



A Review of Global Silver Supply Trends

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This article provides a broad sweep review of both the long-term trends in global silver mining supply and in global silver supply concentration. The authors anticipate mine supply growth to remain challenged and for industry consolidation to marginally increase.

Long-Term Global Silver Mine Supply Trends

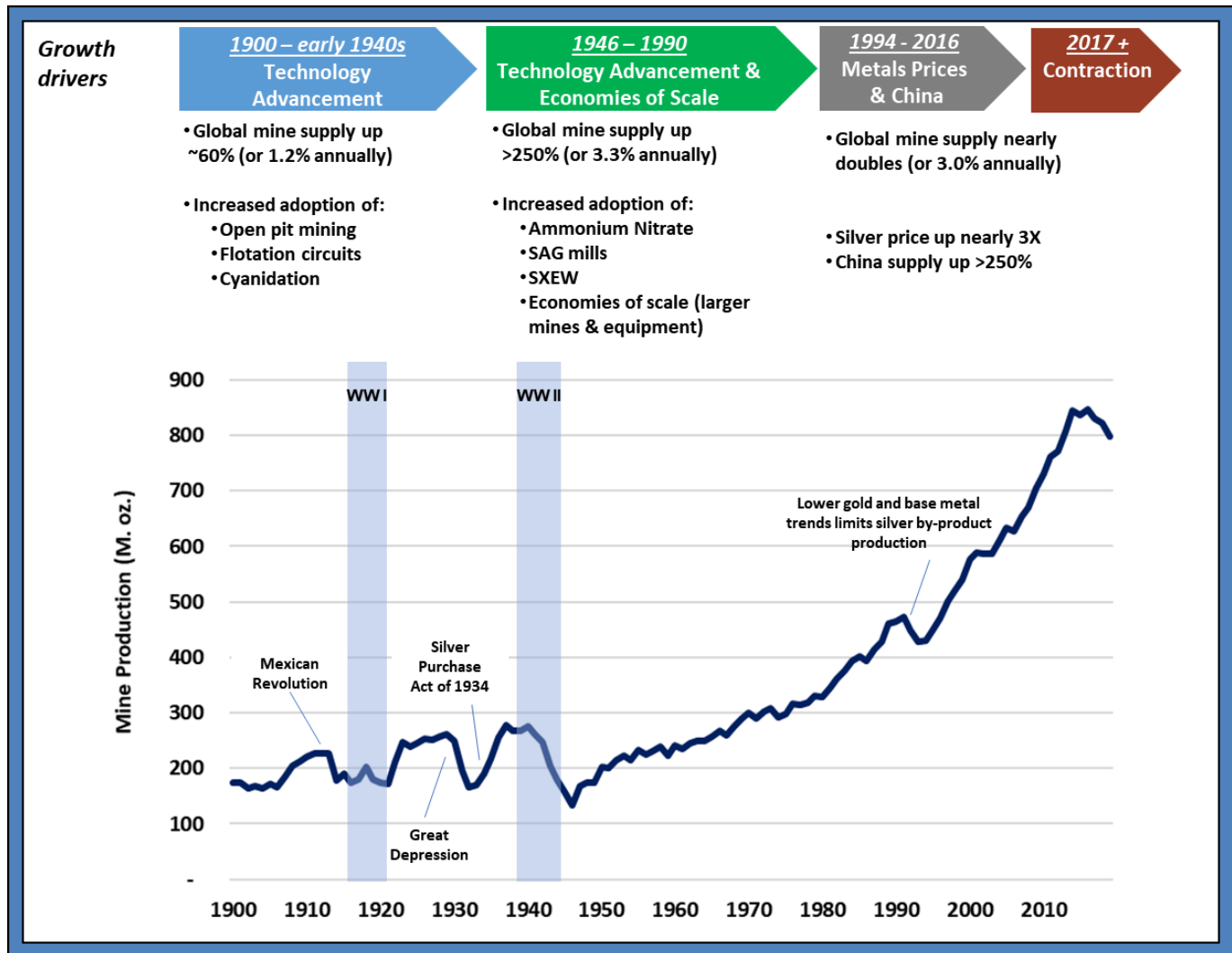
In this section, we review global silver mine supply trends. Figure 1 displays global silver mine supply since 1900 and the various drivers that buoyed growth including technology advancements, economies of scale and relatively new sources of supply (namely from China). As shown, global silver mine supply totaled slightly under 175M ounces in 1900. Aside from declines resulting from the Mexican Revolution that began in 1910, the First World War and the Great Depression, by 1940 global mine supply increased by approximately 60 percent to 275M ounces (or 1.2 percent annually). Silver mine production, along with that of other metals, benefited from increased adoption of open pit mining methods, improved ore separation techniques (such as froth flotation) as well as cyanidation processing. In the midst of the Great Depression, global mine supply declined by 35 percent, and the value of silver was nearly cut in half to average \$0.28 per ounce in 1933. To stabilize the value of silver, in 1934 Congress enacted the Silver Purchase Act whereby all U.S. mined silver was sold to the U.S. Mint for either storage or to be made into coins. By 1936, global production levels climbed back to pre-Depression levels.

Following the Second World War, during which global silver mine supply declined by over 50 percent, the years from 1946 through 1990 realized fairly steady increases in global production. Over this 45-year period, global supply climbed by over 250 percent to nearly 475M ounces (or by 3.3 percent annually). Widespread use of ammonium nitrate for blasting, heap leaching, semi-autogenous grinding (SAG) mills, Solvent Extraction/Electrowinning (SX-EW) processing and others contributed to increased production across precious and base metal operations, allowing mining companies to profitably extract gold from lower-grade and more complex ore types. Accompanying the implementation of new technologies during the 1980s and 1990s, silver mine supply growth is also being driven by large gains in economies of scale with mining and other equipment. For example, Caterpillar haul truck capacities climbed from approximately 35 tonnes in 1950 to 150 tonnes with the CAT 785 in 1984 to over 360 tonnes in 1998.¹

The early 1990s saw a sharp pullback with global mine supply declining by approximately 45M ounces to 420M ounces by 1994. Supplies declined from primary silver mining operations as well as from by-product sources. Over this period, prices dropped by over 30 percent for copper, approximately 14 percent for gold and by nearly 20 percent for silver.



