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Copper: Price volatility and its impacts on the industry

Presentation to 23rd Regular Meeting of the International Copp
Study Group

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Presentation agenda

- Why invest in commodities?
- Speculative activity in the copper market
- Structural issues – supply/demand over the long-term
- Long-term prices
- Conclusions
- Q & A

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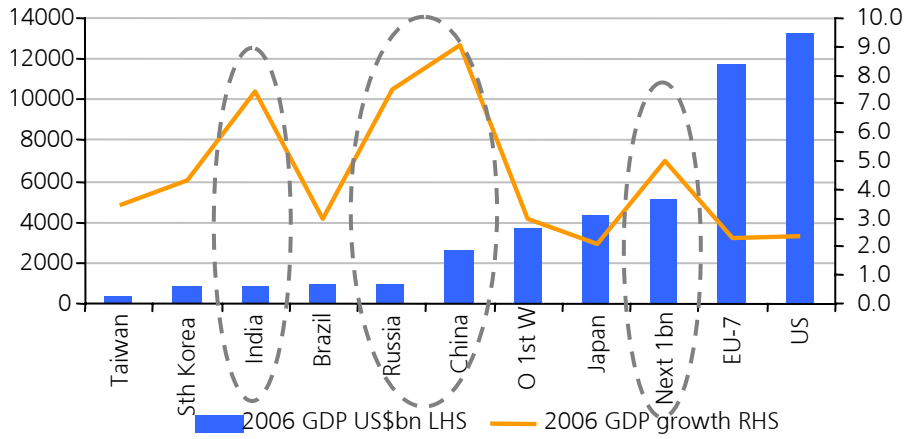
Why invest in commodities?

A secular shift in demand strength – Emerging Asia

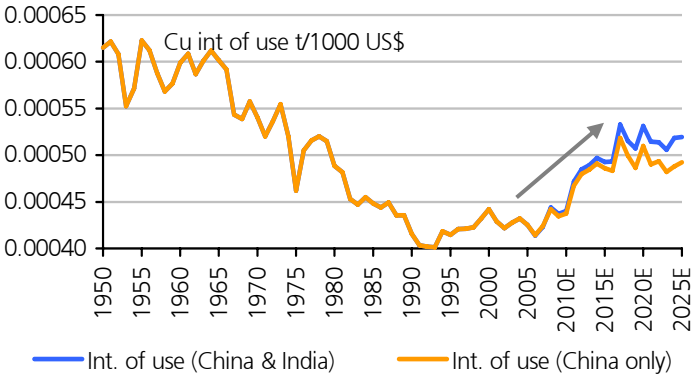
- The developing world growing faster, driving a take-off in materials intensity
- Increased globalisation of markets
- Greater competition for limited resources

