Chapter 1
Key Challenges and Opportunities in the Gold and Silver Industry

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Gold and silver have been known to mankind since the fourth millennium BCE. For a large part of history, gold and silver have been considered stores of value and used as currencies. With the switch to fiat money and the advent of the industrial age, gold and silver have become commodities. The profitability of gold and silver industry is directly dependent on the prices of gold and silver, which is no longer dependent on supply and demand only but many other factors including investor sentiment. To get a complete picture of the price dynamics of gold and silver, it is important to understand the role gold and silver have played in human history.

1.1 Gold and Silver as Currency

Gold has always been considered more valuable than silver. Menes, the founder of the first Egyptian dynasty, has described the value of gold to be two and one half times the value of silver. Gold coins were first produced in Lydia, Western Turkey, in the sixth century BCE from electrum, a natural alloy of gold and silver. The use of gold coins called aureus was prevalent in the Roman Empire. Emperor Julius Caesar (49–44 BCE) set the weight of aureus gold coin to be 1/40 of a Roman pound (328.9 g) of pure gold or about ~8.2 g. The weight of aureus was successively reduced during the reign of Roman emperors (Wikipedia 2018a).

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It fell to 1/45 of a Roman pound (~7.3 g) during the reign of Nero (54–68 CE) and to 1/50 of a Roman pound by the time of Caracalla (211–217 CE). New gold coin named solidus, meaning sold gold, was introduced by Diocletian (284–305 CE) around 301 CE and weighed 1/60 of a Roman pound or about 5.5 g each. The value of one gold coin solidus was set to 1000 silver coins called denarius. Only limited amount of solidus gold coins were struck and aureus also remained in circulation. Emperor Constantine the Great (306–337 CE) reintroduced the solidus gold coins but set its weight at 1/72 of a Roman pound or about 4.5 g each. Through all these changes, the purity of gold coins remained the same at over 99%. However, this was not the case with the silver coin denarius, which contained less and less silver as the time passed.

Around 211 BCE, denarius weighed 1/72 of a Roman pound or around 4.5 grams. During the rule of Augustus (31 BCE–14 CE), the weight of denarius decreased to 1/84 of a Roman pound or around 3.9 g. The silver content of denarius was 95–98% by weight between 211 BCE and 37 CE. The weight of denarius coins decreased to 1/96 of a Roman pound or around 3.4 grams during the time of Nero (37–68 CE) and silver content decreased to 93.5% (Wikipedia 2018b). The weight of denarius coins remained constant at 1/96 of a Roman pound or around 3.4 g after this time, but the silver content kept on decreasing. The denarius contained about 85% silver during the reign of Trajan (98–117 CE), 75% silver during the reign of Marcus Aurelius (161–180 CE), 60% silver during the reign of Septimius Severus (193–211 CE), 50% silver during the reign of Caracalla (198–217 CE), and only 0.5% in 268 CE during a period of intense civil war and foreign invasions (Peden 2017). The silver content of denarius was set to 5% in 274 CE by Aurelian. There was runaway inflation in the Roman Empire during the fourth century, which ultimately led to its disintegration. One Roman pound of gold was worth 50,000 denarius coins in 301 CE, 120,000 denarius coins in 311 CE, 300,000 denarius coins in 324 CE, and 20,000,000 denarius coins in 337 CE in the year of Constantine's death (Peden 2017).

