

Market Trend Report

Factors that Determine the Silver Price



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Conducted By: Precious Metals Insights

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1. Introduction

Over the last two decades, the daily silver price (basis the London fix) has risen from a low of \$5.50 in 2004 to a high of \$48.70 in 2011 before sliding to a bear market trough five years later of \$13.58. Since then, with the exception of a brief COVID-related spike downwards, silver has tended to recover strongly over the last three years, with several rallies driving the price into the upper \$20s.

This Market Trend Report seeks to identify and explain the factors behind the rise and fall in the silver price over recent decades. First, it assesses silver's supply/demand fundamentals to ascertain to what extent changes in these may have affected the price. Second, it looks at various exogenous factors that could have been responsible for movements in the silver price.

An analysis of the historical data and contemporary reports of what market participants and observers believed was at the time driving prices leads to some key conclusions on silver price determination.

This Report concludes that there is no magic formula or combination of factors that consistently and accurately explains either the level of or change in the silver price. While the silver price is not a random walk neither is its future path entirely predictable based on past trends. This observation particularly applies to exogenous factors, some of which might be thought to have a stable and entirely predictable impact on the price of silver. In practice, while one or a combination of these exogenous factors, such as exchange rates or interest rates, may for a period be a dominant driver, even in the short run there will be times when they are not and another price-driver (even if temporarily) takes center stage.

However, it would be misleading to conclude from the above that it is impossible to identify and sort by degree of importance those relationships that will most likely have the strongest influence on the price of silver. (Indeed, that is one the principal objectives of this Report.) And, while one should not confuse correlation with causality, the statistical data points out clearly those factors that have proved to be the most relevant for silver prices over the long run.



Before addressing the key question of which of the supply/demand elements and exogenous drivers covered in this Report are most influential for silver prices, it is worth commenting on why the silver price is determined by multiple factors that vary in their influence temporally and in their intensity.

This state of affairs is to no small extent because silver is both a precious metal and an industrial commodity. Much of the time, it is those factors that typically drive investor behavior, such as the level of the dollar or interest rates, which are to the fore. But, at other times, silver moves more in line with changes in or expectations for those economic indicators that are especially relevant to commodities, such as industrial production and GDP growth. Illustrative of silver's dual nature is the metal's high correlation with gold but also, frequently, with copper and the broader commodities complex.

Basic supply/demand analysis would to a large extent explain prices for commodities that have little or no stocks and limited investor/speculator interest. Silver, of course, does not fit such a simple profile. Nevertheless, it would be wrong to dismiss the influence on the price of major changes in silver mine production or fabrication demand, particularly over the long term. For example, the cumulative growth in mine production of over 150 million ounces (Moz) (34%) between 1994 and 2001, increased supply sufficiently to be a factor in keeping prices depressed in the late 1990s and early 2000s. On the demand side, the collapse in silver use in photography (a gross loss of 200 Moz from its peak in 1999 to 2022) would have been devastating for the price had it not been offset by, firstly, a huge growth in industrial demand in the 2000s and, secondly, since the end of that decade, a surge in purchases of bars and coins by investors.

As the reference above to investment implies, the impact of supply and demand factors on the price is not just restricted to mine supply or manufacturers' demand. In large measure due to silver being a precious metal of high unit value and with a monetary legacy, there are abundant above-ground stocks in near-market form, both fabricated products and bullion. These can come back to the market in response to price and other signals and, in turn, impact the direction in and level of the silver price.

Above-ground stocks in all forms are a high multiple of annual supply/demand for silver. Over the last three decades, cumulative fabrication demand (excluding coins) has amounted to nearly 24 billion ounces. Much of this silver has not been recycled and theoretically remains "available" to the market. In practice, though, a good part of it would have either been "lost," or it is impractical and/or uneconomic at virtually any silver price to be recycled. Yet, while the above-ground stock of silver products is not nearly as liquid as is the case for gold (due to the dominance of high-value jewelry in its case), the data show that occasionally a rise or fall in scrap supply has been large enough to have had some impact on prices. For example, in the absence of the over 60 Moz drop in scrap supply between 2012 and 2015, the slump in the silver price over the same period would surely have been even worse.

While it can be concluded that the recycling of the above-ground stock of fabricated products only rarely impacts the price, this observation is not true for the above-ground stock of bullion, linked as it is to changes in demand from investors and governments.

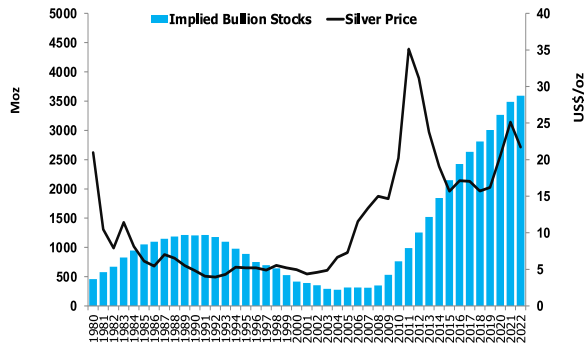
During the 1970s a generally rising silver price resulted in a depletion of bullion inventories that had been accumulated in the 1960s. In 1979, the surge in the price prompted both profit taking from existing holders and fresh buying from new investors but with a net increase in bullion stocks. 1980 and the rest of that decade was characterized by a sizeable increase in investor-held inventories, notwithstanding the

trend down in the silver price. The 1990s, in contrast, saw a depletion of these bullion stocks as investors finally gave up hope of a return to a silver bull market or those inheriting these positions liquidated them to invest in other assets or to finance consumption. It is surely the case that the increase in bullion stocks cushioned silver's fall during the 1980s and exacerbated its bear market in the 1990s.

Since 2008, bullion stocks have increased substantially as investors have year-after-year been net buyers of silver. (Government sales, which were substantial over 1999-2006, have been tiny over the last 15 years.) The steady build-up in inventories has occurred during a period when silver prices have, much of the time, been highly volatile. Investment demand has, in the aggregate, mopped up all the available surplus silver in the market. Occasionally, such as in 2015, bargain hunting, notably in India, has dominated investment and the related increase in implied bullion stocks. This phenomenon helped establish a floor for the price when silver was under pressure. At other times, stock-building has been related more to investment driven by rising silver prices, most notably in 2020.

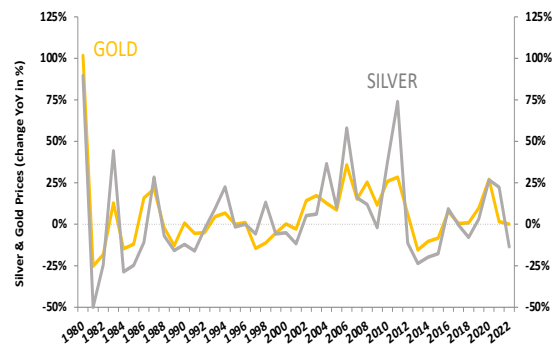
Gold is of particular relevance among the among the exogenous factors impacting silver that this Report covers. While the vast variation in the gold:silver ratio could indicate a loose relationship, the opposite is the case. The price correlation between these two metals is historically very high. However, this does not mean they cannot diverge over extended periods. Silver is less correlated than gold to economic and financial factors that drive financial asset prices. It correlates more with gold with those factors that typically drive commodity prices. And, while silver is the more volatile of the pair with typically a much larger trading range, gold and silver usually travel in the same direction.

Implied Bullion Stocks* and Silver Price



*1950-1979 Cumulative Implied Net Investment; 1980-2009 Cumulative Implied Net Investment plus Coins plus change Government Stocks; 2010-2022 Market Balance plus Net Physical Investment plus change Government Stocks
Source: Silver Institute; LBMA

Annual Change in Silver and Gold Prices



Source: LBMA

Besides the gold price, particular mention among the exogenous factors impacting the silver price should be made of copper and the CRB Index (both are nearly always positively correlated with silver but often only moderately so) and the DXY US dollar index (over the last 13 years negatively correlated save for just one quarter but a far weaker relationship statistically than the gold:dollar one). Finally, the influence of inflation and interest rates on silver prices appears to be less clear-cut from the data.

