence with the gold bloc, Austria was able to float a large issue of paper bonds in the 1860s (in addition to silver and gold bonds). As much as 20% of the paper bonds was held by foreign investors (Morys 2008) and the size of the paper debt issue actually exceeded that of the silver and gold-based bonds.[13] Based on the silver-gold interest rate spread, Mitchener and Weidenmier (2009) find that the implied silver-based expected inflation rate averaged 1.25% over the 1880-1911 period.[14] Meanwhile, Austria's gold holdings rose dramatically. While the Austro-Hungarian bank's silver holdings were approximately three times as large as its gold holdings in 1890, this situation reversed over the 1890s such that gold holdings were nearly two times silver holdings in 1895 and nearly four times silver holdings by 1900 (Table 1). This massive reversal in the holdings of the Austro-Hungarian Bank leaves little room for any belief that Austria remained tied to the silver standard. An ongoing link between silver and aggregate prices would still not be surprising, however, given the apparent juxtaposition between silver and other commodity prices seen in other countries, such as the United States, that had moved off silver earlier than Austria.

With data on consumer and wholesale prices not widely available to investors in the pre-World War I era, the silver price of gold represented a coordinating price for forming expectations about overall price movements. As noted earlier, the relationship between silver and overall commodity prices was seen to be maintained in spite of the rise in the relative value of gold in the late nineteenth century (*The Statist* 1890, p. 502). Confirmation of the relevance of the silver price of gold as a proxy for overall price trends arises from our examination of the correlation between silver and wheat, cotton, maize and lead over the 1870-1913 period. Using the data from

[12] Flandreau and Komlos (2006) categorize the post-1896 situation as an informal target zone, with an effective band of around ±0.5%.

[13] As of 1910, the market value of the unredeemed paper bonds totaled 886 million kronen, while there was around

Blattman, Hwang and Williamson (2007), we find correlations with silver equal to 0.81 for wheat, 0.56 for cotton, 0.60 for maize and 0.51 for lead – plus 0.67 with respect to an equal-weighted index of the four commodities together.[15] Wheat was a particularly important commodity, with average consumption of 65.7 million quintals in Austria-Hungary combined exceeding that of both Germany and Italy in the pre-World War I period (Wilson 1921, p. 336).[16] Hungary later settled a debt to Switzerland on the basis of a special wheat export in lieu of the cash sum owed (Einzig 1936, p. 207).

As shown in Figure 1, the silver price of gold features a rising trend during the gold standard era. This upward movement appears to accelerate quite markedly after the aforementioned 1893 closure of the Indian mints. The relevance of this advance in silver prices (relative to the fixed gold price) is supported by the substantial co-movement with commodity prices detailed above. Indeed, Figure 2 offers a compelling visual indication that Austrian silver and paper bonds were essentially two peas in a pod over the available 1880-1913 sample period.[17] As noted in Table 2, the average spread is less than five basis points over the full sample, shrinking to just 2.79 basis points after 1896. Each series features a much more substantial yield spread with respect to the gold bond, varying between approximately 100 and 150 basis points. The average spread relative to gold exceeds 120 basis points over the full sample for both the silver and paper issue, and remains more than 100 basis points higher than gold over the second half of the sample

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490 million kronen in gold bonds and 519 million kronen in silver bonds.

[14] This calculation relies upon the Fisher equation laid out below.

[15] While we would not ascribe the same importance to silver in the postwar period, observers such as Mundell (2003) and Hanke (2010) have pointed to the US dollar serving an analogous role as a barometer of commodity price trends in the modern era.

[16] A majority of the Austrian and Hungarian labor force remained in agriculture at this time, which still accounted for 54% and 73% of total employment in the respective economies in 1910 (Schulze 2007, p. 194).