After the fall of Western Roman Empire, Byzantine gold solidus coin commonly called bezant was widely used during middle ages throughout Europe and the Mediterranean. As the influence of Byzantine Empire waned, silver currencies became prevalent in Europe. Silver pennies, Italian denari, French deniers, and Spanish Dineros circulated in Europe. This led to use of a silver standard, which was followed in many countries before being abandoned in the early twentieth century. The ratio of value of gold to silver was 15½:1 from the sixteenth century to nineteenth century. The price of an ounce of gold was set at £0.89 in 1257 CE by Great Britain, which was gradually increased to £4.25 in 1717 CE and then kept at £4.25 per ounce of gold till 1944 Bretton Woods Agreement. In the nineteenth century, most countries printed paper currencies that were backed by gold reserves. It became known as the gold standard. The United States followed the British gold standard prior to 1791 CE. It set the price of gold at $19.49 per ounce in 1791, raised to $20.69 per ounce in 1834, and adjusted to $20.67 per ounce by the Gold Standard Act of 1900. Bretton Woods Agreement was adapted by most developed countries in 1944 to settle their international balances in US dollar effectively making the US dollar the official global currency. Under this agreement, the US dollar was made fully convertible to gold at the exchange rate of $35/ounce. Till 1960, the United States maintained the price of gold close to $35 per ounce by selling gold to the free market whenever the price of gold increased. In 1961, the London Gold Pool was established by pooling of gold reserves from eight central banks in the United States and seven European countries. The London Gold Pool tried to maintain the Bretton Woods System of fixed-rate convertible currencies and defend a gold price of US$35 per troy ounce in the London gold market. This resulted in major losses to the member countries, and the London Gold Pool collapsed in 1968. In 1972, the Gold Standard or the pegging of gold price to US dollar was abandoned, and in 1974 all restrictions on trading of gold were lifted. Gold became a commodity to be traded on stock exchanges.

1.2 Gold and Silver as Commodity

After gold started trading in the open market, the gold price rose sharply. It was trading over $160 per ounce in 1975 and over $600 per ounce in 1980. After that, the gold price dropped slowly to below $260 per ounce in 2001 and then rose again to peak at over $1900 per ounce in 2011. The gold price fell to below $1100 per ounce in 2015 and was trading above $1200 per ounce in October 2018. Figure 1.1 shows the price of gold over the last 6 years.

Silver price was around $1 per ounce in 1961 and rose slowly to around $6 per ounce in the beginning of 1979. The Hunt brothers, Nelson Bunker Hunt and William Herbert Hunt, tried to corner the silver market, and the silver price rose rapidly to a record high of $49.45 per ounce on January 18, 1980. In response to the rising silver price, COMEX (Commodity Exchange, Inc.), a division of the New York Mercantile Exchange (NYMEX), introduced Silver Rule 7 on January 7, 1980, placing heavy restrictions on the purchase of commodities on the margin. The price of silver started to fall and silver market crashed. The price of silver dropped by

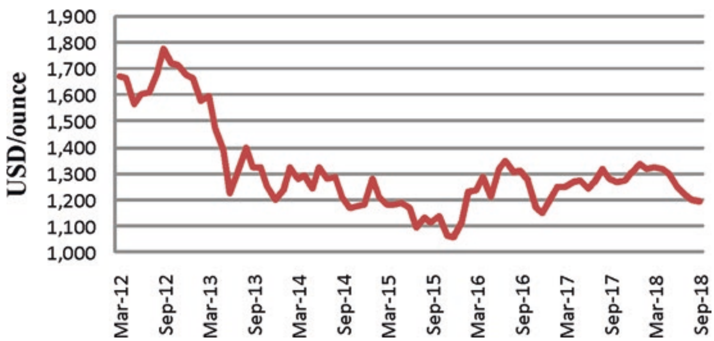

Fig. 1.1 The price of gold between 2012 and 2018 (Data from investing.com)

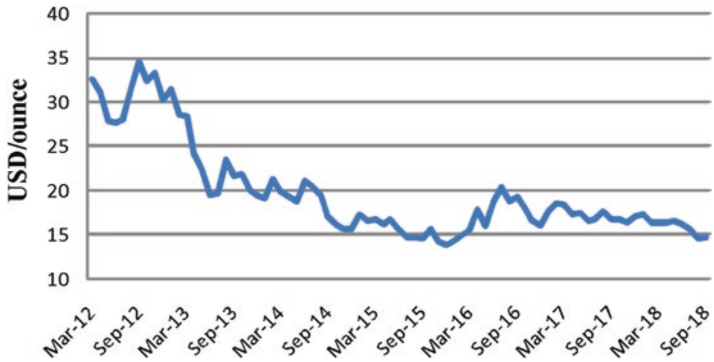

Fig. 1.2 The price of silver between 2012 and 2018 (Data from investing.com)

