

Desautels Capital Management

Industry Overview: Palladium's 'Danger Zone'

Diversified Industrials

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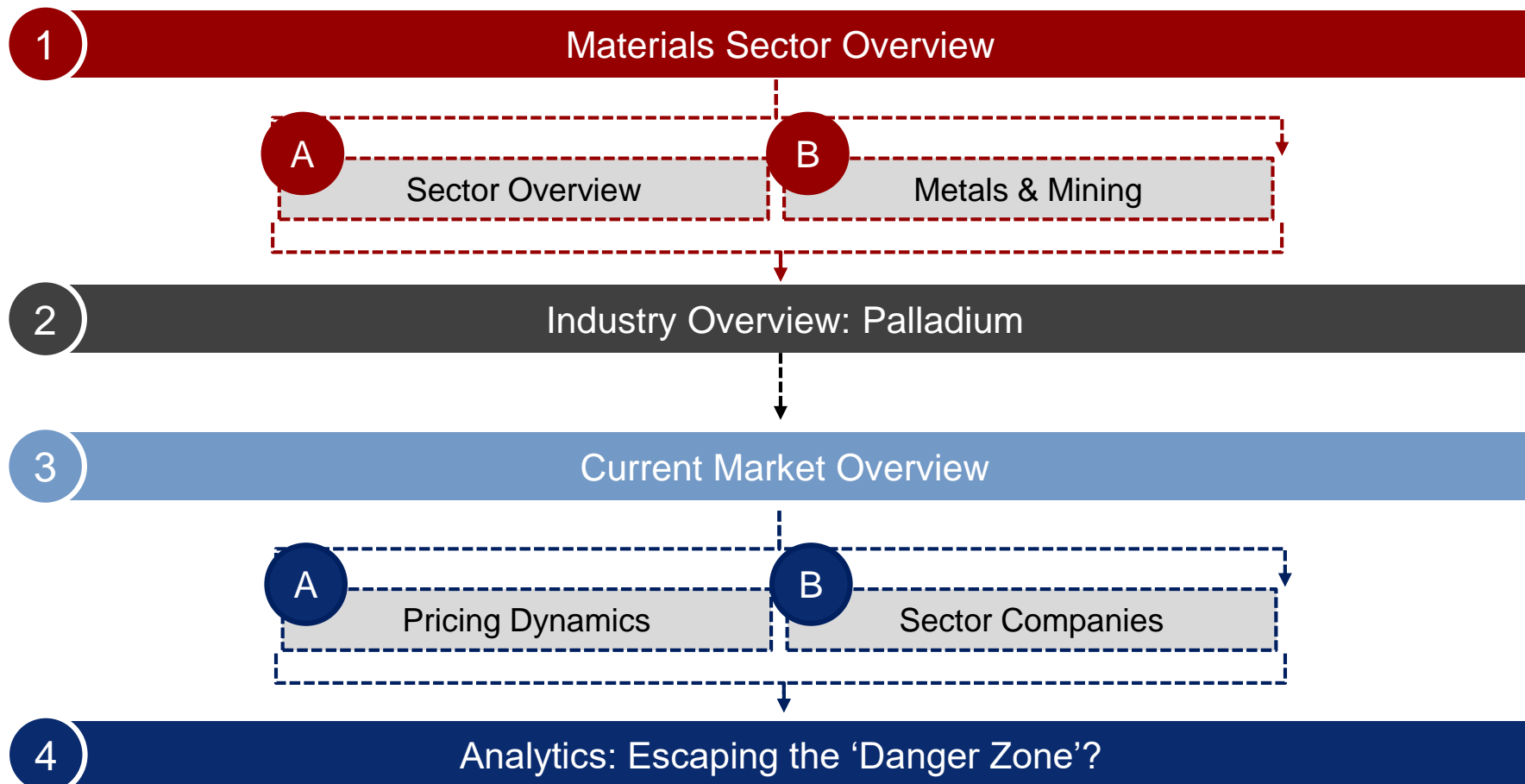
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February 6, 2019

Executive Summary

Sit Tight And Enjoy The Ride



Materials Sector Overview

SECTION I



Materials Sector Holdings

Current Portfolio Composition

Corporate Single Securities

ETFs

Hold



iShares®
by BLACKROCK®

Sold



Materials Sector Holdings

Sector Updates



Poor Weather Plaguing Earnings

- Weather impacted earnings in Houston
 - Heavily rainfall throughout the last quarter have delayed expected cash flow from Hurricane Harvey reconstruction products
- Slow growth in the U.S. housing market
 - A slowdown in housing starts and building permits issued for single and multi-occupancy residential units
- Optimism going into 2019
 - Significant backlog of products and projects with signed contracts and obtained purchase orders
 - New push for infrastructure funding by the Trump administration



Lack of Investment Theses Materialization

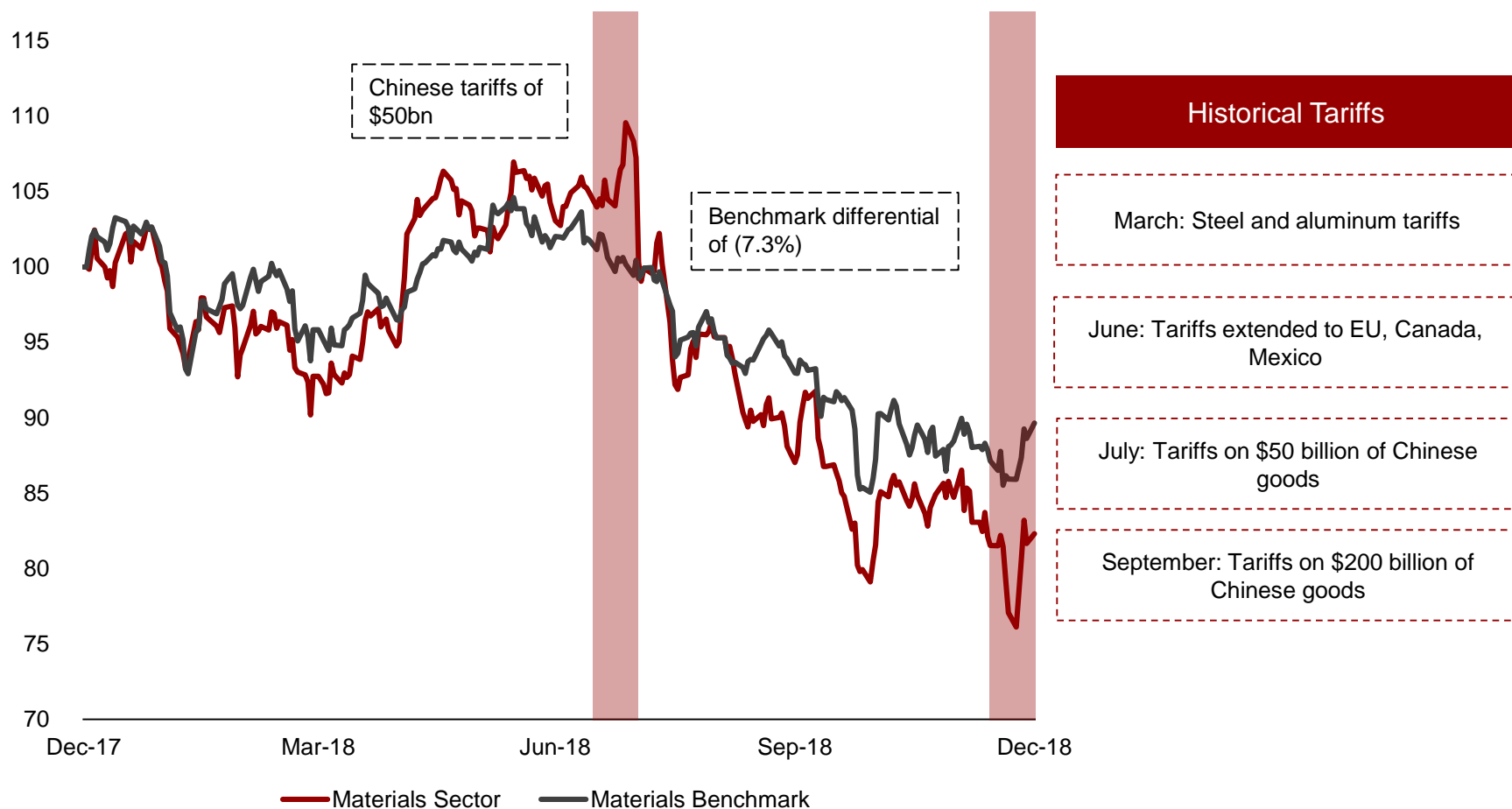
- Closed out our position early December
 - Sold at an average share price of \$2.17, realizing a total loss of -9.58%
- Thesis I: Risk within global operations
 - Alacer maintains a 80% in Çöpler gold mine in Turkey, where political tensions have not normalized both domestically and internationally, leading to a lack of anticipated price correction
- Thesis II: Potential acquisition target
 - Alacer has not yet been acquired by another mining company

Sector Outlook

SECTION II

Global Economic Headwinds Posing Major Challenges

Sector Performance vs. Benchmark

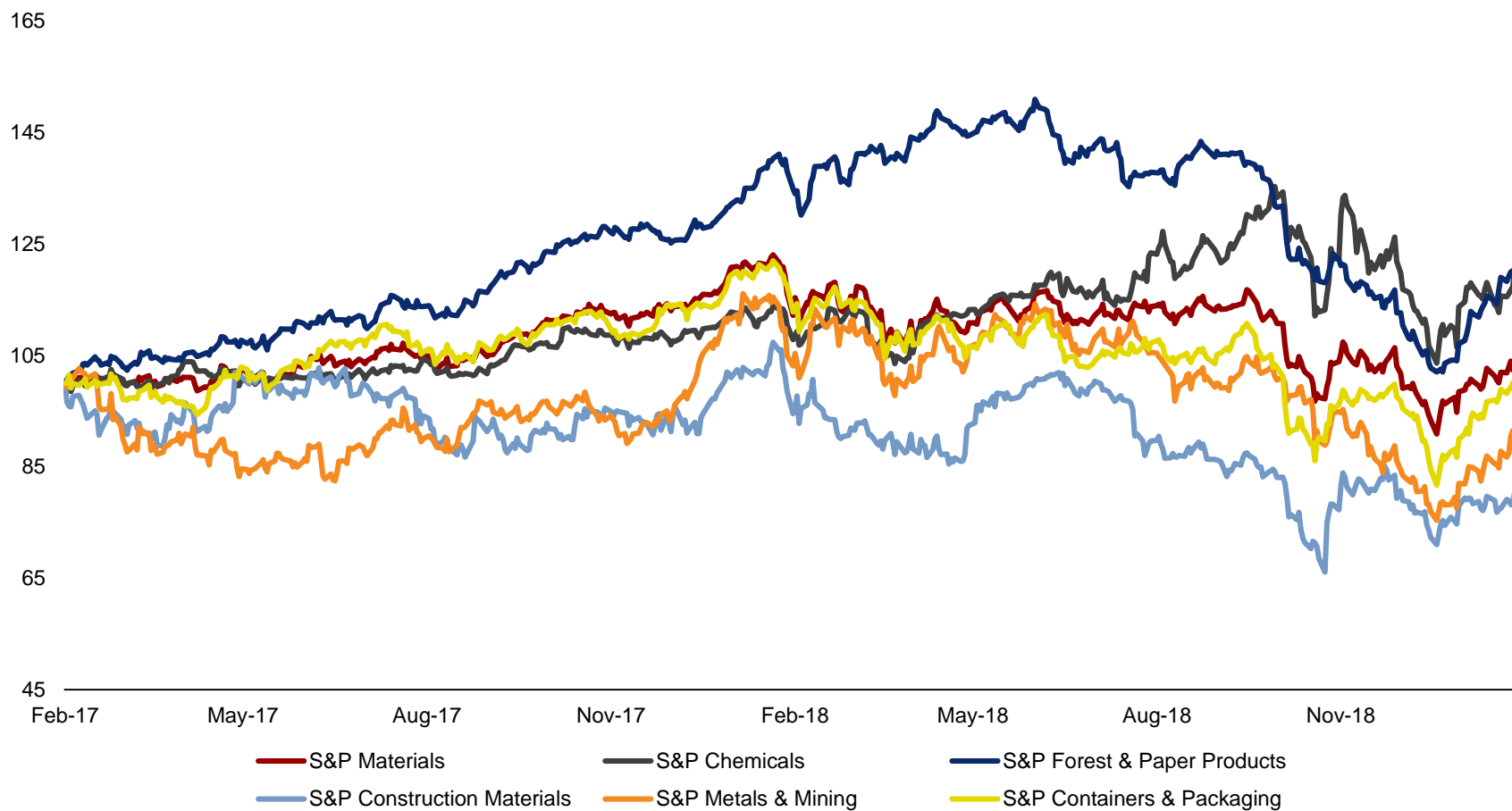


U.S.-China trade dispute driving poor performance of the Materials sector

Source: Bloomberg, FT.

Performance Differentiation Across Subindustries

Subsectors vs. Benchmark Performance

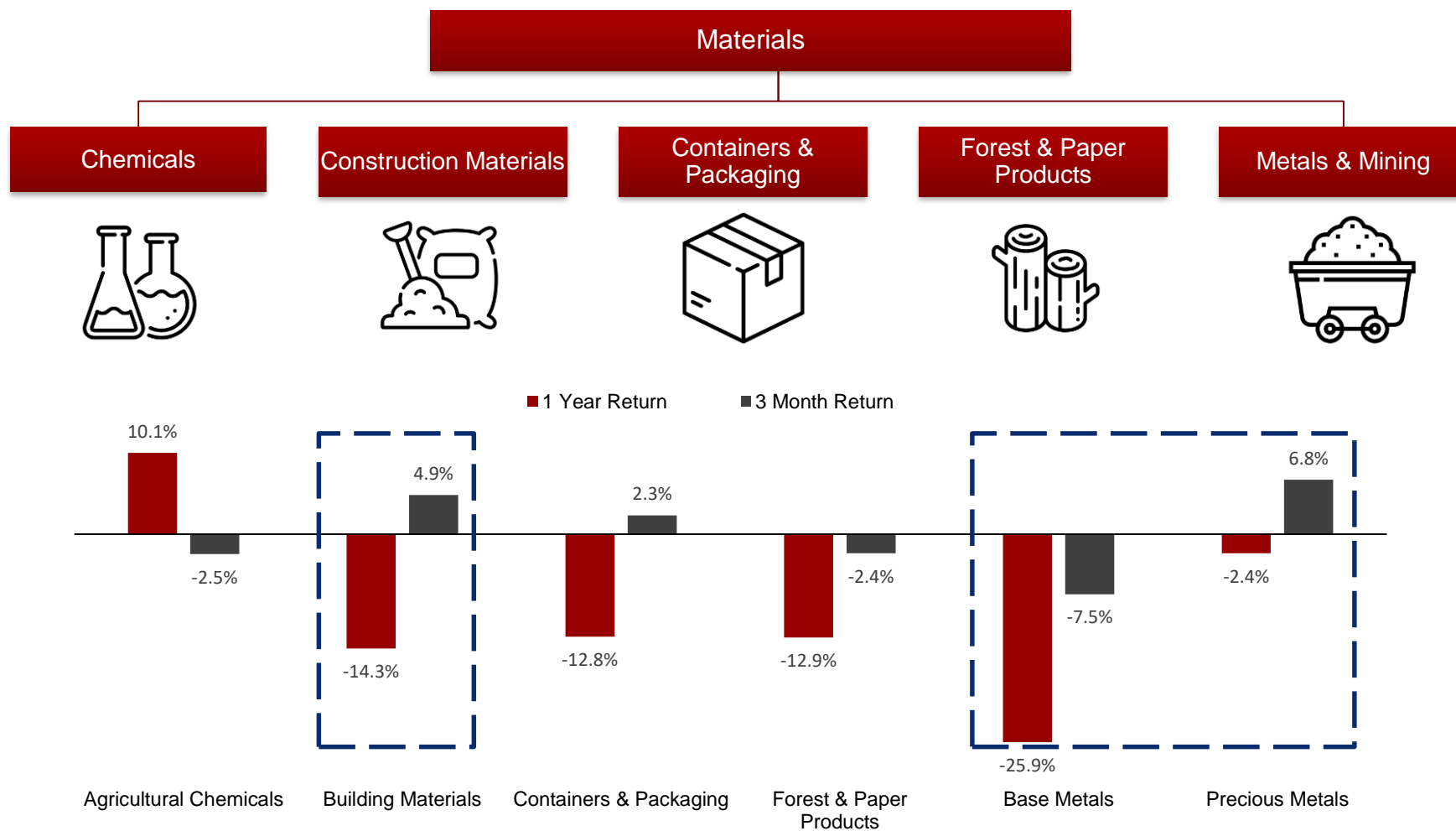


Domestically focused subsectors are hurt less than internationally oriented ones

Source: Bloomberg.

2019 Outlook: Starting Off On The Right Foot

One Year Subsector Returns



Quick movement in relative performance across different Materials subindustries

Source: Bloomberg.