GDP US$bn and 2006 GDP growth



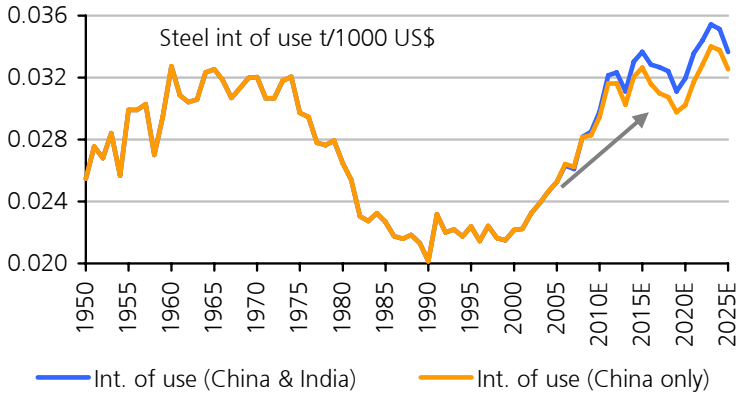
Source: Datastream, EIU, UBS estimates

World copper intensity of use, 1950-2025E



Source: AME, Brook Hunt, IISI, WBMS, UBS estimates

World steel intensity of use, 1950-2025E



Source: AME, Brook Hunt, IISI, WBMS, UBS estimates

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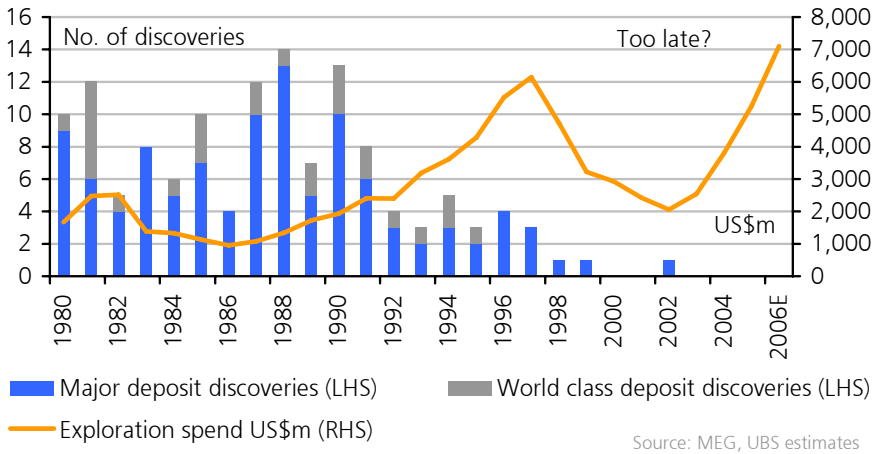
Why invest in commodities? (2)

Challenges in supply response

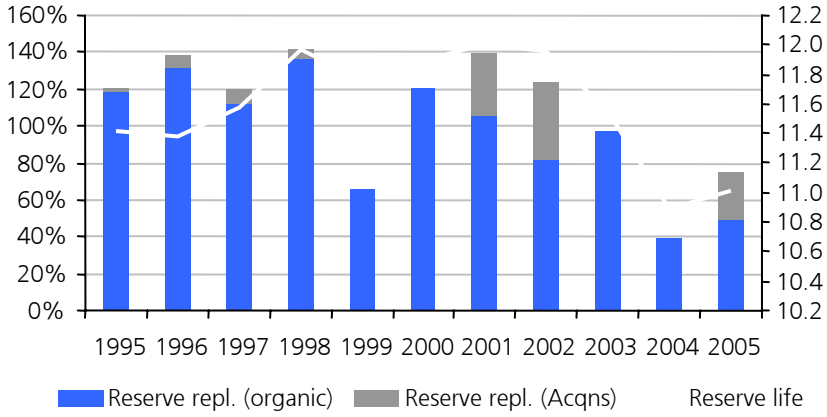
- Discovery rates have declined in both energy and metals markets
- Demand increasingly reliant on older and lower quality resources
- Exploration spend rising – time lag consideration between discovery and production
- Political risk remains a critical aspect of supply dynamics
- Environmental drivers/considerations

Global Mining discovery rates and exploration spend



Source: MEG, UBS estimates

Global OilCo reserve replacement and reserve life



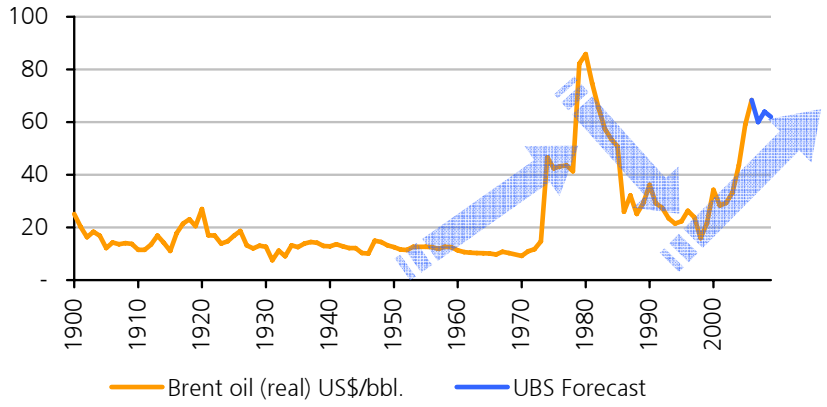
Source: Company data, UBS estimates

Why invest in commodities? (3)

Long-term pricing reflects secular imbalances

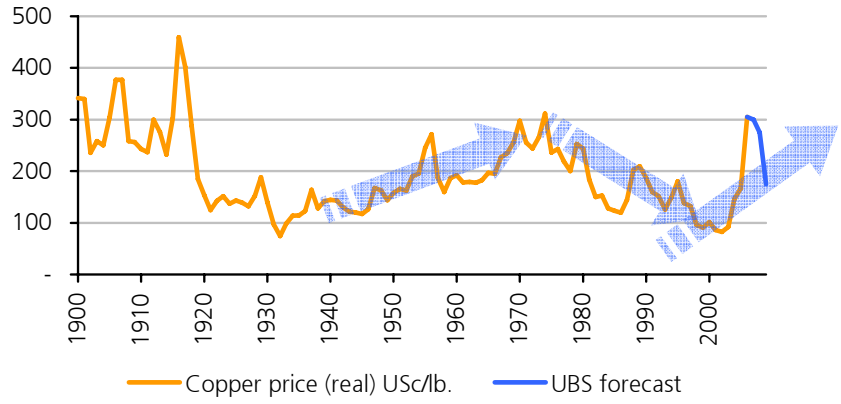
- Changes in global intensity of use combined with delays in supply response contribute to periods of extended strength and weakness in commodities markets
- China, India and the next billion represent an unprecedented block of long-term demand as industrialisation/urbanisation trends build
- Supply response hampered by cost pressures, political risks and scarcity of quality resources