Figure 1
Silver Mine Supply (in Million Ounces) and Significant Growth Drivers



Sources: United States Geological Survey (USGS), Silver Institute, CPM Group, Bloomberg, and Capitalight Research.

Reverting back to Figure 1, the most recent period of significant growth in mine supply commenced in 1994 through 2016, resulting from a period of prolonged increases in silver prices, as well as the prices for gold and copper and most mineral commodities, with the progression of the Metals Super Cycle. Average annual silver prices climbed from \$4.30 per ounce in 1993 to over \$35/ounce in 2011, prior to retreating to over \$17 in 2016. Over this period global silver mine supply almost doubled to nearly 850M ounces. Growth in Chinese mine supply was a key driver as output from the country increased from under 34M ounces in 1993 to over 120M ounces in 2016 (up nearly 260 percent).

From 2016 through 2019, global supply contracted by over 55M ounces, driven by large declines in Peru (nearly 11M ounces) and China (approximately 10M ounces). The suspension of the mining license at the Escobal mine in Guatemala in 2017 (which continues to be on care and maintenance) has contributed to

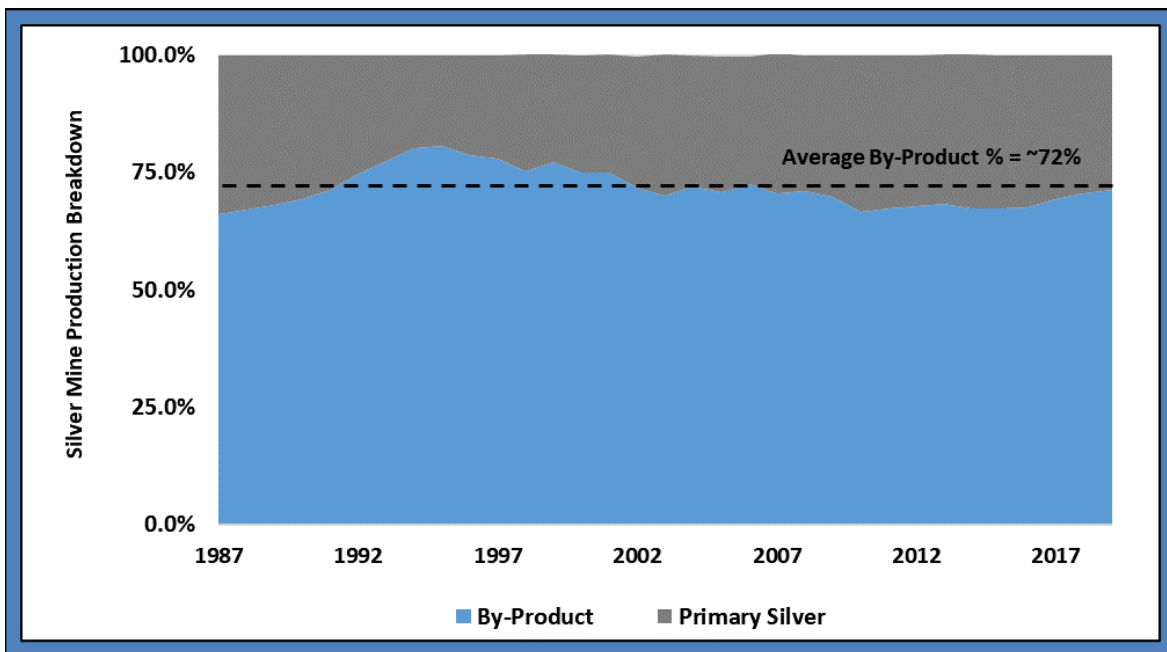


an over 20M ounce decline over this period. Overall, the majority of the drop resulted from lower production from primary silver mines (which includes Escobal) with only marginal declines from by-product sources.

By-Product and Primary Silver Mine Supply

In contrast to gold, the majority of silver mine supply has been and continues as a by-product with production and investment decisions generally driven by either gold, copper, lead and/or zinc prices and outlook.² Figure 2 displays the breakdown of annual silver mine production between primary and by-product operations since the late 1980s. As shown, on average over 70 percent of annual silver mine supply results from by-product sources. As such, global silver mine supply is less responsive to sustained increases and decreases in silver prices, influenced more by market trends in lead and zinc, followed by copper and gold.

