SFA Oxford

THE PALLADIUM STANDARD

September 2016

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Edition 01

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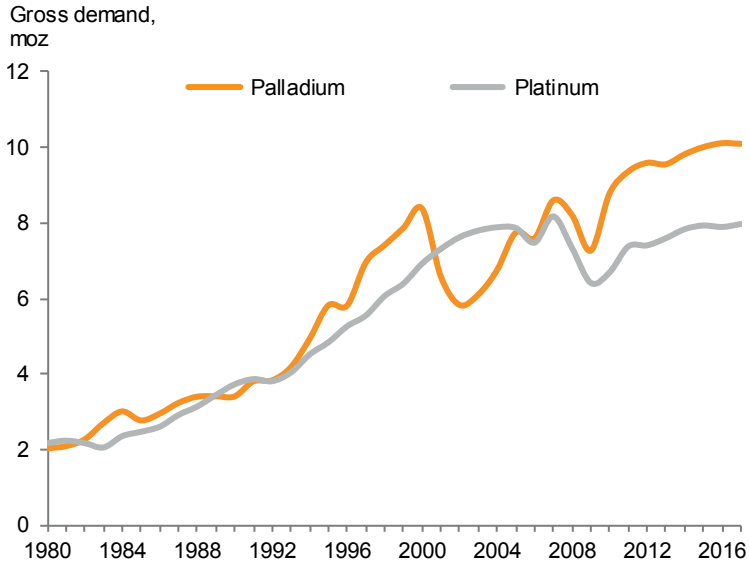
FOREWORD

Foreword

And the winner is...

...palladium! By a mile, or at least by a couple of million ounces over platinum. For the palladium market will grow to over 10 million ounces in 2016. From humble beginnings in the 1970s and 1980s, it was North America that was responsible for unlocking palladium's potential when the same company that commercialised the car ignited a cleaner gasoline market. Ford figured out a way of substituting cheaper palladium for platinum in gasoline cars from the late 1980s and since then the number of vehicles manufactured worldwide has doubled and palladium's use in vehicles has tripled! North America will continue to be palladium's biggest supporter, as its largest consumer, recycler and as a major investor. Leader of the free world of PGMs and America's favourite PGM by a landslide, it's now time, and what better place than New York, to inaugurate SFA's dedicated palladium market report: *The Palladium Standard.* Inside: Beresford Clarke recounts palladium's journey to control of the white metal house.

Polls apart: Palladium vs. platinum market size

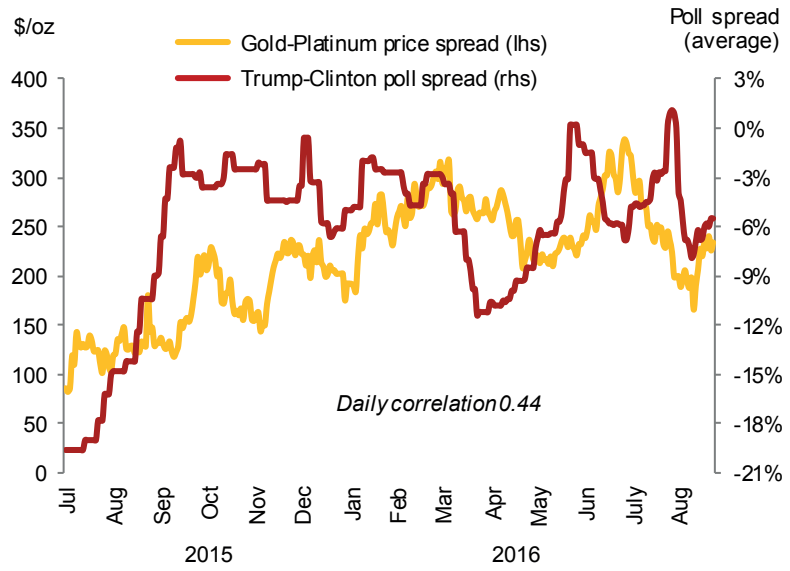


Source: SFA (Oxford)

One other choice this year is less obvious and arguably more odious. Or, as H.L. Mencken timelessly observed almost a hundred years ago: "Consider...a campaign for the Presidency. Would it be possible to imagine anything more uproariously idiotic – a deafening, nerve-wracking battle to the death between Tweedledum and Tweedledee, Harlequin and Sganarelle, Gobbo and Dr. Cook – the unspeakable, with fearful snorts, gradually swallowing the inconceivable?"

If the polls are anything to go by, Hobson has made his Choice. For the most part, the prospect of Mr. Trump rather than Mrs. Clinton appeared to be scarier – boosting/deflating the gold price over that of platinum as his rating towered/tottered.

Electing gold or platinum?

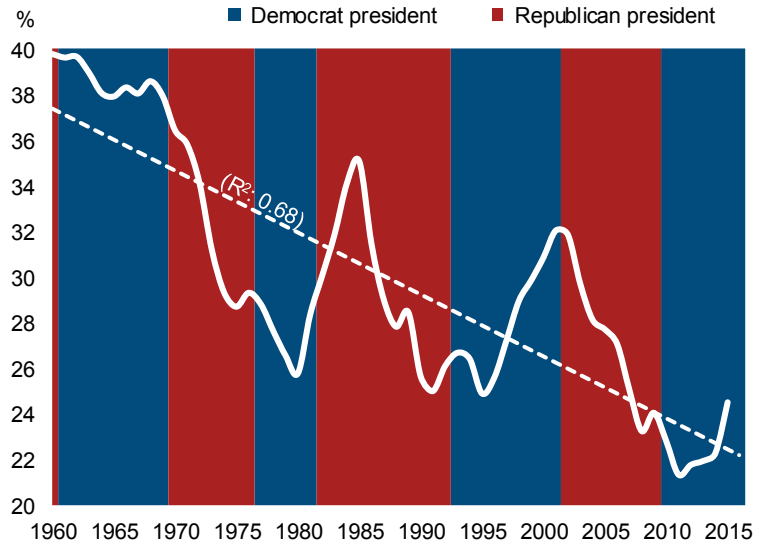


Source: SFA (Oxford), RealClearPolitics

Perhaps the most minor upset would be the American electorate discovering they've again made the "false assumption", as Mencken put it, "that politicians are divided into two classes, and that one of these classes is made up of good ones". In this report, Oxford Economics puts the macroeconomic fallout under its microscope.

What is beyond doubt, the US election, or indeed politics, is that the US will lose more of its share of world GDP in the next presidential term. So it's more likely to be relatively less important for every metal, not just PGMs.

Managing decline #1: America's share of world GDP

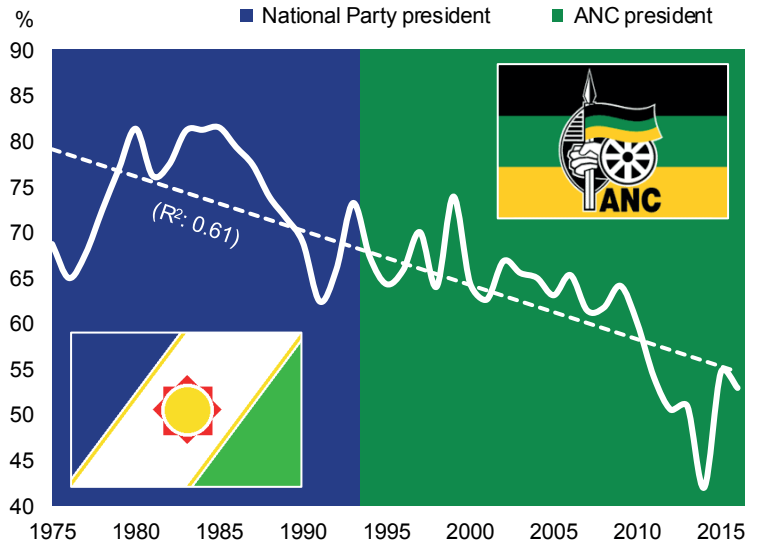


Source: World Bank, IMF

At an estimated trend rate of a quarter of a per cent per annum, America will mislay another 1% of its world output share during the next presidential term, whatever its stripe. And an R^2 of 0.68 suggests around two-thirds of this trend decline is 'pre-ordained' – it's *not* the politics, stupid (but the inexorably better growth of 'the Rest').

South African platinum also knows something about managing decline.

Managing decline #2: South Africa's share of world platinum supply

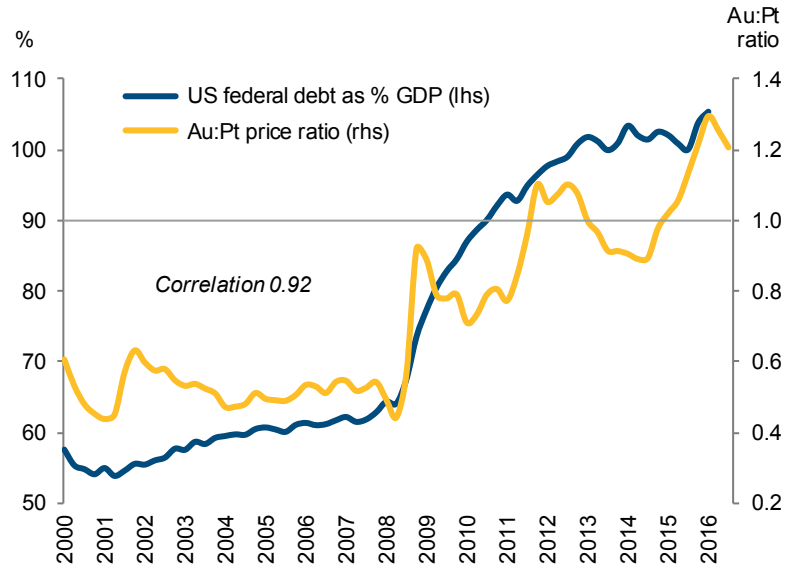


Source: SFA (Oxford). Note: World supply is mine output + recycled metal.

South African mining has been losing its share of world platinum supply at over half a per cent per annum, twice the rate of America's relative decline, for the last two generations. The next US president will oversee, albeit from a distance, another 2+ per cent loss in supply share (and hopes over experience of pricing power?) by SA PGM Inc. With an R^2 of 0.61, about two-thirds of South Africa's trend slippage is also baked in the cake, or ore body – 'natural' causes (geology plus the inexorable growth of recycled metal) – whatever the palette of political colours.

Under its last CEO, America confronted its decline by digging harder when in a hole; with 'shovel-ready' projects public debt doubled under Obama. But then Washington enjoys a strategic stockpiler of its debt – the Federal Reserve, conveniently buying government paper. Investors may see the futility/danger of this buck-passing – witness the attendant rise in the premium of the gold price over that of platinum – even if the US electorate does not, yet.

Nothing to fear but debt itself?

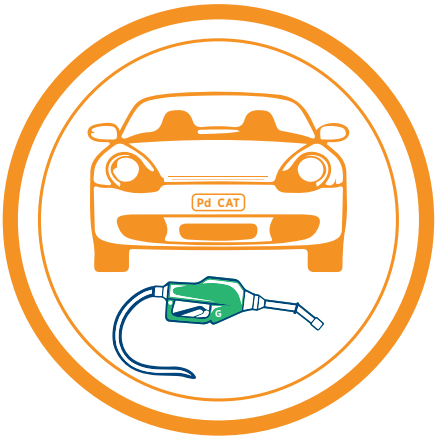


Source: SFA (Oxford), St Louis Federal Reserve

In the PGM community, as Mick McMullen's article recounts in this report, Stillwater addressed its decline by desisting digging in some holes, and by slashing debt. But then the Fed doesn't buy Stillwater IOUs!

All of which seems to confirm the prejudice of Mencken's father that, "All mankind...was divided into two great races: those who paid their bills, and those who didn't." And leaves open the question: does Obama's experience managing US decline qualify him for consultancy work in PGM mining, or might Stillwater find lucrative advisory work in DC?

THE PALLADIUM MARKET



The palladium market

Beresford Clarke, Managing Director, Head of Research, SFA (Oxford) Ltd

From humble beginings to 10 million ounces

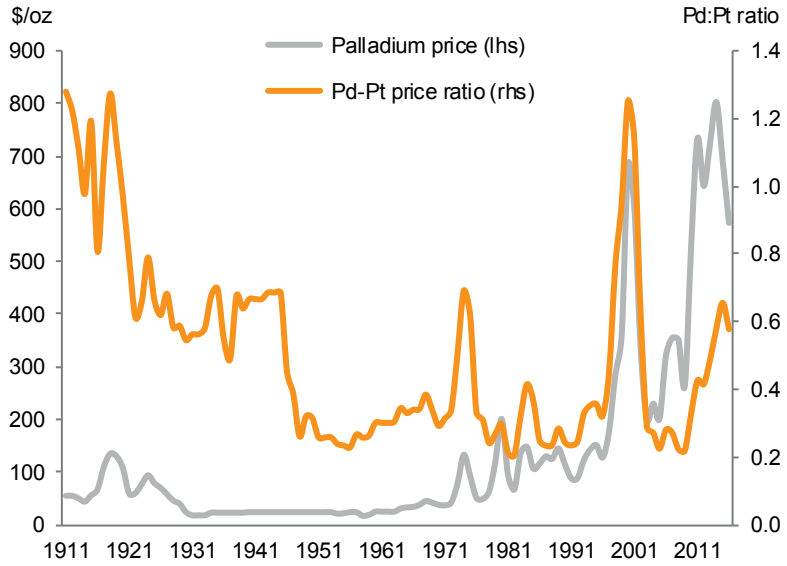
Prior to 1990, palladium prices generally remained below $150/oz and traded at a deep discount – between a quarter and a half of platinum prices (see chart below). However, palladium's fortunes turned a corner when Ford figured out a way of using palladium at the expense of platinum in gasoline engines in the late 1980s.

Ford unlocked palladium's potential in the late 1980s

The dissolution of the Soviet Union in 1991 boosted end-user confidence in the availability of palladium with new globally obtainable supplies from accumulated Russian State stockpiles over and above normal mine output. From 1994 to 2003 Russian exports exceeded mine production by between 1 moz and over 3 moz. Norilsk Nickel (now called Nornickel) even used palladium to buy part of Stillwater Mining Company in 2008, with total exports of 966 koz to the US recorded. The exports of State stocks appear to have come to an end in 2013, which, combined with reduced mine output, has aided the recent bull market for palladium.

Market liquidity improved with Russian stock sales from the 1990s

Palladium prices and ratio to platinum



Source: SFA (Oxford)

A new era of high palladium prices began

Demand grew tenfold from 1990 in just seven years

Demand for palladium in the auto sector amounted to less than 250 koz in 1990, but grew tenfold in just seven years. A lethal combination of panic buying, fund speculation and export quota delays from the Russian government pushed prices over $1,000/oz in 2001 and led to a spike in metal lease rates (to over 20% in 2001 – normally less than 3%). In 2001, palladium demand for gasoline cars and light trucks reached over 4.5 moz.

