

Precious Metals Ecosystem Dynamics: The Microeconomics of Gold and Silver

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Gold and silver are both largely supply-driven markets. The demand for precious metals is nearly infinite: who, if given the opportunity to possess them, would refuse? As such, changes in mining supply appear to have an outsized impact on prices, which, in turn, influence all other aspects of the market, including fabrication demand for jewelry, dentistry and industrial use, investment (public and private), and the availability of secondary supply.

Gold and silver prices respond in differing degrees to changes in supply, as does demand for jewelry fabrication and investment to movements in the relative prices of the two metals. There are two major reasons for this: first, substitutability, and second, price differences. Sales of gold jewelry plunge when the price of gold rises, to the benefit of silver jewelry.

Although gold and silver are not perfectly substitutable, they exert a strong influence on one another as underscored by their strong and consistently positive correlation (Figure 1). As such, the two metals are best understood as members of an ecosystem, and this paper analyzes how that ecosystem works. Since 1978, one-year rolling correlations have ranged from as low as +0.35 to as high as +0.9 and have averaged around +0.7. The underlying reason for the positive correlation is that the use of gold and silver has significant overlap in jewelry, dentistry, and as investments.

Figure 1.

One Year Rolling Gold-Silver Correlation



Source: Bloomberg Professional (GOLDS and XAG) with CME Group Economics Research Calculations

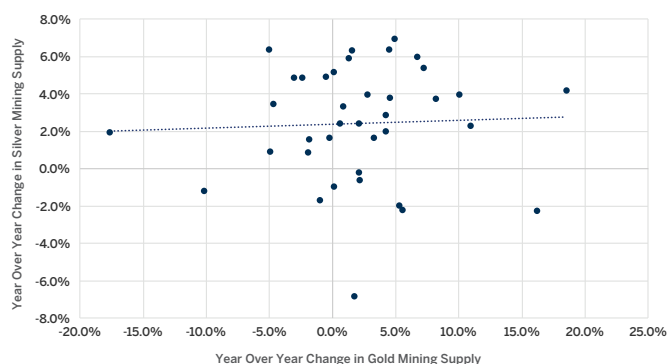
Mining Supply and Price

The only true way to bring more gold or silver onto the market is through mining. There is also what is called secondary supply, i.e. previously mined gold and silver. Secondary supply doesn't appear to influence price; rather, the opposite is the case, as higher prices bring out more secondary supply to the market. What matters in terms of gold and silver prices is primary mining supply.

Both gold and silver prices are negatively sensitive to changes in mining production; gold much more than silver. Using annual data from 1977 to 2014, we constructed a simple regression that relates the change in the average real price (after inflation) of gold (or silver) from one year to the next (the "y" or "dependent" variable) to the year-on-year change in the mining supplies of gold and silver (the "x" or "explanatory" variables). Before we discuss the results, a housekeeping note: there is almost no correlation at all between the year-over-year change in gold and silver mining supplies (Figure 2). This is important from a statistical perspective because it eliminates the possibility of multicollinearity, which can make regression results difficult to interpret.

Figure 2.

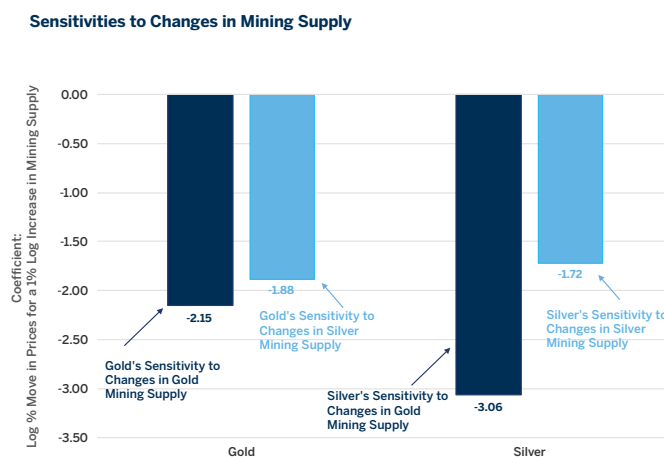
0.04 Correlation of Annual Changes in Gold and Silver Mining Supply 1977-2014



Source: CPM 2015 Gold and Silver Yearbooks with Calculations from CME Group Economic Research

What is interesting is that gold not only reacts negatively to an increase in its mining supply but also to an increase in silver's mining supply. For silver, the results are intriguing: it reacts even more negatively to an increase in gold mining supply than to a change in its own mining supply (Figure 3).