Long-term pricing patterns: Real Brent oil price from 1900 (US$/bbl.)



Source: Bloomberg, UBS estimates

Long-term pricing patterns: Real LME copper price from 1900 (USc/lb.)



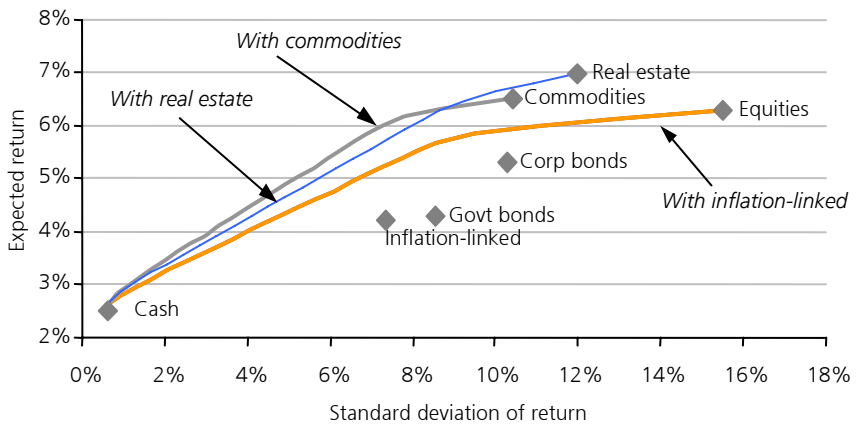
Source: Bloomberg, UBS estimates

Why invest in commodities? (4)

Asset allocation advantages are also important

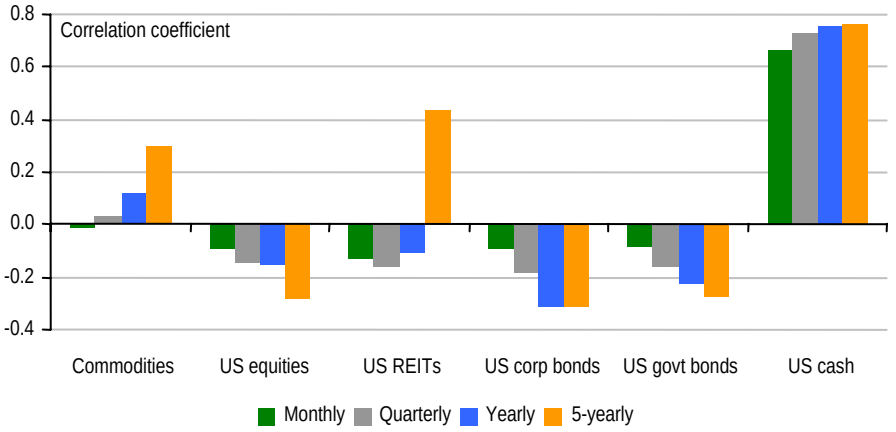
- Diversification advantages for portfolios holding commodities – diversified commodity exposure augments this benefit
- Commodities seen as a compelling inflation hedge
- Currency implications – US dollar weakness is inflationary
- Commodities appear attractive in a wider asset allocation context – competes effectively for marginal investment dollar
- Liquidity read-through