Alas, palladium discovered it was not immune to the embrace of price elasticity of demand. In the run-up to 2001, three-way catalysts in gasoline vehicles were overloaded with metal as car manufacturers replaced platinum with palladium at a ratio of 2:1. This came to an end with the price spike and a 1:1 replacement of platinum was achieved. By 2003, palladium prices were back below $200/oz.

Prices spiked and usage collapsed in 2001

Further fallout from the price spike was demand destruction in electronics applications which accounted for over 2 moz in 2000, but fell below 700 koz in 2001. More than 60% of palladium was substituted in multi-layered ceramic capacitors (MLCCs) for base metals.

The success of Pd-loaded gasoline cars aided recovery

Thereafter, palladium prices took a long time to recover. Nonetheless, more and more gasoline vehicles were being made and emissions legislation was tightened and rolled out to new regions, while the increasing prevalence and sophistication of electronic equipment containing more MLCCs led to a strong recovery in palladium requirements.

The established markets of North America, Western Europe and Japan combined have not fully recovered since early 2000, but the popularity of gasoline-powered cars globally and the roll-out and tightening of tailpipe emissions legislation have boosted the use of palladium in the emerging markets.

China is now a 2 moz market

China's demand in 2000 was less than 300 koz but has grown to reach more than 2 moz in 2015. Palladium requirements in the remaining countries outside the established markets and China have increased from less than 800 koz in 2000 to almost 2 moz in 2015.

Palladium entered diesel autocatalysts in 2006

The year 2006 was another major milestone for palladium when it entered diesel car catalytic converters, again at the expense of platinum.

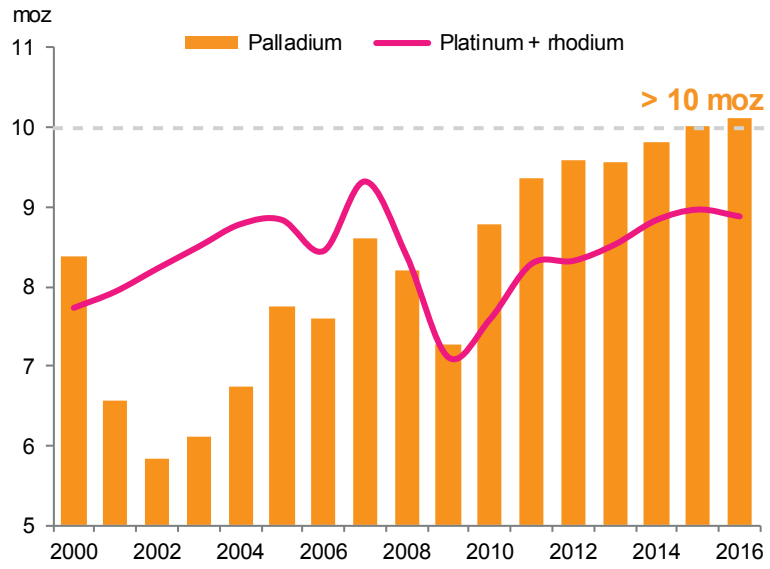
Palladium is more susceptible to sulphur poisoning than platinum, so platinum remained the preferred catalyst in dirtier diesel cars. However, Euro 4 emissions standards legislated a maximum of 50 ppm of sulphur in diesel fuel (down from 350 ppm at Euro 3 standards) and this allowed some palladium to be used in diesel car catalysts. As time went on and Euro 5 was legislated (2009), diesel fuel became even cleaner (10 ppm sulphur) and the engines

operated at higher temperatures, at which it was found that platinum was less stable and was being lost to the road. The addition of some palladium helped to create a better catalyst and limit PGM losses. The use of palladium in light-duty diesel catalysts rose from nothing to over 700 koz by 2015.

Global demand now exceeds 10 moz

In total, palladium demand reached a milestone of 10 moz in 2015 (see chart below and centre spread overleaf), above the combined total of platinum (7.9 moz) and rhodium (1 moz).

Palladium demand



Source: SFA (Oxford)

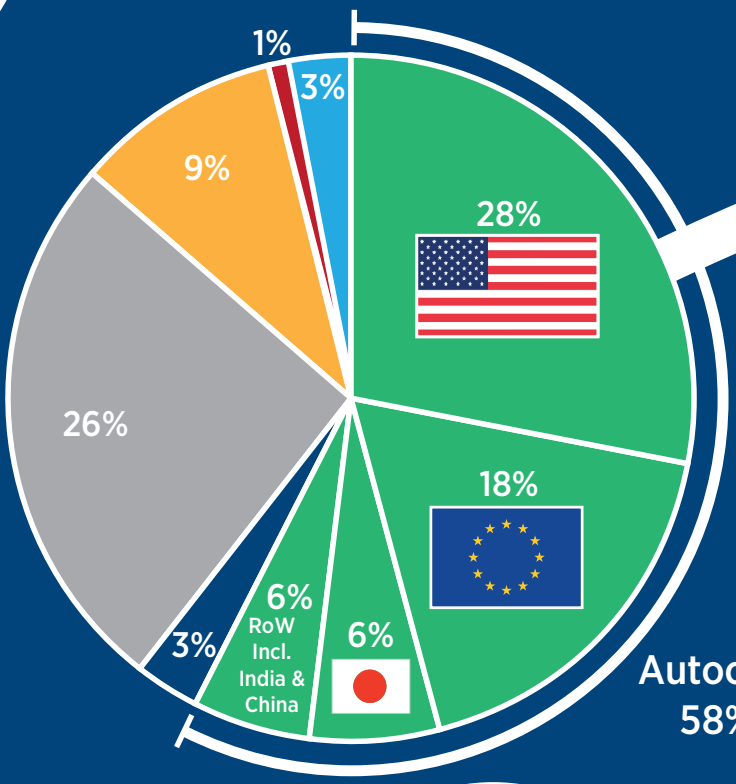
Millions more gasoline engines ahead, great for palladium...

Collectively, the world has been building in excess of 13 million more gasoline vehicles annually since 2000. In another seven years LMC Automotive forecasts another 13 million more gasoline vehicles will be manufactured per year. On this basis, palladium will more than likely continue to extend its demand lead relative to other PGMs.

Market spotlight

46 Pd 106.42
Palladium

Gross demand 2000: 8.4 moz



Temporary suspension of Pd exports from Russia *1999*

Ford
Replacement of Pt with Pd at a 2:1 ratio in gasoline autocats *1991*

Dissolution of the Soviet Union *1991*

Euro 1 *July 1992*
Tier 1 *1994*
Euro 2 *Jan 1996*

Real price ($/oz)

1,500
1,250
1,000
750
500
250
0
-250
-500
-750

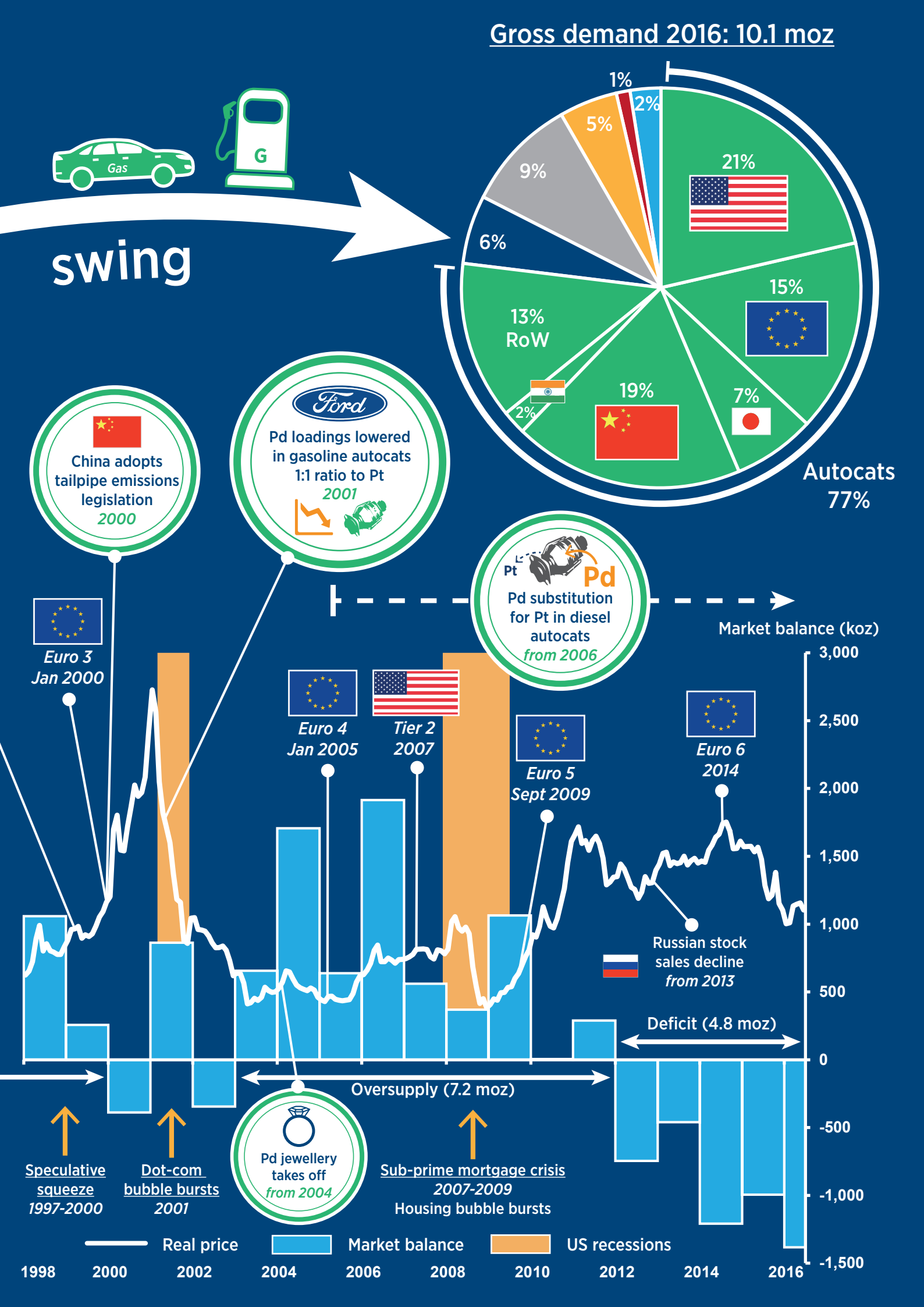
1980 1982 1984 1986 1988 1990 1992 1994 1996

Oversupply (5.6 moz)
incl. Russian stock sales

Energy crisis
1980, 1981-82
Interest rates raised to control inflation

Oil price shock
1990-1991
High interest rates

TOCOM Tokyo Commodity Exchange
Pd is listed on TOCOM *1992*

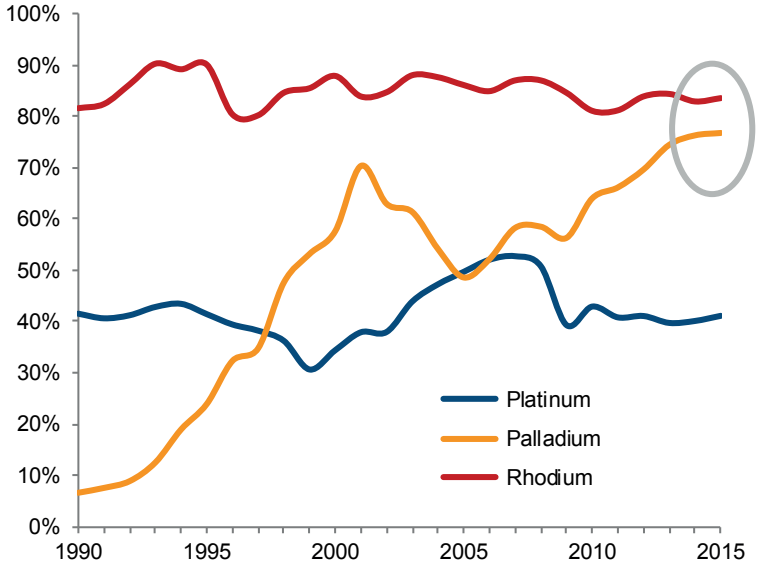

Gross demand 2016: 10.1 moz
Gas
G
swing
1%
2%
5%
9%
6%
21%
15%
13%
RoW
2%
19%
7%
Autocats
77%
China adopts tailpipe emissions legislation
2000
Ford
Pd loadings lowered in gasoline autocats 1:1 ratio to Pt
2001
Pt
Pd
Pd substitution for Pt in diesel autocats
from 2006
Market balance (koz)
Euro 3
Jan 2000
Euro 4
Jan 2005
Tier 2
2007
Euro 5
Sept 2009
Euro 6
2014
Russian stock sales decline
from 2013
Deficit (4.8 moz)
Oversupply (7.2 moz)
Pd jewellery takes off
from 2004
Speculative squeeze
1997-2000
Dot-com bubble bursts
2001
Sub-prime mortgage crisis
2007-2009
Housing bubble bursts
3,000
2,500
2,000
1,500
1,000
500
0
-500
-1,000
-1,500
Real price
Market balance
US recessions
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016

Of course, success comes at a price

...but becoming too reliant on one end-use, so risks growing

The captive link with palladium and gasoline automotive demand and tighter emissions legislation has led to some substitution and loss of demand in other end-uses – electronics, dental, jewellery and chemical. Palladium is, therefore, becoming increasingly reliant on autocatalyst demand, having grown from less than 10% of total consumption in 1990 to 77% in 2015 and rising.

Autocatalyst demand as a proportion of total demand



Source: SFA (Oxford)

Increased price volatility in the future is likely

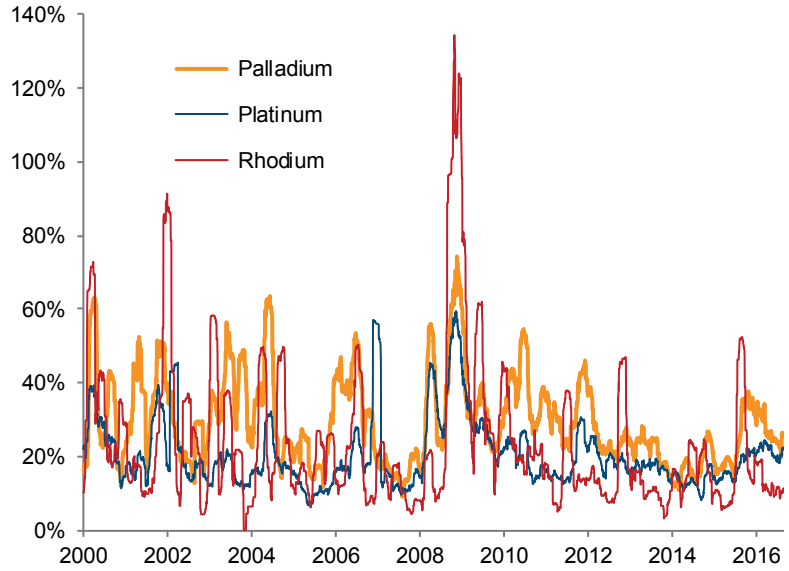
The lack of diversity in palladium end-uses could leave the market exposed to fluctuations in requirements, technology changes and, potentially, increased price volatility. This is great for investors, but not so good for end-users, recyclers and mining companies. There is a danger that the palladium market is becoming more like that of rhodium – a market where autocatalysts dominate end-use and one that is prone to extreme price moves. Nonetheless, the rhodium market is a tenth of the size of the palladium market, so price movements may not be as exaggerated.