2. Nominal and Real Prices

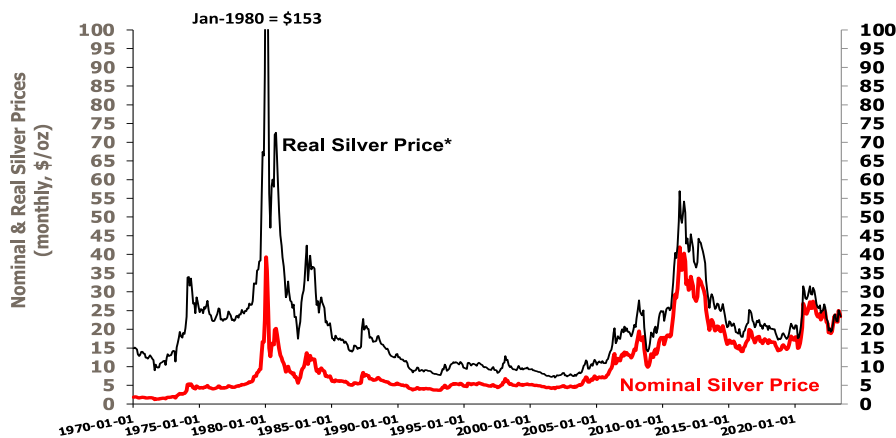
The silver price over the first ten months of 2023 averaged \$23.29/oz. This is a solid improvement on 2022's full-year figure of \$21.73/oz. Silver is also trading well above its 2014-19 average of \$16.81/oz. Over the past three years, a recovery in fabrication from its COVID-induced slump coupled with buoyant investment has led to a ratcheting up in the silver price and its trading range. Nevertheless, as the chart below shows, prices remain distant from their 2011-12 bull market peaks.

Moreover, these are, of course, nominal prices. Looking at the price in inflation adjusted terms provides a more sobering perspective, especially the further back in time one looks. Adjusting the nominal price by the US Consumer Price Index and indexing the monthly average data to June 2023 terms shows how high past peaks were in "today's money." On this basis, the April 2011 peak was \$57/oz, while the all-time monthly average high in January 1980 comes in at no less than \$153/oz. It is also interesting to observe how high real silver prices were in the second half of the 1970s and the first half of the 1980s.

Looking ahead, silver bulls may take comfort from the fact that silver is in real terms still looking "good value" at a little under the \$25-mark. It is also arguably "under-priced" relative to gold, with the gold:silver ratio averaging a historically high 83:1 in the first half of 2023.

Silver is also a small market: In 2022, the value of global mine production was just \$18 billion. It would therefore not require a considerable amount of additional investment to drive prices much higher. On the other hand, those inclined to see the glass "half empty" might fear an opposite outcome: that silver could settle at a lower level if, as in the 1990s, disappointed investors were to turn against the metal and liquidate substantial bullion stocks. At present, there is no indication that such a sea-change in investors' attitudes towards silver is likely – quite the opposite – but the impressive build-up in investors' holdings over the past 15 years could represent a threat for the price in an environment of low inflation, high real interest rates and much lower gold prices. If that were the case then the focus would shift to the metal's other supply/demand fundamentals, especially the outlook for mine production and fabrication demand.

Nominal and Real Silver Prices



*Real price basis US CPI in June 2023 US dollar terms
Source: LBMA; US Bureau of Labor Statistics; Precious Metals Insights

3. Silver Supply and Demand

That silver supply and demand matters for the price and vice versa might be considered a truism. After all, it is a fundamental law of economics that in a free market the interaction of supply and demand determines the price of the commodity, goods or service in question. However, in silver's case supply/demand analysis is complicated by silver's legacy as a monetary metal and its continued acceptance as an investable asset. The result is that above-ground stocks of bullion and investment demand play an outsized role in silver compared to other "purer" commodities, such as copper or palladium, where stocks are much smaller and investor interest far narrower and shallower. In this regard, silver is closer to gold, whose price to an even greater extent is subject to changes of ownership in its huge level of above-ground bullion stocks and in investor sentiment towards the precious metal.

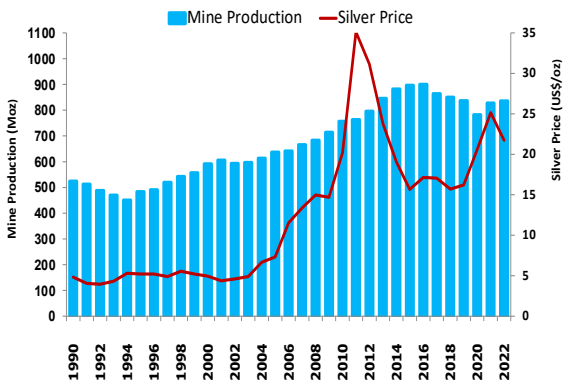
3.1 Mine Production

Silver supply is dominated by mine production. From 1990 to 2022 output from the world's mines constituted an average 76% of total annual supply. Between these points, mine production has grown by 59% or nearly 312 Moz from 1990's 524.5 to 2022's 836.0 Moz. A simple correlation analysis of the levels of mine production and the silver price shows a strong positive correlation between the two series over the last 32 years, with an adjusted R-squared of 0.80. And, indeed, the annual average silver price rose by 350% over the same period and doubled in real terms. Yet, this is simply a good example of the fact that correlation does not necessarily imply causality. This is shown by the fact that the same statistical exercise using the annual change in both series shows no meaningful relationship whatsoever.

Furthermore, logic and economic theory tells us that, taken in isolation, a major increase in supply has to have been negative for silver prices. However, a mitigating factor will have been the fact that this "supply shock" was largely spread out over a multi-year period. For example, taking the period of most intense growth from 2002-16, when output rose by 306 Moz, the average annual growth rate was "only" 3.0%. Nevertheless, persistent growth of 3% would have created a significant headwind for the price over time. Therefore, other factors were clearly at work to mitigate and overwhelm the impact of this "supply shock" on the price. Nonetheless, it is interesting to consider the counterfactual of what might have been had silver mine production increased by a lot less than 3% per annum over this 30-year period.

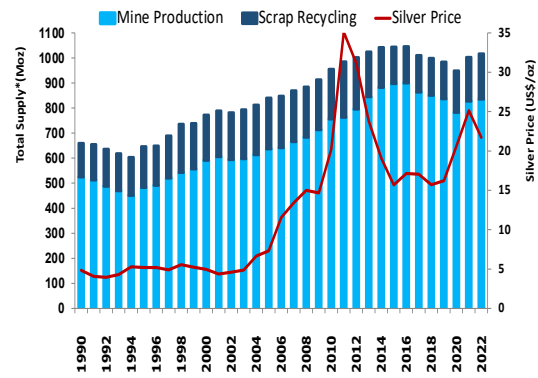
This brings us to another key observation when analyzing the relationship between mine production and the silver price: The fact that most silver is mined as a by-product. As a result, the prices of lead, zinc, copper and gold are more important for most mined output. That said, the silver price level is critical for the smaller primary sector. For example, primary production was stimulated in the mid-1990s by a recovery in the silver price and a further boost came from the bull market from the mid-2000s to the early 2010s. Between 1991 and 2010 primary production grew from 73 Moz to 225 Moz. (Primary's share of total mined output over this period rose from 17% to 30%.) Undoubtedly, the additional ounces that were entering the market by the latter date will have had some dampening effect on the silver price. Conversely, since peaking in 2014 at 882 Moz, total global silver mine production has tended to decline (mainly due to lower output from primary silver mines), with a drop of 46 Moz by 2022, providing a modest amount of support to the silver price.