[17] Our data are from the London and Amsterdam markets as reported in *The Economist*, *The Times*, and the *Amsterdamsch Effectenblad*. The quotations are all in percent of par, thereby avoiding any exchange rate complications stemming from variations in the relative valuations of gold, silver and paper currency. (See Neal (1990) on the longstanding utilization of percent of par quotations on the London market.)

period– the period when Austria had become closely integrated with the gold bloc. All three bond issues feature high levels of liquidity, with bid-ask spreads of 65 basis points for the paper bonds, 63 basis points for the silver bonds, and just 52 basis points for the gold bonds during 1880-1911.[18] These bid-ask spreads compare favorably with the 150-450 basis point range identified by Alquist (2008) for the London sovereign bond market over the 1871-1907 period.

The silver and paper bond yields themselves not only feature similar trends but also match each other over essentially every up and down that occurs over the more than 30 years of data. Such co-movement is hard to credit unless investors treated the discount attributed to silver over gold to be synonymous with the discount attached to paper assets in general. That is, silver price expectations appear to have been indistinguishable from aggregate price expectations (as reflected in the paper bond). Meanwhile, the divergence with gold remains strikingly higher. Table 2 reveals that the average paper-gold spread is more than 29 times larger than the paper-silver spread over the full sample, over 24 times higher during 1880-1895, and over 38 times higher during 1896-1913. Although Austria's move to shadow the gold standard is followed by much lower standard deviations in the paper-gold spread after 1896, the shrinkage in the actual size of the paper-gold spread is much less than the shrinkage in the paper-silver spread. This implies that, irrespective of whether Austria was part of the gold bloc, a "silver rule" would have been much more likely to stabilize aggregate prices than a gold-based policy. Using a simple policy focusing only on silver, our results for Austria are consistent with Bordo, Dittmar and Gavin's (2007) finding that Fisher's compensated dollar plan is superior to the gold standard.

[18] The bid-ask values are based on price quotes from the London market over January 1880-April 1911. After 1911

B. Cointegration Tests

The Fisher equation states that the nominal interest rate on a given sovereign debt obligation is equal to the real interest rate plus the expected rate of inflation. Support for the implied short-run relationship between expected inflation and nominal interest rates during the gold standard era is obtained by Perez and Siegler (2003) using U.S. data as well as by Mitchener and Weidenmier (2009) for the Austrian case. The nominal interest rate for Austrian paper bonds can be written as:

$$i_t^P = r_t + \pi_t^{e,P}, \tag{2}$$

where r_t is the real interest rate and $\pi_t^{e,P}$ is the expected rate of inflation for paper assets.

At the same time, the Fisher equation for Austrian silver bonds can be written as:

$$i_t^S = r_t + \pi_t^{e,S}, \tag{3}$$

where $\pi_t^{e,S}$ is the expected rate of inflation for silver assets.

This leads to the testable proposition that, if real interest rates are the same for both securities, the yields on paper and silver bonds will track one another so long as the expected rate of inflation for paper assets matches the expected rate of inflation for silver assets. Such co-movement is suggested in Figure 2 and implies that the two series should be cointegrated.

In order to formally test the relationship between the silver and paper bond series, we first determine whether they contain unit roots. The Augmented Dickey-Fuller-GLS test implies that each series does, in fact, have a unit root. There is strong evidence of cointegration, however, and the λ_{MAX} statistic from the Johansen procedure for the cointegrating equation below is significant at better than the 99% confidence level – as is the coefficient on paper bonds:

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the Austrian paper bonds were quoted only in the *Amsterdamsch Effectenblad*, which did not report bid-ask prices.

$$Silver_t = 17.640 + .960 Paper_t \quad (4)$$
$$(.009)$$

The sample period for equation (4) is January 1880-1913. The standard error is in parentheses and the λ_{MAX} statistic is equal to 143.753. The restriction that there is a one-to-one relationship between silver and paper bonds can be rejected at the five-percent level of significance (even though the coefficient on the paper interest rate is close to one).

If we re-estimate the cointegrating equation over the second half of our sample, when Austria had become more fully integrated with the gold bloc and bought and sold gold to peg the price of its currency, the null hypothesis of no cointegration can again be rejected at better than the 99% confidence level. The λ_{MAX} statistic is equal to 63.8444. and we have:

$$Silver_t = 17.112 + 1.027 Paper_t \quad (5)$$
$$(.038)$$

The sample period for equation 5 is January 1896-1913. The restriction that the coefficient on paper bonds equals one cannot be rejected at the 90% or 95% confidence level, thereby supporting a one-to-one relationship between silver and paper bonds during the period when Austria shadowed the gold standard.