Breaking Down Metals & Mining

Varied Industrial and Commercial Uses of Base and Precious Metals

Base Metals Primarily Used For Industrial and Construction Purposes

Electrical Wiring

Metal Alloys

Coating & Plating



Nickel



Aluminum



Zinc



Copper



Lead

Precious Metals Varied In Uses and Applications

Circuits & Processors

Jewelry

Catalytic Converters



Gold



Silver



Platinum



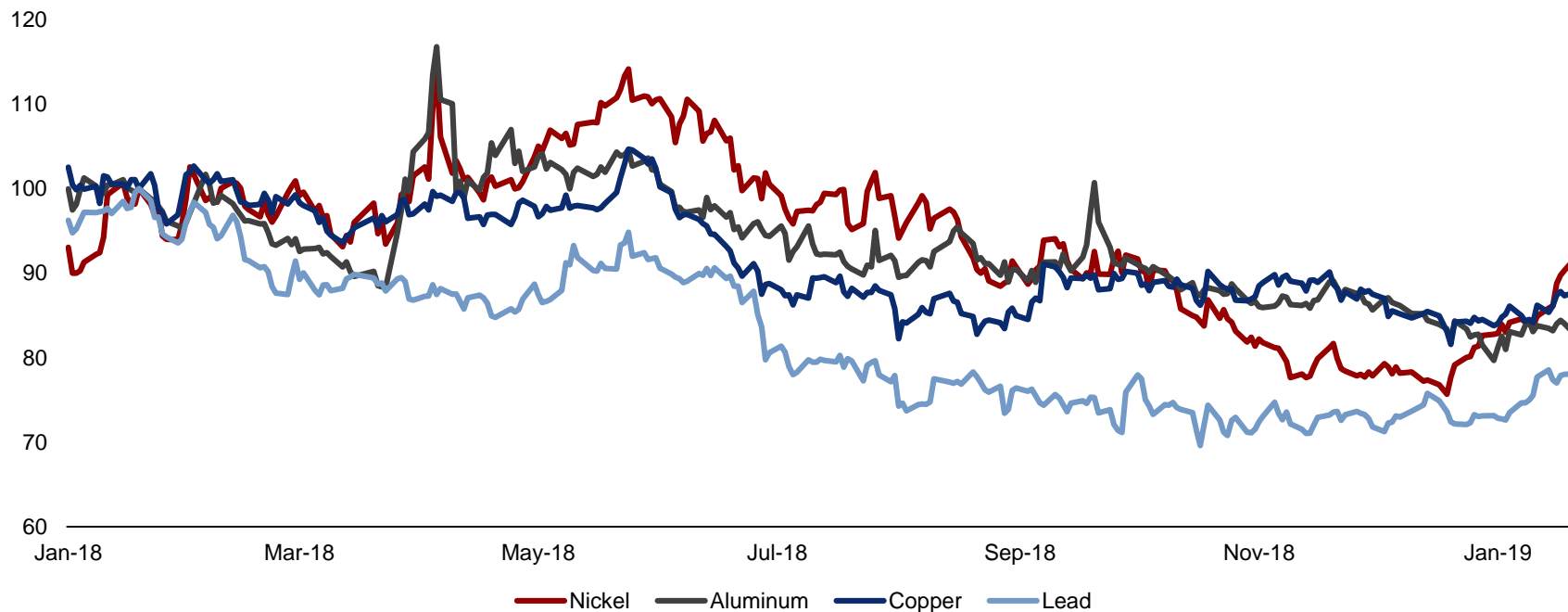
Palladium

Metals have a wide variety of end markets that drive global demand and usage

Source: Bloomberg, Forbes, Company filings.

Base Metals Outlook

Base Metal Spot Price Movement



Micro-fundamentals across the spectrum are uninspiring. Zinc will probably remain tight, the copper market is largely balanced, and nickel will contend with weaker demand out of China.
-Andrew Cosgrove, Bloomberg

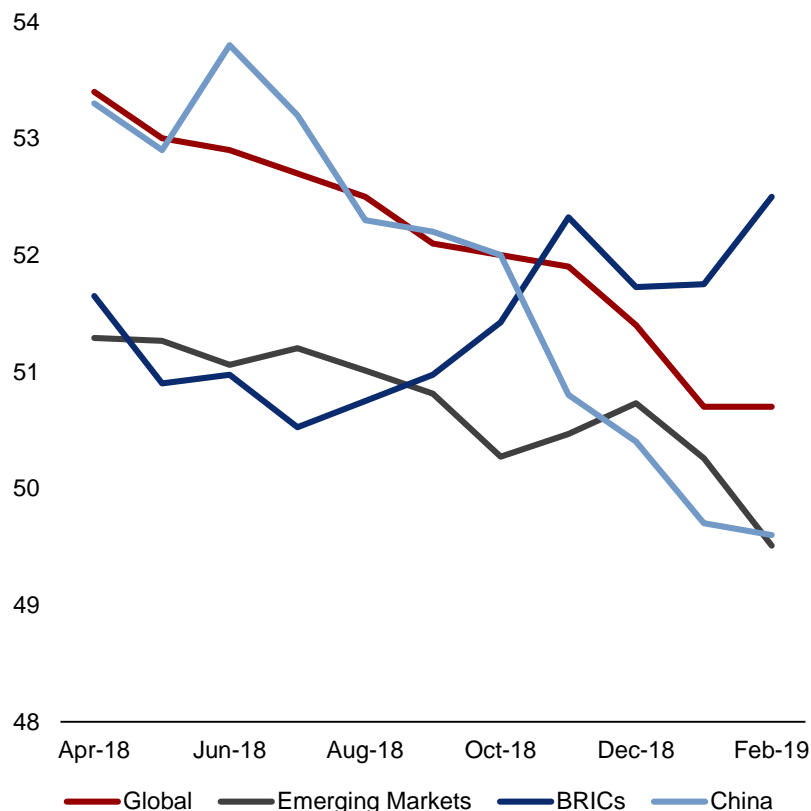
We maintain an outlook for rising industrial metals prices, however trade concerns have pushed anticipated price increases out by at least a year.
-Jean-Francois Perrault, Chief Economist RBC

A Potential Global Economic Slowdown?

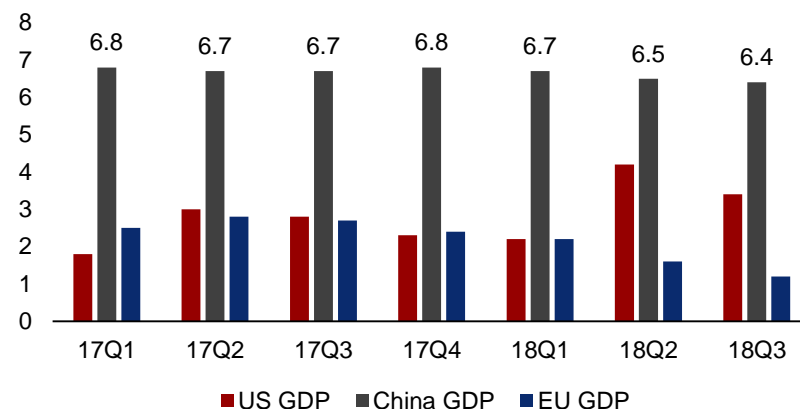
Weakening Downstream Indicators May Reflect Poor Conditions

(in \$ millions, unless noted)

Continued Manufacturing PMI Declines



Declining Global GDP



"The Great Stall of China"

- External observers estimate China GDP may in reality be as low as 4%
 - Credit growth currently running at double the rate of GDP growth, expected to slow in the coming year
 - Given that metal prices track industrial production, there is an expectation of hard landing for base metals

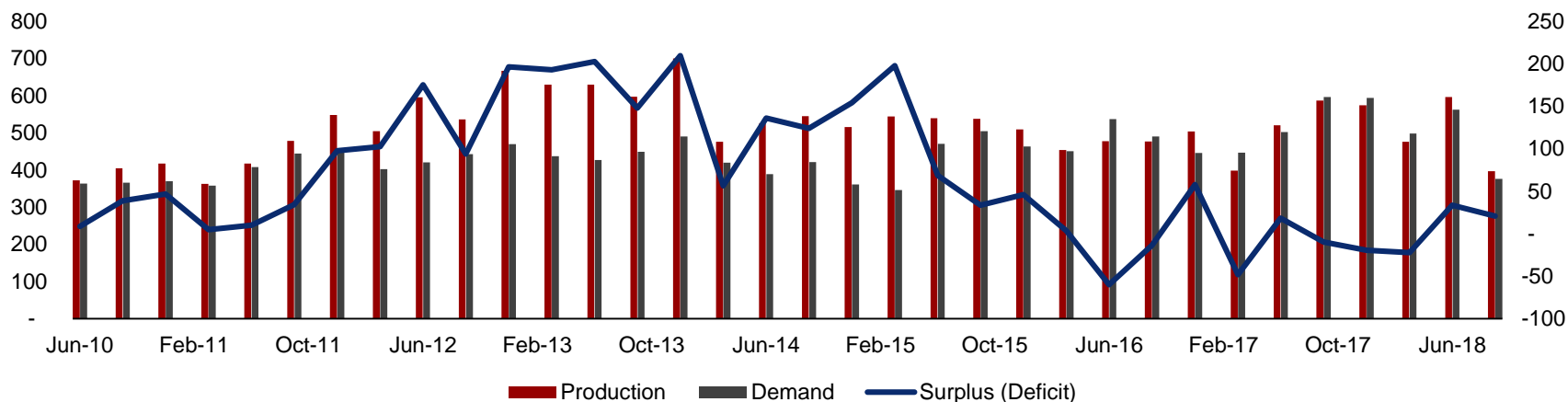
A slower increase in base metal prices may result from poor global demand

Source: ECB, Bloomberg, Goldman Sachs.

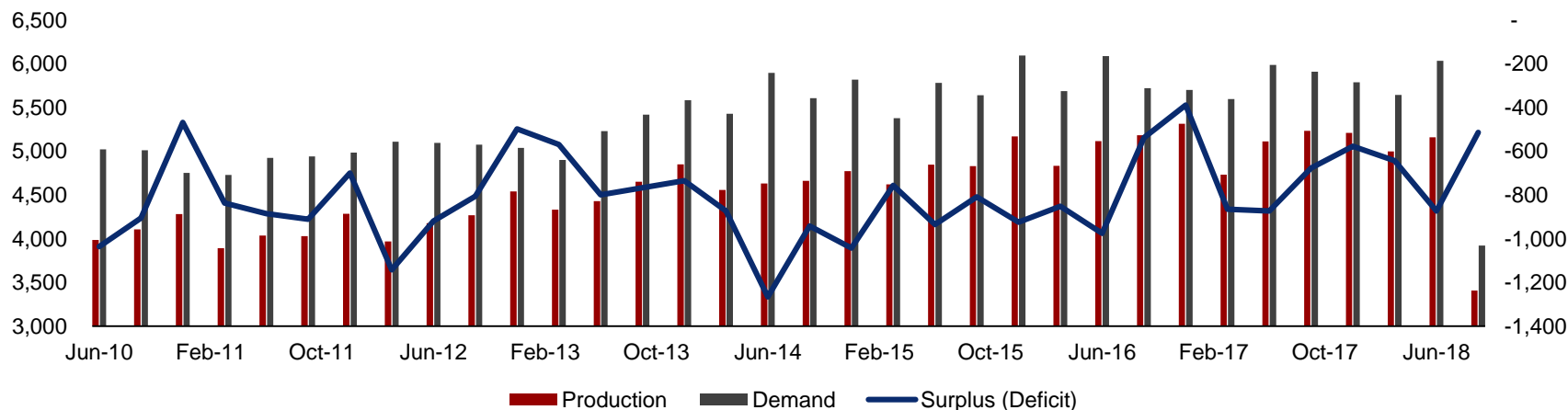
Key Drivers: Supply and Demand

Producers Weary to Meet Demand With Low Selling Prices

Global Refined Nickel (kt)



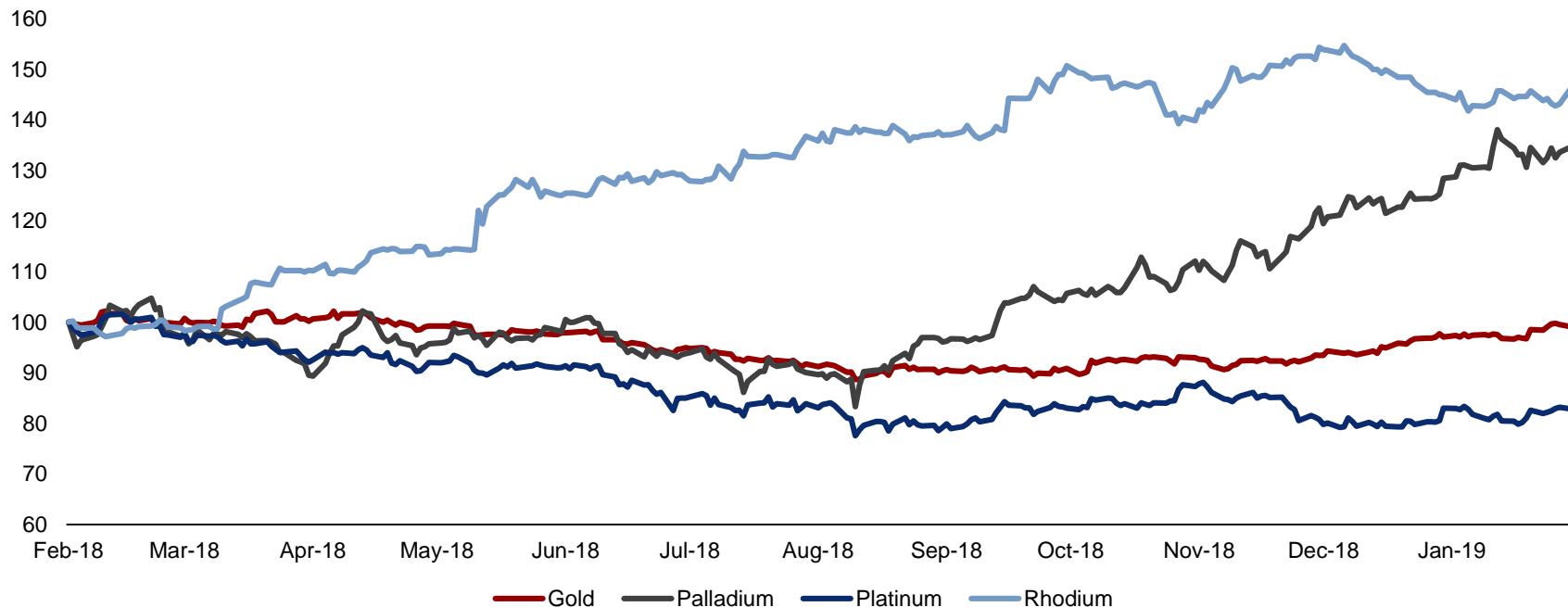
Global Refined Copper (kt)



Source: Bloomberg.

Precious Metals Outlook

Precious Metal Spot Price Movement

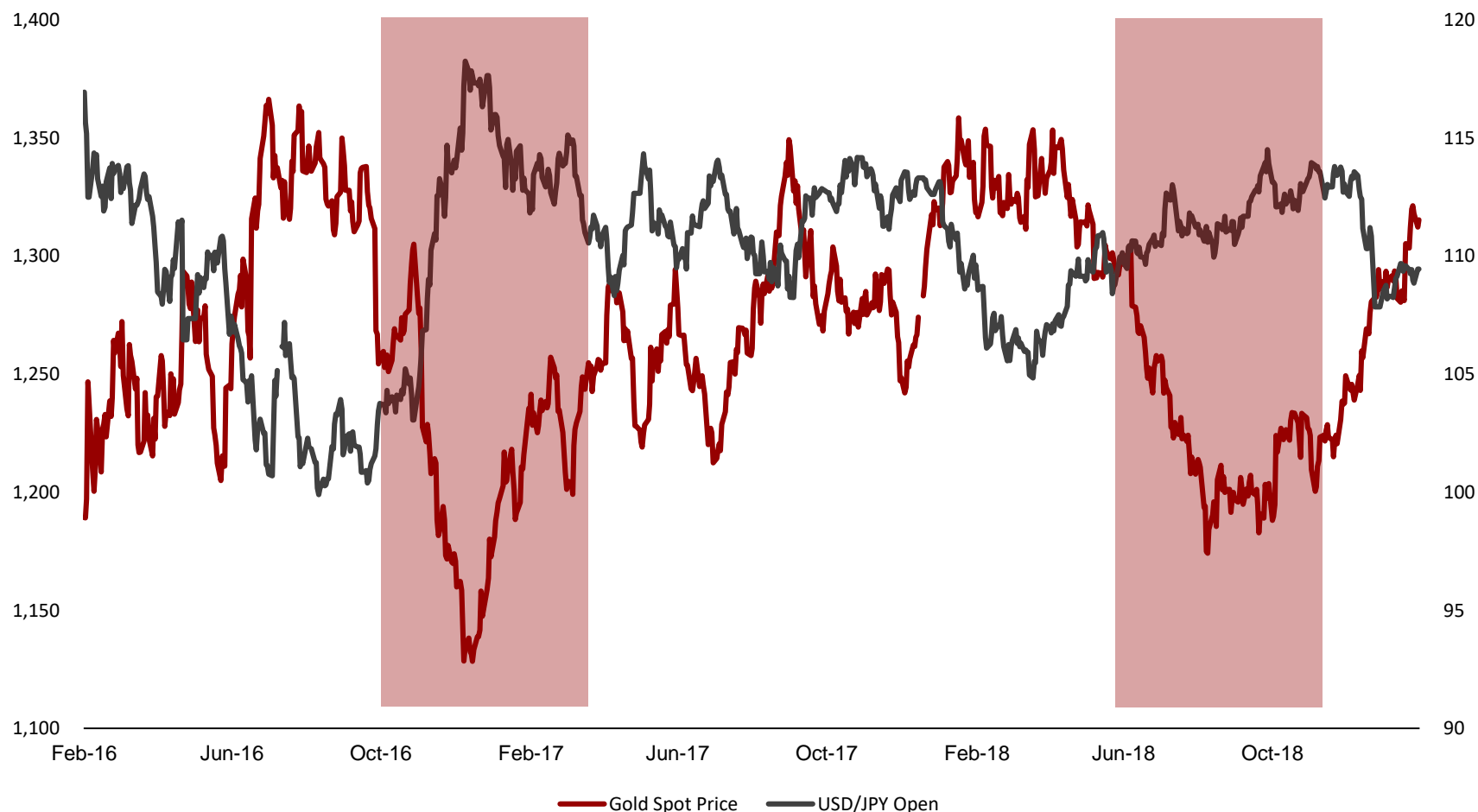


We are bullish on gold due to potential for a weaker U.S. dollar and its appeal as a safe haven.
-Dominic O’Kane, J.P. Morgan

The absence of language suggesting the Fed will continue to raise rates has the market thinking the tightening cycle is over.
-George Topping, Industrial Alliance

What Do Precious Metals Tell Us About Investor Speculation?