Mine Production and Silver Price



Source: Silver Institute; LBMA

Total Supply and Silver Price



*Total Supply is here defined as Mine Production plus Scrap Recycling
Source: Silver Institute; LBMA

3.2 Scrap Recycling

Above-ground stocks of silver can be divided into two principal categories: Fabricated products and bullion (bars and coins). This section covers the supply of scrapped fabricated products, with supply from bullion stocks covered in section 3.5 of this Report.

The above-ground stock of silver in fabricated products is enormous. From 1990-2023 alone, a gross 25,600 Moz of silver was transformed into fabricated products (excluding bars, coins, and medals). Basis World Silver Survey data for the previous 40 years, from 1950-89, another 13.448 billion ounces was used for industrial purposes from (excluding the Communist Bloc countries). To this figure of 39 billion ounces could be added fabrication demand in the Communist Bloc countries prior to 1990 and global legacy stocks built up over the centuries prior to 1950, which in the latter case would mostly consist of silverware.

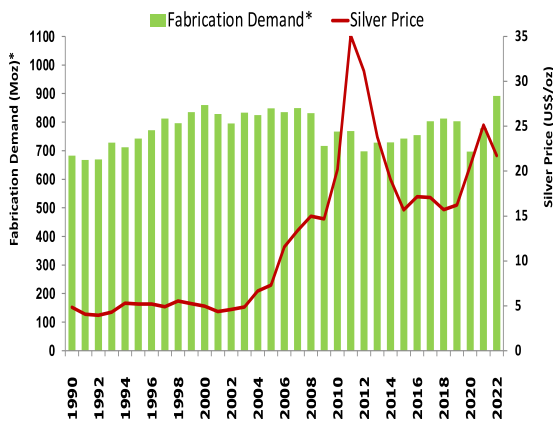
Yet, while in theory a good part of this apparently huge pool of metal could be available to the market, in practice the reality is very different. Firstly, a not insignificant part of the silver fabricated since the 1950s will have already been recycled. Based on an analysis of the historical data, cumulative recycling over these 70-plus years has been the equivalent to a bit less than one-fifth of total fabrication excluding coins over the same period. Secondly, the bulk of the legacy silverware is to be found in religious objects that will not as a rule be recycled, no matter what the price of silver. Thirdly, when it comes to a large share of industrial products, the silver contained generally is too small to warrant economical recycling and where this is not the case, recycling is driven more by product end-of-life and environmental considerations than any price factors.

The data on recycling and price bear-out the above observations that the level of recycling is related only to only to a limited extent to the level of or change in the silver price. (At 0.29 the correlation co-efficient for levels is positive but rather low, while the figure for changes in the two series between 1990 and 2022 is 0.52.) Experience during the last major bull market for silver also demonstrates that even very rapidly rising and high silver prices have a relatively small impact on scrap supply. For example, at its peak in 2011 at 223 Moz and an average price of \$35/oz that year, silver scrap was just 10% higher than it had been in 2008 when silver averaged \$15/oz. Indeed, independently of the price, other factors have been at work in driving recycling volumes, such as the displacement of silver halide photography by digital technology (leading to a halving in the amount of scrap silver from this source since 2012) or the substantial growth in ethylene oxide capacity (80% between 2010 and 2022) and the related jump in the recycling of these silver-rich catalysts.

3.3 Fabrication Demand

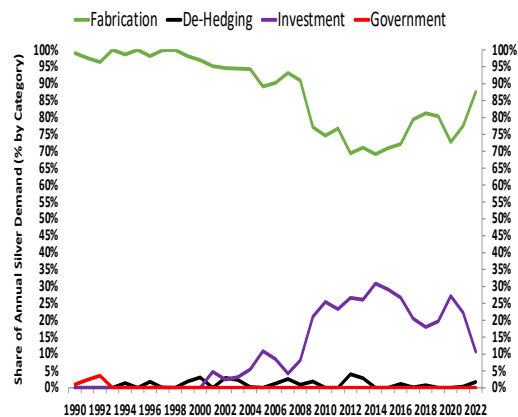
Fabrication demand is defined for the purposes of this Report as the sum of its Industrial, Photography, Jewelry and Silverware components. It therefore excludes all coins, medals and bar demand, which are analysed in section 3.5 of this Report. The ground for doing so is that coins, medals and bar demand are categories of investment, more suited to the analysis of the relationship that has with the silver price.

Fabrication Demand* and Silver Price



*Fabrication demand excluding coins & bars
Source: Silver Institute; LBMA

Share by Category of Silver Demand



Source: Silver Institute

Between 1990 and 2022 fabrication demand on average accounted for 86% of total silver demand. Taken in isolation, this fact might be suggestive of a close relationship between the level of and changes in fabrication and silver prices. The data, however, tell a more nuanced story. While fabrication and price are as expected negatively correlated, the correlation values over 1990-2022 for both the levels and changes in the series are not significant at just -0.09 and -0.12, respectively. (The correlation for changes at -0.18 is little changed for 1990-2003, when fabrication's share of total demand averaged 95%.)

That there is only a weak negative correlation is not all that surprising when considering that the bulk of silver fabrication has consisted of industrial and photographic demand (an average of 69% for 1990-2022). These categories of demand have been driven far more by technological developments than by silver prices. (Hence fabrication demand's steadiness over 2003-08 in spite of a tripling in the price and its remarkable resilience over 2010-12 in the face of a soaring silver price.) In addition, industrial demand and to a lesser extent jewelry & silverware demand are strongly influenced by changes in industrial production and GDP growth. This is not to say that fabrication demand does not exhibit any price sensitivity. Its jewelry & silverware component certainly does and arguably more so these days as much of this demand has shifted to India and China, where consumers are more price sensitive and articles are typically sold on lower mark-ups. And, even when it comes to industrial demand, higher prices over time can lead to thrifting and, in a few cases, outright substitution. Photovoltaic demand has experienced the former and the amount of silver used in brazing alloys has long since dropped back to a specialized core due to substitution by lower-cost alternatives.

Looking ahead, fabrication demand may also have an important eventual impact on the price if it exceeds the amount of supply derived from mine production and scrap. The precedent for this was in the 1990s, when increasing fabrication demand and little growth in supply from mines and scrap led to large deficits in the market that depleted near-market stockpiles of bullion, setting the scene for a move higher in the price. With still reasonably high levels of investment demand (implying an overall surplus in the market) such a scenario may seem a little unlikely but a derivative of it is plausible. This would rest on continued high levels of fabrication demand and net demand for silver bars and coins (i.e., the Net Physical Investment category in the World Silver Survey) plus stability in ETF holdings, that would together require a drawdown of other bullion stockpiles for overall supply and demand of silver to be in equilibrium. This would in time, lead to upward pressure on the price if the other above-mentioned conditions were to remain in place.

3.4 Deficits & Surpluses

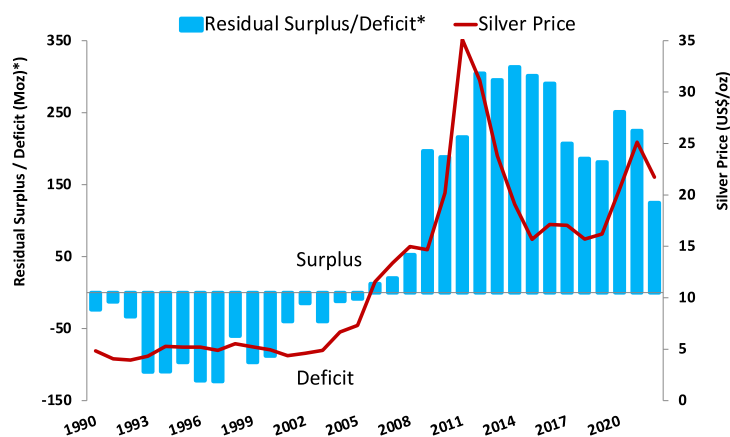
The silver market tends to move through cycles of deficits and surpluses. These are brought about by changes in the principal components of supply and demand that can bring about extended periods when there is a requirement to draw down bullion inventories to fill a deficit or when a surplus results in a build-up in bullion stocks.