A more diverse suite of end-uses for platinum has meant lower price volatility in the past when compared to palladium (see chart opposite). This is most likely due to jewellery manufacturers buying during the price dips and staying away from the market in the peaks, and also more reactive supply historically. Just as jewellery demand is a price dampener, arguably ETF buying is a volatility booster, rising and falling in sync with the price.

However, changes to the platinum market in the last year suggest the patterns of the past may not be relevant in tomorrow's market.

Manufacturers failed to buy on the dips and platinum prices dropped to below $900/oz, while primary platinum supply is becoming increasingly inelastic to price owing to high labour contingents with limited closures/supply cutbacks.

Rolling 50 days PGM price volatility



Source: SFA (Oxford)

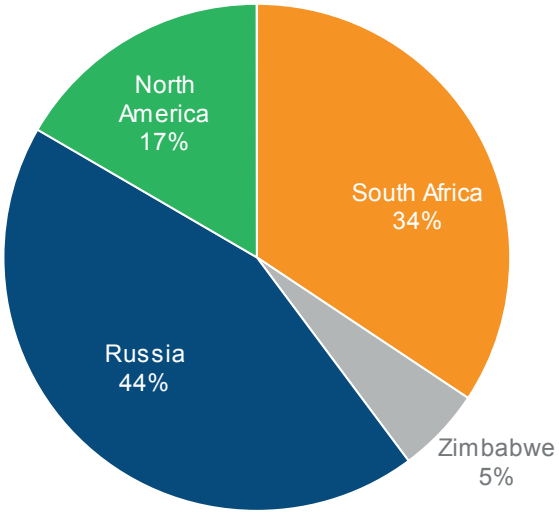
Mine supply diversity, but a by-product metal

Palladium mine supplies are more geographically diverse than other PGMs. South Africa supplies 70% of the world's mine production of platinum but just 34% of palladium, whereas Russia dominates mine output of palladium at 44% of global supplies, although large reserves of palladium reside in South Africa (see second chart overleaf).

Russia provided 44% of world palladium supply in 2015

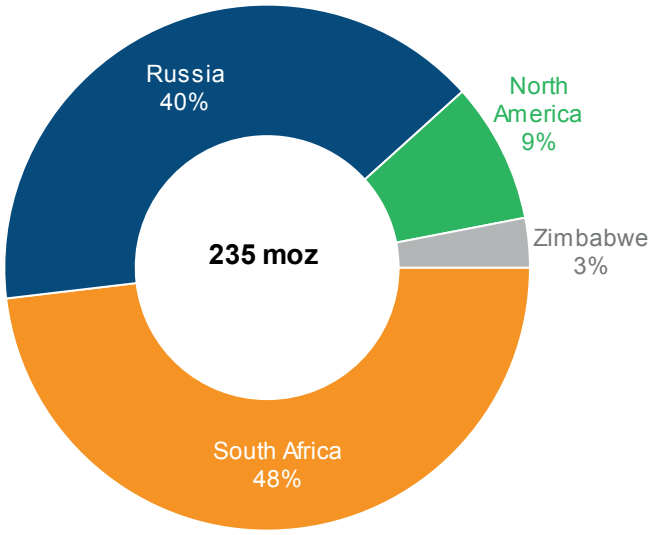
Current reserves indicate more than 30 years of production from both Russia and South Africa, though reserves need to be capitalised to convert to production. Nornickel indicated that $1 billion/p.a. of expenditure was required to maintain current production.

Palladium primary supply, 2015



Source: SFA (Oxford)

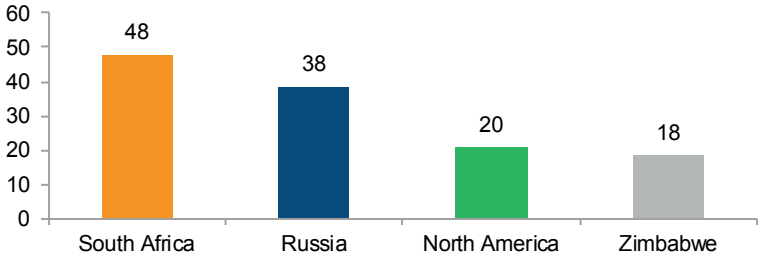
Palladium mine reserves, 2015



Source: SFA (Oxford)

Significant reserves in Russia and South Africa to be capitalised in future

Years of palladium production from current reserves



Source: SFA (Oxford)

Nornickel is by far the largest producer, contributing 2.6 moz of palladium as a by-product of its nickel mining operations in Russia. However, this is down from more than 3 moz p.a. of production from 2004 to 2007.

During the extended miners' strike in South Africa in 2014 the country's platinum output was curtailed by 30% year-on-year and palladium was impacted by a lesser 22%.

Palladium is less exposed than platinum to disruptions in South Africa

Steadily rising yield from the Northern Limb of the Bushveld Igneous Complex at Anglo Platinum's Mogalakwena mine, which has a 1:1 platinum to palladium ratio, helped to offset some of the losses from strike-impacted Western Limb operations. On a global basis, platinum supply dropped 21% in 2014, while palladium fell by just 9%.

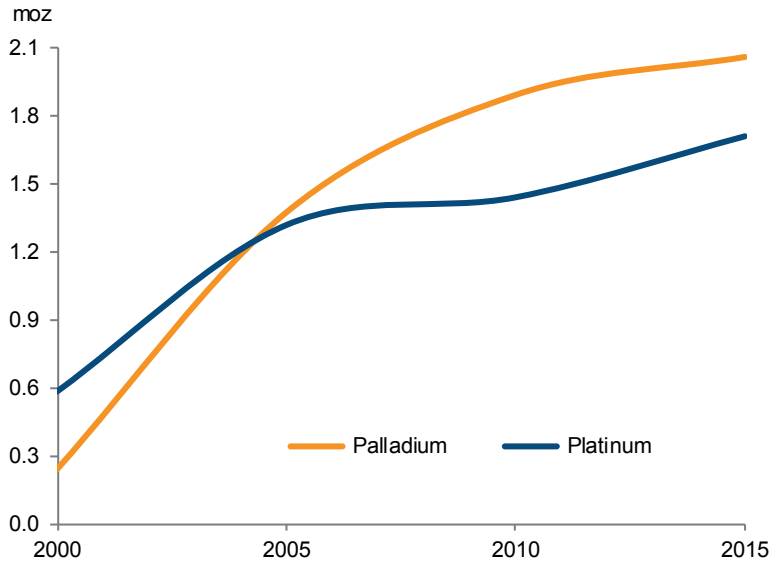
Palladium supply bounced back in 2015, but is still 220 koz lower than pre-strike levels. Looking ahead, the prospects for palladium supply growth are limited and heavily dependent on the price performance of nickel and platinum to motivate higher output. Only 10% of global supplies of palladium are produced as primary products of mining operations.

Palladium dominates recycling of PGMs

Much has been made of the growth or potential growth in platinum supply from recycled autocatalysts from scrapped diesel cars in Europe, but, in reality, far more gasoline cars with bigger engines are scrapped each year and with them comes palladium.

Since 2000, palladium from recycling has grown by double the rate of platinum, at an average of 18% versus 9% per year. Autocatalyst recycling in the US was less than 200 koz in 2000, but breached 1 moz in 2013, while in Western Europe autocatalyst recycling has grown from nothing to over 300 koz over the same period. Autocatalyst recycling is starting to pick up in the emerging markets too. China and the RoW combined recycled 280 koz in 2015 and have the potential to return more than a million ounces per year within the next ten years.

PGM recycling



Source: SFA (Oxford)

Palladium recycling has grown to 2 moz in 15 years

Structural deficit, but ample supplies... for now

While supplies of palladium are less susceptible to disruption than those of platinum, and are more geographically diverse, annual market requirements are larger. A shortfall of over 1 moz a year is estimated for 2015 and 2016.

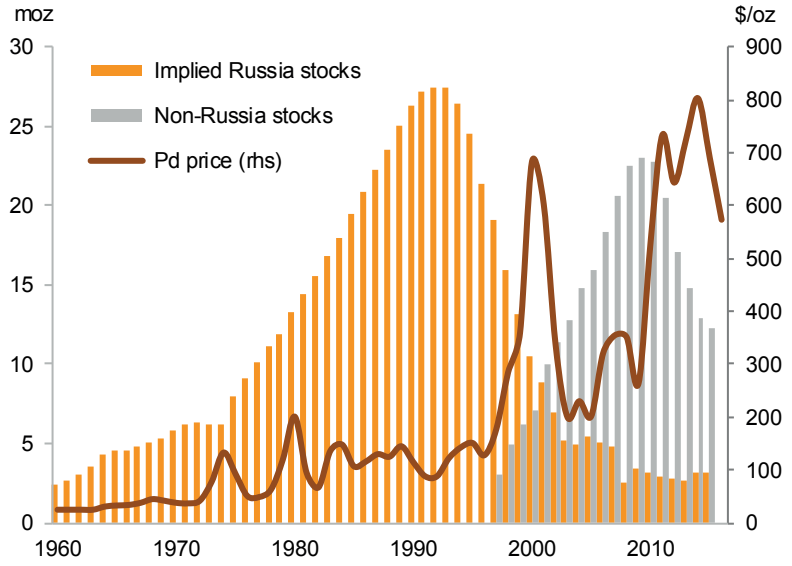
Deficits of >1 moz in 2015 and 2016

That brings us back to the age-old discussion about stocks. How much is out there and how long will it last before we start to see a genuine squeeze on the market, as indicated by rising lease rates and prices? By our estimates there will be a few years yet.

Our data on stocks goes back to the 1930s. We have mined the planet's resources and estimated demand and recycling over the period. By our calculations there were more than 25 moz of palladium stocks in the early 1990s. Since then a great deal has been consumed, while the majority of the remaining stocks have transferred from Russia to Switzerland and from there have been largely distributed to the US and Asia. So how much is left? There is probably around 15 moz (see chart opposite), but how much would actually be available to market when the time came? We estimate around half of the remaining stockpile.

15 moz of stock remaining, of which half might be available to market

Estimated above-ground stocks of palladium



Source: SFA (Oxford)

That sounds a significant amount, but with a drawdown of 1 moz a year, inelastic supply, the world going gasoline (and gasoline hybrid), and emissions limits becoming ever tighter and palladium loadings higher, there continues to be a robust investment case for palladium, so prices should continue to rise.

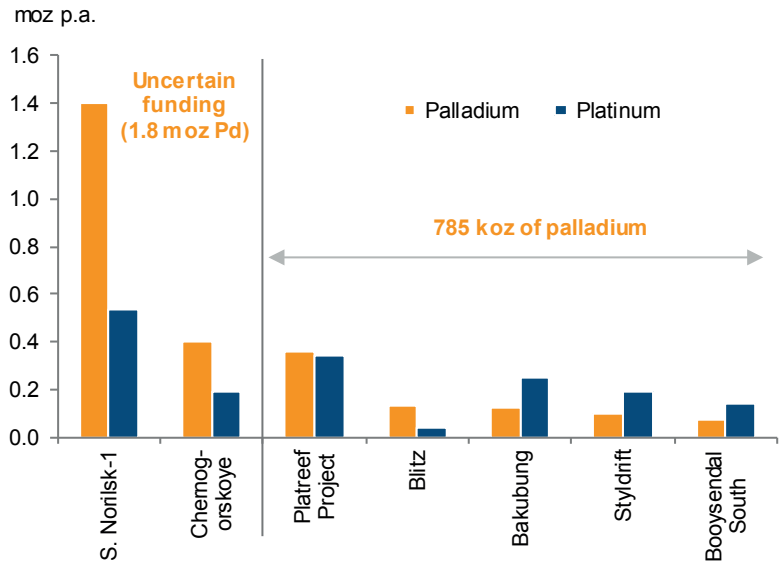
Strong fundamentals should continue to lift prices

Automotive end-users should take comfort in the current availability of metal (as demonstrated by lease rates below 3% and ample global stocks), the potential growth of recycling in the emerging markets, and mine projects and replacement capacity that are so far skewed to palladium output (see chart overleaf on potential new projects). Projects on the Northern Limb of the Bushveld in South Africa and in Russia have the potential to yield more palladium relative to platinum.

A healthy market with ample liquidity

Nornickel has also created a fund to secure palladium on the open market or from the Russian central bank (est. up to 2.5 moz of holdings). The company has allocated funding of $200 million and reportedly secured 90 koz of palladium on the open market earlier this year, while negotiations continue in order to secure central bank holdings. Nornickel seeks to secure central bank holdings and manage supply rather than allow the bank to suddenly flood the market to generate cash.

Potential construction projects



Source: SFA (Oxford)

Palladium projects in the wings but need capital

Finally, if China's economy wobbles (as we saw at the beginning of the year) or if the government pulls incentives for new cars at the end of 2016, then above-ground stocks of palladium may last longer and price pressure will temporarily fall away.

China is the core risk to prices

All of the above suggests that the case to motivate a switch back to either/both platinum or/and rhodium from palladium in autocatalysts could be difficult.

A switch back to platinum or rhodium is unlikely

A prosperous market that demonstrates strong demand, inelastic mine supply, structural deficits and plentiful liquidity for now suggests the time is right for a Palladium Standard, so we can keep a watchful eye on a strengthening market and continue to report from the cockpit as it steadily tightens.

A prosperous market that justifies a Palladium Standard

STILLWATER MINING: AN INDUSTRY PERSPECTIVE AND A STRATEGY FOR CHANGE

Stillwater Mining: An industry perspective and a strategy for change

Mick McMullen, President and CEO, Stillwater Mining Company

PGM industry overview

The PGM industry is interesting in that it is dominated by a relatively small number of producers concentrated in a limited number of jurisdictions. This is much like the iron ore industry, but unlike the iron ore industry the PGM miners have struggled to consistently deliver shareholder returns.

Poor track record of companies delivering shareholder value

All mining industries are typically cyclical in nature and many companies now talk about "delivering shareholder value through the cycle". History would suggest that the PGM industry in general has not had a good track record of delivering through the cycle, and it could be argued that the majority of returns for shareholders in the good years have been more than offset by the periodic requirement for shareholders and debt holders to contribute funding to maintain the PGM industry.