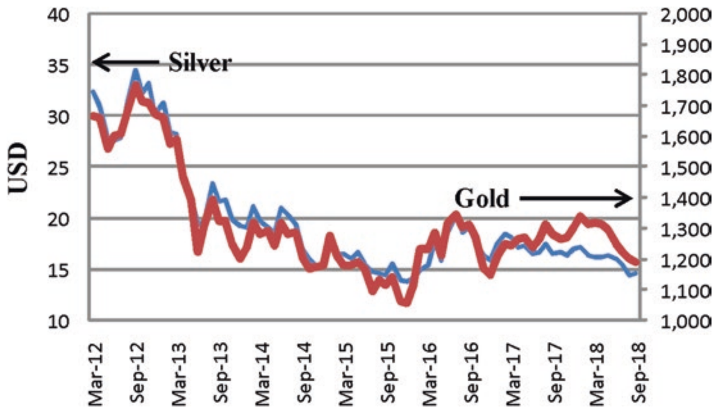

Fig. 1.3 The comparison of gold (thick line) and silver (thin line) prices between 2012 and 2018 (Data from investing.com)

50% on March 27, 1980, known as Silver Thursday, from $21.62 per ounce to $10.80 per ounce. Subsequently, the price of silver slowly fell to under $4 per ounce in the early 1990s. The price of silver then recovered and peaked to around $50 per ounce in 2011. Since then the price of silver has retreated, and silver was trading below $15 per ounce in October 2018. Figure 1.2 shows the price of silver over the last 6 years. The prices of gold and silver are highly correlated as seen in Fig. 1.3.

There are many factors that affect the price of gold including the strength of US dollar. The US Dollar Index is an index that measures the strength of US dollar compared to the currencies of major traditional US trading partners. It is maintained and published by ICE (Intercontinental Exchange, Inc.), with the name “US Dollar Index”. It is a weighted geometric mean of the dollar’s value relative to Euro (57.6% weight), Japanese yen (13.6% weight), Pound sterling (11.9% weight), Canadian dollar (9.1% weight), Swedish krona (4.2% weight), and Swiss franc (3.6% weight). It was established in March 1973 after the Bretton Woods system was dismantled.

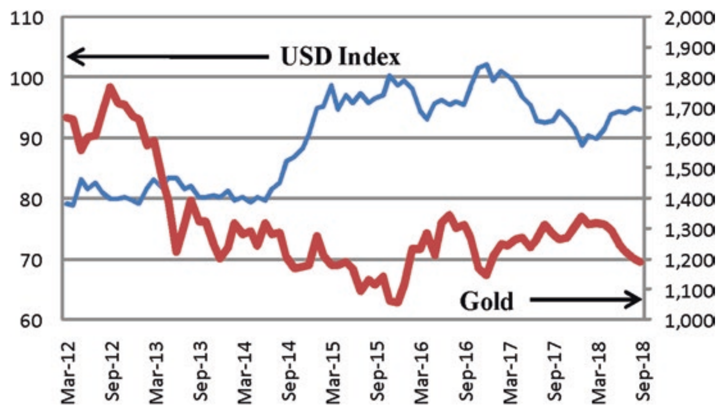

Fig. 1.4 The comparison of the gold price (thick line) and the US Dollar Index (thin line) between 2012 and 2018 (Data from investing.com)

Its value was 100 to begin with. Its highest value was 164.72 in February 1985 and lowest value was 70.70 on March 16, 2008 (Wikipedia 2018c). Figure 1.4 shows the value of the US Dollar Index and the price of gold over the last 6 years. It can be seen that the US Dollar Index and the price of gold have been negatively correlated since 2014.