Figure 3.



Source: CPM 2015 Gold and Silver Yearbooks with Calculations from CME Group Economic Research

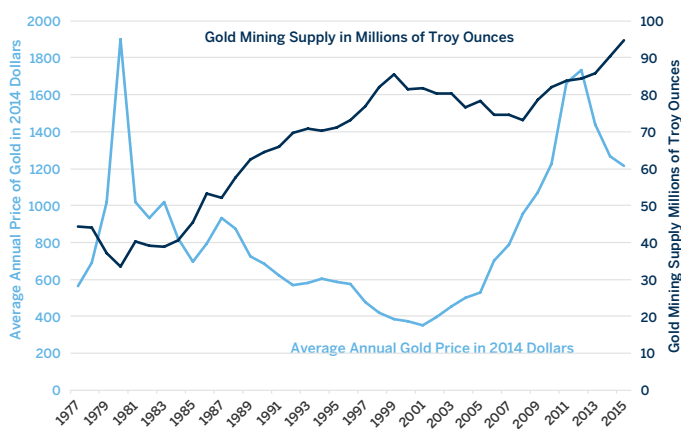
According to the regression results, between 1977 and 2014 a 1% log increase in gold mining supplies produced (on average) a 2.15% log decrease in the price of gold and a 3.06% log decrease in the price of silver. Meanwhile, a 1% log increase in the mining production of silver led to (on average) a 1.88% log decline in the price of gold and a 1.72% log decrease in the price of silver. Moreover, the regression results are quite strong from a statistical perspective: changes in the mining supply of gold and silver explain 52% of the year-on-year change in the price of gold and 47% of the year-on-year change in the price of silver. Moreover, the beta sensitivities of the change in gold prices to changes in gold and silver mining supply are quite significant as well. The likelihood of obtaining such strong results randomly are extremely low (p-Values) except in the case of silver supply's impact on silver (Table 1).

<i>Gold</i>	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	0.11	0.03	3.62	0.00
Gold Mining Supply	-2.15	0.36	-5.92	0.00
Silver Mining Supply	-1.88	0.75	-2.49	0.02
<i>Silver</i>	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	0.10	0.05	2.13	0.04
Gold Mining Supply	-3.06	0.55	-5.60	0.00
Silver Mining Supply	-1.72	1.14	-1.51	0.14

The negative impact on the inflation-adjusted price of gold from rising mining supply is clearly seen in the historical data (Figure 4). Gold mining supplies fell in the late 1970s and this coincided with soaring prices. Then from 1981 to 1998, the annual total of gold mined soared from around 30 million troy ounces to over 80 million troy ounces. This coincided with an extended period of depressed prices for both gold and silver. Subsequently, from the late 1990s until 2009, mining production of gold began to decline and the price of gold soared in real terms –almost back to its inflation adjusted 1980 peak. From 2009, however, mining supplies began to rebound, and gold peaked in 2011. Prices have since fallen in U.S. Dollar terms.

Figure 4.