PGM industry data trends

Industry trends have been examined to help understand profitability through the commodity cycle

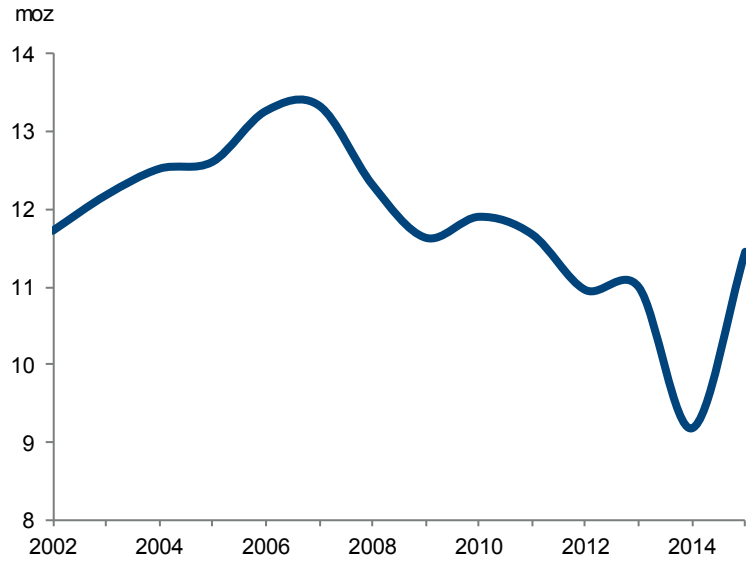
An examination of the financial performance of the eight largest PGM producers globally provides some interesting observations over the period of 2002-2015. This period covers several commodity cycles and provides sufficient duration to examine the trends within the PGM industry.

Unless otherwise noted, all information is sourced from public company filings. Minor differences may exist in the presentation of these data between companies, and assumptions have been made in an attempt to format the data in a uniform manner.

The majority of the companies examined are pure play PGM producers with minor base metal credits. The one exception to this is Nornickel (recently rebranded from Norilsk Nickel) which has been included owing to its predominant position in palladium production.

Firstly, as seen in the chart overleaf, production of primary PGM ounces has seen a gradual downtrend over the period examined, after peaking in 2007.

Primary PGM ounces produced

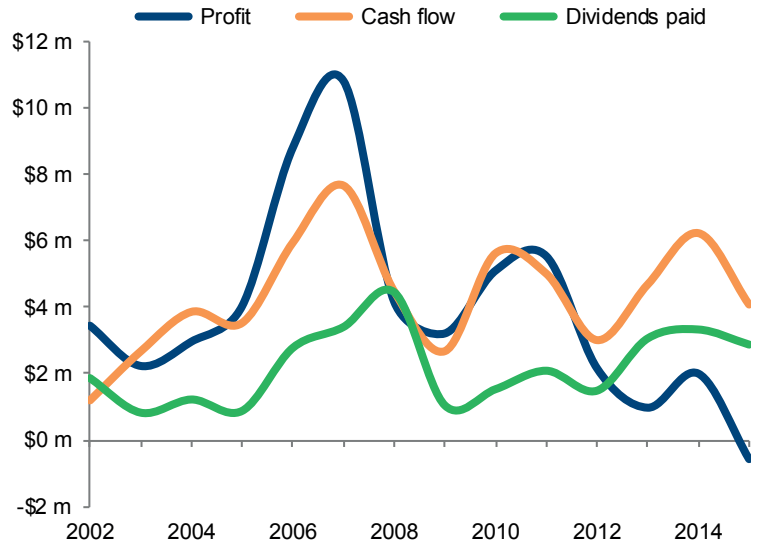


Source: Company reports, SFA (Oxford)

PGM supply peaked in 2007

The chart below illustrates the gross revenue, profits and dividends paid out over the same period by the PGM industry.

Primary PGM industry financial summary



Source: Company reports

Profit margins are down to an average of just 5% since 2011

The PGM industry has, at times, generated very robust returns (2006-2007) and gross profit margins averaged approximately 23% over the period 2002-2011. This dataset is somewhat skewed by the 2006-2007 period when gross profit margins averaged 36%. However, even normalising the data for this period for the average of the remainder of the period would still suggest the PGM industry generated gross margins in the order of 20% over the 2002-2011 period.

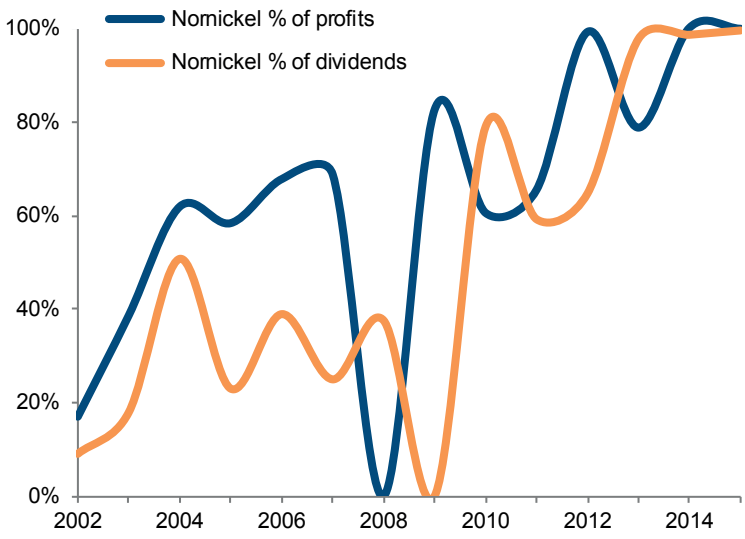
Gross margins of around 20% would indicate a relatively healthy business environment that was conducive to continued reinvestment to sustain the business as well as investment to grow the industry.

The period since 2011 has been characterised by much lower profit margins (partly driven by asset impairments), with an industry gross margin averaging 5%. It could be argued that a margin of 5% is insufficient to incentivise reinvestment in the business, let alone justify new growth projects.

Further mining of the industry dataset highlights some other interesting trends.

Nornickel has managed to consistently deliver profits and dividends throughout the cycle apart from a single year in each case (2008 and 2009 respectively). Over the period 2002-2015, Nornickel has achieved a gross profit margin of 24% on average. Removing Nornickel from the industry dataset highlights the relatively poor returns generated by the remainder of the industry, as shown below.

Nornickel % of PGM industry profits and dividends



Source: Company reports

Nornickel has dominated industry profits and dividend payouts to shareholders

It can be seen that Nornickel has contributed almost all of the profits reported and dividends paid by the PGM industry in the recent past, and its share of industry profits and dividends has grown consistently over the past 13 years.

This could be attributed to several factors: in-situ ore body quality, PGMs as a by-product of base metal production, currency benefits, cost control, or combinations thereof. Regardless of cause, it can be deduced that if Nornickel is providing the vast majority of the PGM profitability, the remainder of the industry is not in a healthy financial condition.

Clearly, the primary PGM producers have some challenges to deal with. If the only company that consistently delivers returns in the PGM industry is, in fact, a base metal producer with large PGM by-product credits, the primary PGM producers will need to change the way they do business in order to restore the industry to a healthy financial state.

Causes of financial underperformance

The financial underperformance of the PGM industry, excluding Nornickel, has many causes and, in general, managers are often more willing to lay the blame on external factors not in their control, such as metal prices, rather than factors under their control. In the words of former US Supreme Court Justice Louis Brandeis:

"Sunlight is said to be the best of disinfectants."

Mining companies in general are typically poor stewards of capital and have a long and chequered history of building expansion projects that rarely deliver as promised. One does not need to look far to find examples of capital blowouts, operating cost increases and, in some of the worst examples, ore bodies that just are not what was envisaged.

Poor project execution to blame for financial underperformance?

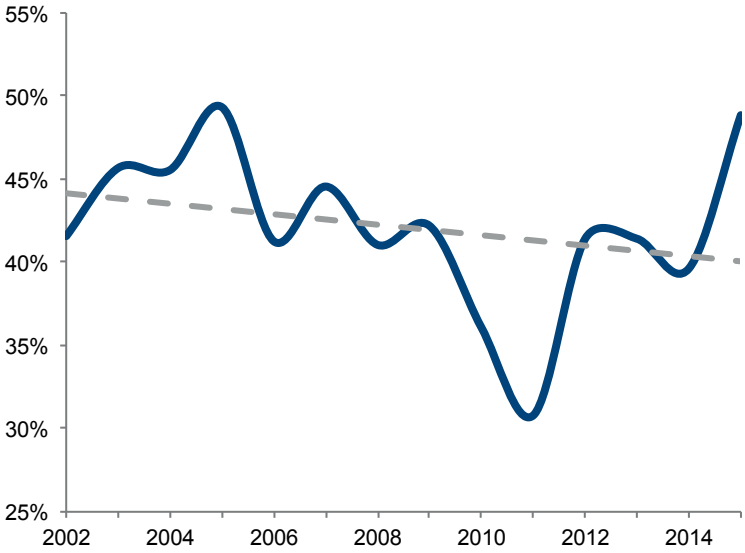
Eventually, unless prices rescue the project, these 'chickens will come home to roost' and the almost inevitable asset impairment arrives on the shareholders' doorstep. The author, at one stage, was responsible for banking technical audits at a large mining consultancy which had a database of over 200 projects that had been built over a 20-year period. Of those projects, only six had gone according to plan or better; for the remainder, it was just a question of how far off the plan development progressed.

It would appear then that those who conceived and executed expansion projects poorly should have to accept some of the blame for the financial underperformance seen in the PGM industry in the recent past.

Another useful metric to examine is the share of revenue that the workforce secures compared to other stakeholders. Much has been written about the fair share of revenue that should be handed to the workforce, and this author is not suggesting one answer is more correct than another. However, what is evident is that workforces within the PGM industry, excluding Nornickel, have secured a greater portion of the revenue 'pie' over the past 10 years than previously.

Looking specifically at Stillwater Mining, our labour costs have averaged 42% of our mining revenue over the period 2002-2015.

Stillwater labour as % of mining revenue



Source: Stillwater Mining Company

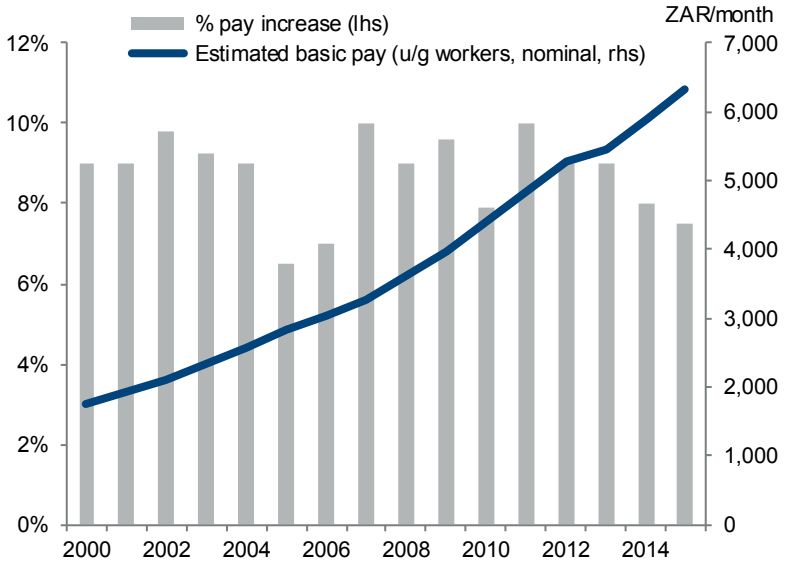
Long-term trend of falling labour costs relative to mining revenue at Stillwater

The increase in the labour costs as a percentage of revenue in 2015 was driven by a sharp reduction in US dollar PGM prices, rather than an increase in absolute labour costs. Labour costs fell year-on-year in 2015 at Stillwater Mining, which reversed the trend of the previous decade.

Previous Stillwater labour contracts had delivered wage rises of around 5% per annum to the workforce, which increased the company's labour cost from $114 million in 2002 to around $200 million in 2015.

A similar trend of rising wages emerges in the South African industry, where annual pay increases have averaged just below 9% (8.7% per annum compounded at Anglo American Platinum), as shown below.

Anglo American Platinum wages



Source: SFA (Oxford), Anglo American Platinum

Rising wages have reduced shareholder dividends

A reasonable observer would most likely conclude that South African workforces have secured a higher proportion of the economic rent than in the past, and that rent has been diverted from shareholders.

There is also often a desire to produce more metal, sometimes regardless of the economic viability of those ounces. We geologists and engineers like to build things, and unfortunately at times we lose sight of the requirement to generate a reliable return on capital, rather than a nebulous, hoped-for return on capital.

An oversupplied market has dampened PGM prices

Producing more metal also has the unfortunate side-effect of depressing prices, which is hardly likely to assist in generating the returns that shareholders are seeking. Whilst there may be some rigorous debate on the actual level of above-ground PGM stocks, most observers would agree that there is some level of stock that has kept the market amply supplied, including through a five-month strike in South Africa in 2014, with a relatively modest and short-lived upward impact on prices.

To the outside observer, to produce more metal into that market environment and to then lose money on those ounces would not appear to be completely rational behaviour.

Funding of these expansion projects is often carried out with debt, and, in some cases, debt is also used to fund operating losses. At the time the debt is put in place, optimistic assumptions make debt servicing appear easy and low risk.

When reality sets in with lower prices, higher capital and operating costs and slower development timetables, the debt servicing becomes an issue and poor financial outcomes result.

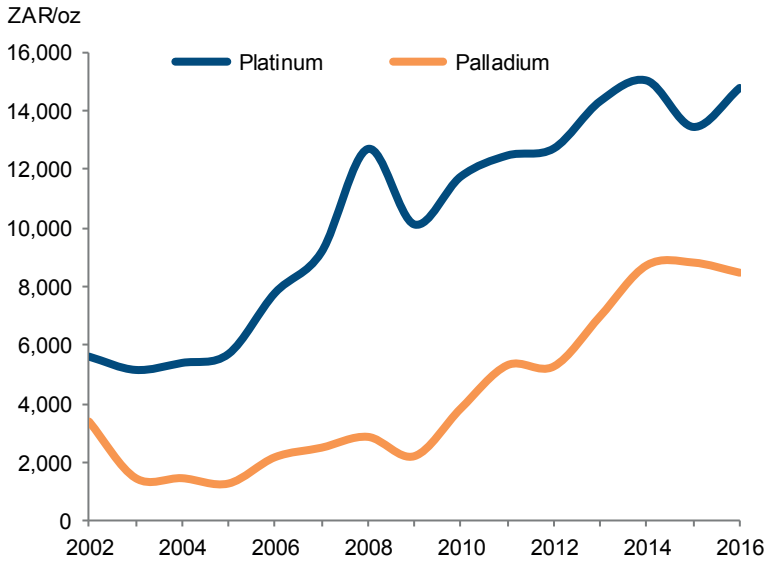
Low prices are often blamed for the majority (or all) of the financial underperformances of the PGM industry, and at times low prices may have a serious negative impact on returns. In US dollar terms, PGM prices can enjoy sharp but brief price spikes interspersed by relatively long periods of moderately lower prices. Planning a business around those price spikes is not conducive to long-term financial success. The PGM industry has, like most mining industries, tended to plan its business whilst wearing rose-tinted glasses. As geologists, perhaps we have to be inherently optimistic.