Figure 2
Breakdown of Annual Silver Mine Supply

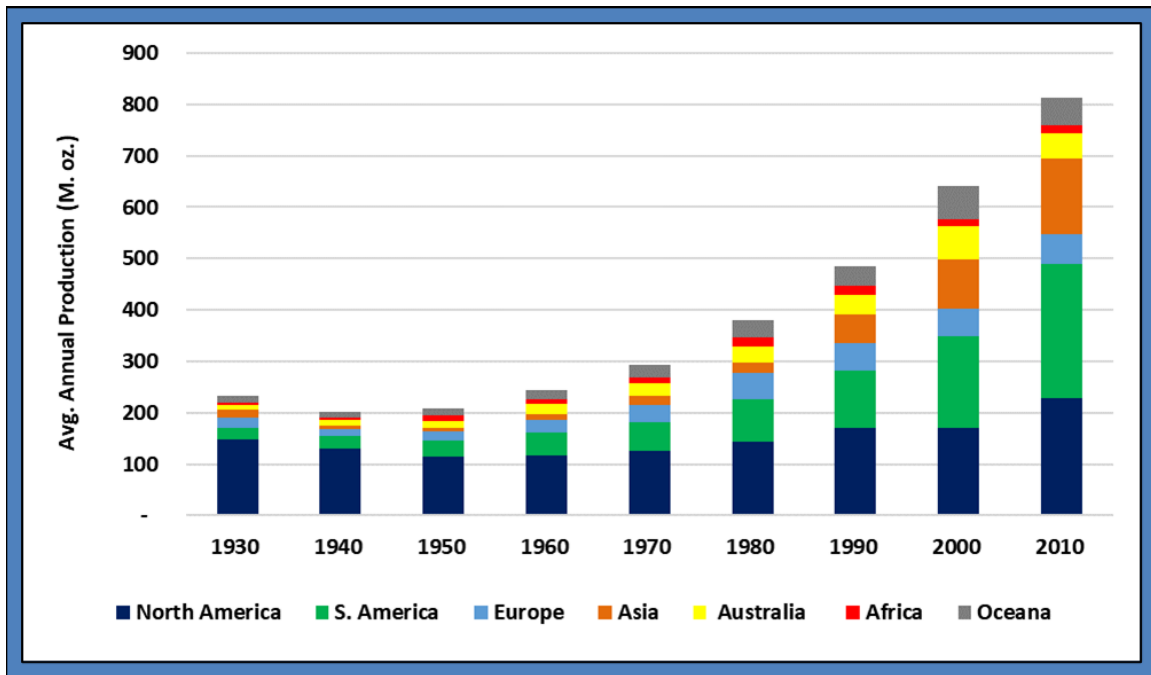


Sources: USGS, Silver Institute, CPM Group, Bloomberg, and Capitalight Research.



Figure 3 provides an overview of average annual silver mine production by key geographies by decade since the 1930s. As shown, during the 1930s, '40s and '50s, well over 60 percent of the annual global total was from North America (which includes the U.S., Canada and Mexico).³ Production from South American countries has grown steadily, from average annual production of 30M ounces during the 1950s to over 260M ounces during each of the last 10 years. Also recording significant increases has been Asia which generated less than 10M ounces annually during the 1950s to nearly 150M ounces during each of the last 10 years.

Figure 3
Key Silver Mine Producing Geographies (Average Annual Production in Million Ounces)

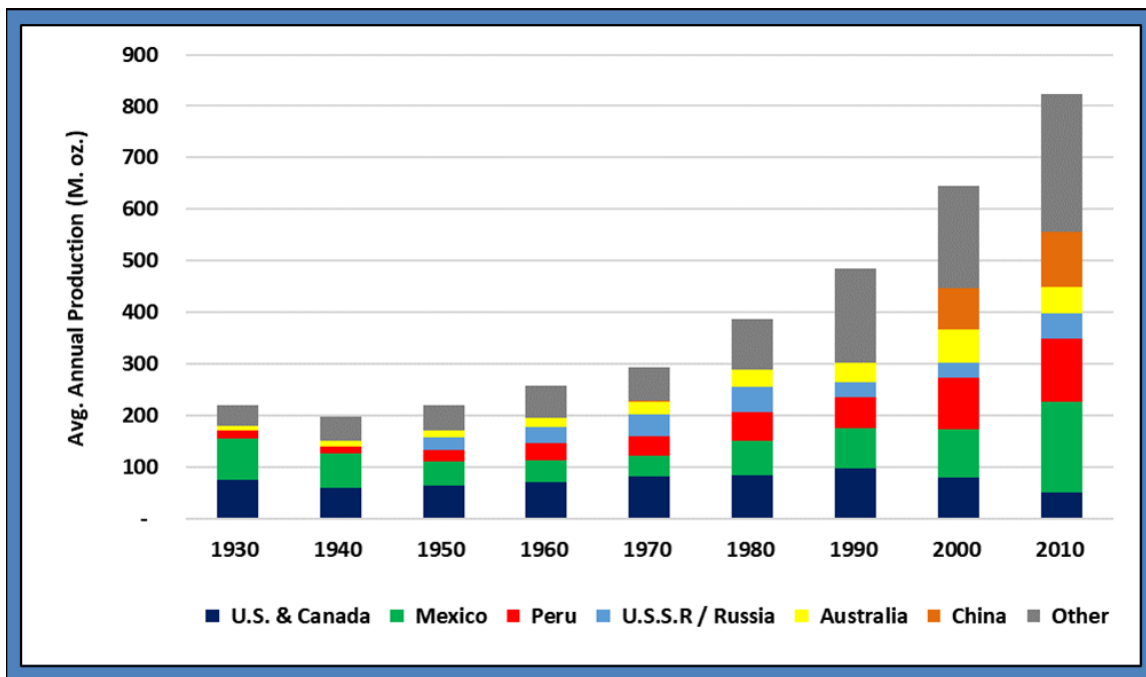


Sources: USGS, Silver Institute, CPM Group, Bloomberg, and Capitalight Research.



Figure 4 provides further silver mine supply detail by key producing countries. During the 1930s through the 1970s, cumulative average production from the U.S. and Canada averaged approximately 70M ounces annually. This increased to over 95M annual ounces during the 1990s, which has since declined to approximately 50M ounces per year during the 2010s. With the exception of a number of years during the late 1960s through mid-1970s and during the 2000s, Mexico has been the dominant annual producing country. During the last 10 years, annual supply from the country has averaged over 175M ounces. Notably, over the past 3 decades China has migrated from a relatively minor producer to mining in excess of 100M ounces over the last 10 years.