Hedging with Gold and Silver



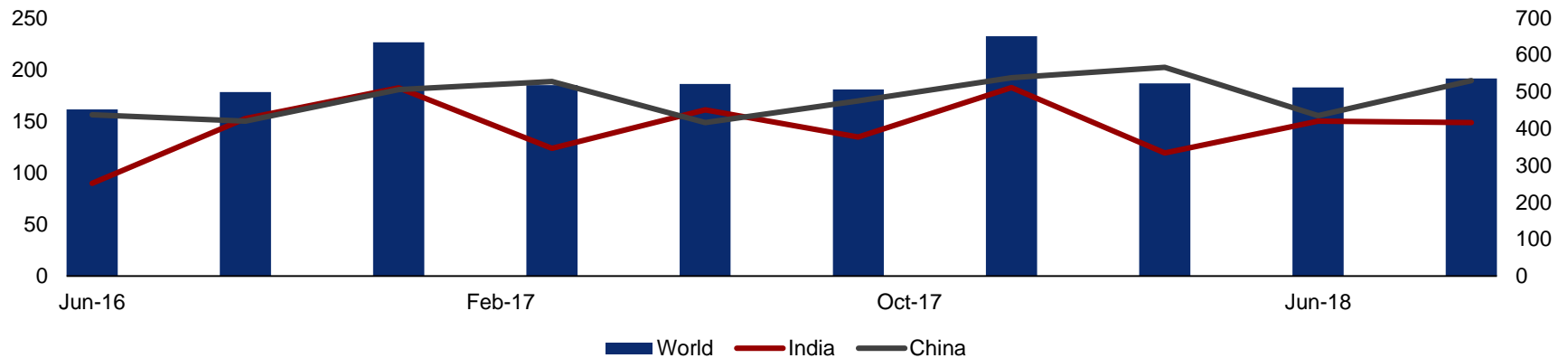
Investors have traditionally hedged against inflation and recessions by investing in gold

Source: Bloomberg.

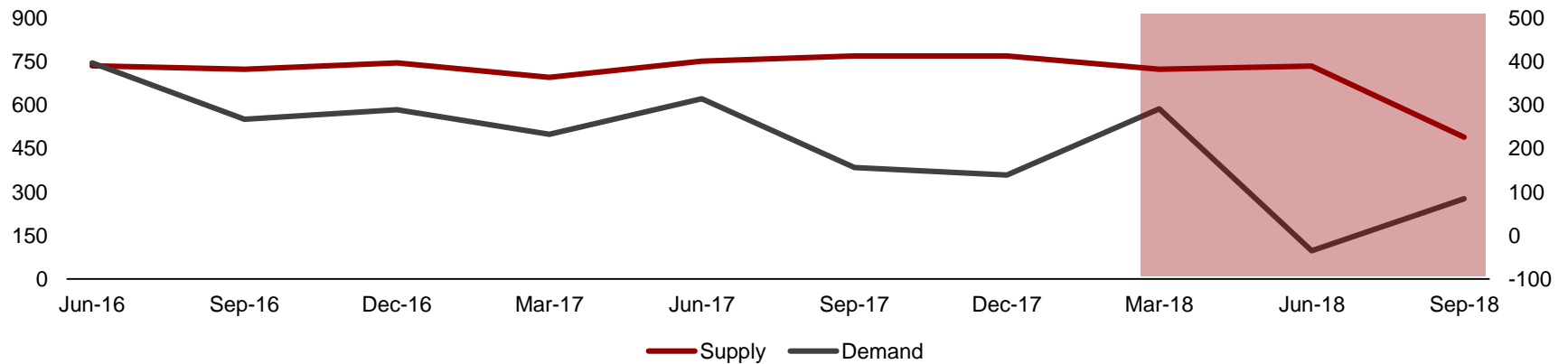
Key Drivers: Supply and Demand

Gold Prices Reflect Seasonality and Market Trends

Gold Jewelry Consumption (t)



Global Gold Supply and Demand (t)

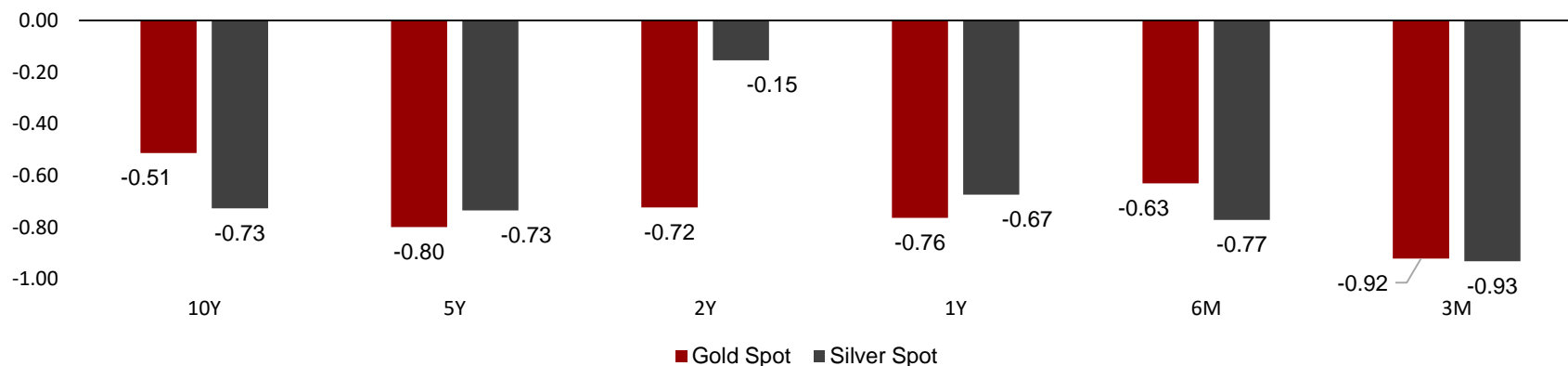


Source: Bloomberg.

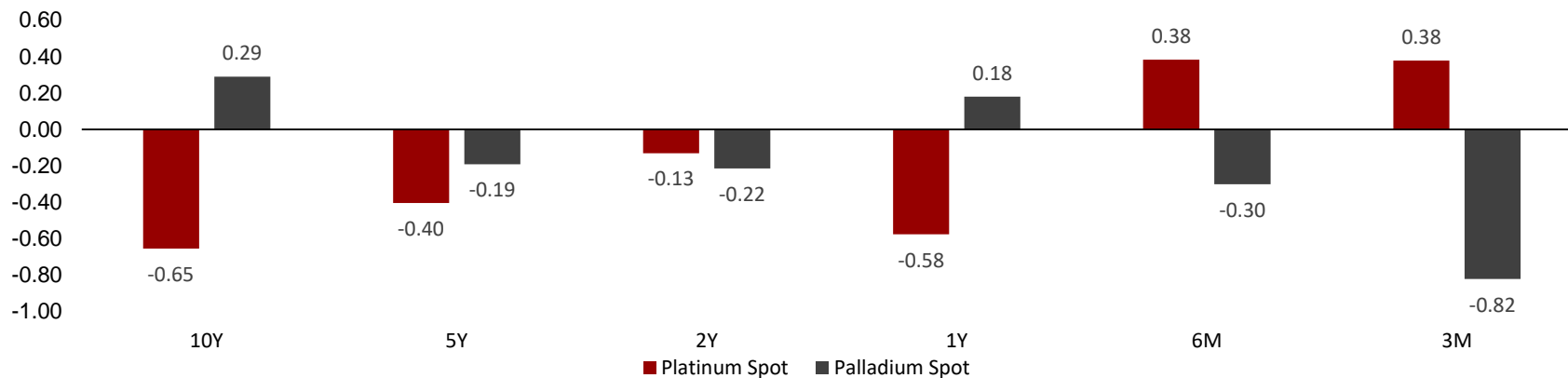
Not All Precious Metals Are The Same

Palladium and Platinum Move According to Other Industries

Gold and Silver Spot Rates Negatively Correlated With USD



Mixed USD Correlations with Platinum and Palladium



Currency Correlation Is Different Across Different Rare Metal Types

Looking Into Differences Between Precious Metal Groups

Differing Key Price Indicators

Characteristics	Gold & Silver	Palladium & Platinum
Market Correlation	<ul style="list-style-type: none">• Negatively correlated to USD strength and Fed rate increases	<ul style="list-style-type: none">• Weak correlation to USD strength but linked to the automotive industry
Price Movement	<ul style="list-style-type: none">• Moderate price movement	<ul style="list-style-type: none">• Significant spot price appreciation
Seasonality	<ul style="list-style-type: none">• Peak demand during wedding/festival season• Fall in demand in Q2	<ul style="list-style-type: none">• Generally posts the strongest gains during the first quarter of the year
Global Stockpiles	<ul style="list-style-type: none">• Central banks slowly amassing gold bullion	<ul style="list-style-type: none">• Oversupply of platinum, significant reserve drawdown for palladium during deficit

Source: Bloomberg, Anglo American.

Palladium Deep-Dive

SECTION III



Palladium Overview

The One Precious Metal that you Probably Never Think About



Palladium:

- **Atomic Number: 46**
- **Protons & Electrons: 46**
- **Neutrons: 60**
- **Most Common Isotope: 106Pd**

Commonly Associated with:



- **Rhodium**
- As a critical alloying agent to improve corrosion resistance in industrial parts



- **Platinum**
- As an alternative in industrial and consumer applications, given similar characteristics

																Helium *** He 4.003
																Neon *** Ne 20.18
																Argon *** Ar 39.95
Potassium *** K 39.10	Calcium *** Ca 40.08	Scandium *** Sc 44.96	Titanium *** Ti 47.87	Vanadium *** V 50.94	Chromium *** Cr 52.00	Manganese *** Mn 54.94	Iron *** Fe 55.84	Cobalt *** Co 58.93	Nickel *** Ni 58.69	Copper *** Cu 63.55	Zinc *** Zn 65.39	Gallium *** Ga 69.72	Germanium *** Ge 72.63	Arsenic *** As 74.92	Selenium *** Se 78.96	Bromine *** Br 79.90
Rubidium *** Rb 85.47	Strontium *** Sr 87.62	Yttrium *** Y 88.91	Zirconium *** Zr 91.22	Niobium *** Nb 92.91	Molybdenum *** Mo 95.94	Technetium *** Tc [98]	Ruthenium *** Ru 101.07	Rhodium *** Rh 102.91	Rhodium *** Rh 102.91	Palladium *** Pd 106.42	Cadmium *** Cd 112.41	Indium *** In 114.82	Tin *** Sn 118.71	Antimony *** Sb 121.74	Tellurium *** Te 127.40	Iodine *** I 126.91
Barium *** Ba 137.33	Lanthanum *** La 138.91	Cerium *** Ce 140.12	Praseodymium *** Pr 140.91	Neodymium *** Nd 144.24	Europium *** Eu 151.96	Gadolinium *** Gd 157.25	Terbium *** Tb 158.93	Dysprosium *** Dy 162.50	Holmium *** Ho 164.93	Erbium *** Er 167.26	Thulium *** Tm 168.93	Ytterbium *** Yb 173.04	Lutetium *** Lu 174.97	Radium *** Ra [226]	Actinium *** Ac [227]	Francium *** Fr [223]
Ra [226]	Ac [227]	Th [232]	Pa [231]	U 238.03	Np [237]	Pu [244]	Am [243]	Cm [247]	Bk [247]	Cf [251]	Es [252]	Fm [257]	Md [288]	No [289]	Lr [262]	Og [284]

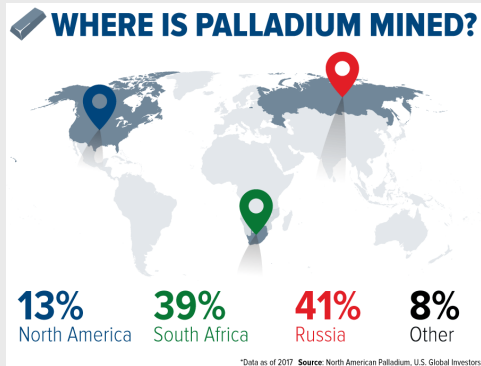
(Named after Pallas, a Gigante slain by Greek Goddess Athena in Combat)

Sources and Uses

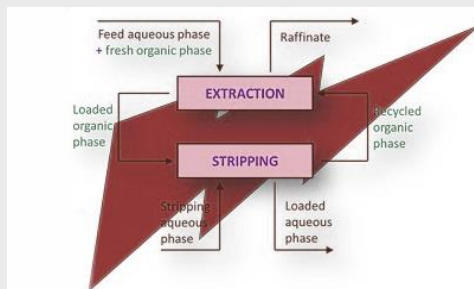
Not Your Average Metal

SOURCES

Primary Extraction:



Secondary Extraction (Scrap):



COMMODITY EXCHANGES



Palladium Futures & Options

USES

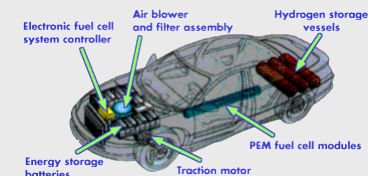
Autocatalyst:



Jewellery:



Industrial:



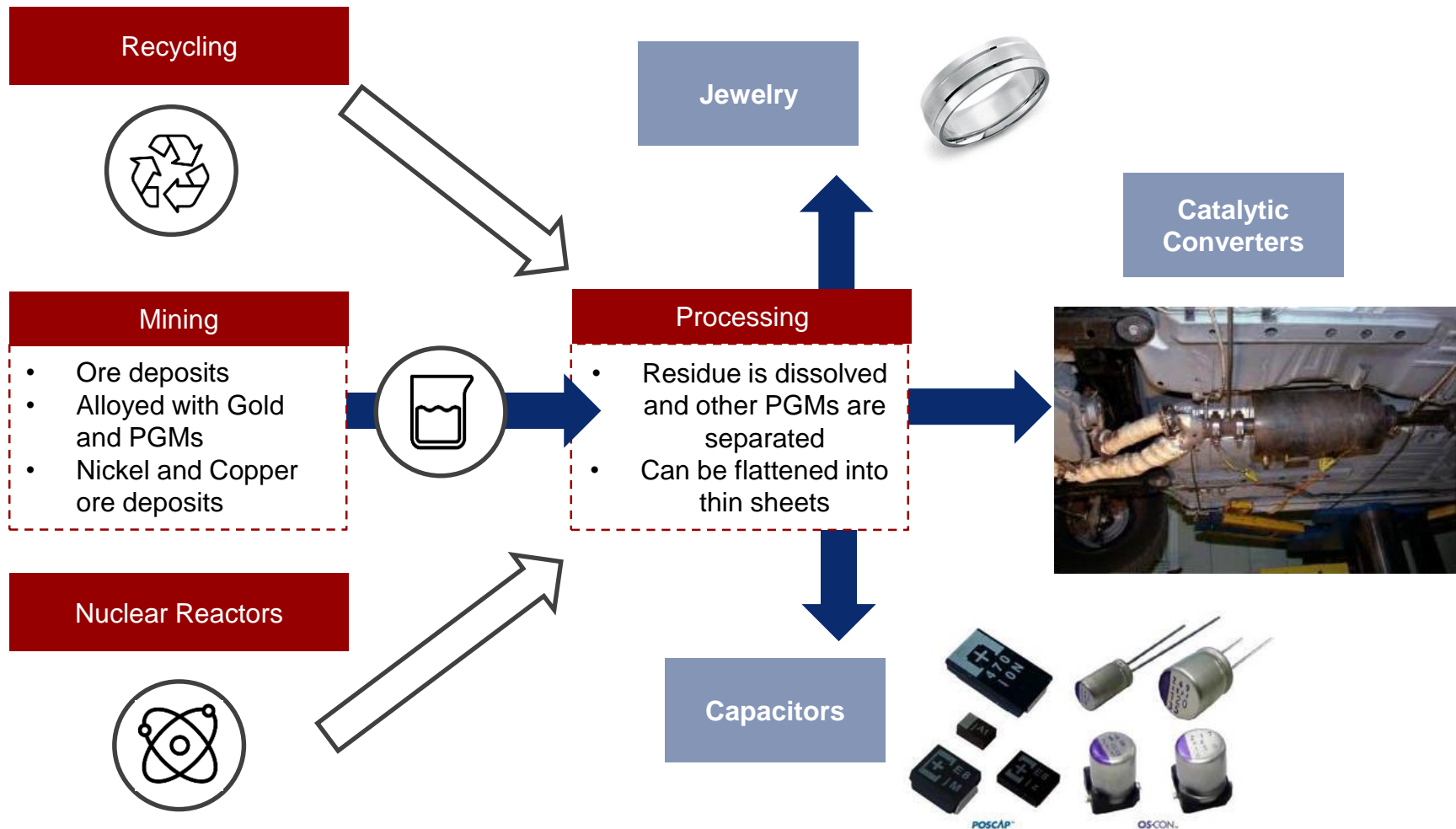
Investment:



Primary Extraction And Autocatalysts By Far The Most Dominant

Palladium Value Chain

Value Creation Through Processing and Application



Source: Agiboo.

To Be More Specific...

The Global Palladium Economy at a Glance

(in \$ millions, unless noted)

The World Palladium “Balance Sheet”

Global Palladium Supply and Demand, in ‘000 oz

Supply	2016	2017	2018
South Africa	2,570	2,554	2,651
Russia	2,773	2,407	2,787
Others	1,417	1,410	1,442
Total Supply	6,760	6,371	6,880
Gross Demand			
Autocatalyst	7,941	8,391	8,565
Jewellery	191	173	167
Industrial	1,866	1,901	1,859
Investment	-646	-386	-373
Total Gross Demand	9,352	10,079	10,218
Recycling	-2,503	-2,907	-3,099
Total Net demand	6,849	7,172	7,119
Impact on Reserves	-89	-801	-239

Key Developments of 2018 (More on these later!)