Planning around PGM spikes is not helpful to long-term success

In rand terms, however, PGM prices have not only increased over the period of 2002-2015, but also they have significantly outperformed the US dollar prices for these metals (see below). It would appear that for the South African industry, prices have not been the underlying factor responsible for the poor returns. Cost inflation is therefore more likely to be responsible.

Price performance not responsible for poor returns, more likely to be cost inflation

Historical platinum and palladium prices



Source: Public data sources

The intersection of low prices and high levels of debt is toxic for any mining company. We have been witnessing the deleveraging of mining company balance sheets for the past three years and there is likely to be more to come. The recent 'pop' in equity markets has opened the financing window and for those companies still with highly leveraged balance sheets, this may be their opportunity to resolve that situation.

It would appear that overall for the PGM industry the challenges we face are mostly internal and are therefore a self-help story if we wish to 'right the ship'. There is potential to stimulate further demand for our products to drive prices higher, but this is a longer-term outcome and may arrive too late for some in the industry.

The role of Stillwater

Stillwater's hostile management takeover in 2013 has forced positive change

Given the poor financial performance of the bulk of the PGM industry, ultimately shareholders will firstly ask politely, and then make demands, for changes in the way our businesses are run. Stillwater has the dubious qualification of being the first company in the PGM space to be the target of an activist campaign to remove the Board and management. This resulted in a partial change of the Board and management in 2013, with the new management (the author) having a clear mandate from shareholders to change the way the business is run.

As one can imagine, trying to change the culture of a business with nearly 30 years of history has not been easy or without challenges. There are many stakeholders who needed to understand the situation the company was in, and the rationale for change.

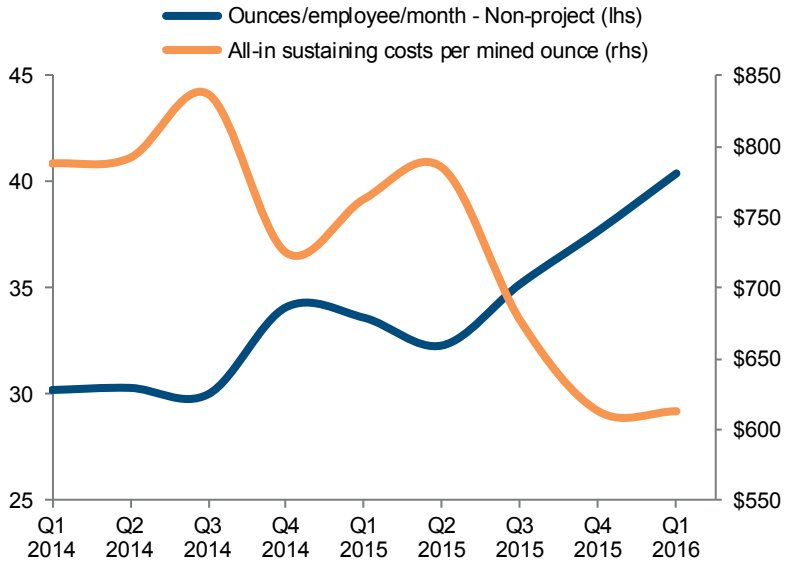
In Stillwater's specific case, there has been no currency benefit to cushion the fluctuation in PGM prices. Our business improvements have had to come through old-fashioned changes to our business; the one advantage being that these changes are in place regardless of currency.

Raising productivity and improving capital allocation are key indicators to future success

When first looking at our business, we had to determine the root cause of our challenged financial performance before we could address it. This required a 'good look in the mirror' and being honest with ourselves. Fundamentally, Stillwater's challenge was not how much palladium was being used in jewellery or the auto industry but how to address poor productivity and a lack of discipline when it came to capital allocation. We are, in effect, price-takers for our product given our relatively small position in the global market, and therefore we need to plan our business around the prices we have, not what we hope for.

As shown in the chart below, there is a clear inverse correlation between productivity (in this case, ounces/employee/month) and all-in sustaining costs (AISC). This is hardly surprising given that labour represents around 55-60% of Stillwater's mine site costs.

Mining productivity



Source: Company reports

From 2014-2016, Stillwater's labour productivity has increased 30% and all-in-sustaining costs per mined oz have dropped 22%

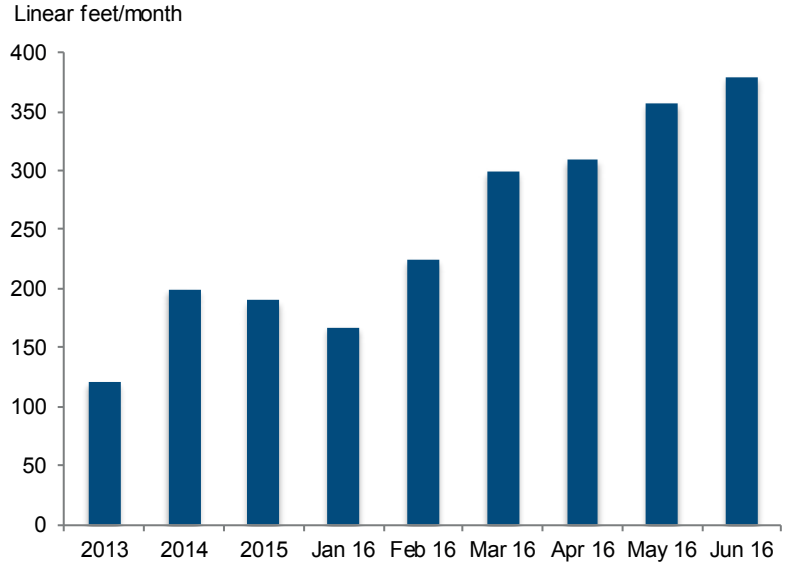
In 2014, our management team set out on a path to address these issues.

Total head count has been reduced by over 20% since 2013 and this year we expect to produce the most ounces since 2006. We have continued to invest in our growth projects (Graham Creek and Blitz) as we believe that the way to make money in the commodity business is to invest through the bottom of the cycle. In particular, Blitz represents an opportunity to step up our production levels and to do so with lower-cost ounces.

Our sustaining capital spend has been cut by almost 40%. This has been achieved not by stopping sustaining capital activities such as development (as has been the case in past times at Stillwater when prices were low) but by becoming more efficient and reducing the unit rates (the cost/foot of advance) for our development. We have reduced our development unit rates by around one-third over the past 18 months, driven by a significant increase in the rate at which we develop with the same workforce (see the chart overleaf).

40% drop in sustaining CAPEX through better efficiencies and reducing development unit rates

56 E incline development rates



Source: Company reports

56 E incline development rates have doubled in 2016

In addition, we have been much more diligent with capital spending. Capital is no longer someone else's problem to fund, but all of the management team now 'own' the capital spend.

Responsible capital spending and management plan ownership

In order to make these changes, we have had to make some difficult decisions. We have also completely changed our compensation structures, such that everyone in the workforce from CEO down is compensated based on what is important to shareholders, thus aligning everyone's interests.

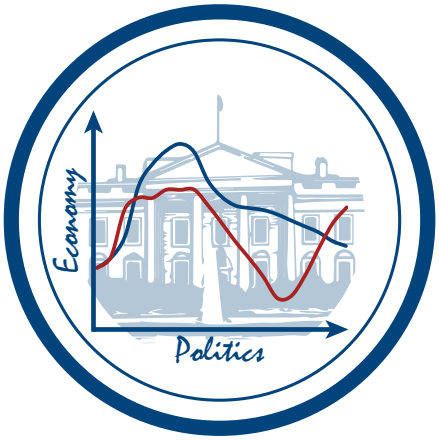
Stillwater has come through what we hope is the bottom of the cycle in a much stronger position than it has arguably ever been, which would not have been the case if we had not made the changes we did over the past three years. Our balance sheet remains intact and arguably one of the strongest in the PGM industry, and we continue to see potential to make further improvements in our underlying business.

Three years of change put Stillwater in the driving seat for the next market upturn

The position in which we find ourselves is largely due to the changes that were started in 2013 and we thus had the early mover advantage over the remainder of the PGM industry, excluding Nornickel.

Putting Stillwater onto a financially viable footing has been in the best interests of not only our shareholders, but also our other stakeholders, including our debt providers, customers and employees, the local communities and the state of Montana. Our goal is to be able to sustainably generate returns for our shareholders over the long term, and to do this we have had to fundamentally change the way we run our business. This approach may not work for everyone, but it does demonstrate that change is possible in a business where even our most optimistic shareholders were dubious of the ability to change.

THE RACE FOR THE WHITE HOUSE



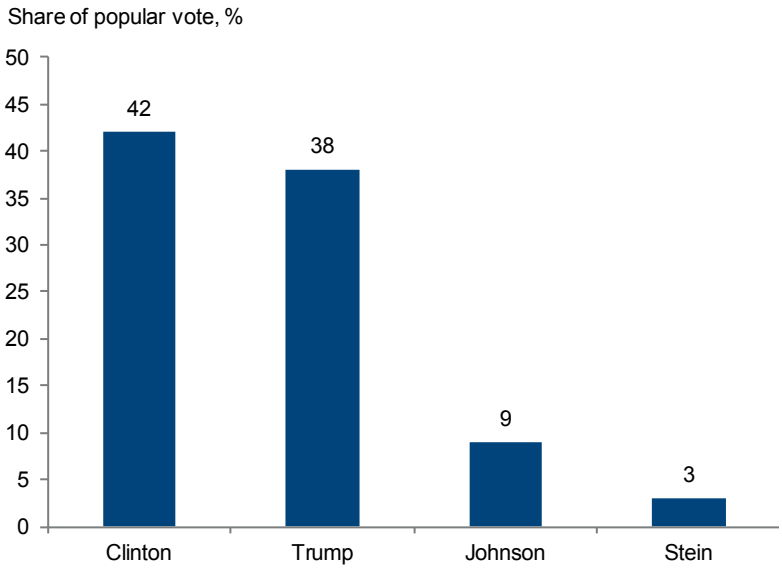
The race for the White House

Oren Klachkin, Senior Economist, Oxford Economics USA

The 2016 presidential race: one for the record books

With the presidential election in America about two months away, the latest polls favour Hillary Clinton to win the race for the White House, though she does not hold a commanding lead. Donald Trump is falling behind in the polls, but he has bounced back from gaffes in the past and so chances of his victory cannot be completely discounted. The main third-party candidates, Gary Johnson and Jill Stein, are vastly behind. The race between Democrats and Republicans for the Oval Office, meanwhile, is very close.

US: Latest general election poll



Source: Oxford Economics, RealClearPolitics

Clinton is still ahead but don't trust the polls

The impact of election uncertainty

Every presidential election tends to generate a certain amount of uncertainty, but the 2016 race is characterised by a particularly high degree of uncertainty. Most of the uncertainty has been concentrated on the Republican side. To be sure, not many expected that the flamboyant Donald Trump, with virtually no policy experience or expertise, would emerge victorious in the primary race. On the Democratic side, Hillary Clinton has beaten Bernie Sanders but his populist message has forced her to move to the left on some of her previously stated views. Furthermore, the general consensus is that Clinton is a "weak" general election candidate. All this has generated a particularly high amount of election-related uncertainty.

Clinton is causing anxiety and concern among the Democrats

Election uncertainty is hindering economic growth

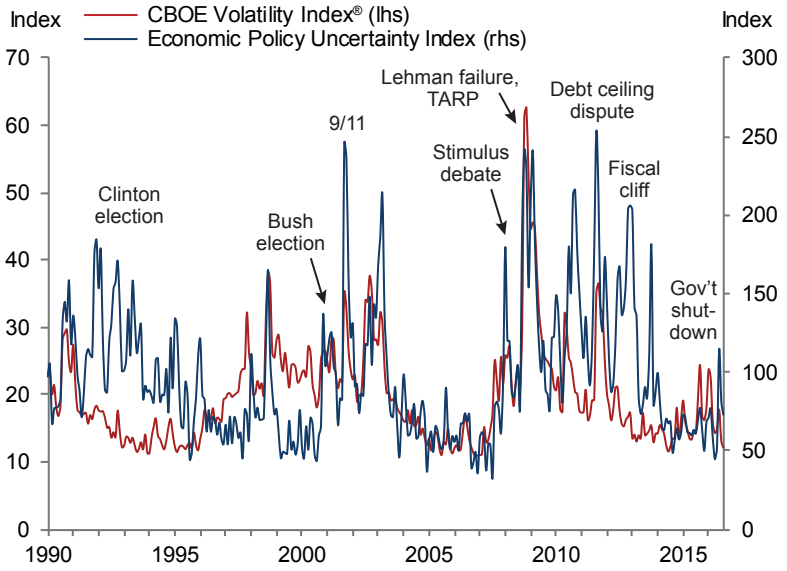
Financial markets and the economy are not fans of uncertainty as it clouds the outlook. Extensive academic work shows uncertainty causes businesses to delay investment[1], hurts employment in policy-sensitive sectors[2], causes households to restrain spending and puts upward pressure on interest rates[3], and heightens corporate risk aversion[4].

The chart below plots the Economic Policy Uncertainty Index, developed by Baker et al., and the CBOE Volatility Index® (VIX®), a gauge of financial market volatility. The chart highlights that increased economic uncertainty coincides with jumps in financial market anxiety. Kelly et al. (2015) find that political uncertainty makes it 5% more expensive to buy protection against stock market fluctuations.

Uncertainty can thus have demonstrable implications. Furthermore, anecdotal information suggests that heightened election uncertainty is dampening business and consumer confidence in 2016. Election-related uncertainty is likely to remain in place until the election, restraining the growth of an economy already constrained by global headwinds, the strong US dollar and low oil prices.

US consumer confidence has weakened

US: Policy uncertainty and market volatility



Source: Oxford Economics, Haver Analytics, Baker et al. (2015), Chicago Board Options Exchange (CBOE)

[1] *Bernanke (1983) – Non-Monetary Effects of the Financial Crisis in the Propagation of the Great Depression*
[2] *Baker et al. (2015) – Measuring Economic Policy Uncertainty*
[3] *Gilchrist et al. (2014) – Uncertainty, Financial Frictions, and Investment Dynamics*
[4] *Panousi and Papanikolaou (2012) – Investment, Idiosyncratic Risk, and Ownership*

Trump's policies – how to shoot yourself in the foot

Donald Trump has built his platform around the idea of disrupting the perception of "business as usual" in Washington, promising to implement measures as he sees fit in many spheres, including fiscal and trade policy. However, if elected, he will be forced to work with Congress. Using the Oxford Economics Global Economic Model, we can analyse the potential implications of Trump's stated fiscal and trade policies on the economy.