Expected returns over next 5 years



Source: UBS estimates

Correlation of US asset class total returns and core inflation

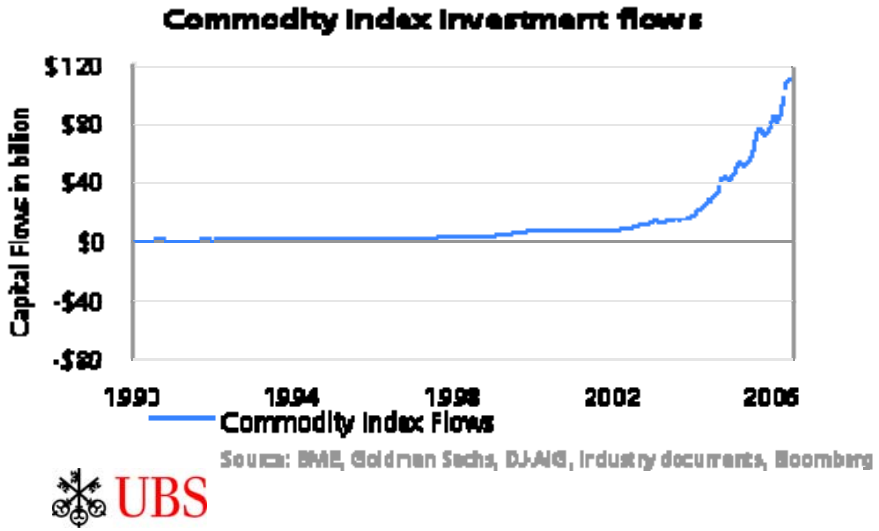


Source: UBS estimates

Traditional commodity indices - Background

Commodity Index Investment

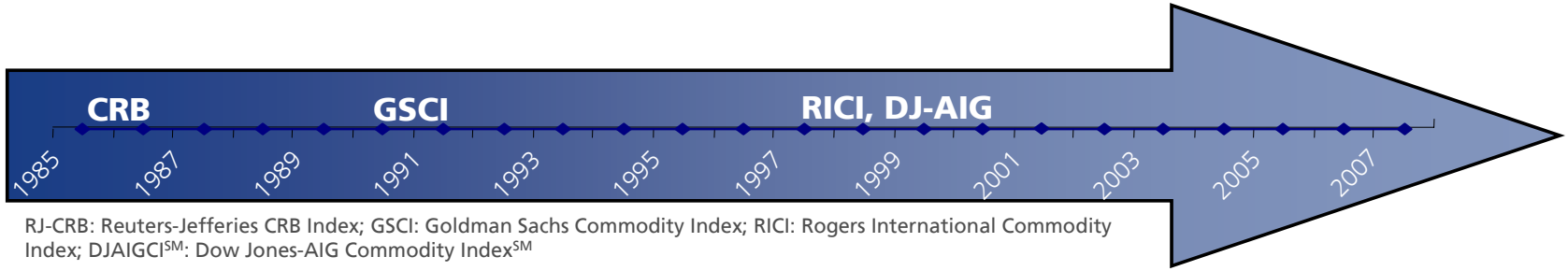
- Equity like returns
- Diversification benefits
- Inflation hedge
- Market event risk hedge
- Low correlation to equities and bonds (and perform best when others do worst)
- Negative returns recently



The Investment Universe

- There is an estimated $120bn tracking commodity indices globally
- Huge growth in the industry over last several years is partly attributable to equity underperformance and the desire to have well diversified portfolios

Investing challenges



RJ-CRB: Reuters-Jefferies CRB Index; GSCI: Goldman Sachs Commodity Index; RICI: Rogers International Commodity Index; DJAIGCI^{SM}: Dow Jones-AIG Commodity Index^{SM}

Purpose

- The indices are aimed to establish an investable benchmark for investors taking **commodity exposure**, by balancing market representation and liquidity

How?

- The indices take **long commodity positions**, through futures contracts on the relevant commodities
- Size of the allocation to each commodity is usually set according to a weighting engine driven by a combination of **global production/consumption and/or traded volume**

Rolling front-month contracts

- The front-month futures contracts are "rolled" into the next contract shortly before they expire

Why rolling front contracts? →

- A number of commodities historically have had limited liquidity beyond the front-month contracts
- Historic performance of rolling the front contracts was positive

Limited involvement of financial investors

- The key players were **consumers and producers** with no material market impact from commodity index investments