Figure 4
Key Silver Mine Producing Countries (Average Annual Production in Million Ounces)



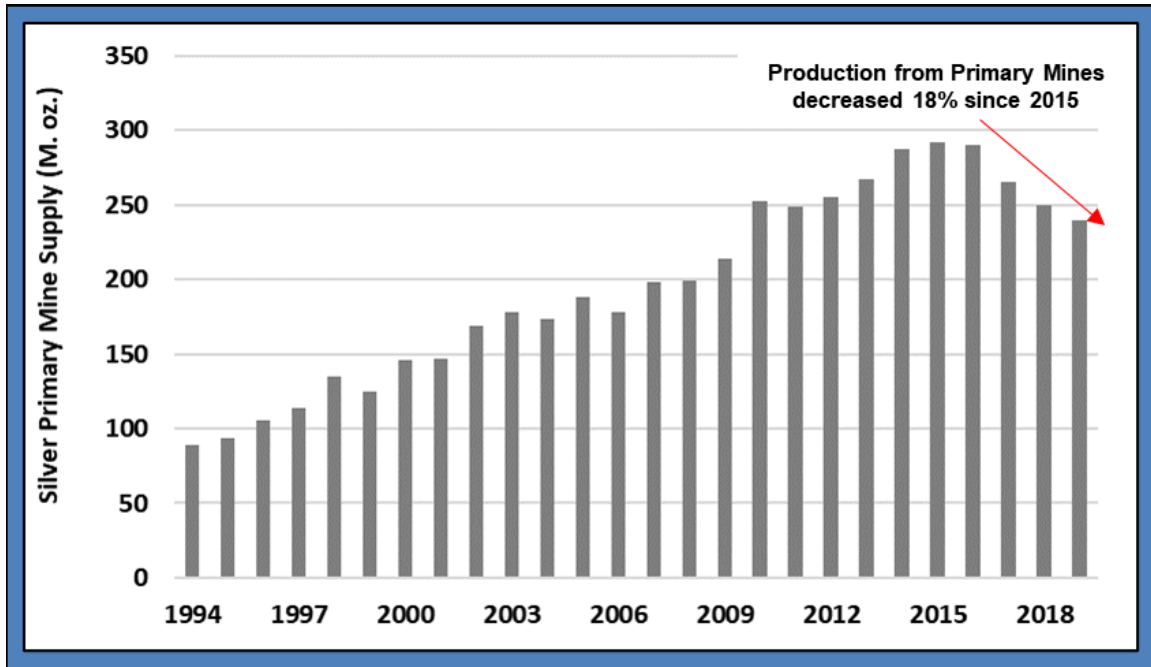
Sources: USGS, Silver Institute, CPM Group, Bloomberg, and Capitalight Research.

Expectations for Mine Supply Growth to Remain Very Challenged

As shown in Figure 1, over the past few years global silver mine supply has declined by approximately 6 percent to under 800M ounces in 2019. Figures 5 and 6 display production trends for primary silver and by-product operations, respectively. Silver mine production from primary mines has declined by over 50M ounces (or approximately 18 percent from 2015 through 2019).



Figure 5
Primary Silver Mine Production (in Million Ounces)

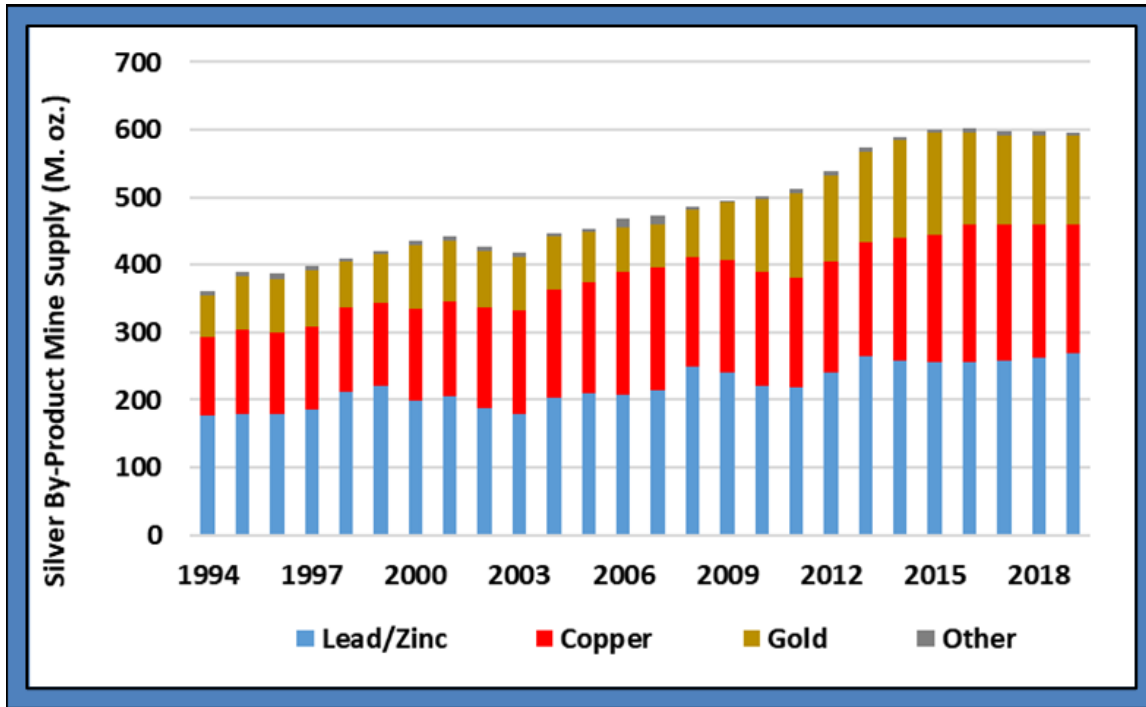


Sources: USGS, Silver Institute, CPM Group, Bloomberg, and Capitalight Research.