As US dollar strengthens, gold becomes more expensive in other currencies leading to a fall in demand and a lower price of gold. Conversely, as US dollar weakens, gold becomes less expensive in other currencies leading to a rise in demand and a higher price of gold. As both gold and US dollar are considered safe havens, the price of gold and the value of US Dollar Index can rise together during times of economic uncertainty.

1.3 The Competition for Investment

Since gold is now traded as a commodity in the open market, the price of gold is affected by investor sentiments. Gold has traded lower since it peaked in 2011 at over $1900 per ounce. After making a low below $1100 per ounce in 2015, the price of gold has failed to reach $1400 per ounce. This has resulted in many investors shying away from investing in gold mining companies as the return on investment has been poor or negative. This can be judged from the share price performance of Barrick Gold Corporation, one of the largest gold mining companies in the world as seen in Fig. 1.5.

The share price of Barrick Gold Corporation peaked over $50 in 2011 but then fell below $7 in 2015 as the price of gold fell. Subsequently, the share price rose above $20 in 2016 as gold price rose due to economic uncertainty caused by Brexit. Since then share price of Barrick Gold Corporation has been trending lower and was trading above $11 in September 2018. Due to poor returns, investors have been

Fig. 1.5 The share price of Barrick Gold Corporation (Data from investing.com)

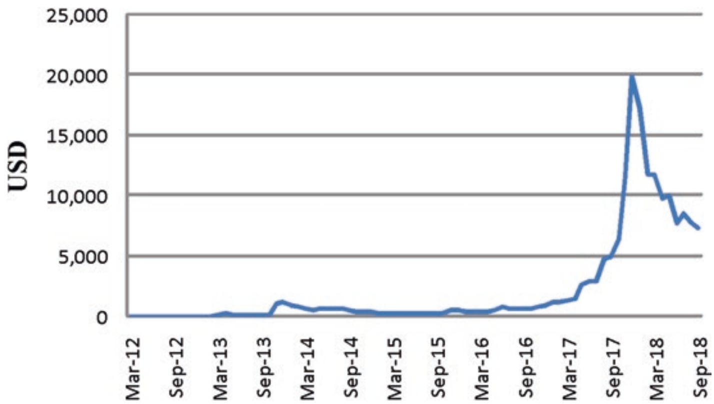

Fig. 1.6 The price of Bitcoin between 2012 and 2018 (Data from investing.com)

flocking to other asset classes in recent years such as cryptocurrencies and marijuana stocks.

A cryptocurrency (or crypto currency) is a digital asset that uses cryptography for secure financial transactions. It uses decentralized control as opposed to centralized banking systems through distributed ledger technology, typically a Blockchain, which serves as a public financial transaction database (Wikipedia 2018d). The most popular cryptocurrency is Bitcoin, first released as open-source software in 2009. Since the release of Bitcoin, over 4000 other cryptocurrencies have been created. Figure 1.6 shows the price of Bitcoin between 2012 and 2018.

The price of Bitcoin rose exponentially in 2017 reaching a peak of $19,891 in December 2017. The price of Bitcoin then fell sharply making a low below $6000 in June 2018. The Bitcoin was trading above $6000 in October 2018. The collective market cap of all cryptocurrencies has fallen from the peak value of over $700 billion

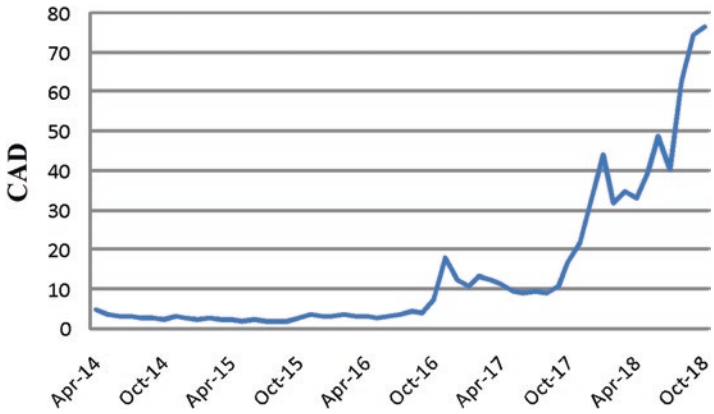

Fig. 1.7 The share price of Canopy Growth Corp (Data from investing.com)

in January 2018 to below $200 billion in August 2018 and was holding above $200 billion in October 2018 (Tradingview 2018).