Gold Mining Supply and Prices



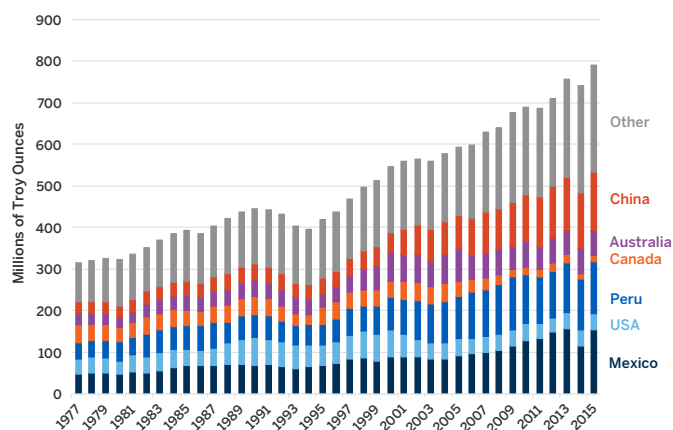
Source: CPM 2015 Gold Yearbook

If gold mining supplies continue to increase in coming years, this will likely exert downward pressure on the prices of both gold and silver. However, if gold prices fall, it won't necessarily cause mining production to pull back for either metal. Gold prices collapsed in the early 1980s and didn't hit bottom until 1998. All the while, mining production continued to soar. Once mining companies invest in new mines and begin producing, they are more or less obligated to continue producing so long as their operating cash flow remains positive, even if the prices of gold and silver fall.

While gold is clearly the dominant partner in the gold-silver ecosystem, mining production of silver also has an important role to play. Silver production has been growing strongly, notably in China and Peru (Figure 5). If silver production continues to grow, this may depress silver and gold prices.

Figure 5.

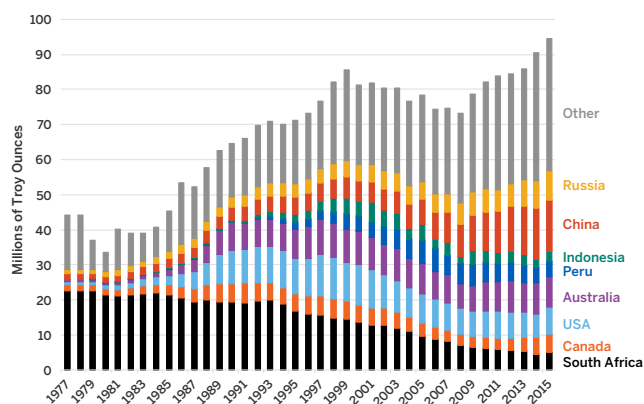
Silver Mining Production Worldwide



Source: CPM Group Silver Yearbook 2015

Figure 6.

Gold Mining Production Worldwide



Source: CPM Group Gold Yearbook 2015

If silver and gold mining production (Figure 6) is uncorrelated, why are their price movements so highly correlated? The answer lies in the demand side of the equation; but first we must address the issues of correlation and abundance.

While the two metals share a positive correlation, their relative abundance and prices differ greatly and this has important implications for their economic relationship within the precious metals ecosystem. Silver is about 60-65 times as abundant in the Earth's crust as gold. As such, it's not surprising that the price of gold is much higher than that for silver. Since 1977, the price of gold has ranged from 16x to 100x that of silver and has averaged 60x (Figure 7) – close to the metals' relative abundance ratio.

Figure 7.

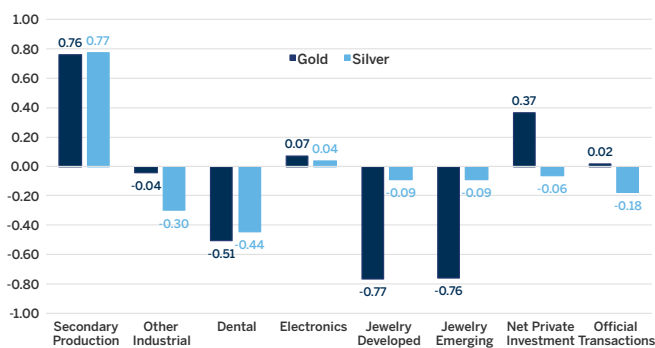
Gold/Silver Ratio



Such differences in prices make consumers more price sensitive to gold than of silver. If the price of gold goes from, say, \$300 per ounce to \$1,800 (as it did between 2002 and 2011), that will mean a great deal less in gold jewelry. Some of the decline in demand for gold jewelry will filter into a relative increase in demand for silver jewelry, whose sales may remain stable or even increase despite a significant and parallel rise in silver prices over the same period from around \$5 per ounce to as much as \$50.

Figure 8.