Silver production as a result of by-product operations has only declined marginally since 2015 (down 4M ounces or less than 1 percent). The decrease in by-product production has been driven from lower silver from primary gold mines (down approximately 13 percent), offset by increases from lead and zinc, and marginally from copper.



Figure 6
By-Product Silver Mine Production (in Million Ounces)



Sources: USGS, Silver Institute, CPM Group, Bloomberg, and Capitalight Research.

Over recent years, both primary and silver by-product mine production have been impacted by continued lower processed ore grades as well as by disruptions. As an example, Fresnillo reported lower production of over 6M ounces (or nearly 12 percent in 2019 from the year prior driven by lower ore grades at its Fresnillo, Saucito and San Julián mines). Operational disruptions from blockades, labor strikes, and social challenges also continue to impede production. Blockades at Newmont’s Penasquito mine last year drove production to approximately 21M ounces (or nearly 50 percent) below expected levels. Higher costs and lower grades also led Buenaventura to report silver production declining by over 20 percent in 2019 compared to 2018.

Going forward, we anticipate mine supply growth to remain very challenged. Lower processed grades, which in turn result from longer-term downward trends in exploration success, will pressure operating costs as well as production levels. Upticks from mining operations such as Penasquito returning to more normalized levels and the potential for the aforementioned Escobal mine to receive operating permits will likely be more than offset by structural trends with lower processed grades. Over the near-term, COVID-19 restrictions will also potentially impact production levels going forward. In the next section of this article, we will cover trends in global silver mine supply concentration.

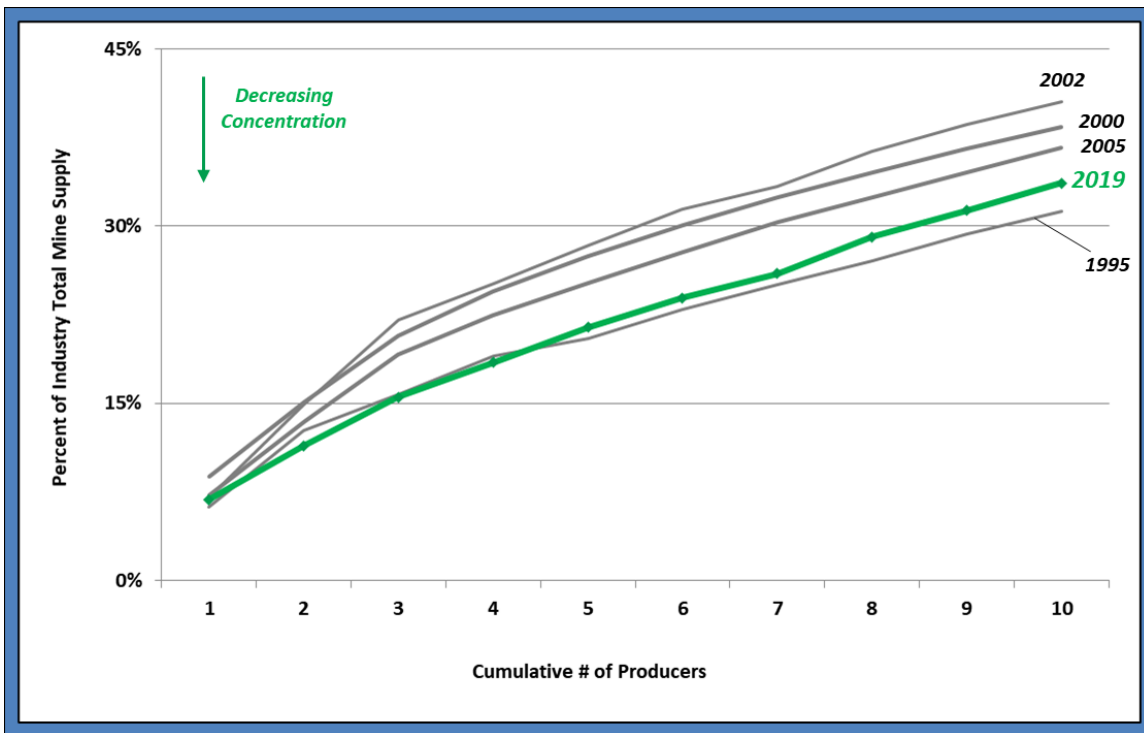


Global Silver Mine Supply Concentration Trends

Since 2000, per Bloomberg, there have been approximately 400 completed mergers and acquisition (M&A) deals (totaling nearly \$17B) in the silver mining segment. These range from the relatively large such as Pan American Silver’s acquisition of Tahoe Resource in early 2018 (for nearly \$1.1B) and First Majestic’s take-over of Primero Mining (for approximately \$320M, also in 2018) to numerous smaller deals for exploration assets. With this activity, it would seem logical to assume that global mine supply would become more concentrated with fewer firms dominating annual totals over time.

Figure 7 displays concentration of mine supply in the silver sector for various years with cumulative output from the 10 largest producers (on the x-axis) and the percent of total industry supply (on the y-axis). As shown, cumulative production from the top 10 mining companies was over 40 percent of the total in 2002. Since the turn of the millennia, supply concentration has declined with the top 10 producers contributing over 40 percent of the industry’s total mine supply in 2000, compared to 33 percent last year. Concentration, however, is still marginally higher than in the mid-1990s when the top 10 contributed slightly over 30 percent of the industry total.

Figure 7
Silver Mine Supply Concentration Trends (% of Industry Total)



Sources: Silver Institute and Capitalight Research.