1

Sky-High Prices

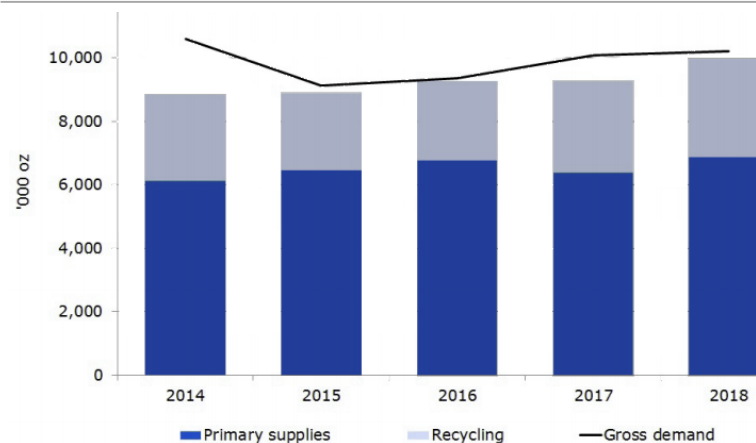
Palladium soared past platinum to take the seat as the biggest gainer in the rare metals market in the past year

2

Production and Usage Accelerating

The prevalence of Palladium in industrial use cases is set to benefit from a number of factors, alongside mining operations

Supply vs. Demand Time Series



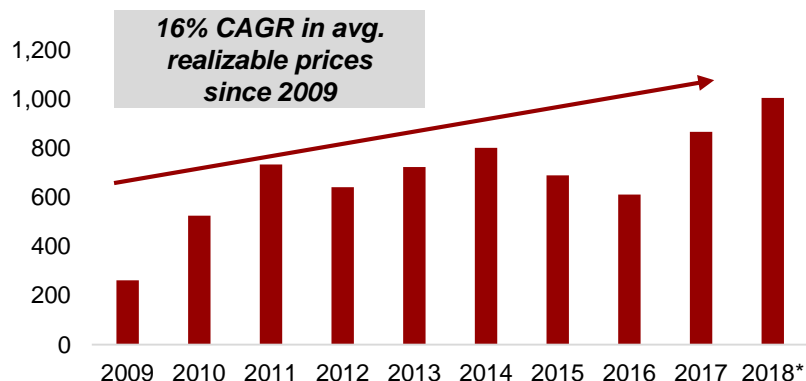
Pronounced Supply Deficit in the Past 3 Years

Source: Capital IQ, Bloomberg, Johnson Matthey

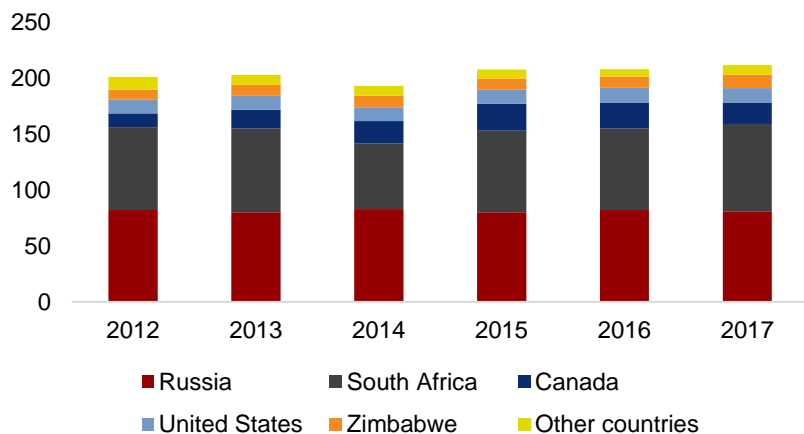
Supply Deep Dive

Global Supply Stable and Growing

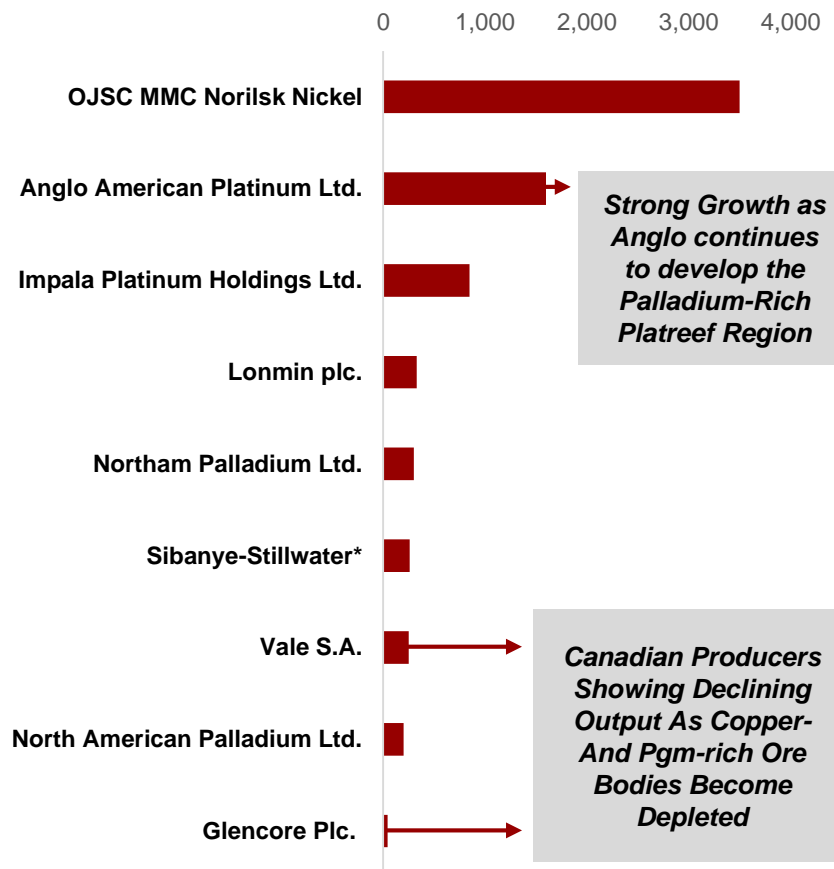
Rallying Palladium Prices Continue to Incentivize (\$/Troy Ounce)



Production by Country of Origin (Metric Tons)



Top Producing firms in 2018 (Thousand Ounces)



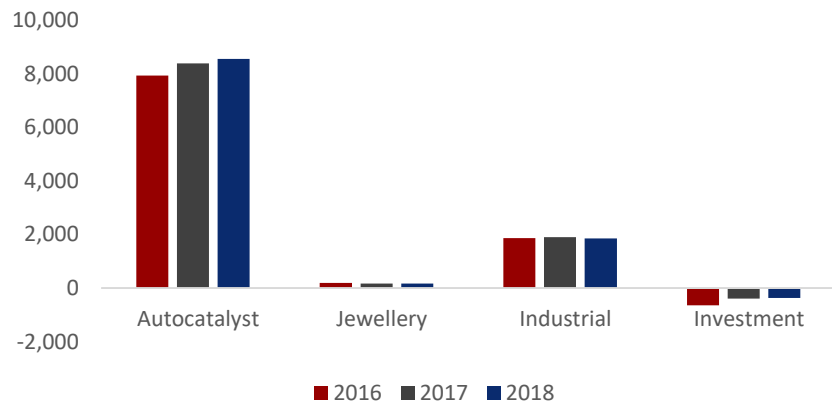
Supply Healthy and Trending Up with Increased Incentivization

Source: Capital IQ, Company filings.

Demand Deep Dive:

Winning Some, Losing Some

Demand Cross Section



Qualitative Developments (More on these later!)

- Emergence of Electric Vehicles**

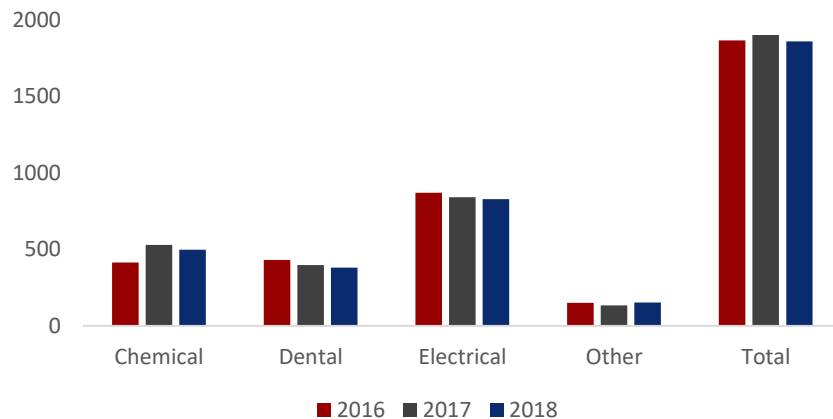
We do see electric and hybrid vehicles taking on a larger and larger share of future production
- Rise of Secondary Sources**

Secondary Supply is quickly becoming a major force in driving global demand dynamics

Steep Profit-Taking Among Palladium Commodity Investors



Industrial Usage Breakdown



Mixed Demand Outlook on the Surface Level

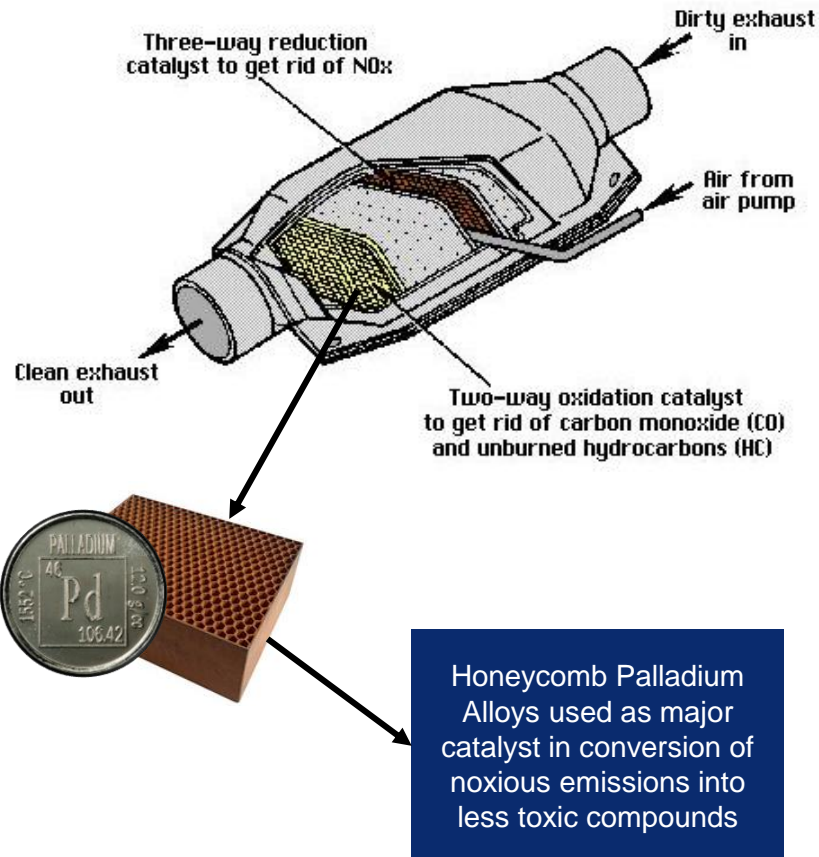
Source: Bloomberg, Johnson Matthey

A Look at Automobiles

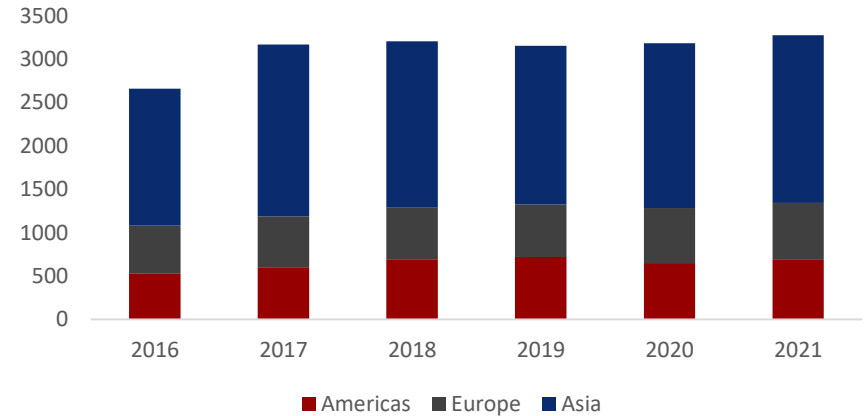
Catalytic Converters a Major Conversion Catalyst

(in \$ millions, unless noted)

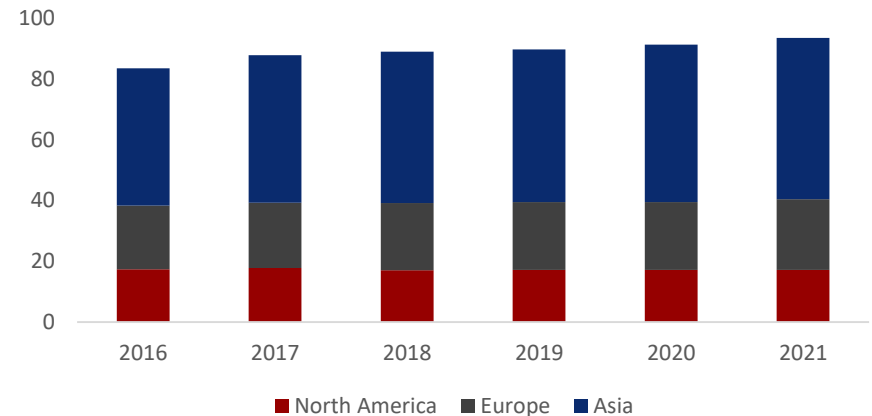
Catalytic Converters Overview



World Heavy Vehicle Production Projection (thousands)



World Light Vehicle Production Projection (millions)



Vehicle Production Worldwide Looking Largely Flat

Source: Bloomberg, Datastream.

Heavy Vehicle Regulation Outlook:

Per Unit Demand to at Least Partially Offset Slowing Production

China V

Selective catalytic reduction + ammonia slip catalyst



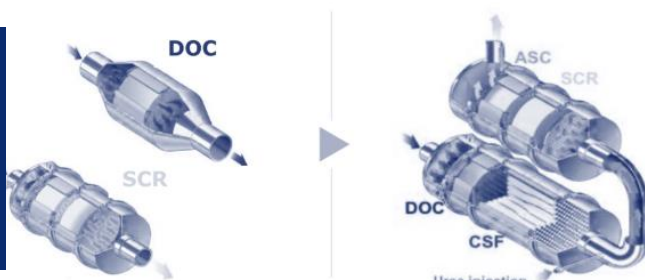
China VI

diesel oxidation catalyst + catalysed soot filter + selective catalytic reduction + ammonia slip catalyst
From January 2021 (expected)

~3x China V Pd Usage

India BS IV

Diesel oxidation catalyst or selective catalytic reduction



India BS VI

Diesel oxidation catalyst + catalysed soot filter + selective catalytic reduction + ammonia slip catalyst
From April 2020

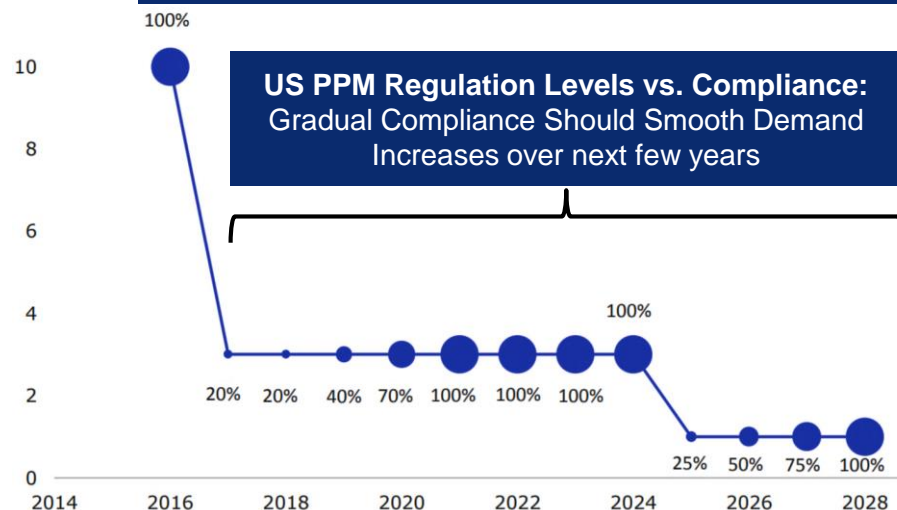
~3x India BS IV Usage

China VI

two-thirds of all new heavy-duty vehicles globally will be soot-free in 2021, compared with 50% if otherwise