In the 1950s and early 1960s supply from mine production and scrap was insufficient to meet industry's requirements for silver. The deficit during those years was covered by government sales, especially from the United States. From the late 1960s to the early 1970s the silver market was in surplus, with the excess silver purchased by investors. Some of these stocks were subsequently liquidated in the 1970s as

the market was in deficit and required additional supplies of metal. Higher silver prices were needed to tease that silver out of inventories. From the late 1970s through to the mid-1980s the silver market was in substantial surplus. Higher prices had reduced fabrication demand and stimulated additional supply from mines and recycling. Investors were keen buyers of silver in an environment of (initially) rising silver prices, high inflation and negative real interest rates. The subsequent fall in silver prices for a while simply encouraged more investment as investors betted on a rebound in the price. In contrast, the 1990s saw the market swing into deficit and this was filled by a substantial run-down in investors' bullion stocks. The depletion of much of the near market bullion stocks over that decade facilitated the price recovery in the following decade. The period since has seen the market return to a substantial surplus that has been absorbed by very high levels of investment demand.

Taking the 1990-2022 data on deficits and surpluses – defined in the case of this Report as the difference between supply from mine production plus scrap and fabrication demand excluding coins & bars – shows a strong positive correlation between bullion surpluses and the silver price. A correlation coefficient of 0.86 for the price and surplus/deficit levels is not surprising given investors' prominent role in price determination. (Regression analysis also shows a strong relationship with an adjusted r-squared of 0.72.) As will have been noted, the most important component since the 1970s of these swings back and forth from surplus to deficit has been investment or disinvestment. It is also noteworthy that while in the 1970s higher prices were needed to stimulate supply from investors' bullion stocks, the same was not true in the 1990s when sales out of stocks were driven more by low expectations for the price and a desire to raise cash for more promising investments.

Residual Surplus/Deficit* and Silver Price



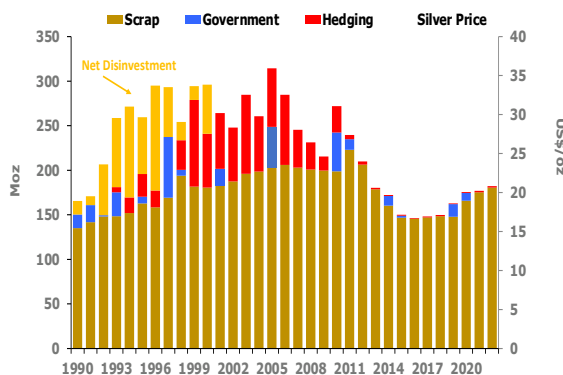
*Surplus/Deficit is the residual balance between Supply from Mine Production and Scrap versus Fabrication Demand (excluding coins & bars) Source: Silver Institute; LBMA

3.5 Supply from Bullion Stocks

The second major component of above-ground silver stocks consists of bullion inventories. Such stocks are held principally by the private sector, either directly as silver bars and coins or on behalf of investors by third parties in allocated form or indirectly via paper claims on different forms of unallocated silver. According to Metals Focus, Identifiable Bullion Inventories totaled some 1,278 Moz at the end of 2022, the bulk of these stocks were held by loco-London (841 Moz) or in CME depositories (299 Moz). In addition, global ETP holdings came to 1,009 Moz at the end of 2022, a little less than half of which are not reflected in the loco-London numbers or the other components of Identifiable Bullion Inventories.

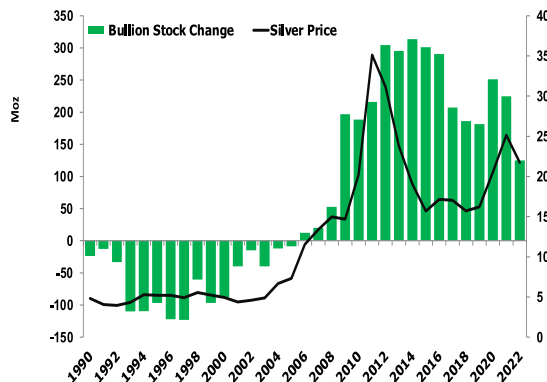
Besides these near-market bullion stocks is a separate category of bullion stocks that are generally more “retail” in nature, predominantly small bars and coins purchased and often held by individual investors. The Net Physical Investment category in the annual World Silver Survey’s Summary Table details demand from this source, with cumulative purchases of 3,145 Moz between 2010 and 2022. The above analysis supports a figure not far short of 5 billion ounces of known above-ground silver bullion stocks at the end of 2022. Whether silver is added to or subtracted from that total will be critical for the price, as demonstrated in the past.

Supply from Above-Ground Stocks and Silver Price



Source: Silver Institute; LBMA

Annual Bullion Stock Change and Silver Price



Source: Silver Institute; LBMA

Government bullion stocks have in the past been an important element of the silver market. At times, particularly in the US, the government has been a principal buyer of silver, not least for the minting of circulating coins. The transition during the 1960s away from using silver in coins not only reduced demand from governments but also in the US resulted in the Treasury supplying the market from its abundant stocks, at times in an ultimately vain attempt to hold down silver prices and stave off the melting or hoarding of legal tender coins. By the end of this process, US Treasury stocks had dwindled

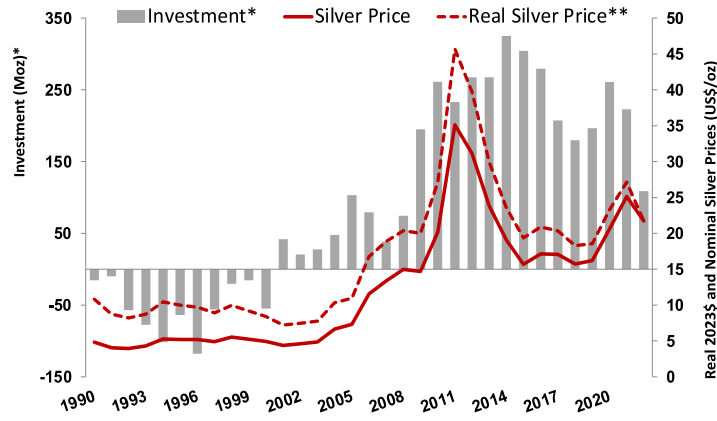
from a peak of over 2 billion ounces to trivial levels. Subsequent decades saw a very much lower level of supply to the market from government stockpiles. Only at the end of the 1990s through to the middle of the 2000s did government sales briefly reappear as a relatively important source of supply. These sales mostly came from China and were negative for the price because of the additional supply of metal and their impact on market sentiment. Subsequently, the very small annual changes in government bullion stocks have had a negligible impact on the silver market.

3.5.1 Investment

The legacy of the supply surpluses in the silver market from the early 1960s through to 1970 and again from 1979-89 was a tremendous build-up in investors' silver bullion inventories, much of this in the United States. Subsequently, from 1990 to 2000, the silver market experienced a phase of continuous net disinvestment. During this period, there was a sustained deficit as supply from mine production and recycling fell short of fabrication demand (excluding coins). Investors' net sales supplied most of this shortfall. (A smaller contribution came from government stock sales.) Total sales from the private sector's above-ground bullion stocks came to some 590 Moz over the eleven years, with hefty selling between 1992-97 and in 2000. Liquidation of these stocks reflected a combination of investor disillusionment and inherited positions being sold for cash to invest in other assets or simply to support consumption expenditure. At the time, silver dipped to well below the \$5-mark, with seemingly little scope for a meaningful rebound in the price. Of course, the selling out of the enormous stocks, much of them in the US in the form of coin bags and 100-oz bars, that had been built up in the 1960s and late 1970s/early 1980s was precisely one of the reasons why silver languished at such a low level. This was also noteworthy because of the contrast with the 1971-78 period when deficits could only be supplied through rising silver prices teasing metal out of above-ground stocks.