Table 1 provides a listing of the top 10 silver producers in 2019, with Fresnillo's total nearly 55M ounces, followed by KGHM and Glencore. Cumulatively, these three mining companies supplied nearly 130M ounces (or 16 percent) of the industry total of approximately 837M ounces, as reported by the Silver Institute. By comparison, in 2002, the three largest producers (Fresnillo, BHP and KGHM) accounted for slightly under 25 percent of industry output. On an annual basis since 2013, Fresnillo has been the largest silver producing company, with production increasing from approximately 39M ounces to nearly 55M ounces, last year.⁴

Table 1
2019 Top 10 Silver Producers

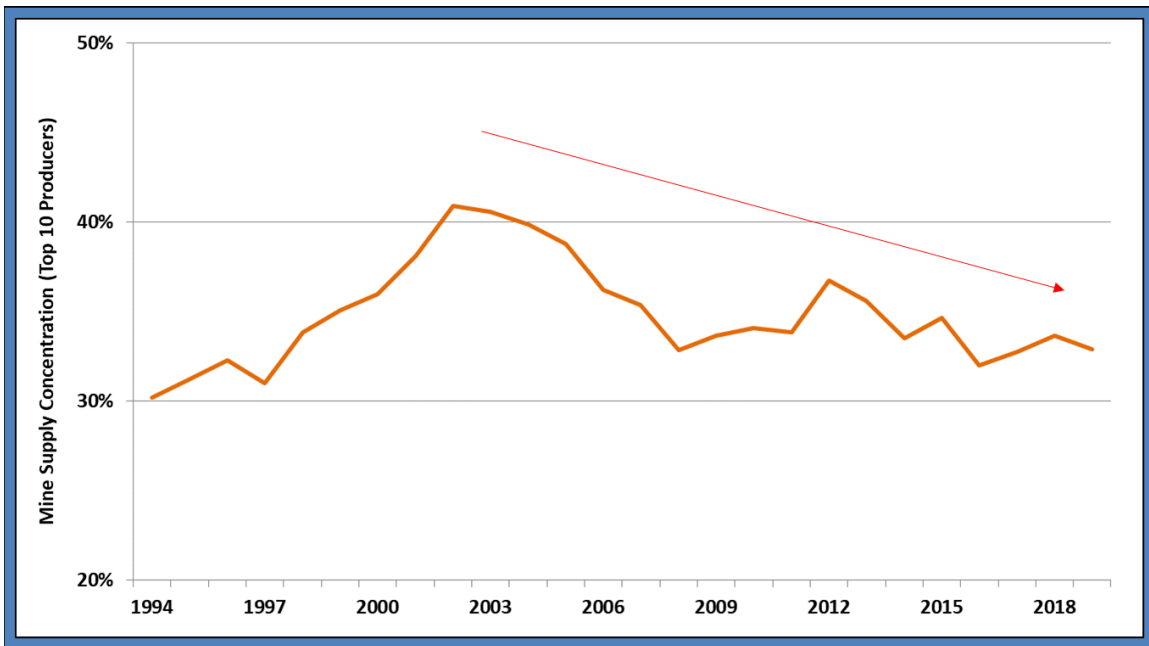
Rank	Company	2019 Silver Mine Supply (M. oz.)	Cumulative (% of Total)
1	Fresnillo	54.6	7%
2	KGHM	45.6	12%
3	Glencore	32	16%
4	PanAm Silver	25.9	19%
5	Polymetal	21.6	21%
6	Hindustan Zinc	20.4	24%
7	Southern Copper	20.3	26%
8	Buenaventura	20.1	29%
9	Codelco	17.9	31%
10	Hochschild	16.8	33%
Industry Total		836.5	

Sources: Silver Institute and Capitalight Research.



Figure 8 summarizes annual supply concentration from the top 10 producers over the last 25 years. As shown, concentration increased from the mid-1990s through early 2000s, peaking in 2002 and 2003 when output exceeded over 40 percent of the industry total. As shown in the figure, concentration has since generally trended downward, but has yet to reach the lows that occurred in the mid-1990s.

Figure 8
Silver Mine Supply Top 10 Producers (% of Industry Total)