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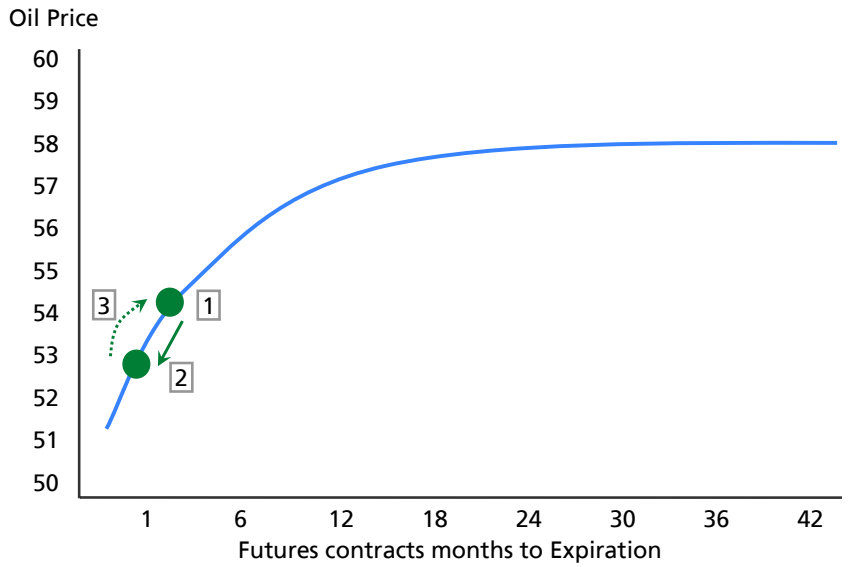
Investing challenges

General roll process

1. **Buy** short-dated futures
2. **Hold** for 1 month
3. **Roll** back to the new short-dated futures contract



- Two fundamental shortcomings with this process:
  1. **"Buying High/Selling Low":** when curves are upward sloping like above
     - Current negative roll yield on GSCI ~ 1.50%/month (18% p.a.)
  2. **Lack of Diversification:** only "invested" on one point of curve
     - High Volatility
     - Short-end of curve tends to exhibit the most negative roll yield

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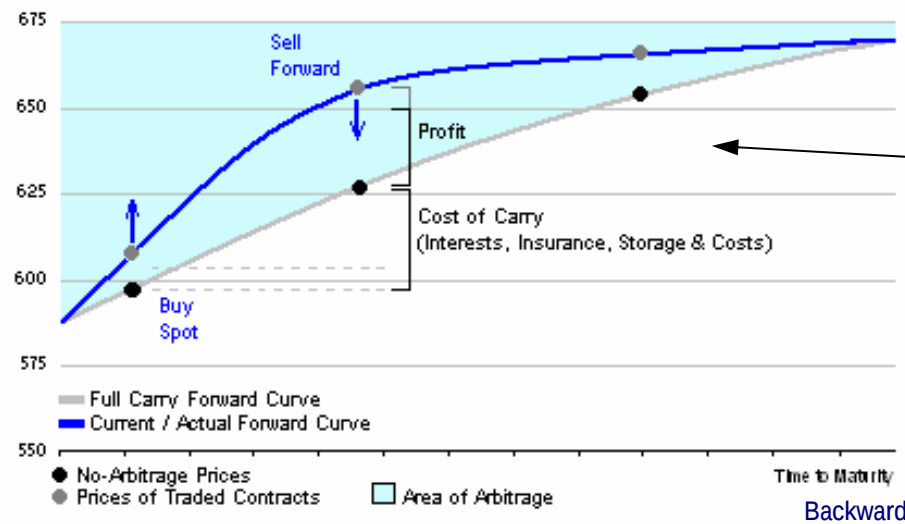
Deconstructing index returns - components

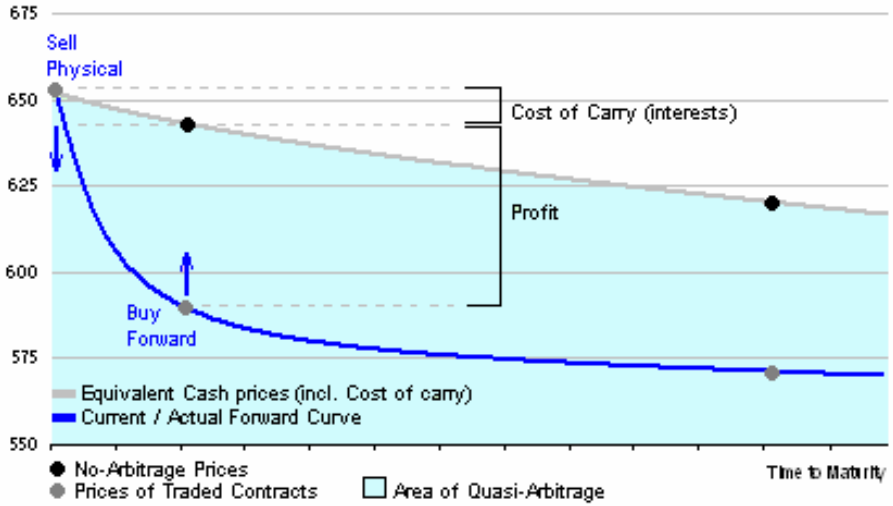
Contango – Full carry curve and arbitrage potential