India BS VI

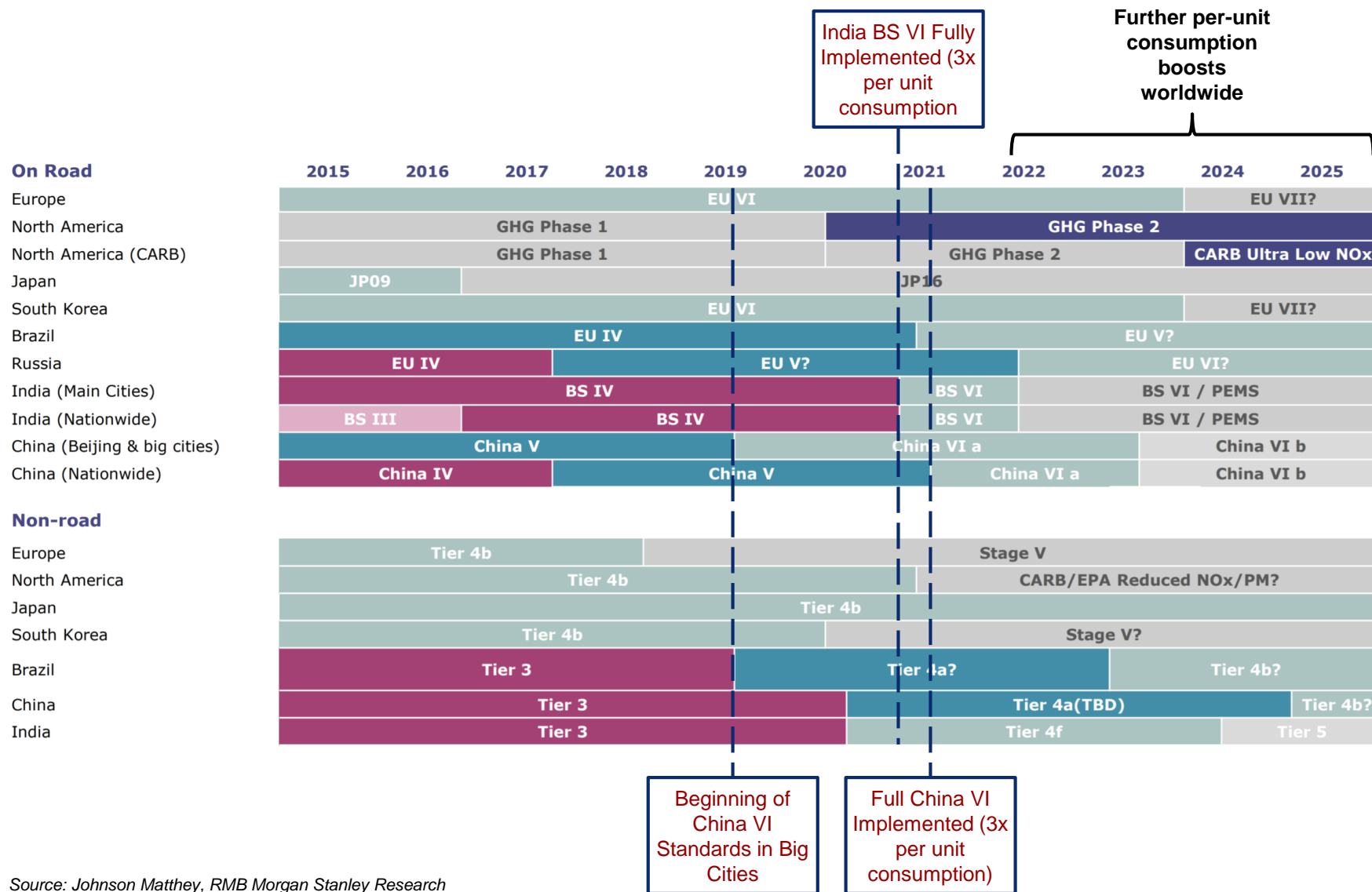
Union government to leapfrog directly from BS-IV norms for petrol and diesel vehicles to BS-VI emission standards



Source: Johnson Matthey, RMB Morgan Stanley Research

Heavy Vehicle Emissions Regulation Roadmap:

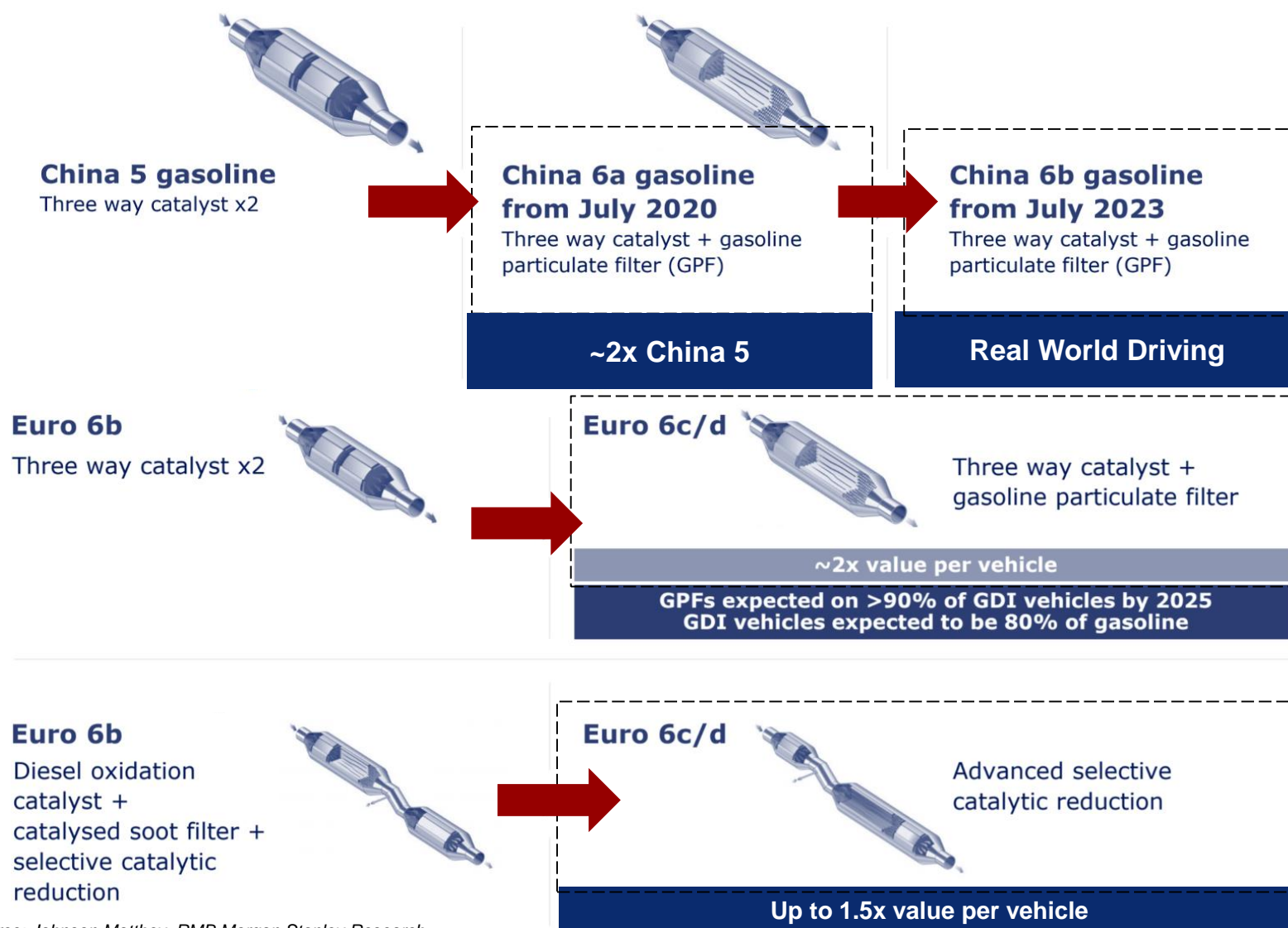
Consistent Tightening Worldwide



Source: Johnson Matthey, RMB Morgan Stanley Research

Light Vehicle Regulation Outlook:

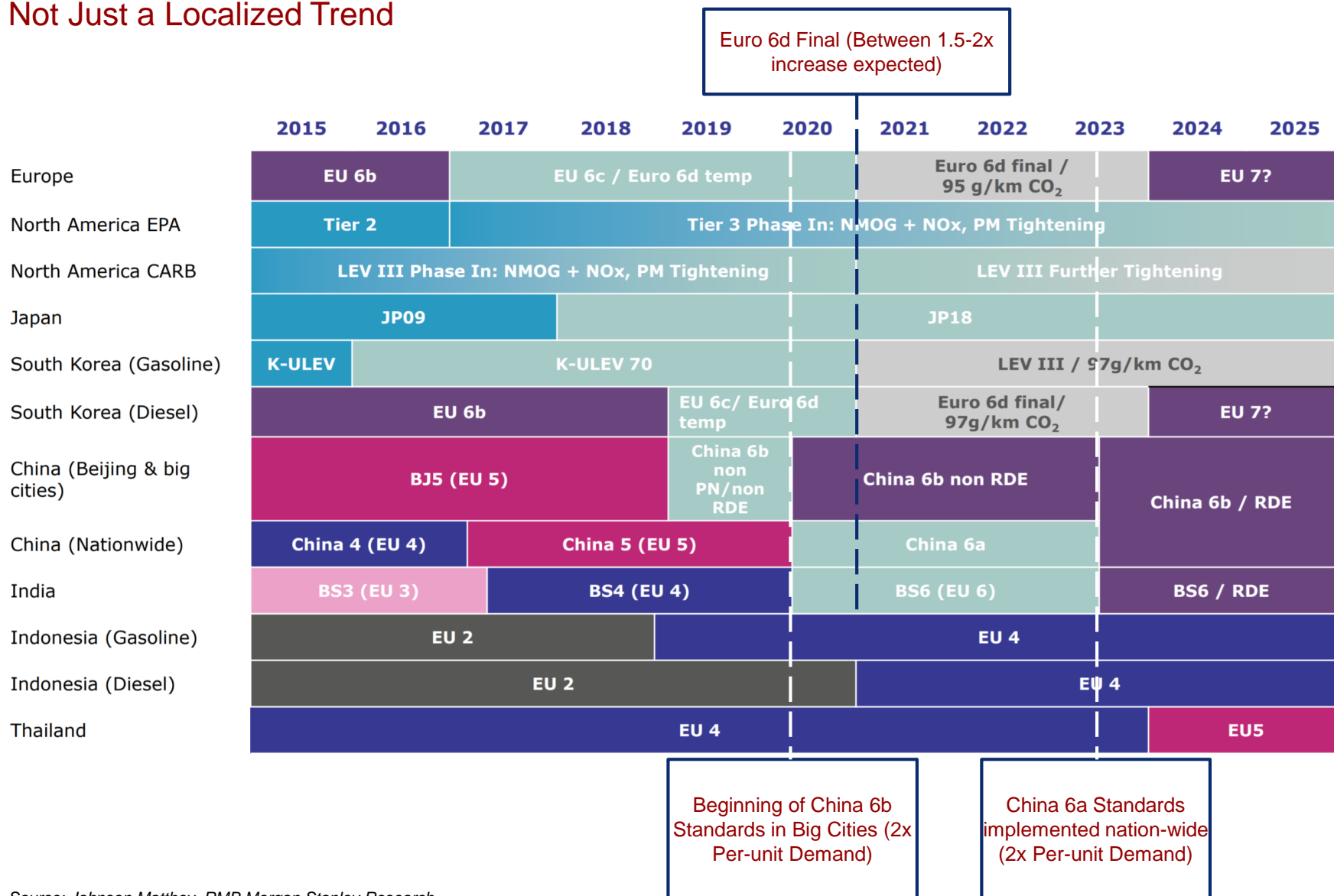
Per Unit Palladium Demand to at Least Partially Offset Slowing Unit Production



Source: Johnson Matthey, RMB Morgan Stanley Research

Light Vehicle Emissions Regulation Roadmap:

Not Just a Localized Trend



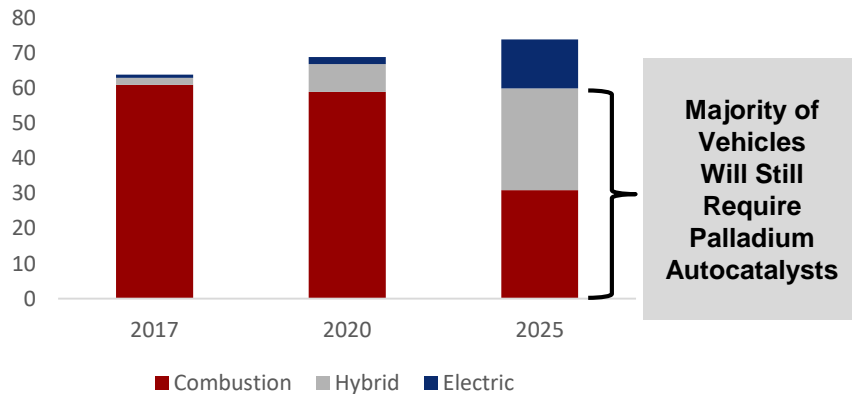
Source: Johnson Matthey, RMB Morgan Stanley Research.

Electric Vehicle Adoption:

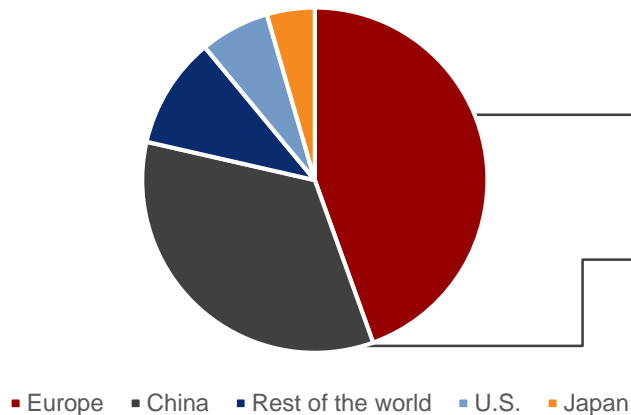
Is it a cause for concern?

(in millions of vehicles)

Projected Auto Sales by Propulsion Method, 2020 and 2025



Projected Full Electric Vehicle Sales in 2025



2025 Electric Vehicle Snapshots



United States

Projected 2025 Penetration: 3%

Key Developments:

- Low gasoline prices
- Poor BEV infrastructure
- Preference for Large SUV's/pick-ups

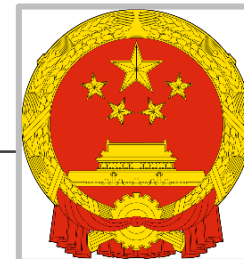


Europe

Projected 2025 Penetration: 9%

Key Developments:

- Total costs of ownership not yet known
- Uncertain Infrastructure Development
- Unstandardized Implementation



China

Projected 2025 Penetration: 13%

Key Developments:

- Strong government incentives for BEV
- Tightening fuel use legislation continues to support BEV uptake

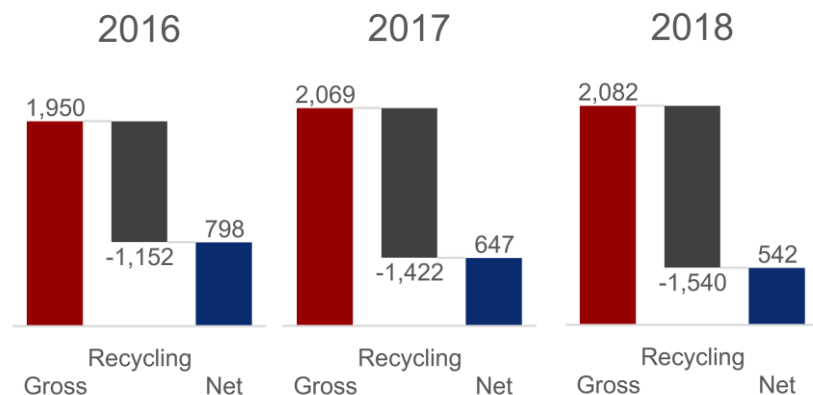
Electrical Vehicles not Yet a Very Serious Threat

The Other Catch:

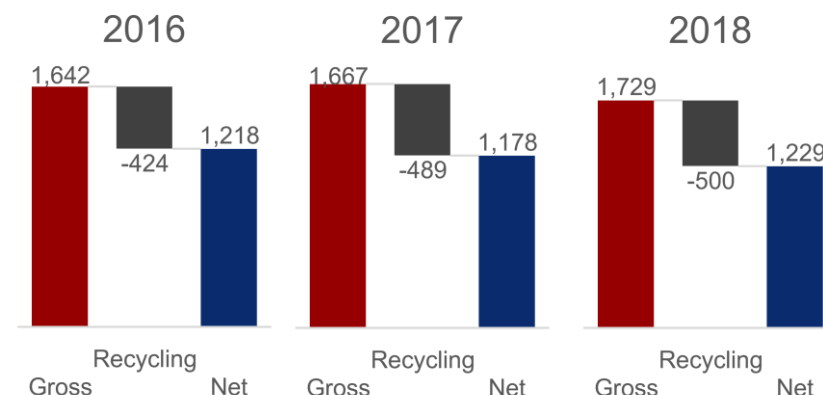
Demand Might Not Translate Into Producer Tailwinds

(Palladium Demand: Autocatalyst '000 oz)

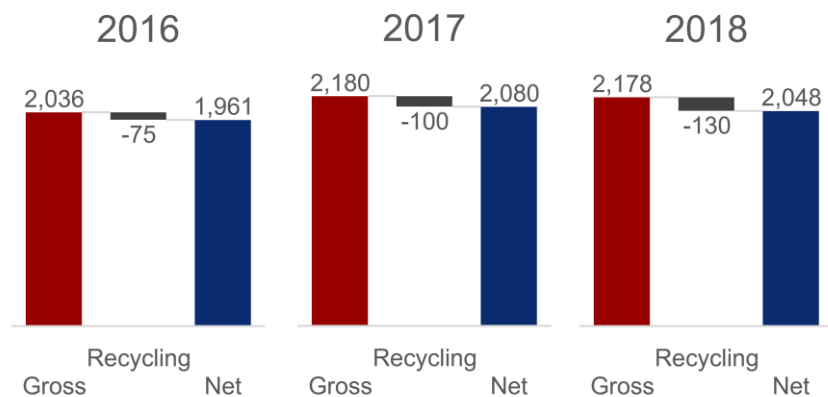
North America: Recycling Negating Net Demand Effects



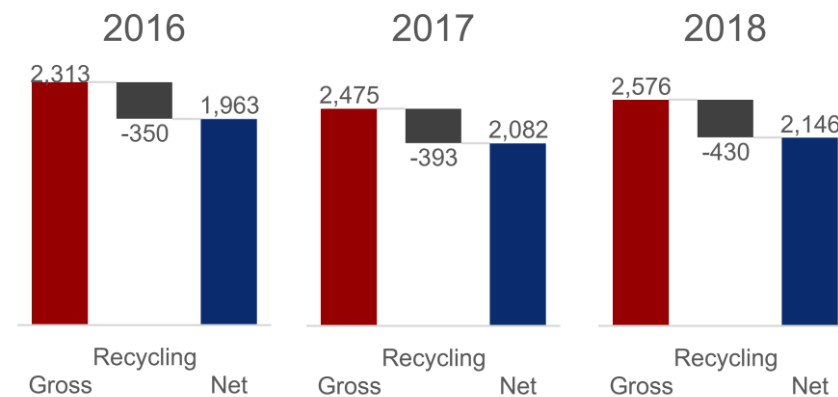
Europe: Recycling Neutralizing Net Demand Effects