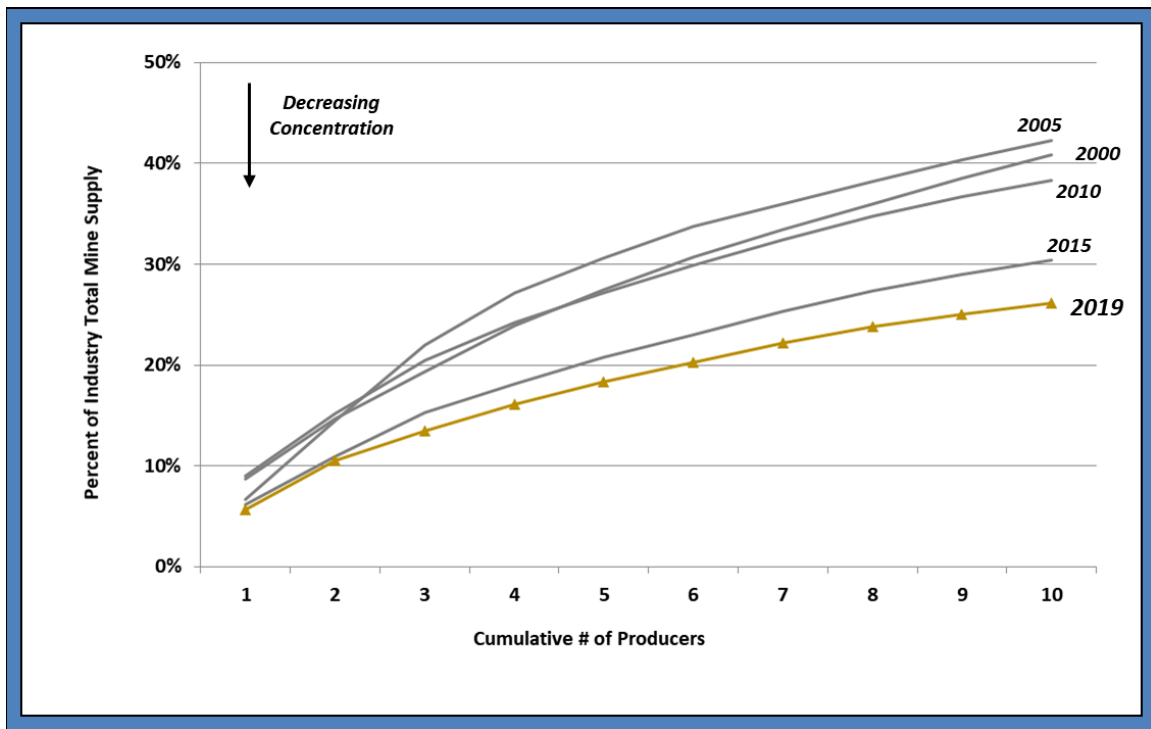


Sources: Silver Institute and Capitalight Research.



For comparative purposes, Figure 9 displays industry concentration trends in gold mine supply. Similar to silver, but relatively more dramatic, production from the top 10 gold companies has declined over the last 20 years. In 2005, production from the top gold miners accounted for 42 percent of the industry total, whereas in 2019 the total had declined to 26 percent. Gold production is less concentrated within the top miners in relation to silver.

Figure 9
Gold Mine Supply Concentration Trends (% of Industry Total)

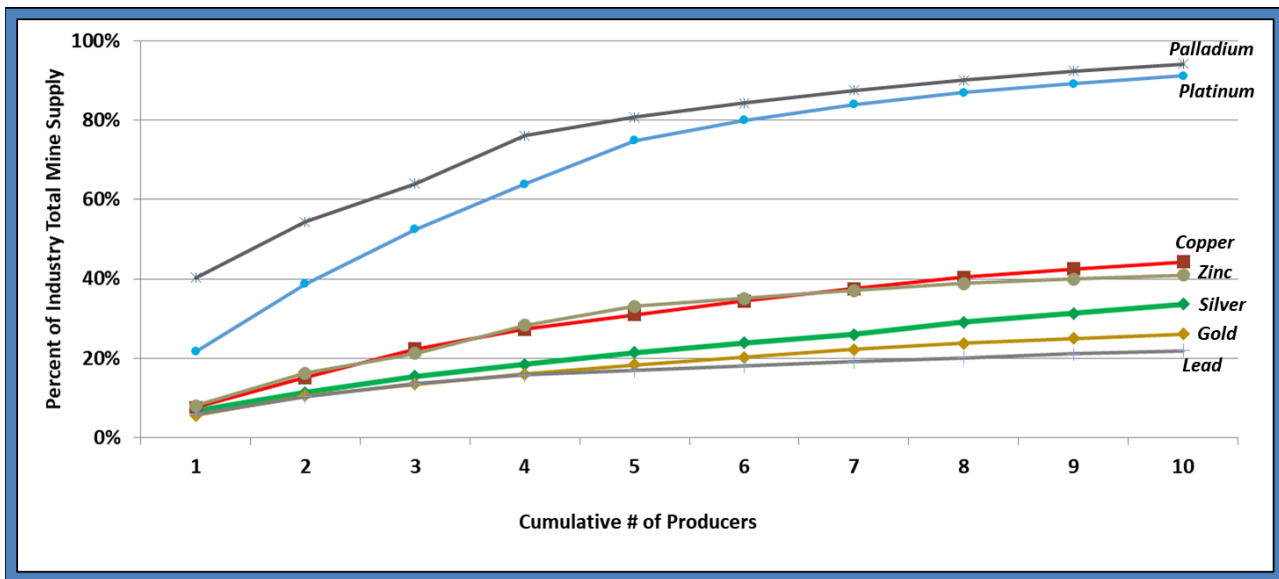


Sources: GFMS and Capitalight Research.
 [GFMS, formally Gold Fields Mineral Services, is part of Thomson Reuters.]



To provide further context, Figure 10 expands the analysis to include industry supply concentration for platinum and palladium and for key silver by-product base metals (copper, zinc and lead). As shown, mine supply is highly concentrated in the platinum and palladium sectors with the top 10 producers accounting for over 90 percent of their respective industry totals. Further the top three mining companies in these segments generated well over 50 and nearly 65 percent of the platinum and palladium totals, respectively.⁵ As mine production in these industries is geographically limited (platinum overwhelmingly dominated in South Africa and palladium production centered in Russia and South Africa), high concentration is logical due to higher barriers to entry (from relatively few commercially viable deposits).

Figure 10
Other Metal Mine Supply Concentration Trends (% of Industry Total)⁶



Sources: Silver Institute, GFMS, and Capitalight Research.

As covered previously, the vast majority of silver mine supply continues as a by-product, driven by production from zinc/lead and copper mining operations.⁷ Concentration from the top 10 copper producers represents nearly 45% of the industry total. BHP, Codelco and Freeport are the three largest producers with combined production representing over 20 percent of the 2019 global total. As with silver and gold, copper production has become less concentrated. In general, during the 1990s and 2000s the top 10 producers accounted for approximately 55 percent of global annual totals.