During the last few years, investors were also pumping money in the cannabis sector. Canada is the first country among G7 nations to legalize marijuana. Recreational cannabis was legalized on October 17, 2018, in Canada. In anticipation, many companies were listed on Canadian stock exchanges and attracted significant investment. In May 2018, there were 90 publicly listed cannabis companies in Canada with a market value of about CAD 31 billion (Financial Post 2018b). Figure 1.7 shows the share price performance of Canopy Growth Corp, the biggest company in the world in the cannabis sector. From under 2 Canadian dollar in 2014 and 2015, the stock price of Canopy Growth Corp has rallied to over 75 Canadian dollar in October 2018.

With investors pumping money in cryptocurrencies and cannabis companies, mining companies are struggling to raise money for exploration and capital expenditures. As a result, a number of resource companies have become marijuana companies by reverse takeover and spinoffs. Nearly half of the Canadian marijuana companies, over 40 in March 2018, had started out in the resource sector before converting to marijuana companies (Financial Post 2018a). Reverse takeover of an existing mining or oil and gas "shells" as the listing vehicle is a potentially faster way to list on a stock exchange instead of a traditional initial public offering, which requires a full securities commission review or filing of a prospectus.

1.4 Challenges and Opportunities

The gold and silver mining companies are facing multiple challenges. It is difficult to find a large deposit with good grades. As shown in Fig. 1.8, the average grade of gold ores has been falling. This has resulted in a decreasing yield to spend ratio as

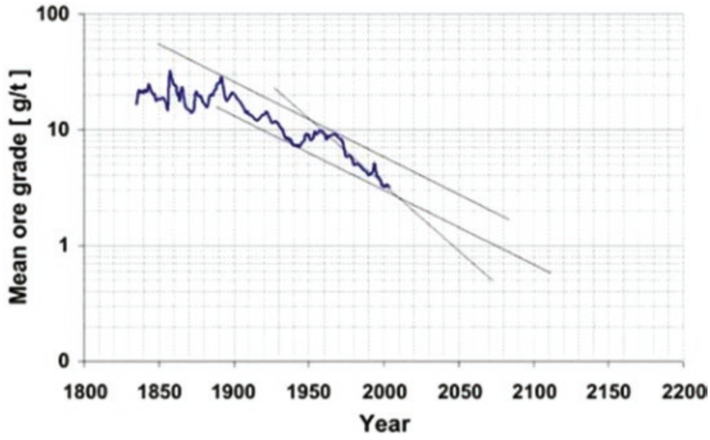

Fig. 1.8 The variation of average gold ore grade with time (Müller and Frimmel 2010)

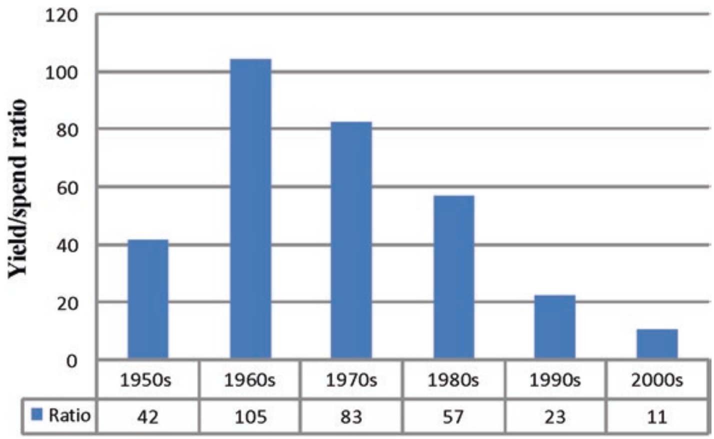

Fig. 1.9 The yield to spend ratio over time (Müller and Frimmel 2010)

shown in Fig. 1.9. In the 1960s, 1 US$ expenditure on exploration yielded 105 US$ of value in the ore discovered on average. This had decreased to 11 US$ of value per 1 US$ expenditure in the 2000s.