The econometric results therefore confirm a close and highly significant relationship between the silver bond and paper bond yields that is indistinguishable from a one-to-one mapping.[19] Whereas Fisher's ideal index envisaged looking at a wide range of commodities, we focus on only one – silver. These findings suggest that, at least over the period of the classical gold standard, silver prices served as an excellent proxy for paper assets in general. This property persists through Austria's move to a *de facto* gold standard near the mid-point of our sample period

[19] The results are in each instance robust to allowing for the addition of a time trend. Our analysis utilized a lag length of ten based upon the AIC criterion.

and also survives silver's extended plunge in value against gold. Indeed, the near one-to-one ratio between the Austrian silver and paper bonds is maintained despite the silver-gold ratio nearly doubling from 18.0 in 1880 to 34.6 in 1913. While we have no way of eliminating the possibility that the adoption of a silver rule would have disrupted the relationship in line with the Lucas critique, it is not clear that such a policy move would have changed the landscape as much the existing worldwide movement away from silver into gold that so dramatically transformed the gold-silver relationship in the pre-World War I era.[20]

V. CONCLUSION

In contrast to inflation targeting, the price-level targeting strategy of Irving Fisher provides a clear commitment to reverse any under- or over-shooting in aggregate prices. This could not only lower short-run variability in inflation and nominal interest rates, but also help ward off expectations of deflation. Although a broadly-enough defined commodity basket as suggested by Fisher (1920) would be an almost perfect target, we show in this paper that a simpler, silver-focused strategy would have worked well in the past. Much importance was attached to silver by contemporary observers under the classical gold standard and the Austrian data offer a rare, if not unique, opportunity to test the empirical relevance of silver in the formation of aggregate price expectations and its potential role in implementing Fisher's compensating dollar proposal. By comparing paper and silver bond yields for the same sovereign issuer over the same sample period, we sidestep the otherwise insurmountable problem that the historical price indices one would wish to set alongside the silver price series simply do not exist. Investors actually

[20] Naturally, any direct intervention in the silver market would be expected to disrupt this relationship – as with the 1934 Silver Purchase Act that had the effect of driving silver prices up far faster than prices in general as the US government actions drew in silver stocks from all over the world, especially China (Burdekin 2008).

appear to have viewed the Austrian paper bonds and silver bonds as perfect substitutes, in turn implying that the expected rate of inflation for silver relative to gold mirrored the expected rate of inflation for paper assets in general. This not only supports Fisher's focus on a commodity-based approach to inflation targeting, but also indicates that, at least in the pre-World War I period, a singular focus on silver may have sufficed.

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Table 1: Gold and Silver Holdings of the Austro-Hungarian Bank, 1885-1910

	Gold Assets	Silver Assets
1885	6,916,000	12,968,000
1890	5,412,000	16,547,000
1895	24,401,000	12,776,000
1900	38,325,000	9,904,000
1905	44,755,000	12,122,000
1910	55,023,000	12,025,000

Note: All figures are in pounds sterling.

Source: End-of-year balance sheet data reported in *The Economist*, various issues.