China: Recycling Neutralizing Net Demand Effects



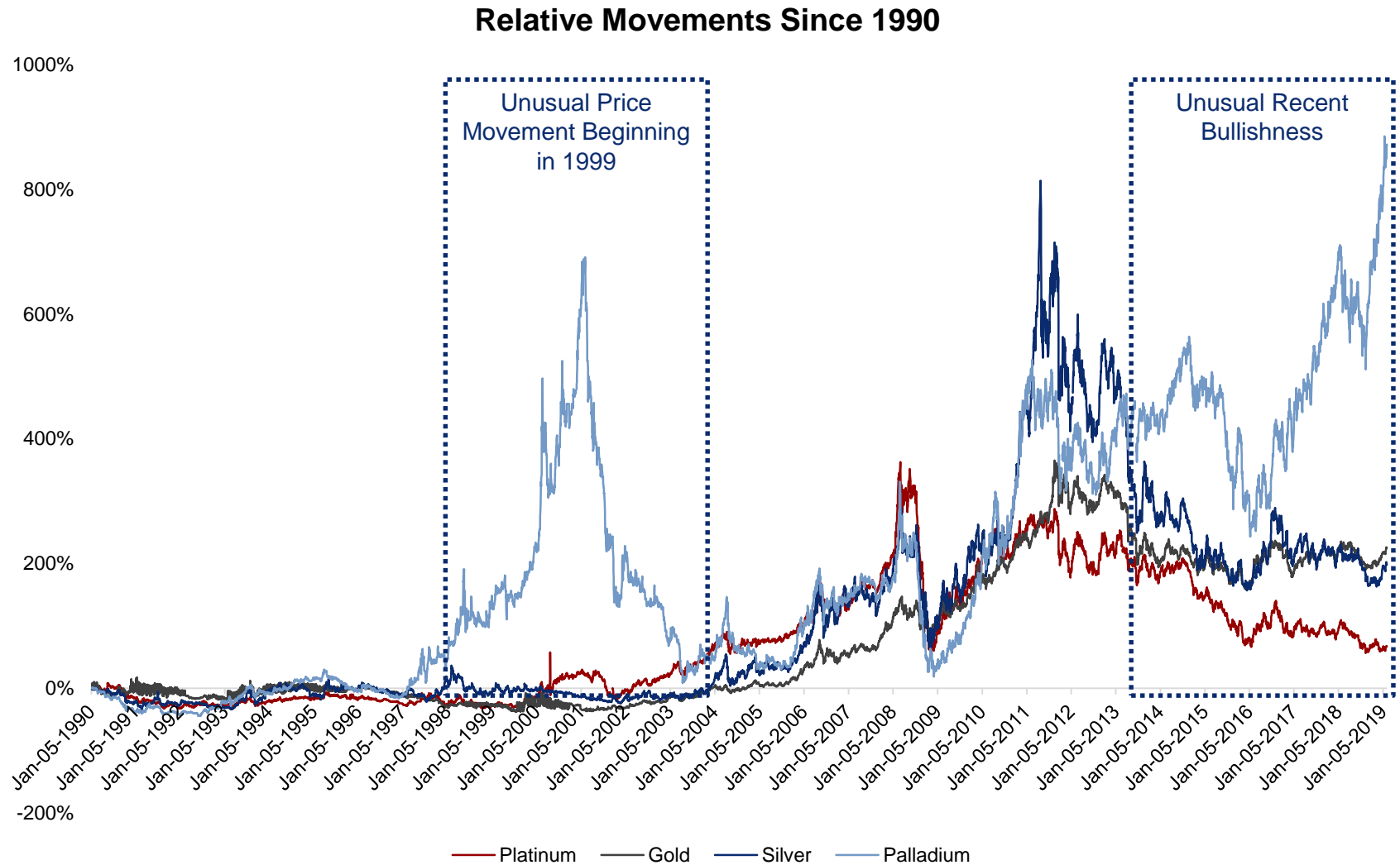
Rest of World: Recycling Diminishing Net Demand Effects



Recycling Perhaps the Biggest Long-term Dampener to Palladium Production

Trading Prices:

Palladium vs. Platinum vs. Gold vs. Silver



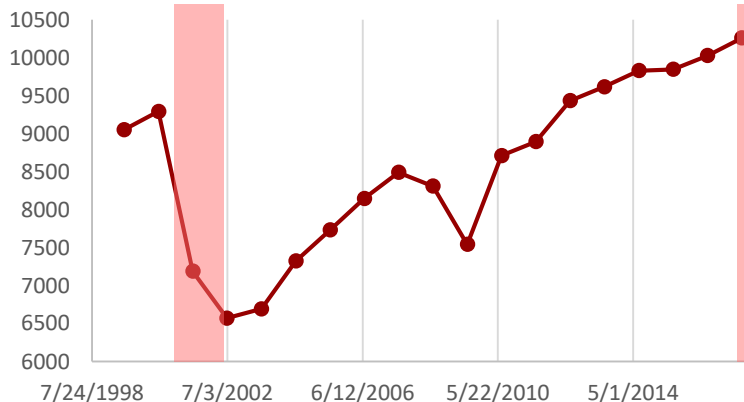
Source: Capital IQ

The New 'Danger Zone':

Bigger and Worser?

(in thousand ounces, unless noted)

Total Palladium Demand Drops During Overpricing:



What happens when...

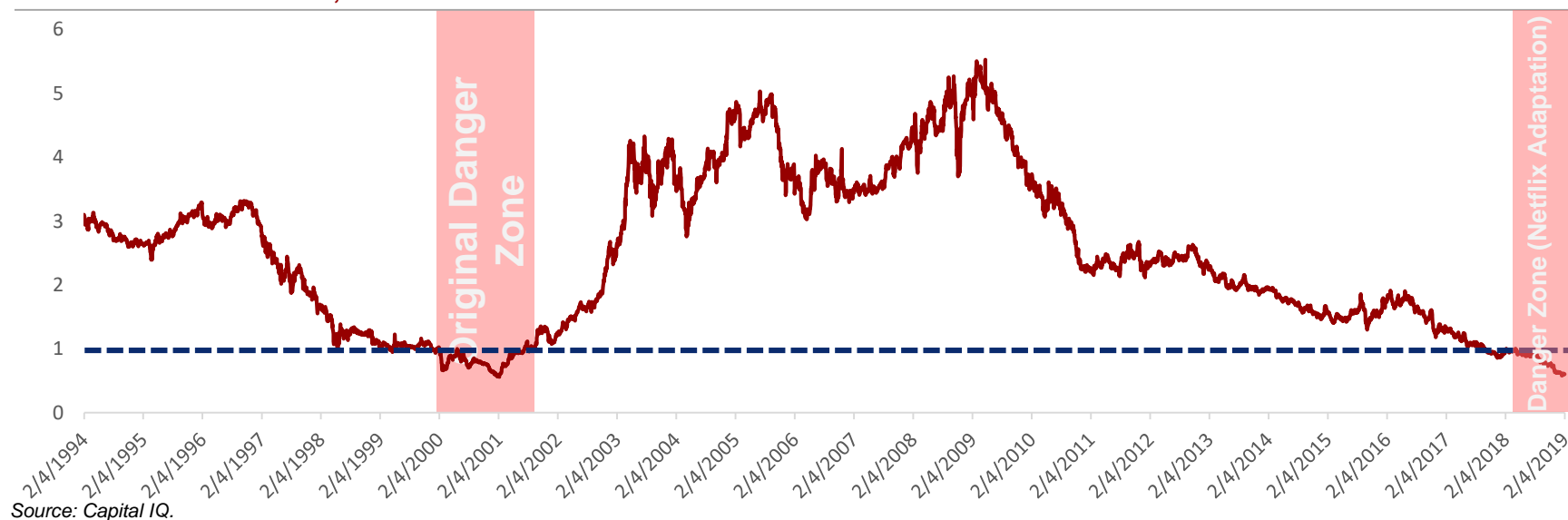
$$\$P_t > \$P_d$$

Palladium demand growth prospects look healthy, **little unsystematic risk of demand falling y-o-y**

$$\$P_t < \$P_d$$

Questionable Palladium demand growth prospects, **high unsystematic risk of demand falling y-o-y**

Platinum to Palladium Ratio, 1994 to 2019



Source: Capital IQ.

What Happened in 1999?

What Analysts Say

1999

“Palladium demand dropped rapidly (-48% to c.3.1m oz from the 1999 peak to 2002 trough). A number of points have been cited as contributing factors:

As prices rose, US automakers drew down on large accumulated stock piles rather than purchasing the metal.

A number of auto companies actively thrifted palladium loadings from 2000 in response to both the palladium price and future uncertainty around Russian supply. This was particularly pronounced for US automakers who had moved quite heavily towards palladium. 2001 also saw a sharp contraction in the North American auto market and this contributed to the need for US auto makers to reduce costs.

Substitution of platinum for palladium in gasoline engines from 2001, following technical programs that were initiated in 2000/2001. Once again this was driven by both cost and future uncertainty around Russian supply. The growth in diesel market share in Europe at the expense of gasoline engines (a tighter spread between diesel and gasoline prices rendered diesel’s fuel-efficiency more important).”

RMB Morgan Stanley,
2019

Today:

Worse than in 1999:

Auto manufacturers have been facing tougher carbon emission standards and rising Palladium prices for the past 3 years, **stockpiles are much less significant**

Worse than in 1999:

New Standards worldwide may end up costing manufacturers **2x and 3x as much rare metals** in future catalytic converters for light and heavy vehicles, respectively

The Most Plausible Solution:

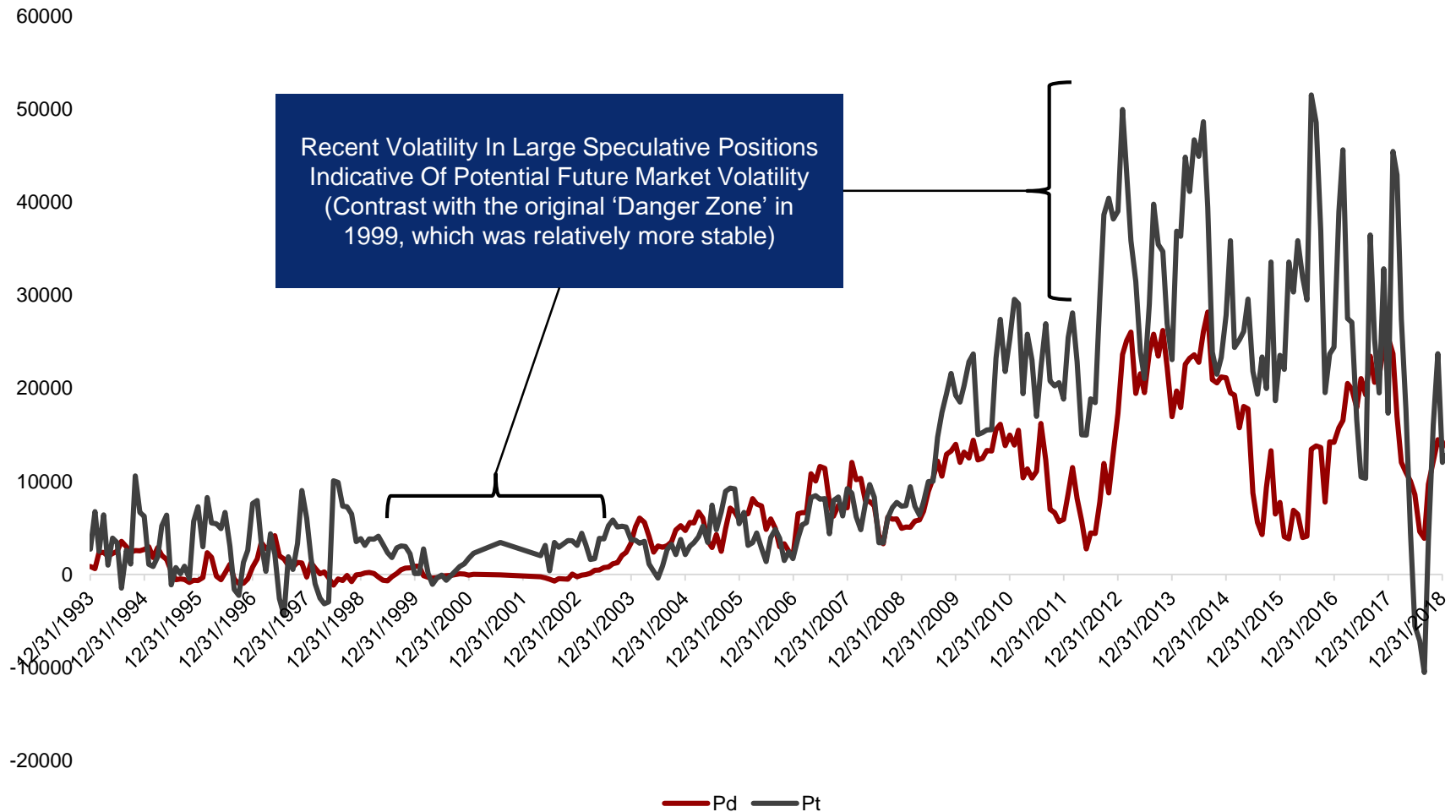
Catalytic converter engineering has progressed significantly since 1999, and studies have shown that **Pt is slightly more effective than Pd** in catalytic and industrial use

Replacement looking increasingly likely, given the price differential holds

Speculators:

What do the Traders Think?

Net Speculative Platinum and Palladium Position Indices, 1993 to Now



Source: Bloomberg

Palladium Mining Companies Overview

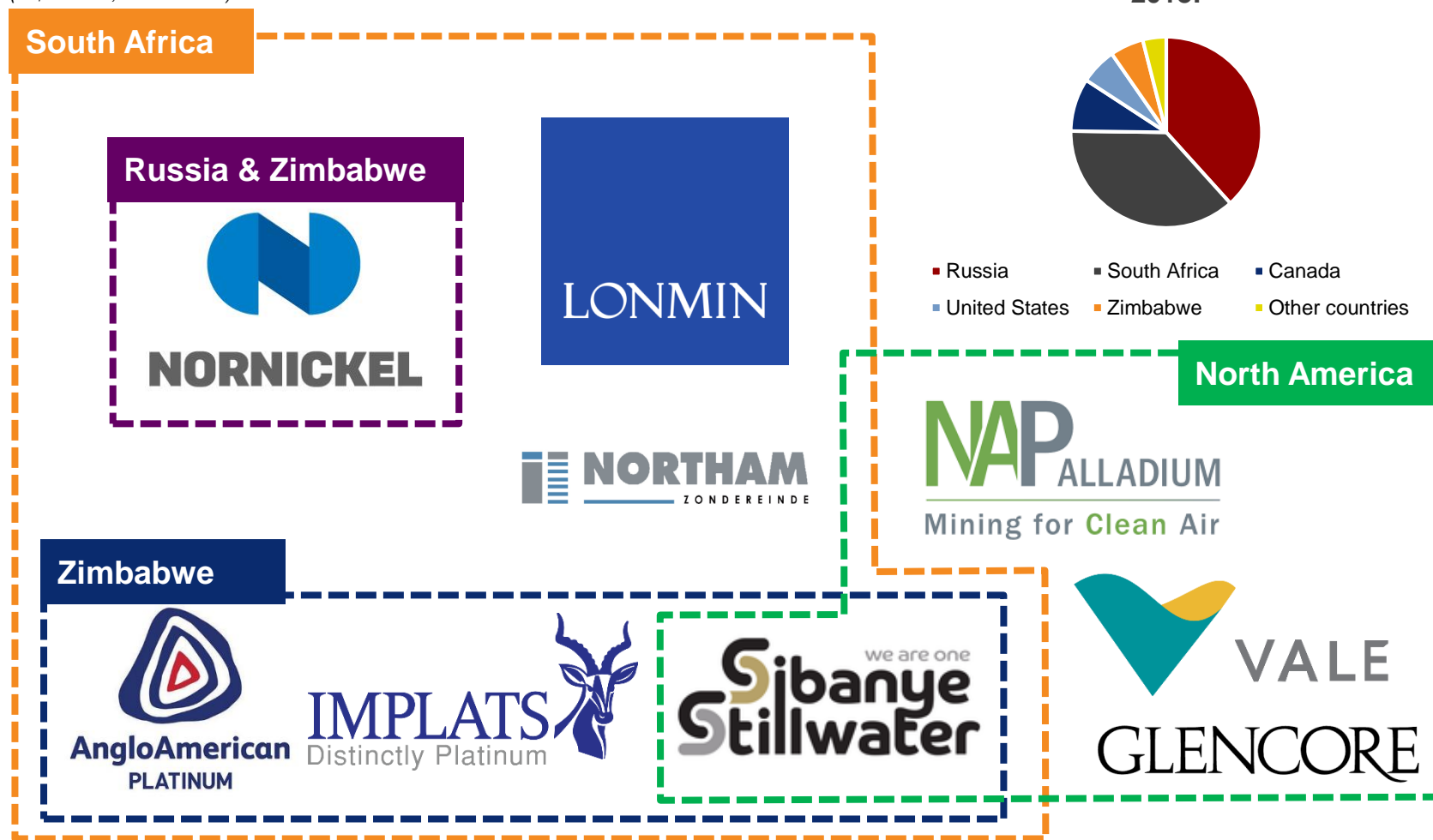
SECTION IV



Firms Overview:

Top Players in the Space by Geography of Operations:

(in \$ millions, unless noted)