- Contango: cost to the investor
- Physical availability
- Arbitrage: buy physical, sell the forward contract, pocket the yield

Source: UBS

Backwardation – Full carry curve and quasi-arbitrage potential

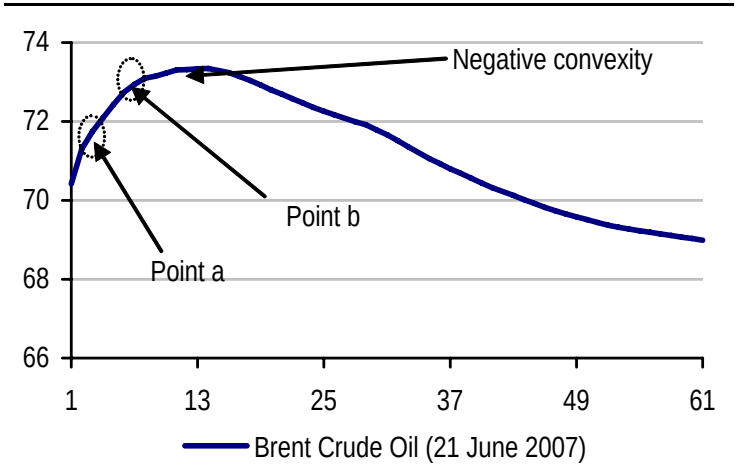


- Backwardation: return to the investor
- Physical scarcity
- Arbitrage: sell physical, buy the forward contract, pocket the yield

Source: UBS

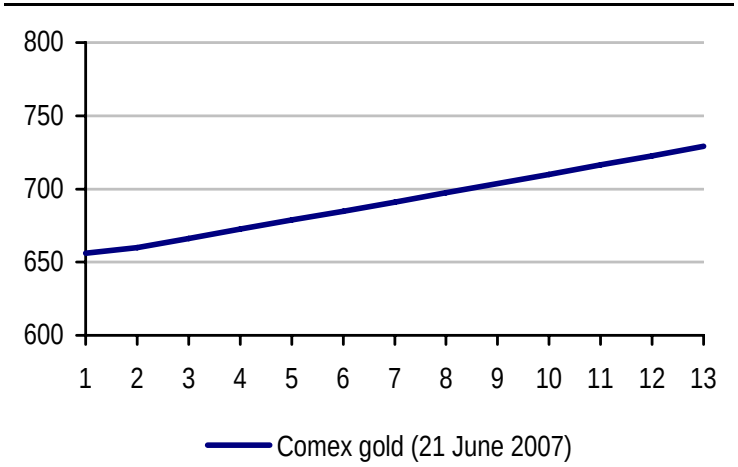
Curve asymmetries

Forward curve, Brent Crude Oil



Source: Bloomberg

Forward curve, Comex Gold



Source: Bloomberg

- Changing slope along the curve (convexity) can create differentiation in returns achieved
- Creates opportunities for outperformance
- Lack of convexity generates a lower performance differentiation

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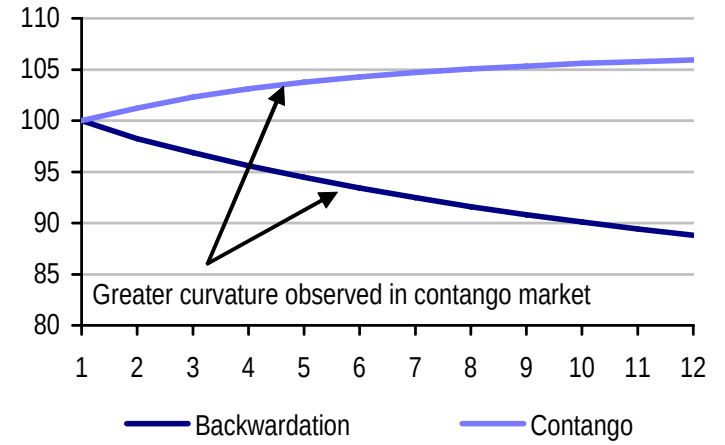
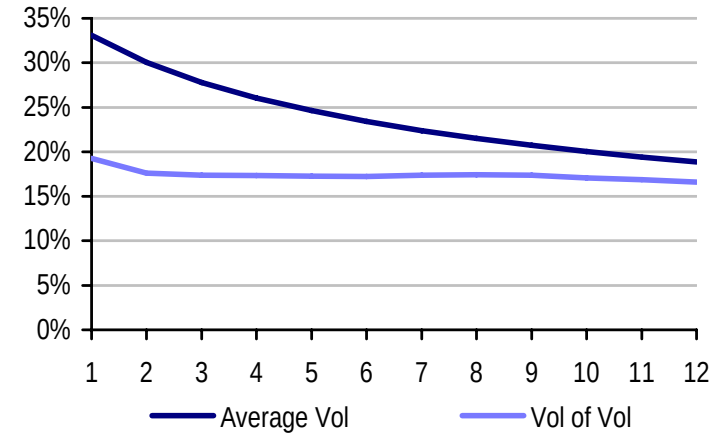
Curve asymmetries – the evidence