The need of the hour is for gold miners to find large economically viable deposits in mining-friendly jurisdictions with no environmental issues. The gold miners are facing the problem of depleting reserves as they are unable to find huge deposits of gold to replace the large gold mines that are close to getting depleted. Many gold miners have also sold some of their mines to reduce their debt. As shown in Fig. 1.10, gold reserves of Barrick Gold Corporation decreased from 140 million ounces at the end of 2012 to 64 million ounces at the end of 2017. This represents a drop in gold reserves of 54% in just 5 years. The amount of gold produced by Barrick Gold Corporation has also been decreasing as shown in Fig. 1.11. The amount of gold

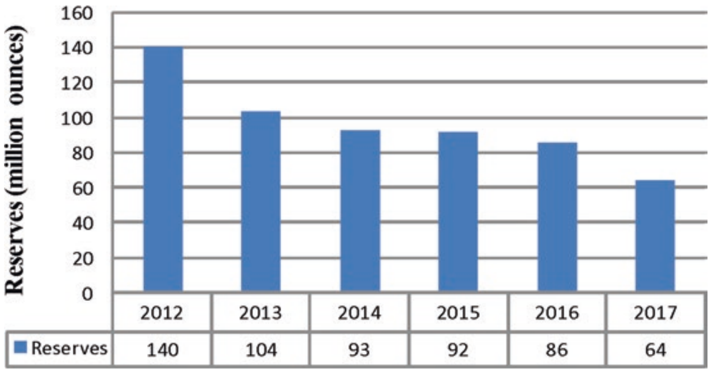

Fig. 1.10 The change in gold reserves of Barrick Gold Corporation

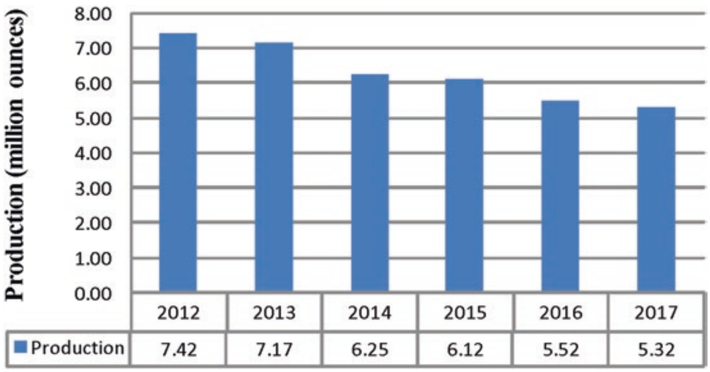

Fig. 1.11 The amount of gold produced by Barrick Gold Corporation (Reuters 2018)

produced by Barrick Gold Corporation decreased from 7.42 million ounces in 2012 to 5.32 million ounces in 2017. This represents a drop in gold production of 28% in 5 years. Other major gold miners have also reported lower gold production. The loss in gold production by major gold mining companies has been compensated by gold production by junior mining companies, and as a result, the world production of gold has reached a plateau. As shown in Fig. 1.12, world gold production has been close to 3250 tons during 2015, 2016, and 2017.