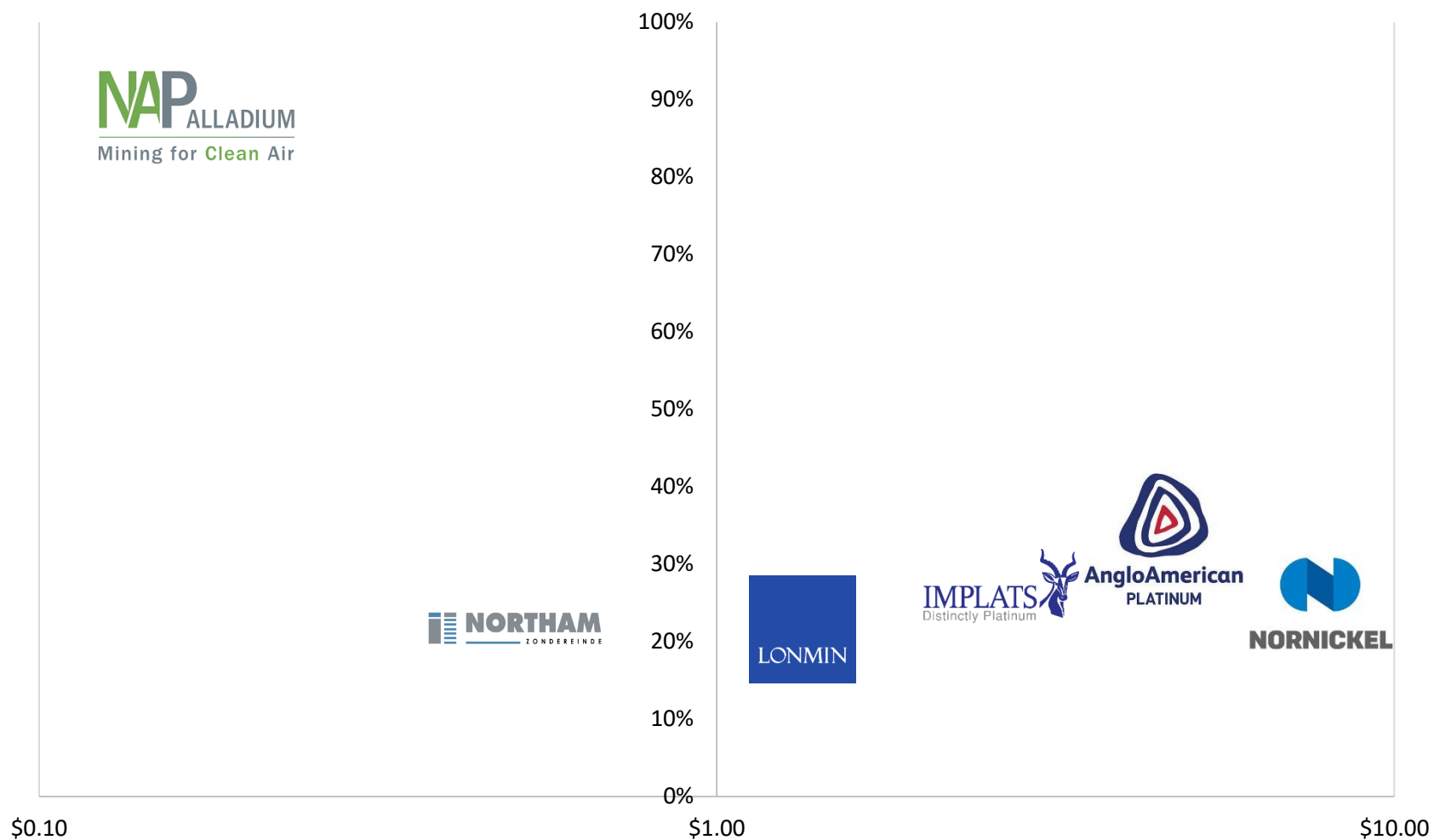


Most Producers are Globally Integrated in Operations

Source: Bloomberg

Firms Operating Matrix:

Revenues (B) vs. Palladium Exposure (%Revenue)



Very Few Pure-Play Palladium Companies

Source: Bloomberg

Comparable Trading Valuation:

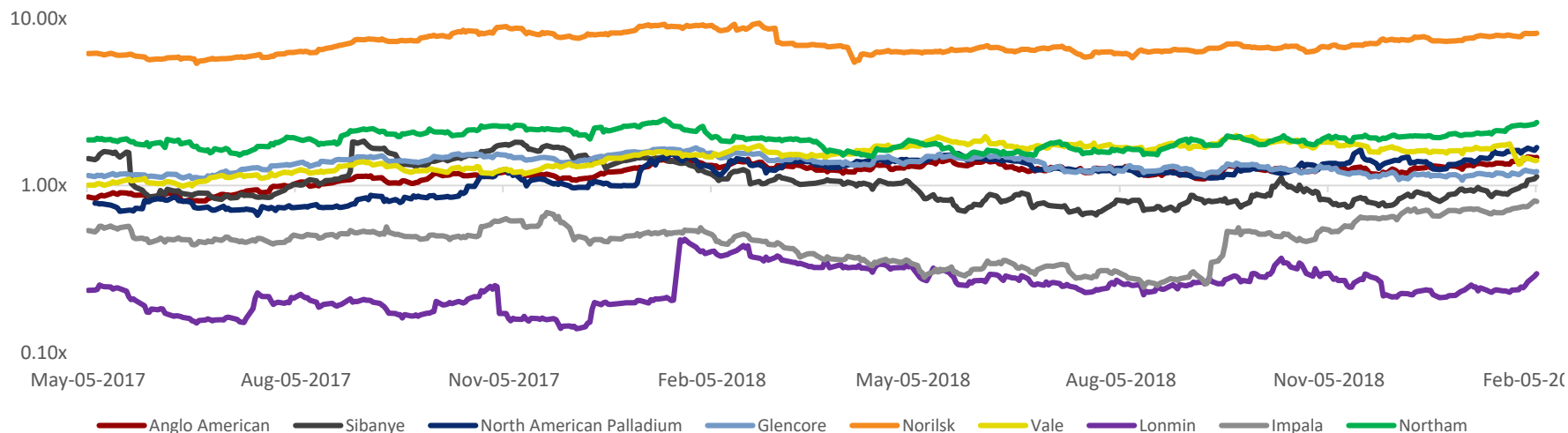
Similar Large Players Trading Very Differently

(in \$ millions, unless noted)

Quick Comps Table

	LTM Net Income Margin %	LTM EPS	LTM Sales Growth%	TEV/EBITDA	LTM P/E	LTM P/TangBV
Anglo	10.9%	2.36	18%	5	11	1.7
Glencore	2.9%	0.42	16%	5.9	9.5	1.4
Impala	-29.8%	-1.11	-3%	7.6	NM	0.8
Lonmin	3.1%	0.15	15%	NM	5.4	0.3
Vale	10.8%	0.82	16%	5.1	14.8	1.7
Northam	-9.3%	-0.15	10%	24.2	NM	2.4
Norilsk	26.9%	1.82	24%	7.3	11.4	8.5
Sibanye	0.9%	0.01	42%	5.8	66.9	1.6
North American	13.9%	0.65	56%	6.6	16	1.7

Recent P/B Ratios Movement



Source: Capital IQ.

Mini-Spotlight: North American Palladium

Truly One-of-a-kind

(in \$ millions, unless noted)



Company Overview

- North American Palladium Ltd. produces precious metals in Canada.
- It explores for palladium, platinum, gold, nickel, copper, and other metals.
- It primarily holds interest in the *Lac des Iles* mine that is located to the northwest of Thunder Bay, Ontario.
- The company was founded in 1968 and is headquartered in Toronto, Canada

Market Capitalization

Capitalization Breakdown	
Share Price as of	13.14
Shares Out.	58.84
Market Capitalization	773.17
- Cash & Short Term	20.30
+ Total Debt	74.30
+ Pref. Equity	-
+ Total Minority Interest	-
= Total Enterprise Value	827.17

Source: Capital IQ, Company Filings

What we See:

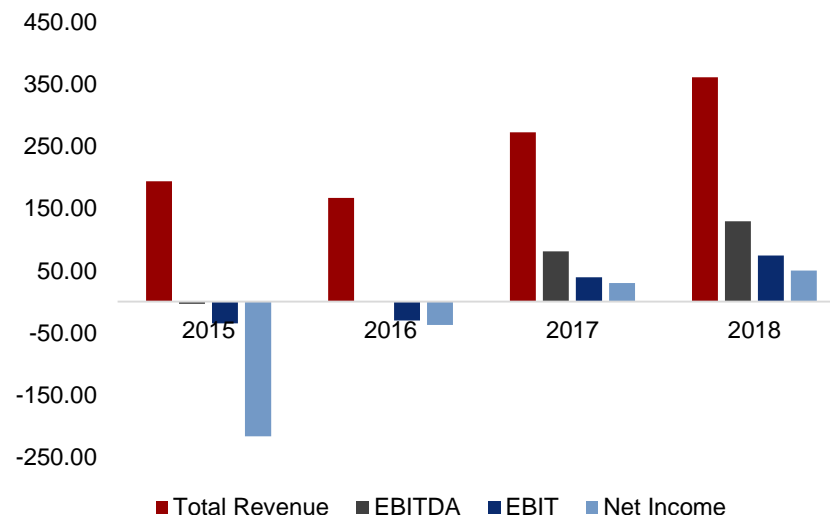
Vibrant & Flexible

Rapidly Improving Top and Bottom Lines, Leading the Pack in North America Palladium Recycling

Very \$Pd Sensitive

Perhaps the only Palladium Pure-play company on the markets, which given uncertainty may not be good

Rapidly Improving Fundamentals in Past Years



Sector Outlook:

What we see in Palladium

TAILWINDS

Recent Demand
Outpacing Supply

Rapid Appreciation of
Prices Driving Producer
Top Lines

Worldwide
Implementation of Strict
Emission Standards a
Continued Driver of Per-
Unit Consumption

Kola and Platreef
Expansions



PRICING UNCERTAINTIES

The 'Danger Zone'?

HEADWINDS

Flat Unit Consumption
Dampening Demand

Strong Push for
Utilization of Electric
Vehicles Regionally

The Rise of Advanced
Palladium Recycling
Techniques Vastly
Reducing Need for New
Palladium

Easily Replaced With
Cheaper Metals

We are Perhaps Looking at the Most Dangerous Time for Palladium in Almost 20 Years

Quantitative Analysis: Stochastic Differential Equations in Forecasting Likelihood of Switching

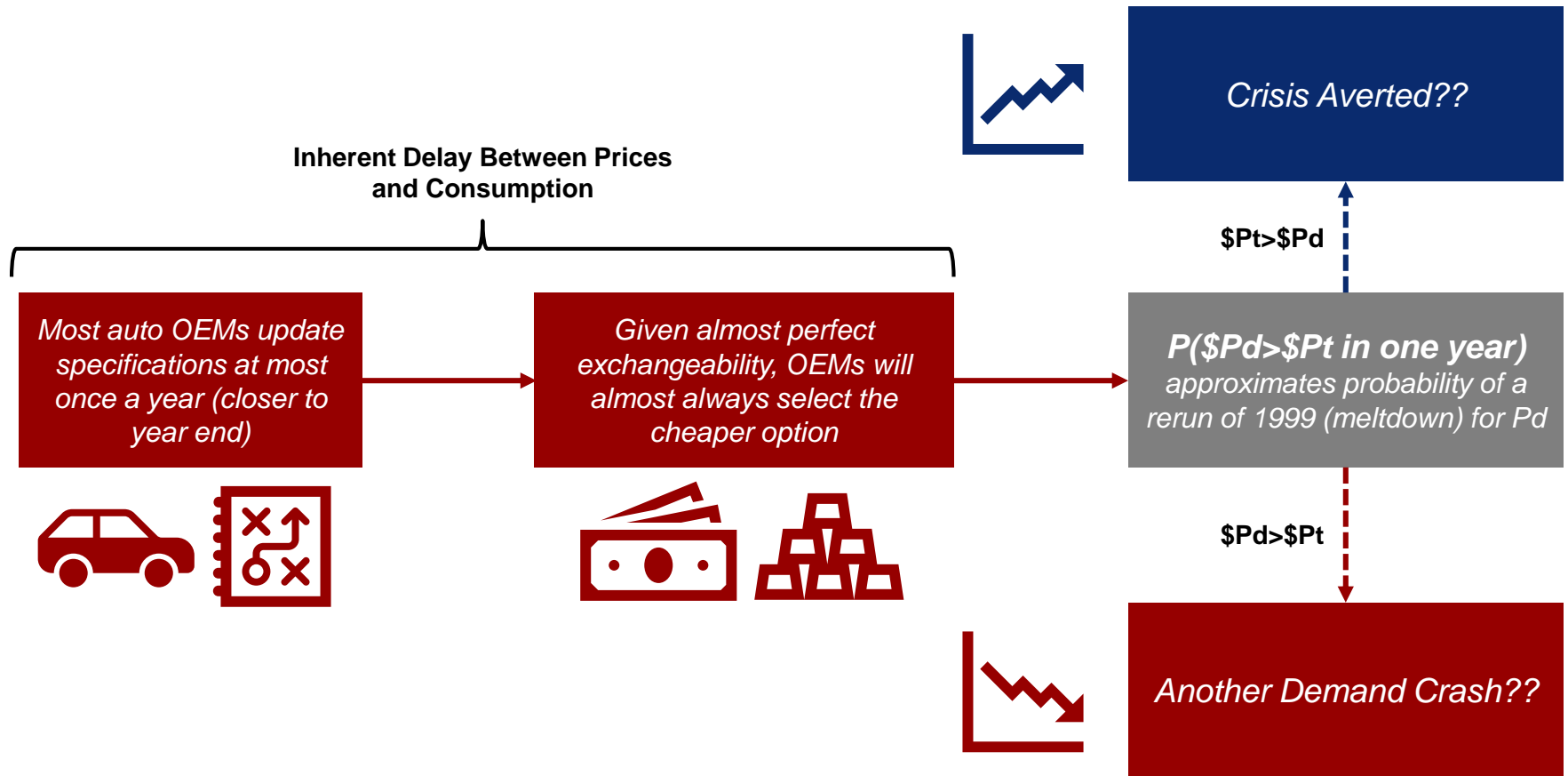
SECTION V



DESAUTELS Capital Management
Gestion de capitaux

The Problem Statement:

Can we quantify the 'Danger Zone'?



We Can Compute this Probability!

Formal Definition

This Is Great... But What Does It Mean?

Geometric Brownian Motion SDE:

$$dX_t = \overset{\substack{\text{Instantaneous Rate of} \\ \text{Return}}}{\mu} * X_t * dt + \overset{\text{Volatility}}{\sigma} * X_t * dW_t$$

Hull-White/Vasicek SDE:

$$dX_t = \overset{\substack{\text{Rate of Mean Reversion}}}{\alpha} * \overset{\substack{\text{Mean Level}}}{(\mu - X_t)} * dt + \overset{\text{Volatility}}{\sigma} * dW_t$$

Pedesis (Brownian Motion) terms ensure that the output is also a random walk

What Are Stochastic Differential Equations?

- A stochastic differential equation (SDE) is a differential equation in which one or more of the terms is a stochastic (controlled random) process, resulting in a solution which is also a stochastic process.
- Are always Gauss-Markov processes
- Geometric Brownian Motion is continuous-time stochastic process in which a randomly varying quantity's logarithm follows a Brownian motion (also called a Wiener process) with drift. (no mean reversion)
- The Hull-White/Vasicek model is an augmented version of GBM with friction (mean-reversion) over the long term

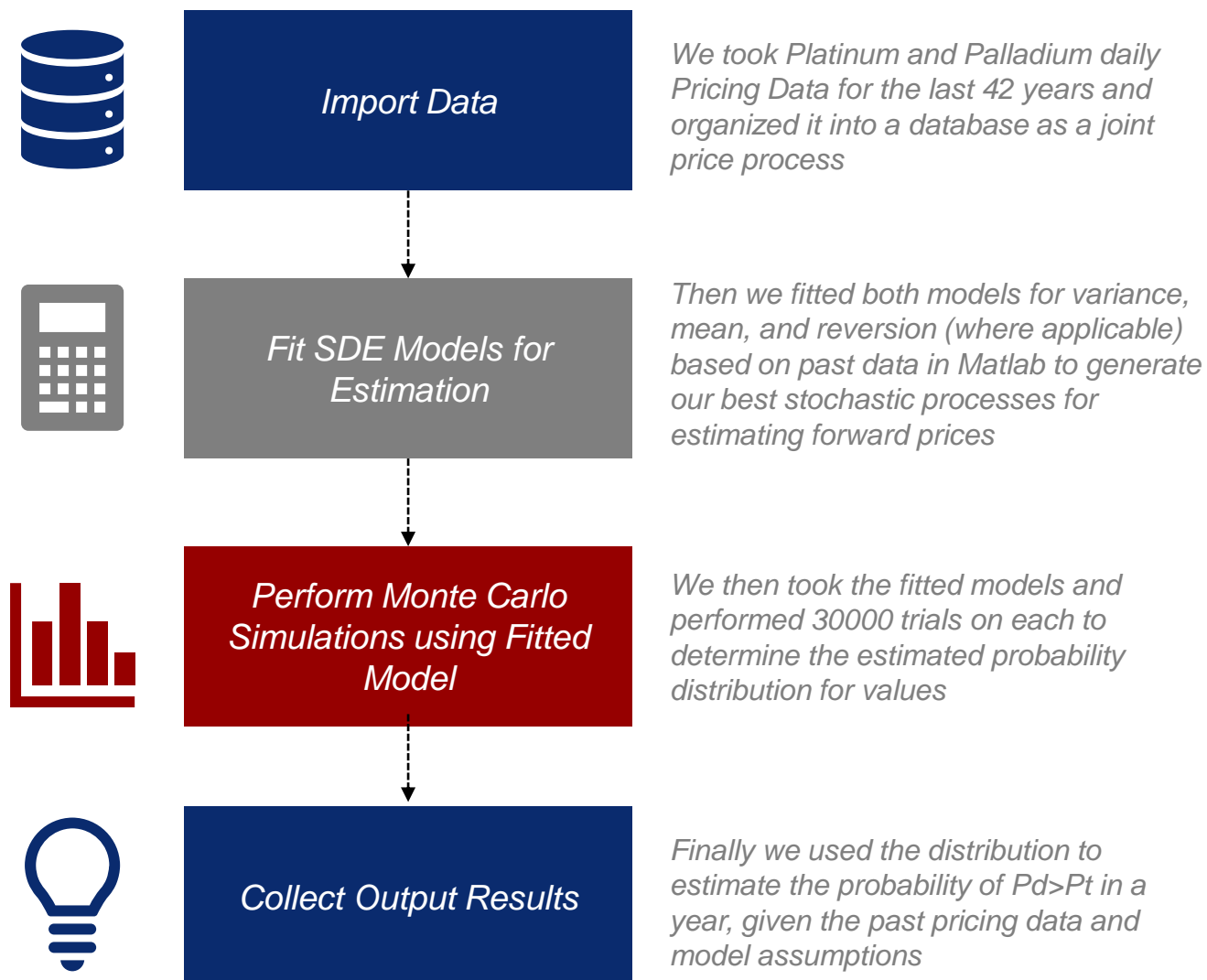
Monte Carlo Iteration to Reapply Model

- Monte Carlo Methods are useful when there are uncountably many possibilities in a model
- Run thousands (or millions) of iterations and compute the probability distributions
- Allows for a simple way to compute mean, variance, skewness and kurtosis for complex processes
- In this case, we simply apply each of the SDEs 30000 times to come up with the general expected outcomes

Source: David Willingham, 2012

Methodology

How do we estimate the likelihood of price reversion?