Brent Crude Oil – avg. shape of the forward curve (from the one month to 12 month contract)



Source: Bloomberg, UBS estimates

Brent Crude Oil – avg. vol and vol of vol (from the one month to 12 month contract)



Source: Bloomberg, UBS estimates

- Weekly data from 1994 – using the first 12 months contracts
- Contango definition: 1m<2m<3m
- Backwardation definition: 1m>2m>3m
- R^2 for best fit line; 75% in contango market, 90% in backwardated markets

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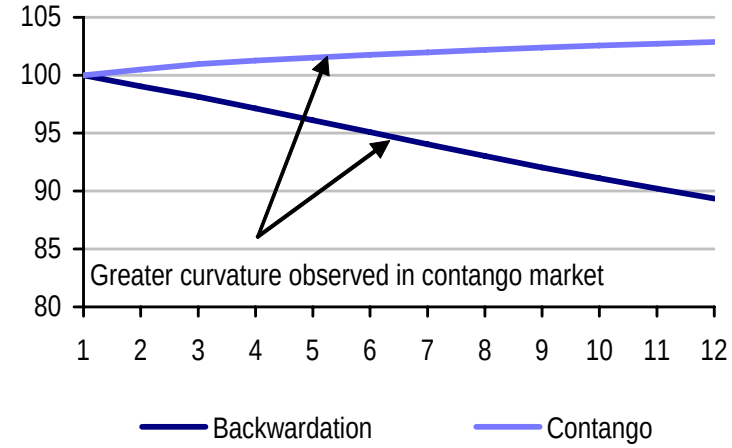
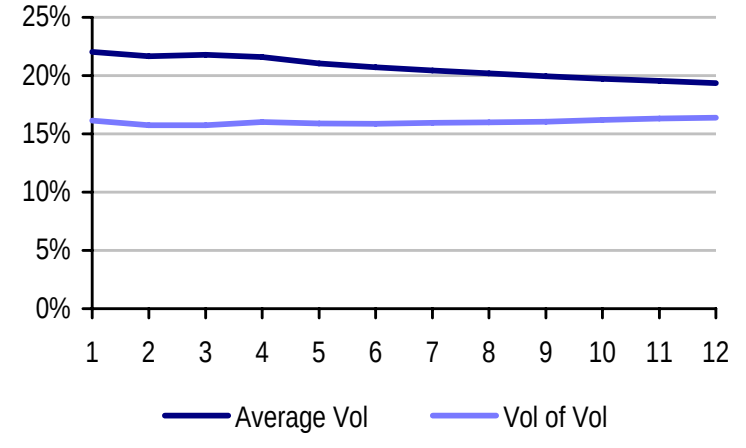
Curve asymmetries – the evidence

LME copper – avg. shape of the forward curve (from the one month to 12 month contract)



Source: Bloomberg, UBS estimates Note: Weekly data from 1997

LME copper – avg. vol and vol of vol (from the one month to 12 month contract)



Source: Bloomberg, UBS estimates

- Weekly data from 1997 – using the first 12 months contracts
- Contango definition: 1m<2m<3m
- Backwardation definition: 1m>2m>3m
- R^2 for best fit line; 83% in contango market, 98% in backwardated markets