Correlation Coefficients: Gold and Silver Price Movements and Uses of Gold and Silver



Source: Raw Data From CPM Group Gold and Silver Yearbooks 2015.

Figure 8 shows the correlation of the year-on-year change in secondary supply in industrial, dental and electronics usage, jewelry fabrication (both in developed and emerging market countries) and net private investments, to changes in the average prices of gold and silver, respectively.

Let's discuss them one by one:

Secondary supply of gold and silver increases when their prices rise. Basically, melting down and reusing existing supplies of gold and silver doesn't negatively impact their price because the market has already taken into account such supplies. However, secondary supply increases in response to higher prices; this is uniform for both metals.

Other industrial uses (excluding electronics) for gold appear to be fairly immune from price swings whereas those for silver appear to suffer from rising silver prices as manufacturers look for substitutes or efficiencies. Electronics usage appears to be relatively immune from price swings for both metals.

Dental uses of both gold and silver decline in the face of rising prices as dentists and their customers are obliged to limit their consumption and find alternatives.

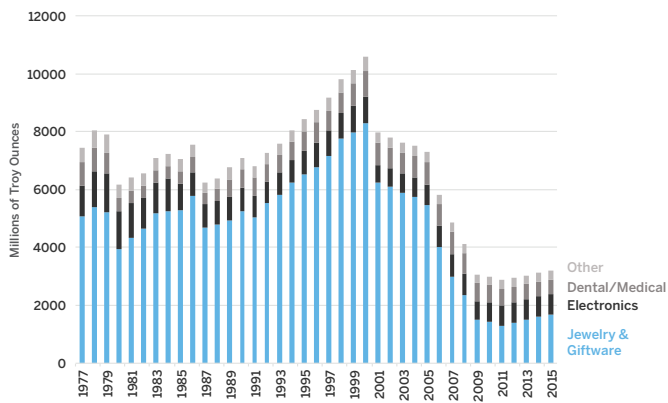
Jewelry is where the difference becomes strongly apparent. When gold prices increase, the use of gold in jewelry collapses, whereas silver's use in jewelry remains relatively steady in the face of rising prices. If mining supplies continue to increase and if gold and silver prices were to continue to fall, this could mean a big rise in the use of gold in jewelry but only a modest gain in the use of silver. Figures 9 and 10 show how the use of gold collapsed in the United States and Western Europe after the year 2000 when prices began to soar. If gold prices continue to fall, this could be a big area of recovery in gold demand.

Private investors tend to be market trend followers in gold, piling into Exchanged-Traded Funds (ETFs) and other gold investment vehicles when prices rise while pulling out when prices fall. Silver, however, doesn't seem to fascinate investors in the same manner as gold despite being a highly correlated (and cheaper) alternative.

Conclusion: When it comes to gold and silver, mining supply drives price, and price drives pretty much everything else. Although gold is the dominant player in the gold-silver ecosystem, silver supplies still exert some influence on gold. End use of gold is much more price sensitive than the end use of silver, especially in jewelry.

Figure 9.

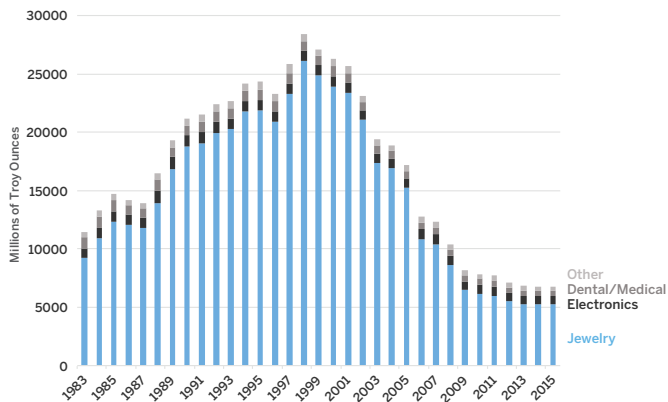
US: Annual Gold Fabrication Demand



Source: CPM Group Gold Yearbook 2015

Figure 10.

Europe: Annual Gold Fabrication Demand



Source: CPM Group Gold Yearbook 2015