The depletion of these above-ground bullion inventories by the beginning of the 2000s helped to set the scene for a recovery in the price over that decade. There was simply less available near-market bullion by then to hold down prices as fabrication demand expanded and, especially, when investor interest blossomed from 2009 onwards. It is the swing from substantial net disinvestment in 1990-2000 to (growing) net investment from the mid-2000s to 2012 that explains much of the silver price movement during those twenty-plus years.

Investment and Silver Prices

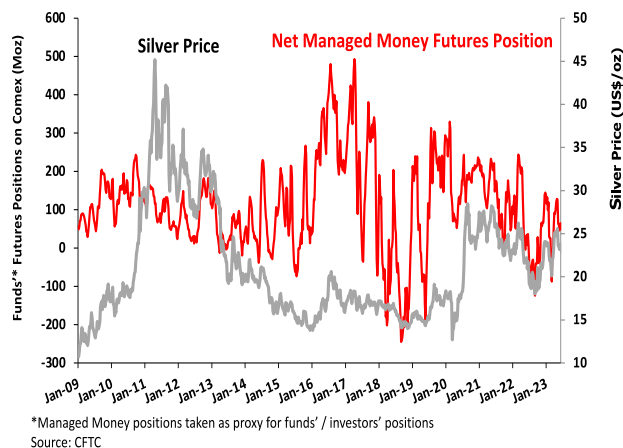


*Investment comprises all identified investment plus the market balance;
Real Price is in 2023 terms adjusted by US CPI. Source: Silver Institute; LBMA; US Bureau of Commerce

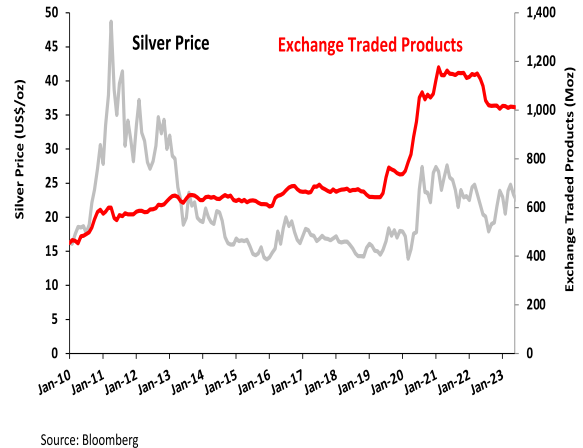
The relationship between investment and bullion stock changes, and the price may initially seem less clear-cut when looking at the past decade. For instance, investment and additions to bullion stocks remained at very high levels over 2012-16, even as silver was more than halving in value. The explanation is that many investors still believed in higher silver prices following the tremendous gains in previous years and therefore saw the dip in price as an excellent buying opportunity. (A similar phenomenon was observable in the early 1980s.) Financial developments at the time encouraged such optimism. Many believed that central banks' quantitative easing (QE) policies would stoke inflation and, in any case, ultra-low interest rates meant the cost-of-carry of silver positions was close to zero. While this commitment to silver was not enough to prevent a slump in the price, an even more severe correction would surely have taken place in its absence.

When assessing the impact of investment on the price it is also important to distinguish between different groups of investors. For example, and taking two extremes, private investors purchasing physical silver tend to take a longer-term view based on more fundamental considerations than Commodity Trading Advisors punting silver futures on the Comex based on technical trading strategies. (Note: The relationship between managed money positions in Comex silver futures and the silver price from 2009-2022 is statistically positive but surprisingly low, although over shorter time periods it can be a lot higher.)

Net Managed Money Comex Silver Futures Positions and Silver Price



Exchange Traded Products and Silver Price



Moreover, while many investors are trend followers, others might be described more as value investors, inclined to buy dips and sell rallies. At times, therefore, investment in aggregate may be more of a supportive factor for prices – as was the case from 2013-2019 – than a driver of higher prices as occurred in 2010-12 and again in 2020-21. The price rise in the latter period led to a surge in interest in Exchange Traded Products (ETPs), particularly from April to August 2020. Conversely, the flow out of ETPs in 2022 was a factor driving down silver prices, even though direct purchases of bars and coins boomed that year, stimulated by private investors' bargain hunting. In conclusion, much depends on who is buying and why. This tends to muddy the waters when it comes to a statistical analysis of the data for annual investment demand and the silver price.

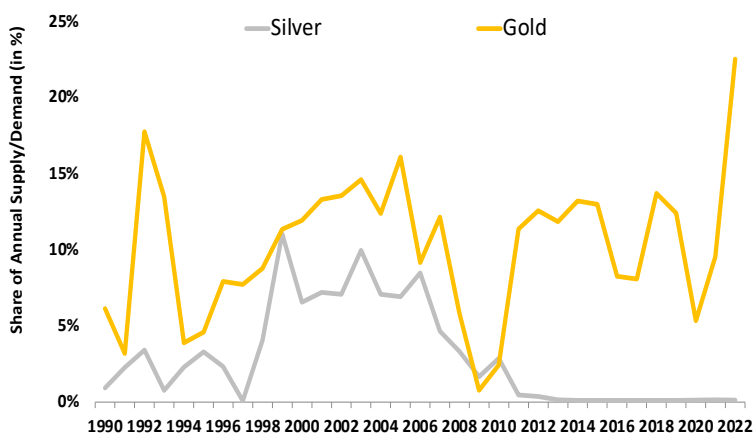
Notwithstanding this caveat, the data for 1990-2022 shows a strong positive relationship between the silver price level and the level of investment, with a correlation coefficient of 0.83 and an adjusted r-squared of 0.68. (It is interesting to note gold investment's higher adjusted r-squared of 0.86 for the same period.)

3.5.2 Official Sector

As indicated above, since the 1970s official sector or government sales (or purchases) have generally not been a significant factor for the market or the price. (Silver is unlike gold in this regard, as indicated by the chart showing sales/purchases as a percentage of supply/demand, respectively for both metals.) The exception to this was the period from 1998-2008 when government sales averaged 62 Moz per annum (sales ranged from a high of 97 Moz in 1999 to low of 31 Moz in 2008). These official sales predominantly came from China, with much smaller quantities offloaded by the US and Russia. The principal motivation for Chinese sales appears to have been the transition from a government-controlled to a largely free market for silver in China. In light of this, a high level of strategic stocks was considered unnecessary.

The quantity of metal sold by the official sector from 1998-2008 accounted for 7% of total supply over these 11 years. This was enough to create some headwinds to the price but not sufficient to halt its advance over the period: annual average prices rose by 2.7 times between 1998 and 2008. Nevertheless, from 1999-2001, anecdotal evidence at the time pointed to government sales and, especially, the fear of further official selling as negatively impacting the price. This was partly related to developments in the gold market, where an exceptionally high level of official sector sales and lending to fund a wave of producer hedging was pushing down gold prices at the time. The fear, in retrospect quite unfounded, was of something similar taking place in silver.

Government Sales or Purchases % Share of Annual Silver & Gold Supply/ Demand



Source: Silver Institute, GFMS, Metals Focus

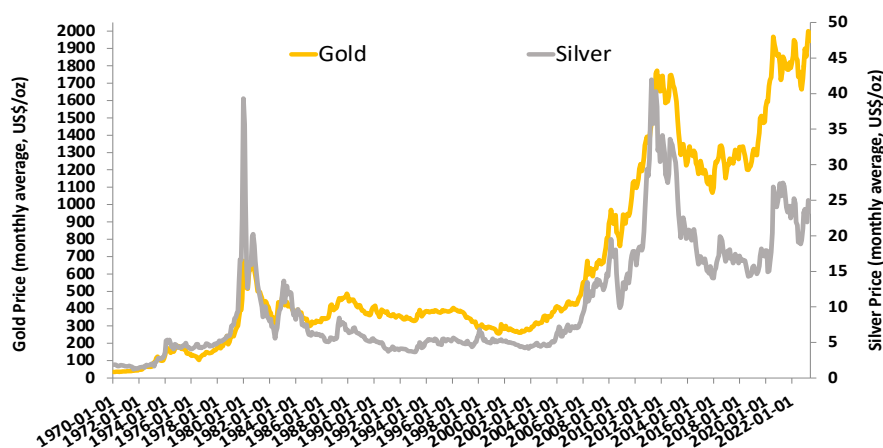
4. Exogenous Factors

Section 3 of this Report discussed the endogenous supply and demand factors that have a bearing on the silver price. In this section the analysis turns to those exogenous factors that could be important for silver price determination.