Around $1 trillion of tax cuts are forecast by 2021 under Trump's budget proposal

We assume that in order for Mr. Trump's budget proposal to be approved by Congress, it needs to be watered-down considerably from his campaign promises and achieve deficit-neutrality (on a static basis). As such, we assume in our scenario tax cuts totalling about $1 trillion over the period 2017-2021, with just over $800 billion in individual taxes and $200 billion in corporate taxes. Offsetting spending cuts are implemented more gradually in discretionary non-defence outlays and mandatory spending from 2017 to 2021.

On the trade front, the Republican-led Congress will not be in favour of the draconian protectionist actions Trump has called for, including levying 45% and 35% tariffs on China and Mexico, respectively. Therefore, in our scenario we assume the size of the tariffs are 15% on China and 10% on Mexico. We also assume the tariffs are lifted by the end of 2018 as China makes progress on letting its currency float more freely and gains are made on reining-in illegal immigration that would appease Trump.

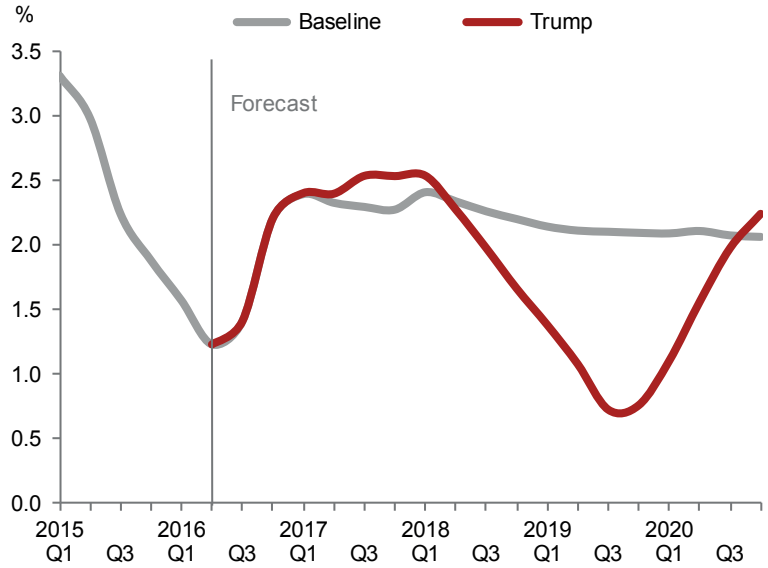
Trump's plans stunt economic growth but are still recession proof

We project that the impact of the fiscal and trade plans would slow economic growth, but the economy would avoid a recession. Initially, lower corporate and income tax rates stimulate private sector activity, with consumer spending and business investment growing modestly faster than in our base case. However, an increase in trade tariffs would moderate some of the initial gains. The higher tariffs raise import prices, which pushes up overall inflation. Additionally, it raises the prices of domestically produced goods since 15% of US imports are intermediate goods that are used in the production of other goods, some of which are consumed within the US. The higher consumer prices weigh on consumer spending.

However, 1 million jobs may be lost if Trump wins

Moreover, economic activity would slow as government spending is gradually reduced. By mid-2018, real GDP growth falls below the baseline, with slower income and employment growth constraining household outlays and business investment. Real GDP growth would average 1.0% in 2019 versus 2.1% in the baseline, while the economy would count about 1.0 million fewer jobs at the end of Trump's term. As the result of slower growth, the Fed would implement a pause in its tightening cycle from 2018 through 2019.

Trump's US real GDP growth scenario



Source: Oxford Economics, Haver Analytics

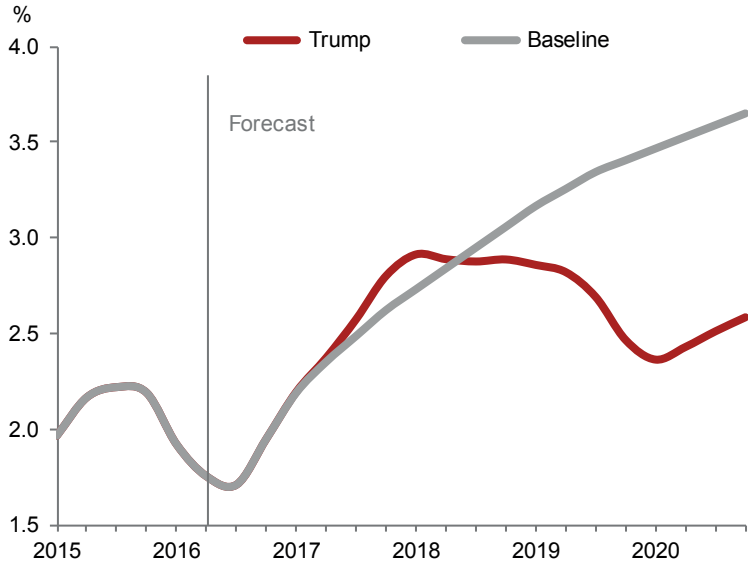
With headwinds likely to form in 2018, economic uncertainty is greatest in 2019 during a Trump presidency

Equity prices would be dampened by slower GDP growth which would translate into slower corporate revenue growth, though a shallower trajectory for the Fed funds rate translates into lower bond yields, which help to offset some of the negative impact on equity prices. In this scenario, equity price gains are moderated to an average 4% gain in 2017-2018 (versus our 5.2% base case), but do not decline outright over the medium term.

Trump's government spending cuts will not offset long-term bond yields

Long-term bond yields would rise modestly in the first year of a Trump presidency since the tax cuts boost economic growth, inflation and debt issuance. However, by early 2018 yields would start to trend lower as cuts to government spending weigh negatively on economic activity and the Fed places monetary policy on hold owing to slower growth. By the end of Trump's four-year term, the yield on the 10-year US Treasury note would be about 1.0 percentage point lower than our current base case forecast. The yield curve would flatten significantly as economic growth slows. The US dollar is about 1% stronger on a broad, trade-weighted basis relative to our base case forecast by the end of Trump's term.

US Treasury 10-year yield



Source: Oxford Economics, RealClearPolitics

Marginal recovery from the baseline long-term bond yields beyond 2018

Unlike those of her rival, Hillary's policies will actually support the economy

Three scenarios examined under a Clinton presidency

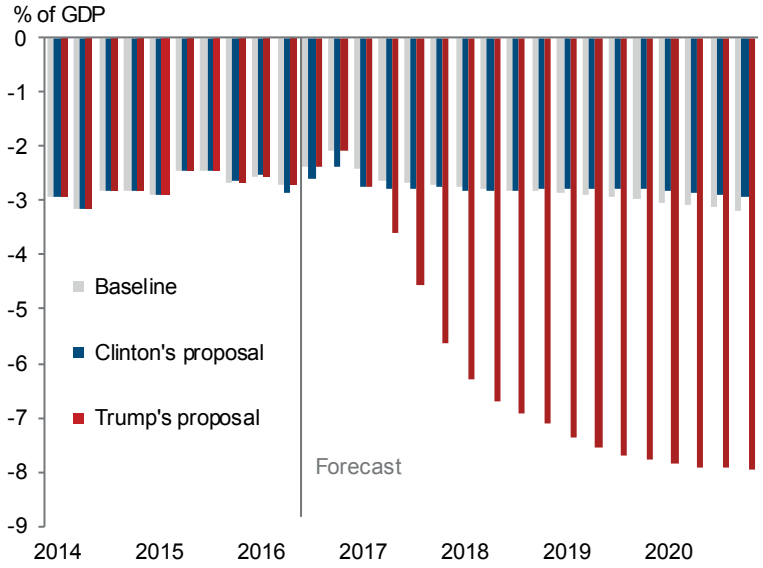
Hillary Clinton's proposals, meanwhile, look much more supportive of the economy and accretive to GDP growth. Using our model, we built three layered scenarios that examine the impact of Mrs. Clinton's proposals for taxes and spending, immigration reform and minimum wage increases.

The first layer assumes Clinton's tax proposal is fully adopted, representing an increase in taxes worth $400 billion over the period 2017-2021. Two-thirds of the tax rises would come from increased taxes on the top 5% of income earners, with the remainder split more or less evenly between higher corporate tax revenues and estate taxes. On the spending front, we assume that the package is fully implemented, worth about $750 billion (3% of GDP) over 2017-2021.

While the static price tag of the proposals would be around $350 billion, the economic boost to real GDP growth and extra tax revenues would offset the cost. The budget deficit as a share of GDP at the end of Mrs. Clinton's four-year term would be 3.0% – less than 1 percentage point higher than its current historically low level. In parallel, the debt-to-GDP ratio would remain close to current levels of around 77%.

Interestingly though, since the static cost would be more visible upon the announcement of the proposal, we would expect to see interest rates rising initially, before moderating towards the baseline. The 10-year government bond yield would, however, remain above the baseline through the 2017-2021 period because of stronger growth and somewhat faster monetary policy tightening.

US: Unified budget deficit



Source: Oxford Economics, Haver Analytics

Clinton's proposal deviates little from the Unified budget deficit baseline

Higher taxes for individuals would be expected to constrain spending. However, since the income tax hikes would be skewed towards the highest income earners, the drag on consumer spending would be relatively limited. Ninety per cent of the increased tax burden would fall on households earning more than $295,000 in 2015, and these individuals have a relatively low marginal propensity to consume on income. When this is combined with the increase in government spending on education, healthcare and infrastructure, real consumer spending growth accelerates relative to the baseline. Businesses witness stronger sales and would be more willing to hire and raise wages to keep their employees in a tight labour market. This creates a virtuous cycle of firmer income growth and increased private sector spending. While higher interest rates initially deter business investment, the negative shock is rapidly offset by increased sales. Likewise, while the modest rise in corporate taxes initially weighs on business investment, the boost from stronger sales acts as a potent tailwind.

Higher taxes planned for large earners (>$295k) and corporation tax will also rise modestly

Clinton could outperform the baseline in 2017-2018 and increase jobs

The US economy would average about 2.9% of growth over 2017-2018, compared with 2.3% in the baseline. This would represent the strongest pace in more than a decade. In an effort to prevent inflation from firming too rapidly, we anticipate the Fed would tighten policy a little faster than in our baseline (about 25bp to 50bp faster). The economy would have about 500,000 more jobs and the unemployment rate would be about a tick lower at 4.7%. The US dollar would strengthen slightly relative to our base case forecast.

Up to 6 million jobs could be created under Clinton's immigration reforms

We then overlay Mrs. Clinton's immigration reform proposal, and gradually increase the size of the labour force. In line with the findings of a 2013 study by the Congressional Budget Office and Joint Committee on Taxation, we assume the labour force rises by 6 million individuals over the next decade. In this scenario, the economy would generate 800,000 more jobs than in our baseline by the end of 2020. Real disposable income would be 0.9% higher while the economy would be 1.2% larger. Reflective of the fact that not all immigrants would be employed (mainly because of skills, language and occupation mismatches), the unemployment rate would creep above 5%, compared with 4.8% in the baseline in 2020.

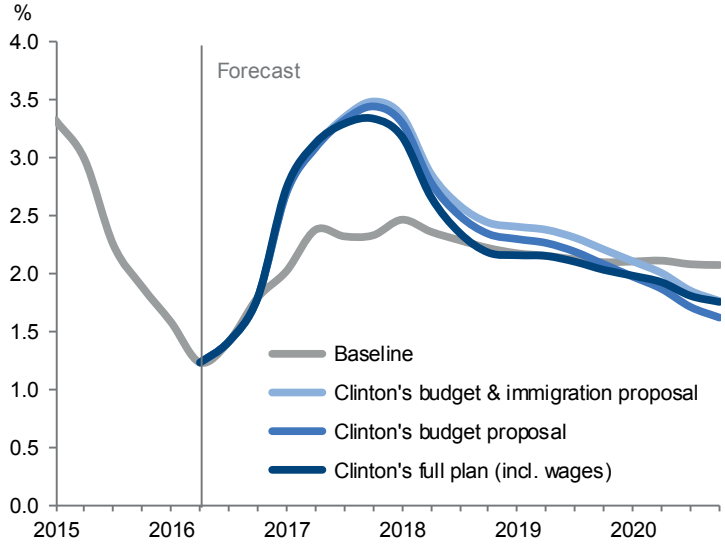
But the new $15 per hour minimum wage proposal could lead to lower consumption and sales

Finally, we layer Mrs. Clinton's proposal to increase the federal minimum wage to $15 per hour "over time". We assume that over time means an annual increase of $1 per year over eight years. Traditionally, this would impact labour markets in two ways: scale and substitution. Firstly, because of higher unit labour costs, businesses would be likely to pass on part of the increased cost to consumers, thereby reducing consumption and sales. In turn, businesses would hire fewer workers. Secondly, higher compensation costs would lead firms to seek more cost-efficient ways of substituting labour (for example, through automation). In addition, companies would be likely to curb other fringe benefits to reduce their compensation bills. All of these factors, all else being equal, would weigh on employment and income. However, we believe there would be offsetting effects as more than 30 million US households would benefit from higher minimum wages. Higher wages for these families, who possess a high propensity to consume, would boost income and, in turn, spending.

Up to 200k jobs more than the baseline are envisaged under Clinton's first term

The final layer of this scenario shows that by the end of Clinton's first term, employment would be 600,000 lower than in the proposal without the minimum wage increase. However, employment would be about 200,000 higher than in our baseline forecast. Likewise, while total real income would be lower than in the prior proposal, it would still be marginally higher (0.1 percentage points) than in the baseline. We caution that there is much uncertainty as to the effects of a rise in the minimum wage, and note that a tight labour market may actually offset some of the downside factors in employment and income listed above.

Clinton's US real GDP growth scenario



By 2020, Clinton's budget scenarios fall below the baseline forecast

Source: Oxford Economics, Haver Analytics

The candidates have taken completely different approaches to winning over the electorate. Clinton has run a traditional campaign and preached policies that would be likely to stimulate economic activity. Trump, meanwhile, has taken a populist view and has advocated completely non-traditional policies which, though they have garnered him support among many Republican voters, would have detrimental effects on the economy if they were actually implemented. With about 60 days left until the election, it is in voters' hands to decide who they want to lead the country and economy for the next four years.

Is the US ready for a new Ronald Reagan or will Clinton continue Obama's legacy?

Scenario results: Summary tables

Average annual growth, %	2016	2017	2018	2019	2020
Baseline forecast					
GDP	1.5	2.3	2.3	2.1	2.1
Consumer spending	2.6	2.6	2.3	2.1	2.0
Consumer prices	2.2	2.2	2.1	2.2	2.2
The US economy under Donald Trump's proposals					
GDP	1.5	2.5	2.1	1.0	1.7
Consumer spending	2.6	2.9	2.4	1.1	1.8
Consumer prices	1.2	2.3	1.8	2.3	2.2
The US economy under Hillary Clinton's proposals					
GDP	1.5	2.9	2.8	2.2	1.7
Consumer spending	2.6	2.7	2.8	2.2	1.7
Consumer prices	1.2	2.4	2.5	2.6	2.5

Source: Oxford Economics

PGMs – scenario-ed

Limited impact on PGM demand

SFA's calculations based on Oxford Economics' scenarios show that there is only a 28 koz difference in palladium automotive demand between a first-term Trump Presidency (four years' cumulative -19 koz vs. base case) and a Clinton Presidency (+9 koz), which does not look large enough to move the price when US auto demand amounts to over 2.1 moz of palladium annually. Perhaps this just demonstrates the lack of impact that US Presidents actually have on the economy.