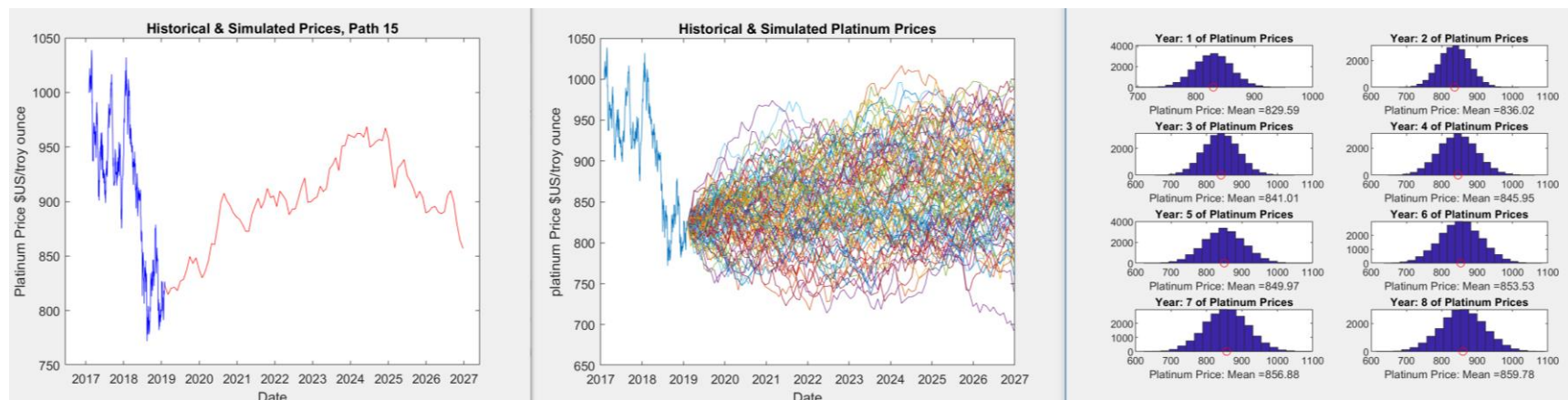


Source: DCM.

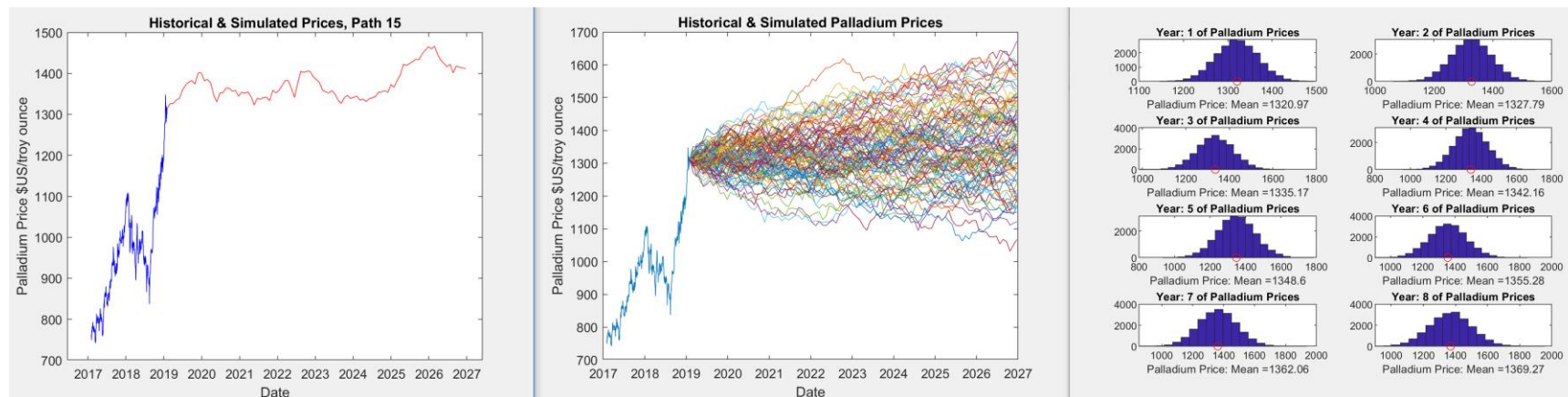
Results Pt.1: Estimates of Palladium and Platinum Prices

Simulated Distributions of Future Prices (GBM)

Platinum Price Forecasts



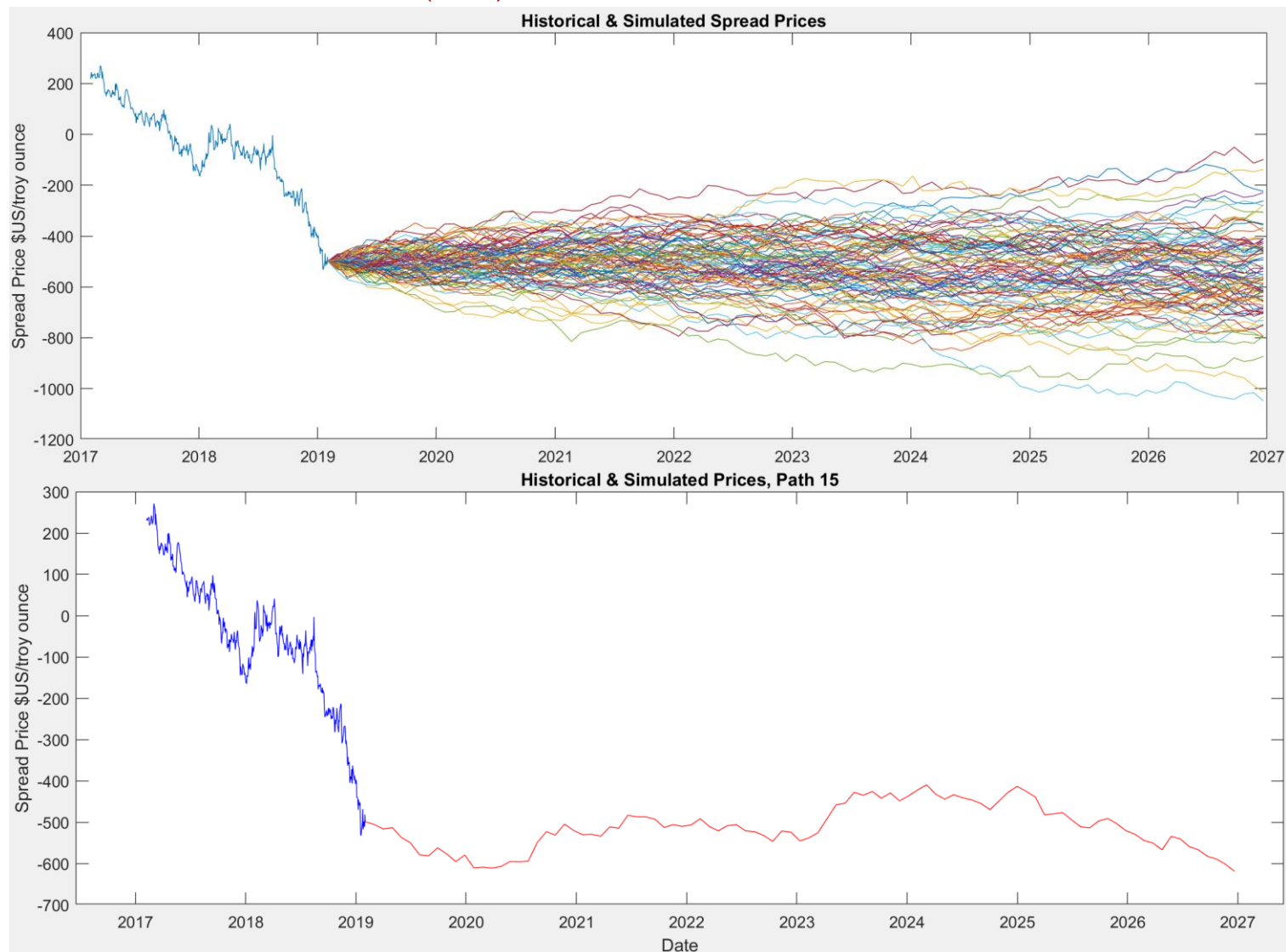
Palladium Price Forecasts



Source: DCM.

Results Pt. 2: Estimates of Future Spreads

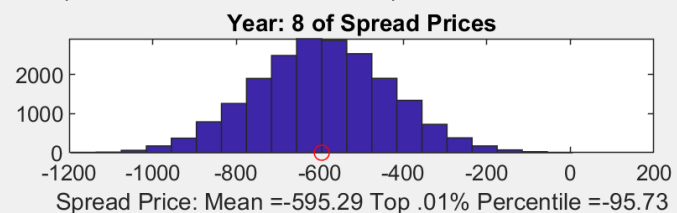
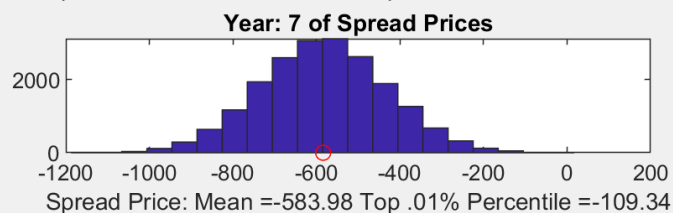
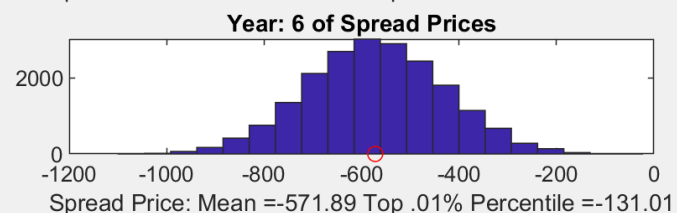
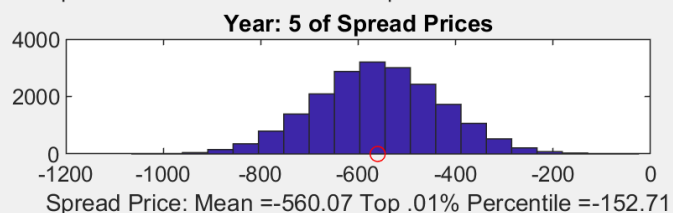
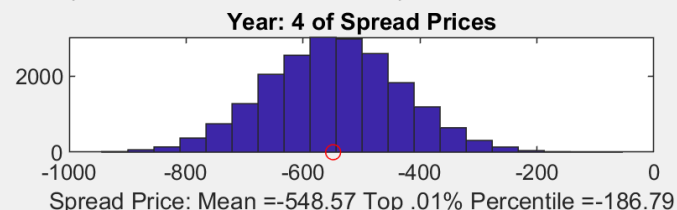
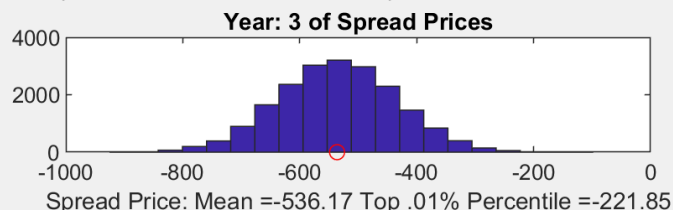
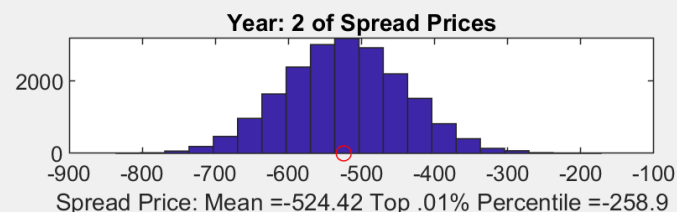
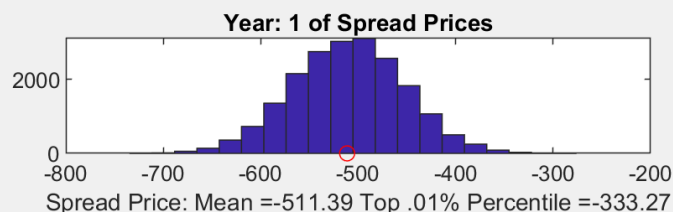
Simulated Likelihoods of Price Reversion (HWV)



Source: DCM.

Results Pt. 2: Estimates of Future Spreads

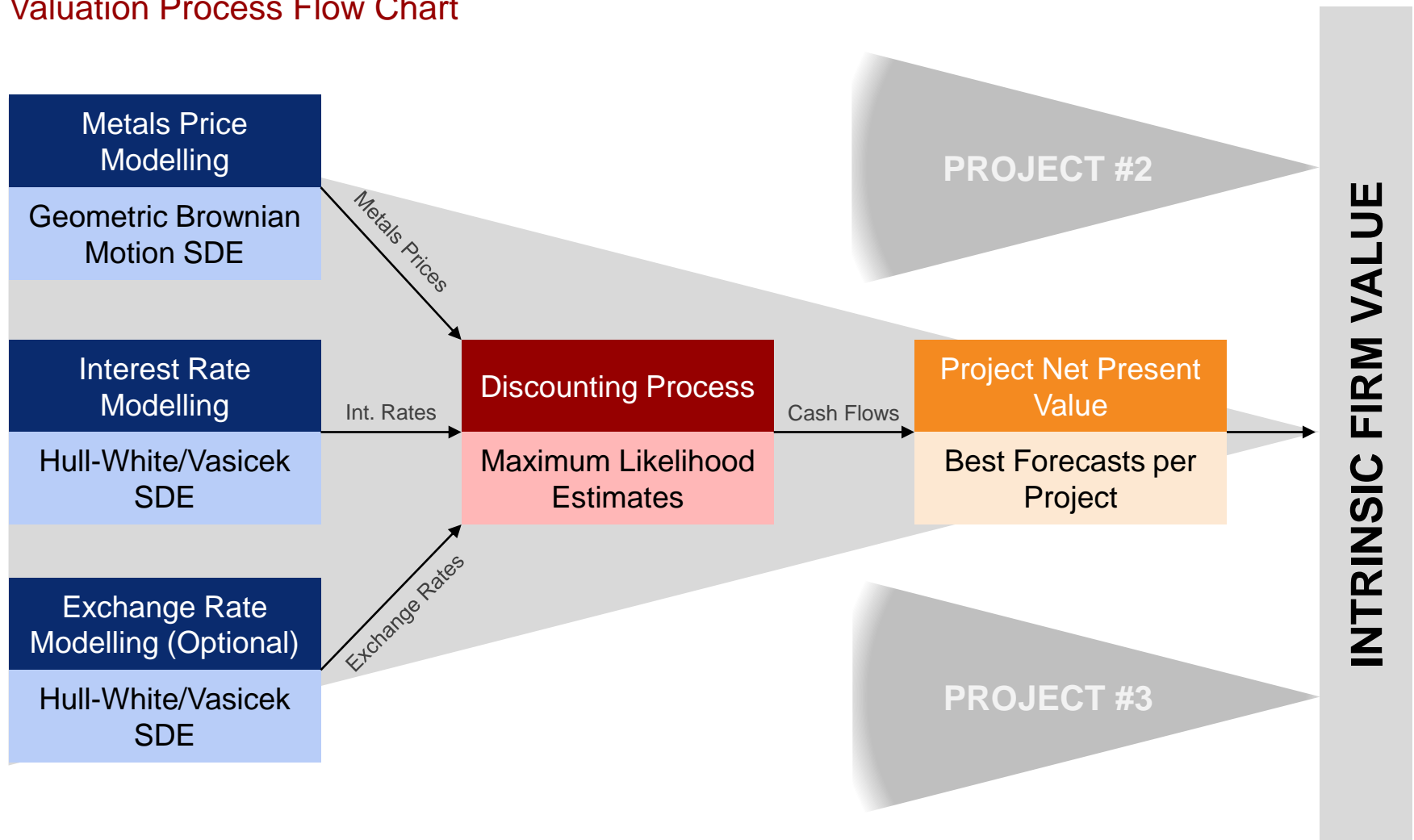
Simulated Likelihoods of Price Reversion (HWV)



Spread Reversion Looks Very Unlikely Without Fundamental Changes

Going Further: SDEs in Determining Valuation

Valuation Process Flow Chart



Flexible Quantitative Methods for Determining Uncertainties in Firm Operations

Source: Brandão and Miranda, 2013

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