4.1 Gold Price

Silver's historically close relationship with gold owes much to these precious metals having been at the center of nearly all pre-modern monetary systems, both as a means of exchange and a store of value. Their legacy as money and the fact that silver and gold are scarce and of high intrinsic value makes them attractive assets for many investors across the globe.

Silver and Gold Prices

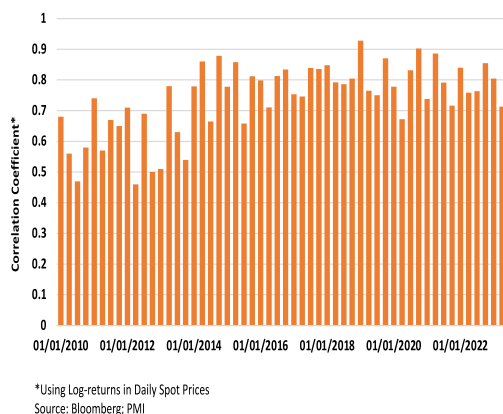


Source: LBMA

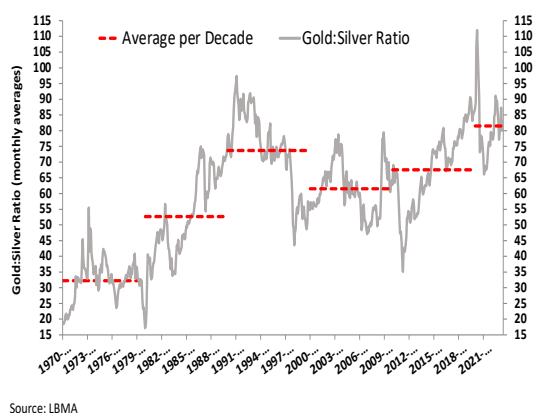
It should come as no surprise then that silver and gold prices mostly travel in the same direction. Major moves up and down in gold over the last 50-plus years since the fixed price was abandoned have always been followed by silver, although the amplitude of its moves have been greater, both to the upside and the downside in the major booms and busts of 1979-86 and 2004-15. Occasionally, silver has clearly gone its own way. For example, in 1997/98 during the period that Warren Buffet was purchasing 130 Moz of silver and in its aftermath or more recently in February-March 2020 when the silver price slumped early on in the COVID pandemic. These are, however, exceptions to the rule that gold and silver travel together, albeit often at different speeds.

The closeness of the silver-gold relationship is borne out by a study of the data for 1970-2022. An analysis of the monthly average price data from January 1970 to June 2022 produces a high correlation co-efficient of 0.90 for silver and gold price levels. Looking at monthly changes for the same data and the same analysis generates a significant correlation co-efficient of 0.69. Similarly, a regression analysis on changes in prices produces an adjusted R-squared of 0.47 for the January 1970 to June 2023 period. Much the same message comes from a quarterly analysis of log returns in daily silver and gold prices from 2010.Q1 to 2023.Q2. This data also suggests that the silver:gold relationship has tended to become closer since 2015.

Quarterly Correlations of Silver and Gold Prices



Gold:Silver Ratio



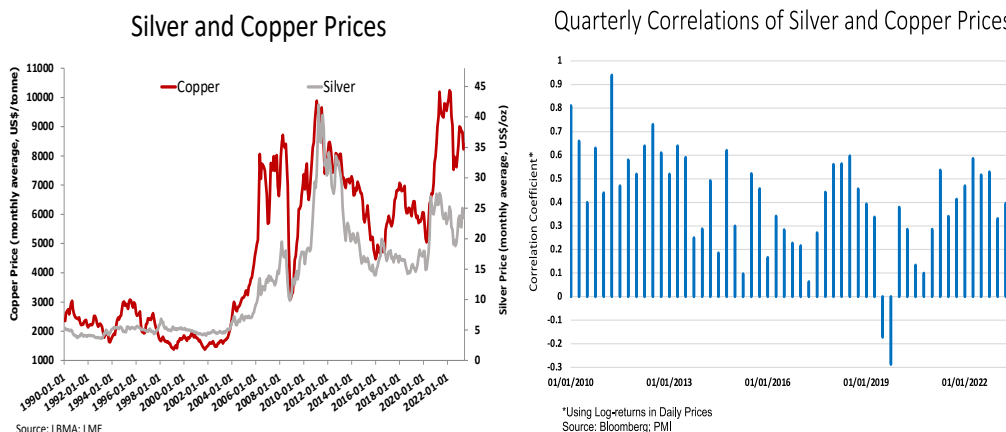
The dominant partner in this relationship is almost always gold, with silver taking its lead from the yellow metal. This is surely a function of market size and depth plus the fact that gold is a “purer” financial asset than silver. Gold is more responsive to changes in other financial asset prices and to interest rates, exchange rates and inflation. On the commodity-currency spectrum silver is somewhat more of a commodity and gold more like a currency, as evidenced by the white metal’s generally much higher volatility.

Finally, while the relationship between silver and gold prices is directionally close, the ratio between the two metals does vary quite considerably. Analysis of monthly average prices shows considerable movement in the gold:silver ratio not only on a monthly basis but also when looking at averages for this ratio by-decade. The current decade to date has so far shown a tendency for the ratio to move higher compared to the 2010s, as silver has underperformed gold.

4.2 Copper Price

It may seem strange to the casual observer that the silver price could be influenced by the price of a base metal. Yet besides the now-distant shared monetary legacy of both silver and copper, there are present-day links between these two commodities. First, on the supply side, a substantial share of silver mine production comes as a by-product of mined copper output. In 2022, no less than 212 Moz of silver was produced from copper mines, a figure that represented 26% of total silver mine production and 21% of total silver supply. Second, on the demand side, industrial end-uses dominate for copper and are predominant for silver at 45% of total silver demand in 2022. Moreover, industrial applications have become a more important component of silver demand. Industrial demand's share of total fabrication demand, excluding coins, has risen from 40% in the 1990s to 63% in the past decade.

Analyzing monthly average silver and copper prices from January 1990 to June 2023 shows a close correlation of 0.90 between the two metals. When it comes to price changes for the same data set, the correlation co-efficient drops to a lower yet still statistically significant 0.35.

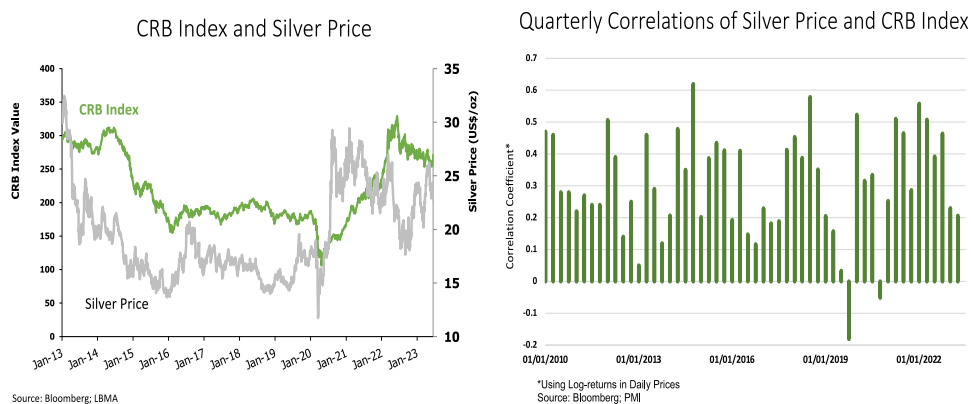


The quarterly correlations data for log returns in daily prices from Q1.2010 to Q2.2023 shows that the relationship between the two metals has almost always been positive, save for Q3 and Q4.2019 when silver and copper prices moved in opposite directions. It also appears that over the last 13 years, silver's correlation with copper has tended to fall – the opposite tendency from silver's correlation with gold over the same period.