In response to the fall in gold price since 2011, gold companies have tried to be more efficient and reduce the cost of gold production. The gold companies have also become more transparent by developing a measure of what it actually costs them to produce an ounce of gold. This metric called all-in sustaining cost (AISC) was established by World Gold Council in 2013. Figure 1.13 shows the AISC of gold production by Barrick Gold Corporation from 2012 to 2017. Barrick was able to reduce AISC of gold production from $945 per ounce to $730 per ounce between 2012 and 2016. AISC increased slightly to $750 per ounce in 2017. For most gold

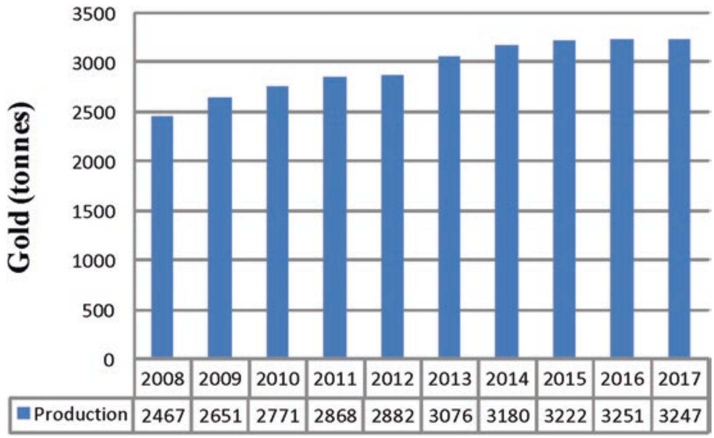

Fig. 1.12 Production of gold over last 10 years (Reuters 2018)

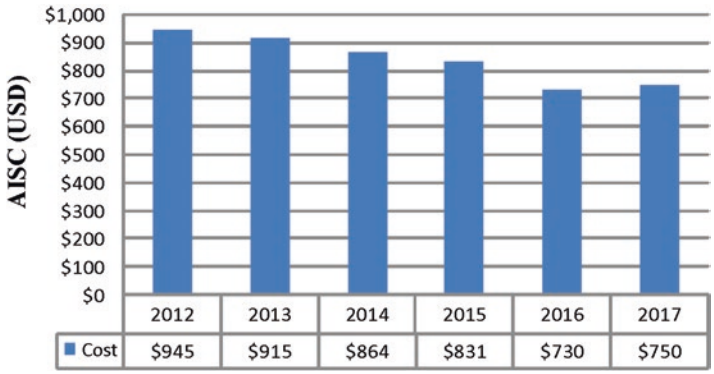

Fig. 1.13 All-in sustaining cost (AISC) of gold production by Barrick Gold Corporation

companies, AISC of gold production is much higher. When gold price fell below $1050 per ounce in December 2015, AISC of many gold miners became higher than the price of gold.

1.5 Embracing Innovation as a Core Value by the Gold and Silver Industry

As the gold mining industry is evolving, so are the challenges associated with mining. Some of the key challenges are low-grade complex ore bodies at greater depths, high capital and operating costs, high energy costs, water scarcity and quality issues, complex environmental issues including tailings management, worldwide constraints on resources availability, stringent regulations impacting the permitting processes, increasing stakeholder expectations, changing demographics of mining operations, and the urgent need for a better assessment of project viability, all these in a very dynamic metals market. This existing mining paradigm is just not sustainable.

The need of the hour for the gold and silver industry is to focus on innovation. There has been no major technology breakthrough in the industry for decades. The last major advancement took place in the 1980s with the emergence of pressure leaching to recover gold from refractory ores. Mining industry needs to invest heavily in research to develop technologies that will drastically lower the cost of finding new ore deposits and processing of ores to produce gold and silver. This is only possible if the fundamental issue of enormous generation of mining waste production, handling, and disposal is addressed as a priority. Selective mining and highly efficient metal extraction right at the mining face or in situ metal recovery is what we need to transform mining, with minimal use of water and energy and zero tailings generation.

The ideal scenario of zero waste mining is not impossible if the industry is determined to embrace innovation as its core value leveraging digital and advanced technologies along with continuously investing in research and development. This is only possible if we engage the young and bright minds to participate in the industry's strategic growth, operational, business, environment, and corporate stewardship activities. The digital era is upon us, and mining needs to gear up to prepare the industry for the next generation of jobs that don't exist today. This is an exciting journey, but the success and investor confidence will only happen if the industry rapidly embraces the digital way of working and innovative technologies.

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