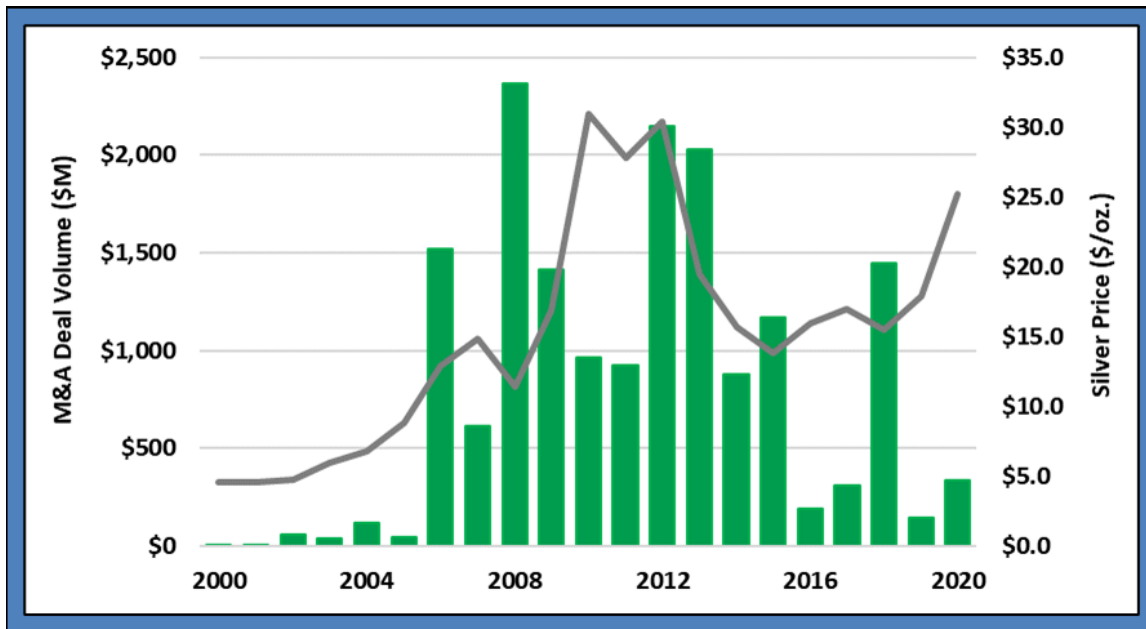
Similar to copper, top zinc producers cumulatively produce slightly over 40 percent of the 2019 annual total with over 20 percent generated by the top 3 (BHP, Glencore and Teck) last year. As shown, lead is less concentrated with the largest 10 producers cumulatively providing slightly over 20 percent of the industry total with the top three including Glencore, Vendanta Resources and Teck.



Industry Concentration Outlook

Since the turn of the millennia, silver mining has seen considerable M&A activities, totaling nearly \$17B. For the sector, Figure 11 displays annual deal volumes and average silver prices.

Figure 11
Annual Silver Mining M&A Deal Volume and Silver Prices



Sources: Bloomberg and Capitalight Research.

As shown, M&A deals, by value, peaked at nearly \$2.4B in 2008 and again exceeded \$2B in both 2012 and 2013.⁸ The aforementioned PanAm Silver and First Majestic deals drove the total to nearly \$1.5B in 2018. Such activity is expected to drive industry concentration; however, as discussed in the above analysis, supplier concentration has generally declined across the sector.

Going forward, we anticipate industry concentration levels to marginally increase in both silver and gold mine supply. The continuing mining challenges of lower processing grades and limited exploration success will force companies to look towards M&A to sustain production profiles.

Endnotes

This article is excerpted from Capitalight Research’s *Silver Monitor*, <https://www.capitalight.co/silvermonitor>.

1 Currently, the largest haul truck is the Belaz 75710, with approximately 490 tons of capacity. The largest CAT truck is the 797F with 400 tons of capacity.

2 In general, silver by-product mine producing companies will record revenues from silver production sales to offset the costs of mining of the primary metal.



- 3 This continues a trend. Seventy-five percent of global mine supply originated in North America from 1900 through 1925.
- 4 Fresnillo produced over 58M ounces in 2018 with the company expecting the 2020 total to be in the 51 to 56M ounce range.
- 5 Platinum production is dominated by South African producers (Anglo American, Impala and Sibyan-Stillwater). The Russian mining company, Norilsk Nickel is largest palladium producer (with over 40 percent of the industry's total in 2019).
- 6 Production data is for 2019 annual totals with the exception of platinum and palladium where 2018 data is used.
- 7 Since the late 1980s, well over 70 percent of annual silver mine supply results from being a by-product of mining other metals with the remainder from primary silver mines.
- 8 These deals include completed merger and acquisitions, investments and joint ventures with disclosed dollar-amounts.

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Dr. Thomas Brady is a mineral and commodity sector economist and is currently the Executive Director of the J.P. Morgan Center for Commodities at the University of Colorado Denver Business School and founder of Brady Commodity Advisors, LLC. Most recently Dr. Brady was the Chief Economist at Newmont Mining Corporation responsible for generating key commodity price, foreign exchange and other financial assumptions used throughout the company. Previously at Newmont, he led the Strategic Planning function that developed and implemented portfolio modeling analytics and also held positions in Investor Relations, Treasury and Corporate Development.

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Dr. Brady holds a Ph.D. in Mineral Economics with research emphases in commodity markets from the Colorado School of Mines. In addition, he holds a Master's degree in Mathematics, also from the Colorado School of Mines.

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Ms. Chantelle Schieven brings fifteen years of experience from the financial industry and five years of entrepreneurial practice to the Capitalight Research team in Toronto, Canada.

Ms. Schieven joined Dundee Economics in 2008 in Toronto where her skills in economic research and analysis and her ability to translate data into concise, meaningful charts and graphs made her a principal contributor to Dundee Economics publications. She also regularly contributed articles about the effect of the actions of Central Banks on global markets.

In 2016, she joined Murenbeeld & Co., rebranded in 2021 to Capitalight Research, also in Toronto, where she continues to contribute articles, research, and analyses in weekly and monthly publications. She specializes in research and analysis with a focus on the effects of macroeconomic events and data on gold and silver prices, equity markets, exchange rates, and interest rates.

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