4.3 Commodity Prices

Silver's relationship with commodity prices stems principally from the high share of industrial end-uses in its fabrication demand. Within this, the importance of silver for the automotive industry, in electronics and for green energy infrastructure helps to strengthen the ties with other commodities that are required for these applications. In addition, besides price and fashion, jewelry & silverware demand is strongly influenced by growth in overall consumer spending and GDP. These factors, of course, will be relevant, too, for the demand for other commodities. Finally, investors who are interested in commodities as an asset class will often purchase (or sell) 'commodity baskets', structures that contain multiple commodities, sometimes with silver as a component.

The Commodity Research Bureau (CRB) Index tracks a basket of 19 commodities, including silver. An analysis of the daily data for the levels of the CRB Index and the silver price from January 2013 to July 2023 produces a relatively significant correlation coefficient of 0.43. The correlation coefficient for the daily changes in both data sets remains noteworthy at 0.33.



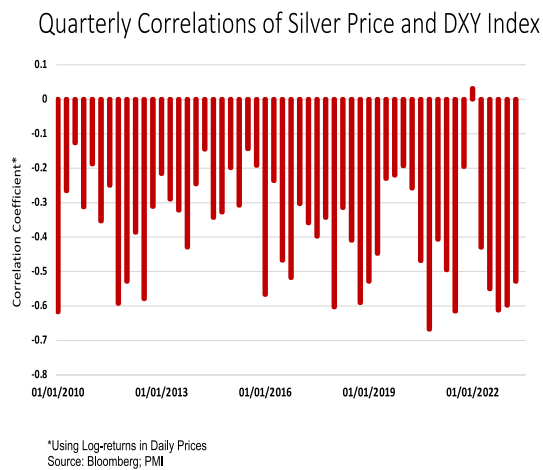
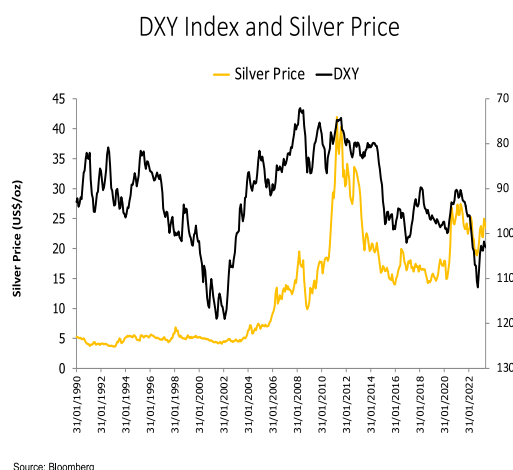
The CRB Index contains gold and copper, so these results might be unsurprising. However, the other 16 commodities in the CRB basket include a diverse set, such as: crude oil, natural gas, nickel, pork, wheat, and corn. The fact that there is a meaningful but loose statistical relationship with silver supports the comments made at the beginning of this section.

Nevertheless, as the quarterly correlations chart shows, the strength of the CRB / silver relationship is quite variable, although almost always positive. The two occasions shown when the correlation turned negative, namely 19.Q4 and 20.Q4, were exceptional because in both these quarters energy prices were strongly negatively correlated to silver (as was copper in 19.Q4) while the precious metal's correlation with gold was on both occasions exceptionally strong.

4.4 Exchange Rates

Global markets trade silver predominantly in US dollars. The professional Over-The-Counter (OTC) bullion market based in London quotes prices in dollars and on the COMEX in New York silver is, unsurprisingly, traded in the American currency. While there are some important exceptions (see below), the fact that silver is generally quoted and traded in US dollars means that the currency's strength or weakness will usually have an important impact on the level and direction of silver prices. This is especially so because of the US dollar's pivotal role in the international financial system. While dollar dominance is under threat, progress to a multi-currency system, let alone replacement by an alternative, is proceeding at a relatively slow pace. Investors will tend to move to the safe haven of precious metals when the globally dominant currency is weak.

Quarterly correlations between the DXY US dollar index and the silver price show a consistent negative correlation between the pair, albeit of varying strength. This is hardly surprising given that the silver price is determined by a myriad of factors, whose influence on the metal tends to wax or wane over time. This observation also holds true for the US dollar:silver price relationship. While the pair are, on average, negatively correlated, it is clear from the data that silver does not always react as might be expected to moves in the dollar. Other factors can overwhelm the influence of the dollar exchange rate, especially for shorter time periods. Indeed, even over an extended period silver has in the past followed its own path, seemingly independent of significant changes in the US dollar exchange rate. The chart shows that this was the case in the late 1990s when a slump in the dollar did not boost the silver price, in no small measure, because of very substantial disinvestment of bars and coins at that time. (Of course, one might conclude that without the support of a weaker dollar silver prices would have been even weaker during that period.)



Over the last 17-18 years or so, it appears that a tighter negative relationship between the dollar exchange rate and silver has emerged. (And, particularly so since the Global Financial Crisis.) This surely reflects the growing investor interest in the metal since the mid-2000s. (And, also probably a stronger correlation over recent years with gold, which is very negatively correlated with the dollar.) As a result, financial rather fundamental factors have been of greater importance. Indeed, if it were otherwise, the substantial supply surplus that has been regularly absorbed by investors would otherwise have driven down the silver price. It could be concluded, therefore, that if investment demand for silver were to fall substantially, then so would the strong negative correlation between the price of the precious metal and the US dollar.

As indicated above, while the US dollar exchange rate is clearly the most important one for silver, fluctuations in certain other currencies may also have an impact on the metal's dollar price. This is predominantly through their impact on physical demand for the metal either for investment or jewelry & silverware. (Supply can also be affected by swings in producers' currencies against the dollar but these are arguably on a smaller scale and, in any case, take longer to manifest themselves in the form of lower or higher mine production.)

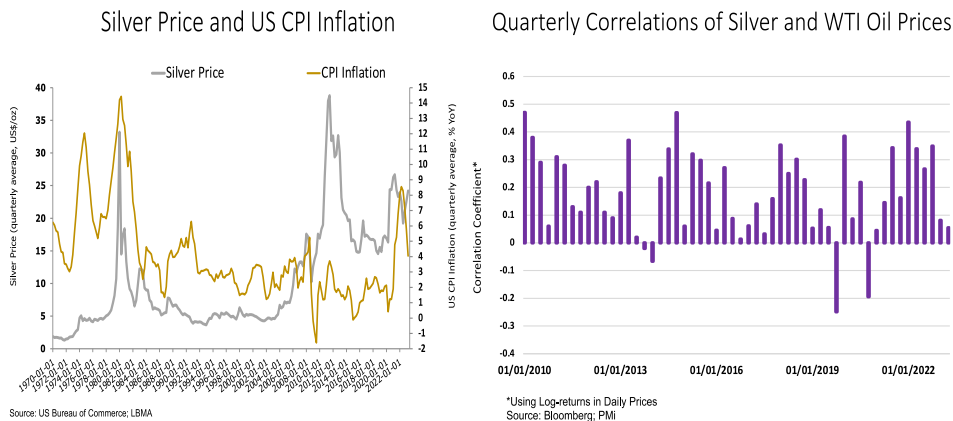
Since 2020, the volume on the Shanghai Futures Exchange has exceeded that on the COMEX division of the CME. Fluctuations in the CNY:USD exchange rate is reportedly one factor behind the noteworthy rise in trading and open interest on the Chinese silver futures market.

The Indian rupee's exchange rate can also from time-to-time influence the dollar silver price. This is because of the price sensitivity of Indian demand, particularly for jewelry & silverware but also increasingly for physical investment. For the former (combined), India accounted for 54% of global demand in 2022, absorbing some 165 Moz. In addition, in 2022, physical investment accounted for over 79 Moz, placing the country second only to the United States. Importantly, India imports the vast majority of the silver it consumes. These imports reached nearly 307 Moz in 2022. The rupee's exchange rate is an important factor for the local price of silver, domestic demand and the level of bullion imports.