Greatest concern is the risk of US consumer defaults on auto loans

Of more concern should be the broader outlook for the US economy and how much longer US consumers can afford to buy new vehicles at the current pace. Over 85% of new vehicle purchases involve financing, either loans or leases. Banks have started to tighten their lending criteria and if this continues and interest rates creep higher, the impact will be to make financing more expensive and hence restrict sales. In addition, the proportion of financed vehicles being leased has been rising and is now over 30%. These vehicles are coming off lease in increasing numbers and this will put pressure on prices in the second-hand market, which are close to record levels. In turn, this reduces the residual value used in the financing calculation, making it more expensive.

THE PGM MARKETS IN 2016

The PGM markets in 2016

Beresford Clarke and Samantha Trickey, SFA (Oxford) Ltd

The palladium market

Summary

>1 moz deficit again

The palladium market is set to record another year of deficits in excess of 1 moz, which means another slice of above-ground stocks will have been absorbed by end-uses.

SFA called the recent rally, price target met

Based purely on fundamentals, SFA's all-in estimate of stocks, including working inventories and investment, is reduced to around 13.5 moz and approximately half of this is likely to be available to market at any point in time, thus avoiding panic buying and extreme price volatility. Nonetheless, prices had recovered by over $100/oz to reach $680/oz by the end of August and had been trading at over $700/oz over the summer. As we told our clients ahead of the summer, our preference for palladium market fundamentals and its previously oversold position led us to forecast the metal's outperformance relative to platinum. SFA correctly called a 1.5:1 platinum to palladium ratio at a time when the ratio was well above 1.8:1.

The end to tax reductions for cars in China

However, the rise in palladium prices has, rather counter-intuitively, led to ETF redemptions, currently estimated at 267 koz. The investment case for palladium may not be as watertight as the fundamentals suggest. Much hinges on the on-going success of palladium-rich gasoline car sales, especially in China (+8.1% year-on-year in H1'16), which continue to defy slowdown fears. A government tax cut for cars with low capacity engines and the trend towards SUVs continue to boost local demand. However, the tax reduction is due to finish at the end of the year, so if the government does not continue to incentivise new car sales, demand could spike ahead of the cut and impact future sales.

Mine supply

Supply is close to peak levels in 2015

Palladium supply hit its stride in 2015, with global primary supply coming in just 35 koz below its all-time peak of 6,980 koz (2006). A temporary dip in output is predicted for 2016, with global supply decreasing to 6,680 koz (-3.8% year-on-year).

Temporary dip forecast for 2016

Russian supply is forecast at 2,390 koz for the year (-8% year-on-year) as Nornickel undertakes processing capacity upgrades. Supply from South Africa is also expected to be lower (-6% to 2,410 koz). Price-induced shaft closures remove 95 koz, and there has been an uptick in unplanned disruptions (primarily safety-related stoppages)

in the first half of the year, which SFA estimates has resulted in the loss of 50-60 koz of palladium so far. A disruption factor of 60 koz for H2'16 is incorporated, and slightly lower volumes are also anticipated from the palladium-rich Northern Limb (-30 koz).

Production from North America is estimated to increase by 5% to 1,040 koz owing to improved productivity at Stillwater's mines and greater throughput following plant maintenance by Vale in Sudbury last year. Zimbabwean production rises by 15% to 375 koz, partly attributable to the release of concentrate stockpiled in 2015.

385 koz lost to shaft closures in South Africa

In platinum-rich South Africa, shaft closures account for a net 385 koz loss of palladium production capacity since 2008, and capital investment by the major producers has decreased by over 70% in the past five years (2012-2016F). While other primary PGM producers have also pared back capital expenditure budgets (by 30-40%), there has been continual investment in replacement capacity by producers in North America (Stillwater, Vale) and Russia (Nornickel).

Combined with less reliance on South African mines (36% of global production vs. 71% for platinum), this has largely offset the trend for sequential losses following the 2006 supply peak that we have seen for platinum. The ratio of global platinum to palladium supply has therefore dipped from around 1:1 prior to 2010 to 0.88:1 in 2015, with 0.9:1 forecast for 2016.

The PGM basket price has increased by 31% in dollar terms since January to $954/oz in August (rand basket +11%), but is averaging 10% below the corresponding period in 2015 so far. Producers are making efforts to cut costs, with over ZAR3 billion in savings identified for FY16. This should help to limit South African cost inflation to 4.0% (including stay-in-business capital and by-product credits) and ensure positive free cash flow for most operations.

Recycling

Scrap autocatalyst recycling is steadily recovering, but is still well down on 2014 levels

Palladium recycling is set to drop 1.0% year-on-year to 2,035 koz, having fallen 6.7% in 2015. Lower scrap steel and PGM prices have been detrimental to automotive scrappage and autocatalyst recycling rates for the last two years. Scrap steel prices have picked up in most regions since the lows at the end of last year, but are still well down on pre-2015 levels. There has reportedly been a pick-up in the number of used catalytic converters presented to recyclers, though still not enough to get back to pre-2014 levels. Forecasts for scrap steel prices for the remainder of the year are relatively subdued, so we do not expect a significant recovery in H2.

Demand

Global demand, excluding investment, is projected to grow by 1.0% to 10,125 koz in 2016, which is the same growth rate as reported for automotive demand (7,795 koz). Industrial demand fares slightly better at 1.7% growth (to 2,080 koz), while jewellery consumption remains flat. Nevertheless, while demand is not exactly racing ahead, it is still a long way ahead of supply.

Demand growth is limited to 1% year-on-year, but still >1 moz higher than supply

Automotive demand

Chinese automotive demand is estimated to grow by a healthy 7.3% to 1,875 koz. Government tax breaks of 50% on cars with engines of less than 1.6 litres is spurring new car sales, as are dealer discounts and the raft of new SUV offerings. However, the incentives come to an end on 31 December, so unless the government makes it clear that there will be an extension, as is being lobbied by car companies, then it is likely that there will be a spike in car sales ahead of the deadline.

Healthy 7.3% demand growth in China

Demand from North America is also expected to be robust in 2016 with 4.0% growth to 2,180 koz, which captures a combination of higher loadings ahead of Tier 3 emissions standards, which are phased in from 2017, and increased vehicle production and a swing to larger-engine light trucks at the expense of smaller saloons.

Elsewhere, demand is holding up relatively well, although in Europe some thrifting and engine downsizing have limited demand growth this year.

Industrial demand

Demand appears to be undergoing a temporary boost from requirements in the chemical industry, rising 10.7% to 565 koz following a period of softer palladium prices. China is set to account for much of the growth, with greater catalyst demand for key processes such as hydrogen peroxide and purified terephthalic acid (PTA) production. This goes some way to offset an on-going reduction in demand from other end-uses such as the dental and electrical segments. Total industrial demand is forecast to rise by 1.7% to 2,080 koz.

Investment and above-ground stocks

ETF redemptions continue, despite higher prices

Year-to-date ETF holdings are down 267 koz (-11.7%) to 2,001 koz. The majority of the reductions have come from the most recently created ETF products in South Africa (-143 koz), with Absa holdings falling 21% to 259 koz and Standard Bank holdings dropping 12% to 537 koz. The US ETFS has also lost metal so far this year (-54 koz, -16%).

Speculative palladium investment positions on NYMEX staged a major recovery during August, with net long positions peaking at 1,577 koz and helping to push the metal prices back over $700/oz. A major speculative revolt against palladium saw net longs falling from over 1,329 koz in October last year to lows of 192 koz in June 2016, leaving palladium prices at less than $550/oz.

SFA's all-in estimate of stocks, including working inventories and investment, is around 13.5 moz and approximately half of this might be available to the market currently.

The platinum market

Narrow deficit of 155 koz forecast

A drop in South African supply is largely responsible for a slight widening of the industrial market deficit (before investment) to an estimated 155 koz for 2016.

Primary supply is down 2% in 2016

Primary platinum supply is forecast to decrease by 2% to 6,000 koz in 2016, almost 855 koz short of the 2006 supply peak. South African production falls by 5% to 4,250 koz, with closures and unplanned disruptions undermining 2015 production levels by around 200 koz. North American supply is up by 8% to 395 koz and Zimbabwean output rises to 475 koz (+17%), while Russian supply dips by around 30 koz to 680 koz.

Demand growth is flat

The fall in Chinese jewellery requirements is offset elsewhere

Global demand is predicted to remain almost flat at 7,900 koz in 2016. A drop in HDV production, engine downsizing and some loss in diesel shares are holding automotive demand at around 3,390 koz p.a. Jewellery demand is forecast to remain flat at 2,885 koz, but masks a fall in China (-65 koz to 1,700 koz) and growth in India (+45 koz to 265 koz) along with slight growth in North America (+20 koz) and Western Europe (+10 koz).

Industrial demand requirements are forecast to drop slightly by 25 koz to 1,625 koz. As always, industrial demand is a mixed bag of mostly net top-up requirements and capacity changes required for plant operations, whether in oil refining, chemicals or glass fabrication. Platinum is also consumed in our industrial demand category in computer hard disk drives, silicones, fuel cells, sensors and other minor applications.

North America is set to report growth of 115 koz, mainly as a result of oil refinery expansions, while demand in Western Europe and Japan is estimated to fall by 80 koz and 25 koz respectively owing to oil refinery closures. China and the emerging markets are expected to report relatively steady demand on a net basis.

As per palladium above, weaker scrap steel and PGM prices impacted the recovery of platinum from autocatalyst recycling. Total recycling is forecast to grow by just 35 koz to 1,745 koz this year.

ETF redemptions are mainly from South Africa

Platinum ETF product holdings are down 119 koz on a year-to-date basis to 2,274 koz. In a similar trend to palladium, the majority of the falls were seen in South Africa, with Absa holdings reduced by 159 koz, while the UK ETFS fund saw sales of 24 koz. Additions to holdings in the US (+46 koz), Switzerland (+14 koz) and South Africa's Standard Bank ETF (+20 koz) were not enough to offset the losses.

The rhodium market

The market is forecast to remain in surplus in 2016 (+35 koz). Primary rhodium supply declined in proportion to platinum in 2016, down 2% to 750 koz. Losses in South Africa and Russia remove 30 koz from 2015 levels, but minor increases (+5 koz) are forecast for Zimbabwe and North America. However, demand is now predicted to fall by 4% (-45 koz to 990 koz) owing to lower automotive demand associated with downsizing and slightly reduced loadings in most regions. Recycling is projected to increase by 20 koz to 285 koz.

Demand is forecast to fall 4% in 2016

The price outlook for the next six months

Palladium $708/oz

Palladium was oversold at below $600/oz based on current fundamentals, but with the platinum-palladium ratio back between 1.5:1 and 1.6:1, our target for this quarter has been met.

Price target achieved

China remains the powerhouse of palladium demand growth (+150 koz) for 2016, followed by North America (+95 koz). Therefore, palladium prices are largely in the hands of the Chinese government in the near term. Should tax incentives on car sales continue into 2017 then palladium will continue to outperform. However, there is a degree of uncertainty about the decision; if the tax incentive comes to an end as scheduled, then the risk is that palladium will trade lower than forecast.

Direction is dependent on the Chinese government's decision on car tax breaks at the end of 2016

Platinum $1,078/oz

Our update to the platinum fundamentals compared to our May report shows a slight weakening in the industrial market balance for both this year and last year. On this basis, as well as on-going limited demand growth for platinum (flat year-on-year), and despite primary supply falling 145 koz year-on-year, there is insufficient impetus to expect higher prices over the next six months.

Lack of impetus for higher prices

However, the rand-dollar exchange rate continues to exert a strong influence on the price. Should the rand strengthen against the dollar, then platinum prices will increase (and palladium prices could rise in sympathy). Nonetheless, it appears more likely that the dollar will outperform over the next six months and platinum prices could actually trade lower than our forecast.

Strong dollar could hit platinum prices

Rhodium $677/oz

SFA's view on the rhodium price holds as our market balance has not changed: prices of between $600 and $700/oz appear fair for the remainder of the year. A major adjustment is required to the rhodium market to lift prices, from either the closure of mines extracting rhodium-rich UG2 Reef ore in South Africa or a sudden uplift in demand. Mines in the upper quartiles of the cost curve have dipped in and out of profitability with price and currency fluctuations over the last year, which may not be enough of a justification to force closure.

Fair value at between $600-$700/oz

Meanwhile, demand is highly unlikely to rebound in the near term despite the metal's attractive properties. Even if there were to be a rebasing of demand, there is plenty of stock available to keep the market satisfied for some time to come.