Table 2: Co-movement of Silver and Paper Bonds Compared to Gold, 1880-1913

Panel A. Whole Period, 1880-1913

Average Spread

paper-silver	paper-gold	silver-gold
4.41	128.96	124.55

Standard Deviation

paper-silver	paper-gold	silver-gold
8.13	31.74	29.32

Panel B. First Sub-Period, 1880-1895

Average Spread

paper-silver	paper-gold	silver-gold
6.25	153.84	147.59

Standard Deviation

paper-silver	paper-gold	silver-gold
9.06	32.55	30.08

Panel C. Second Sub-Period, 1896-1913

Average Spread

paper-silver	paper-gold	silver-gold
2.79	108.76	105.96

Standard Deviation

paper-silver	paper-gold	silver-gold
6.82	9.72	9.29

Figure 1

Silver Price of Gold, 1870-1913

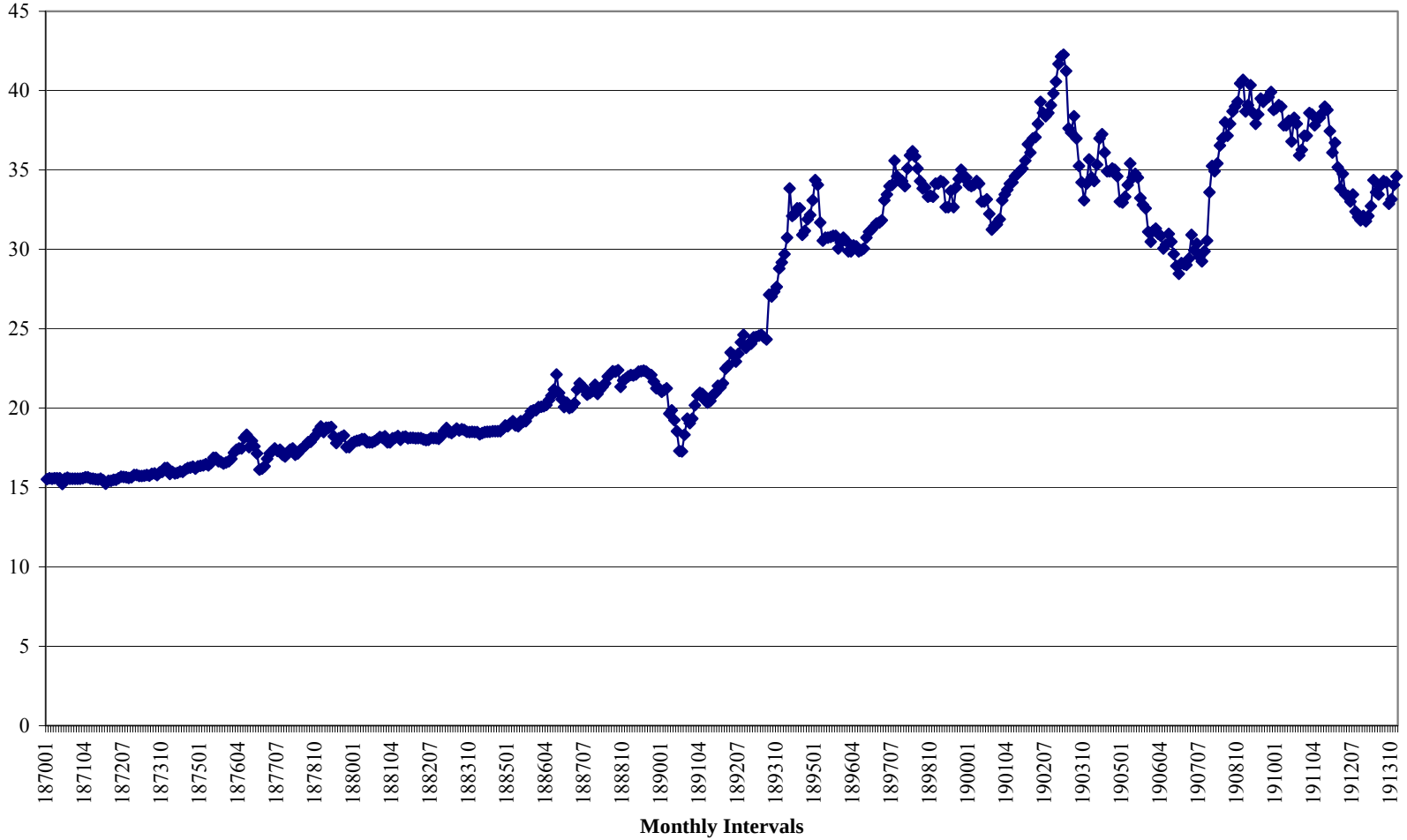

Figure 2

Austrian Gold, Silver, and Paper Bonds 1880-1913
(Basis Points)