4.5 Inflation

Inflation should in theory be good for silver prices. Firstly, most inflationary episodes are characterized by rising commodity prices, which themselves contribute to an increase in the general price level. (In this regard, silver's generally positive, mild correlation with the oil price is noteworthy.) Secondly, albeit much less pronounced than gold, silver is still partially regarded as a financial asset that should provide some degree of protection against inflation.

In practice, historical data provide some support for the theory that silver prices are positively correlated with inflation. Both major inflationary episodes in the US in the 1970s saw silver make substantial gains. Silver tripled in the first of these and in the second it soared to a monthly average above \$33 in January 1980 in the face of double-digit US CPI inflation. While other factors were behind the spike to this peak, the trend higher in the price that foreshadowed it was in part due to investor buying motivated by rising inflation and negative real interest rates.



The drop in inflation brought about by the Volcker Fed’s aggressive monetary policy was an important factor in the subsequent collapse in the silver price in the early 1980s. Similarly, lower levels of inflation, particularly in the 1990s, appear to have helped to keep a lid on silver prices.

The jump in silver prices in the latter 2000s and, especially, at the start of the following decade, occurred at a time of subdued inflation. This proves the point that inflation is not a necessary condition for a rise in the silver (or gold) price. Yet, it is worth recalling that the expansion in the Federal Reserve’s and other central banks’ balance sheets due to Quantitative Easing in response to the Global Financial Crisis at the time raised inflation expectations, which helped to boost gold and silver prices over the 2009-11 period.

The most recent wave of inflation in the US and elsewhere has had far less of a positive impact on the silver price. Gains in the price mostly occurred prior to the major surge in US inflation. Nevertheless, since then, the effect of high levels of inflation may have played a part in keeping the silver price elevated, with no return to the sub-\$20 levels it was trading at pre-COVID. This lack of response could be because the market has generally retained its confidence in the US central bank, and thus, expectations of future inflation have remained fairly subdued. It also may reflect a more general lack of investor interest in silver compared to the past. Investors have not this time reached for silver as a hedge against inflation.

4.6 Interest Rates

As a non-interest-bearing asset for most investors, silver ought to struggle when interest rates are rising and/or at a high level. The opportunity cost of holding silver under such circumstances would have to be more than compensated by other factors recommending the metal to investors. More toxic still for the white metal should be an environment of rising and/or high *real* interest rates.

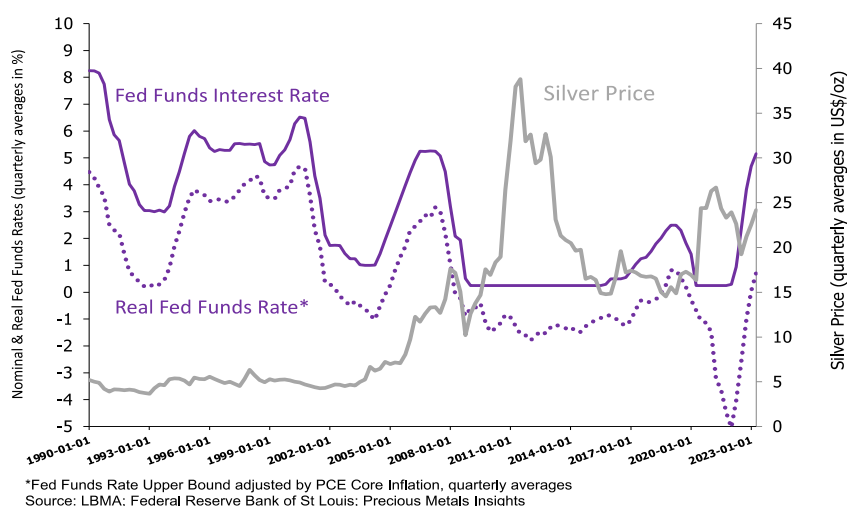
The previous section touched upon the impact of a switch in 1980 from a previously loose to an ultra-tight monetary policy had on silver. The Fed aggressively raised the Federal Funds rate to a peak of 20%

in 1981, which was a major element in driving down the silver price. Thereafter, an extended period of high nominal and real interest rates in the US was undoubtedly a factor in keeping silver prices low during the 1990s. In contrast, the major fall in nominal rates and, especially, real interest rates slumping to negative levels in the wake of the Global Financial Crisis provided a major stimulus to silver prices, even if part of this impact was indirectly through the medium of higher gold prices.

The response of the Fed to the COVID crisis and the financial instability the pandemic indirectly helped to cause was swiftly to cut interest rates, with the Federal Funds rate (upper bound) dropping to 25 basis points in March 2020. Silver prices that had been battered down to the \$12 level in response to the early impact of COVID on commodities demand surged higher in the wake of this. The subsequent further drop in real interest rates appears to have then been an important element in the additional gains silver had in the second half of 2020 and its ongoing strength in the first half of 2021. Curiously, the drop in real rates more deeply into negative territory during the second half of 2021 and the first quarter of 2022 saw silver giving up some of its earlier gains.

Silver’s negative correlation with interest rates appeared to have been re-established during the remainder of 2022 as the Fed embarked on a series of interest rate increases. However, while higher US policy rates and, more recently, a return to positive *real* interest rates have dampened silver prices they have not returned to pre-pandemic levels and, arguably, have been surprisingly buoyant in the face of a significant tightening in US monetary policy. Once more, this supports the observation that silver prices are driven by multiple factors, whose influence on the metal can fluctuate over time.

Nominal & Real Fed Funds Rates and Silver Price

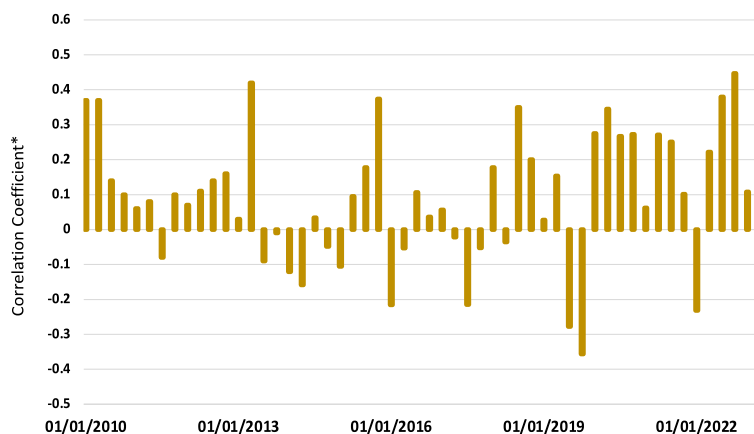


4.7 Stock Prices

The relationship of silver to stock prices should in theory be via the link both have to the real economy. Higher levels of GDP growth should be good for corporate earnings and also, all other things being equal, for raw material prices. Similarly, a high level of liquidity in the markets supporting equity prices – the situation for much of the past decade – ought also to buoy commodity prices. On the other hand, silver’s residual safe haven properties would presumably come to the fore when markets are in “risk off” mode, suggesting a negative correlation with stock prices.

The data for the period 2010-23 broadly support the theory outlined above. Under “normal” circumstances of economic expansion silver does appear to have a fairly strong correlation with stock prices, in this case the S&P 500 index. Moreover, after waning in the second half of the last decade, this correlation appears to have become stronger over the past three years. However, the tendency for there to be a moderate positive correlation between US stock prices and silver is punctuated on an irregular basis by quarters when the correlation becomes strongly negative. The suggestion would be that at these times silver is behaving as a “risk off” asset and/or is being strongly influenced by other drivers that cause it to diverge strongly from the direction taken by the stock market.

Quarterly Correlations of Silver Price and S&P 500



*Using Log-returns in Daily Prices
Source: Bloomberg; PMI

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