APPENDIX

Palladium supply-demand balance

koz	2008	2009	2010	2011	2012	2013	2014	2015	2016f
Primary supply									
Regional									
South Africa	2,345	2,425	2,590	2,550	2,355	2,360	1,855	2,560	2,410
Russia	2,700	2,675	2,720	2,705	2,630	2,580	2,690	2,605	2,390
Zimbabwe	140	180	225	265	280	315	330	325	375
North America	880	610	580	865	895	975	1,055	995	1,040
Other	0	0	300	390	445	450	460	455	460
Total	**6,065**	**5,890**	**6,415**	**6,775**	**6,605**	**6,680**	**6,390**	**6,940**	**6,675**
Demand & recycling									
Autocatalyst									
Gross demand	4,790	4,095	5,620	6,220	6,705	7,160	7,530	7,720	7,795
Recycling	1,215	1,155	1,395	1,525	1,485	1,645	1,720	1,630	1,675
Net demand	3,575	2,940	4,225	4,695	5,220	5,515	5,810	6,090	6,120
Jewellery									
Gross demand	985	775	695	680	545	350	295	240	250
Recycling	0	0	100	135	130	145	120	80	80
Net demand	985	775	595	545	415	205	175	160	170
Industrial demand	2,420	2,400	2,465	2,465	2,325	2,045	2,000	2,040	2,080
Other recycling	315	340	400	355	340	365	370	360	280
Gross demand	8,195	7,270	8,780	9,365	9,575	9,555	9,825	10,000	10,125
Recycling	1,530	1,495	1,895	2,015	1,955	2,155	2,210	2,070	2,035
Net demand	**6,665**	**5,775**	**6,885**	**7,350**	**7,620**	**7,400**	**7,615**	**7,930**	**8,090**
Market balance									
Balance (before ETFs)	-600	115	-470	-575	-1,015	-720	-1,225	-990	-1,415
ETFs (stock allocation)	380	505	1,085	-535	285	0	940	-670	
Balance after ETFs	**-980**	**-390**	**-1,555**	**-40**	**-1,300**	**-720**	**-2,165**	**-320**	**-1,415**

Source: SFA (Oxford)

Palladium demand and recycling summary

koz	2008	2009	2010	2011	2012	2013	2014	2015	2016f
Gross demand									
Autocatalyst									
North America	1,545	1,005	1,310	1,505	1,740	1,835	1,955	2,095	2,180
Western Europe	965	920	1,280	1,500	1,425	1,530	1,650	1,705	1,575
Japan	925	600	810	670	735	745	745	700	680
China	395	705	1,010	1,130	1,300	1,515	1,665	1,745	1,875
India	90	105	145	160	155	165	165	180	220
RoW	870	760	1,065	1,255	1,350	1,370	1,350	1,295	1,265
Total	**4,790**	**4,095**	**5,620**	**6,220**	**6,705**	**7,160**	**7,530**	**7,720**	**7,795**
Jewellery									
North America	60	60	65	45	45	40	35	35	40
Western Europe	45	50	65	65	80	75	60	55	55
Japan	115	80	85	90	95	65	55	50	55
China	740	560	450	450	295	145	120	75	75
RoW	25	25	30	30	30	25	25	25	25
Total	**985**	**775**	**695**	**680**	**545**	**350**	**295**	**240**	**250**
Industrial									
North America	515	495	500	495	480	440	405	415	420
Western Europe	375	365	410	375	335	290	295	300	305
Japan	625	595	575	550	565	430	430	435	430
China	320	420	435	425	405	405	415	425	445
RoW	585	525	545	620	540	480	455	465	480
Total	**2,420**	**2,400**	**2,465**	**2,465**	**2,325**	**2,045**	**2,000**	**2,040**	**2,080**
Total gross demand									
North America	2,120	1,560	1,875	2,045	2,265	2,315	2,395	2,545	2,640
Western Europe	1,385	1,335	1,755	1,940	1,840	1,895	2,005	2,060	1,935
Japan	1,665	1,275	1,470	1,310	1,395	1,240	1,230	1,185	1,165
China	1,455	1,685	1,895	2,005	2,000	2,065	2,200	2,245	2,395
RoW	1,570	1,415	1,785	2,065	2,075	2,040	1,995	1,965	1,990
Total	**8,195**	**7,270**	**8,780**	**9,365**	**9,575**	**9,555**	**9,825**	**10,000**	**10,125**
Recycling									
Autocatalyst									
North America	850	890	975	975	930	1,005	975	895	975
Western Europe	250	135	205	335	325	345	365	325	320
Japan	95	100	175	130	125	125	135	125	130
China	0	0	0	15	20	50	60	115	85
RoW	20	30	40	70	85	120	185	170	165
Total	**1,215**	**1,155**	**1,395**	**1,525**	**1,485**	**1,645**	**1,720**	**1,630**	**1,675**
Jewellery									
Japan	0	0	10	15	20	20	20	20	20
China	0	0	90	120	110	125	100	60	60
Total	**0**	**0**	**100**	**135**	**130**	**145**	**120**	**80**	**80**
WEEE									
North America	85	85	80	70	70	70	65	75	70
Western Europe	70	75	115	80	80	85	85	70	55
Japan	115	115	130	130	115	130	135	145	95
China	15	15	20	15	20	20	15	10	10
RoW	30	50	55	60	55	60	70	60	50
Total	**315**	**340**	**400**	**355**	**340**	**365**	**370**	**360**	**280**
Total recycling									
North America	935	975	1,055	1,045	1,000	1,075	1,040	970	1,045
Western Europe	320	210	320	415	405	430	450	395	375
Japan	210	215	315	275	260	275	290	290	245
China	15	15	110	150	150	195	175	185	155
RoW	50	80	95	130	140	180	255	230	215
Total	**1,530**	**1,495**	**1,895**	**2,015**	**1,955**	**2,155**	**2,210**	**2,070**	**2,035**

Source: SFA (Oxford)

Platinum supply-demand balance

koz	2008	2009	2010	2011	2012	2013	2014	2015	2016f
Primary supply									
Regional									
South Africa	4,555	4,550	4,725	4,595	4,200	4,355	3,115	4,465	4,250
Russia	805	775	790	800	780	740	740	710	680
Zimbabwe	180	230	280	340	365	405	405	405	475
North America	370	275	200	375	345	355	395	365	395
Other	0	0	120	145	180	215	200	200	200
Total	**5,910**	**5,830**	**6,115**	**6,255**	**5,870**	**6,070**	**4,855**	**6,145**	**6,000**
Demand & recycling									
Autocatalyst									
Gross demand	3,730	2,520	2,910	3,110	3,160	3,165	3,300	3,405	3,390
Recycling	1,055	835	955	1,210	1,175	1,120	1,255	1,190	1,240
Net demand	2,675	1,685	1,955	1,900	1,985	2,045	2,045	2,215	2,150
Jewellery									
Gross demand	1,935	2,680	2,170	2,450	2,760	2,945	3,000	2,880	2,885
Recycling	390	415	475	630	840	855	775	515	500
Net demand	1,545	2,265	1,695	1,820	1,920	2,090	2,225	2,365	2,385
Industrial demand	1,670	1,210	1,615	1,820	1,495	1,480	1,535	1,650	1,625
Other recycling	15	15	10	10	5	5	5	5	5
Gross demand	7,335	6,410	6,695	7,380	7,415	7,590	7,835	7,935	7,900
Recycling	1,460	1,265	1,440	1,850	2,020	1,980	2,035	1,710	1,745
Net demand	**5,875**	**5,145**	**5,255**	**5,530**	**5,395**	**5,610**	**5,800**	**6,225**	**6,155**
Market balance									
Balance (before ETFs)	35	685	860	725	475	460	-945	-80	-155
ETFs (stock allocation)	100	385	575	175	200	905	215	-240	
Balance after ETFs	**-65**	**300**	**285**	**550**	**275**	**-445**	**-1,160**	**160**	**-155**

Source: SFA (Oxford)

Platinum demand and recycling summary

koz	2008	2009	2010	2011	2012	2013	2014	2015	2016f
Gross demand									
Autocatalyst									
North America	570	335	390	385	425	430	465	475	435
Western Europe	1,920	1,290	1,335	1,500	1,340	1,360	1,455	1,560	1,590
Japan	540	315	480	500	600	580	590	565	545
China	150	95	135	120	115	130	125	115	125
India	90	100	145	180	200	160	160	170	160
RoW	460	385	425	425	480	505	505	520	535
Total	**3,730**	**2,520**	**2,910**	**3,110**	**3,160**	**3,165**	**3,300**	**3,405**	**3,390**
Jewellery									
North America	195	140	160	160	185	200	230	250	270
Western Europe	200	185	180	175	175	220	220	235	245
Japan	450	430	370	315	325	335	335	340	335
China	1,020	1,860	1,370	1,670	1,915	1,990	1,975	1,765	1,700
India	40	40	50	80	105	140	175	220	265
RoW	30	25	40	50	55	60	65	70	70
Total	**1,935**	**2,680**	**2,170**	**2,450**	**2,760**	**2,945**	**3,000**	**2,880**	**2,885**
Industrial									
North America	315	195	255	250	305	300	305	245	360
Western Europe	315	275	285	280	250	170	235	310	230
Japan	155	125	140	195	85	85	30	85	60
China	275	125	390	310	375	510	450	515	510
RoW	610	490	545	785	480	415	515	495	465
Total	**1,670**	**1,210**	**1,615**	**1,820**	**1,495**	**1,480**	**1,535**	**1,650**	**1,625**
Total gross demand									
North America	1,080	670	805	795	915	930	1,000	970	1,065
Western Europe	2,435	1,750	1,800	1,955	1,765	1,750	1,910	2,105	2,065
Japan	1,145	870	990	1,010	1,010	1,000	955	990	940
China	1,445	2,080	1,895	2,100	2,405	2,630	2,550	2,395	2,335
RoW	1,230	1,040	1,205	1,520	1,320	1,280	1,420	1,475	1,495
Total	**7,335**	**6,410**	**6,695**	**7,380**	**7,415**	**7,590**	**7,835**	**7,935**	**7,900**
Recycling									
Autocatalyst									
North America	580	550	580	600	575	560	560	505	540
Western Europe	310	135	195	420	405	365	470	450	485
Japan	115	110	145	115	115	95	105	95	95
China	0	0	0	5	10	20	30	55	35
RoW	50	40	35	70	70	80	90	85	85
Total	**1,055**	**835**	**955**	**1,210**	**1,175**	**1,120**	**1,255**	**1,190**	**1,240**
Jewellery									
North America	0	0	0	0	0	0	0	5	5
Western Europe	0	0	0	0	0	0	5	5	5
Japan	220	130	150	285	285	250	235	160	150
China	170	285	325	345	555	600	530	340	335
RoW	0	0	0	0	0	5	5	5	5
Total	**390**	**415**	**475**	**630**	**840**	**855**	**775**	**515**	**500**
WEEE	**15**	**15**	**10**	**10**	**5**	**5**	**5**	**5**	**5**
Total recycling									
North America	585	555	580	600	575	560	565	515	545
Western Europe	315	135	200	425	405	365	475	455	490
Japan	340	245	295	400	400	345	340	255	245
China	170	285	325	355	570	620	560	395	375
RoW	50	45	40	70	70	90	95	90	90
Total	**1,460**	**1,265**	**1,440**	**1,850**	**2,020**	**1,980**	**2,035**	**1,710**	**1,745**

Source: SFA (Oxford)

Rhodium supply-demand balance

koz	2008	2009	2010	2011	2012	2013	2014	2015	2016f
Primary supply									
Regional									
South Africa	610	660	650	645	600	590	425	620	595
Russia	80	75	75	75	75	70	75	70	65
Zimbabwe	15	20	25	30	30	35	35	35	40
North America	30	20	15	30	30	35	30	30	30
Other	0	0	10	10	10	10	10	10	10
Total	**735**	**775**	**775**	**790**	**745**	**740**	**575**	**765**	**740**
Demand & recycling									
Autocatalyst									
Gross demand	915	585	730	740	770	785	830	865	820
Recycling	190	170	220	235	235	260	275	270	280
Net demand	725	415	510	505	535	525	555	595	540
Industrial demand	140	110	170	170	150	150	165	170	170
Other recycling	3	2	1	1	1	1	2	2	2
Gross demand	1,055	695	900	910	920	935	995	1,035	990
Recycling	195	170	220	235	240	265	280	265	285
Net demand	**860**	**525**	**680**	**675**	**680**	**670**	**715**	**770**	**705**
Market balance									
Balance (before ETFs)	-125	250	95	115	65	70	-140	-5	35
ETFs (stock allocation)				15	35	50	5	-5	
Balance after ETFs				**100**	**30**	**20**	**-145**	**0**	**35**

Source: SFA (Oxford)

Rhodium demand and recycling summary

koz	2008	2009	2010	2011	2012	2013	2014	2015	2016f
Gross demand									
Autocatalyst									
North America	275	150	180	180	200	220	230	260	255
Western Europe	265	190	200	215	190	195	220	235	195
Japan	240	115	165	135	150	140	140	125	120
China	30	45	70	75	90	95	105	110	120
India	10	10	15	20	20	15	15	15	20
RoW	95	75	100	115	120	120	120	120	110
Total	**915**	**585**	**730**	**740**	**770**	**785**	**830**	**865**	**820**
Industrial									
North America	15	10	15	20	15	15	15	15	20
Western Europe	15	15	25	20	20	10	15	15	10
Japan	45	35	45	45	45	35	25	30	30
China + RoW	65	50	85	85	70	90	110	110	110
Total	**140**	**110**	**170**	**170**	**150**	**150**	**165**	**170**	**170**
Total gross demand									
North America	290	160	195	200	215	235	245	275	275
Western Europe	280	205	225	235	210	205	235	250	205
Japan	285	150	210	180	195	175	165	155	150
China + RoW	200	180	270	295	300	320	350	355	360
Total	**1,055**	**695**	**900**	**910**	**920**	**935**	**995**	**1,035**	**990**
Recycling									
Autocatalyst									
North America	115	125	160	140	145	165	160	150	160
Western Europe	50	20	30	60	60	55	60	60	60
Japan	20	20	25	25	25	25	30	30	35
China	0	0	0	0	0	5	5	10	5
RoW	5	5	5	10	5	10	20	20	20
Total	**190**	**170**	**220**	**235**	**235**	**260**	**275**	**270**	**280**

Source: SFA (Oxford)

GLOSSARY OF TERMS

Basket price

Collective revenue of metals divided by 4E oz

By-products

Copper, nickel, iridium and ruthenium

CBOE Volatility Index®

A gauge of near-term financial market volatility conveyed by S&P 500 stock index option prices and is listed on Chicago Board Options Exchange (CBOE)

ETF

Exchange traded fund

Fiscal cliff

A combination of expiring tax cuts and across-the-board government spending cuts threatening sudden and severe economic decline

Gas

Gasoline

Gross demand

A measure of intensity of use

HDV

Heavy-duty vehicle

koz

A thousand troy ounces

LCV

Light commercial vehicle

Lease rates

Fees payable for the rental of an asset

Merensky Reef

A layer of igneous rock situated in South Africa that contains most of the world's PGM

MLCCs

Multi-layered ceramic capacitors

moz

A million troy ounces

Net demand

A measure of the theoretical requirement for new metal, i.e. net of recycling

Net supply

Proxy supply of metal surplus to requirements

Nornickel

Previously known as Norilsk Nickel and is the world's largest producer of nickel and palladium

NYMEX

New York Mercantile Exchange

oz

Troy ounce

PGMs

Platinum-group metals

Price elastic

Susceptible to changes in price

Primary supply

Mine production

Producer sales

Mine output plus inventory sold to market

Secondary supply

Recycling output

S&P 500

Standard & Poor's 500 Index is an index of the largest 500 US companies by market capitalisation

SUV

Sport utility vehicle

TARP

Troubled Asset Relief Program (TARP) was the largest part of the US government's $700 bn financial bailout plan in 2008

TOCOM

Tokyo Commodity Exchange

UG2 Reef

Found in South Africa, this chromite-rich layer of rock contains fewer by-products than the Merensky Reef

4E

Platinum, palladium, rhodium and gold

Currency symbols

ZAR	South African rand
$	US dollar

METHODOLOGY NOTES

Primary supply is calculated from actual mine production and excludes the sale of stock in order to provide pure production data. Stock sales are treated separately in SFA's database as movement of stocks. Therefore, state stock sales from Russia are excluded in tabulations.

Gross demand is a measure of intensity of use.

Net demand is a measure of the theoretical requirement for new metal, i.e. net of recycling.

Automotive demand is based on vehicle production data not sales.

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Please note: Some tabulated data may not sum owing to rounding of individual numbers.

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