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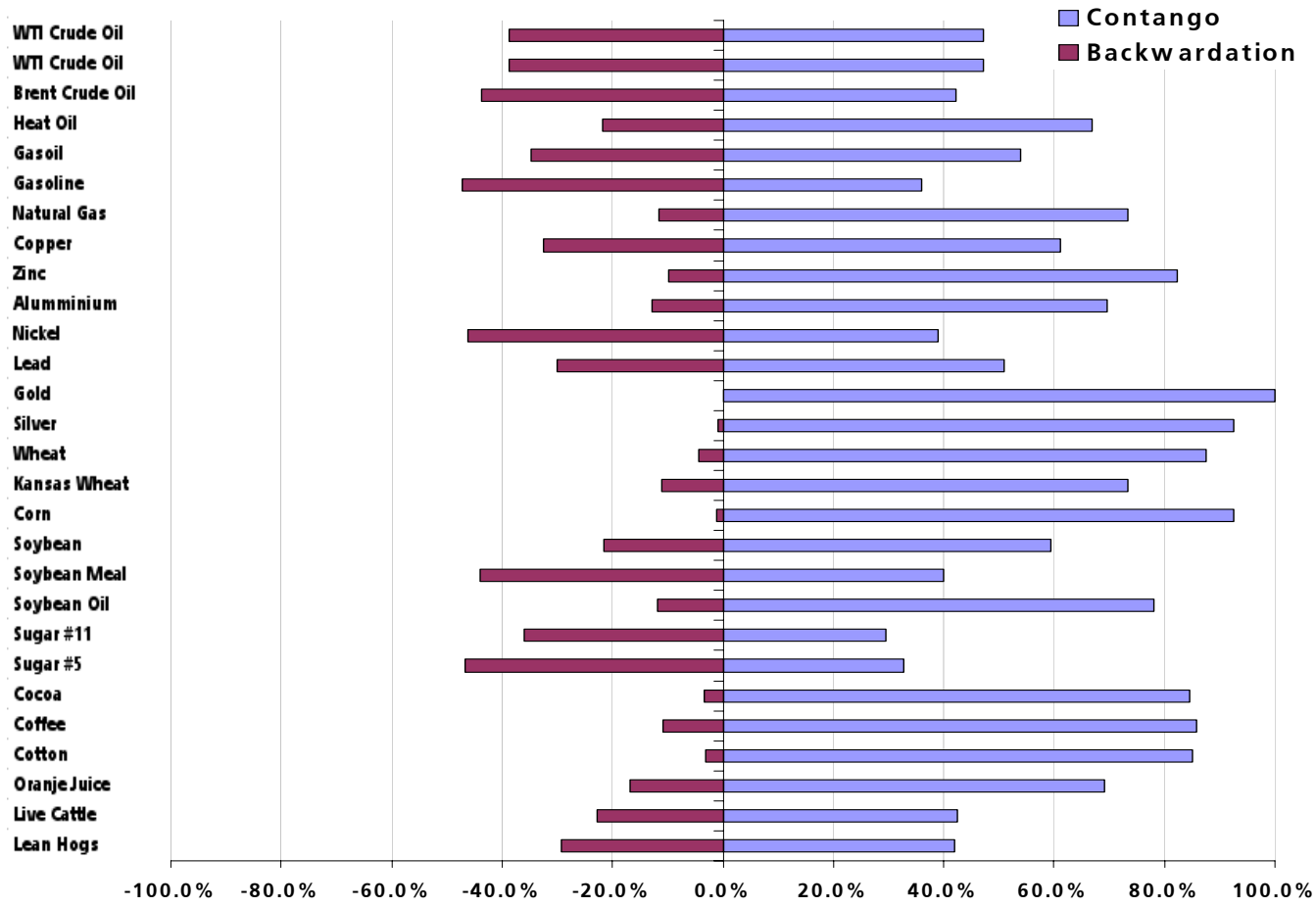
Frequency of contango and backwardation

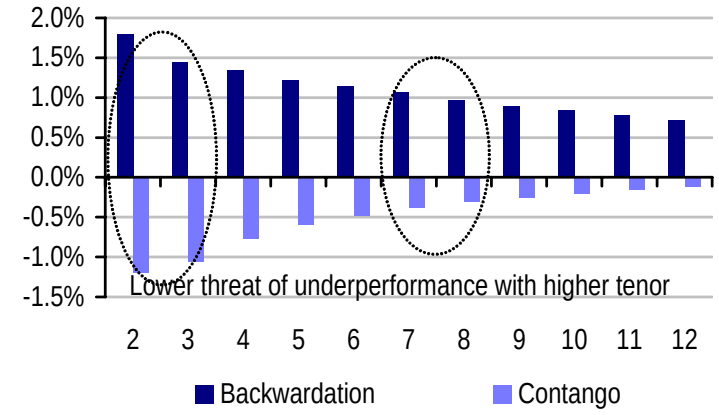
- Over the last 10 years, most commodities have spent more time in contango than in backwardation.



Source data: Bloomberg. Using weekly data between July-1997 to June-2007, the definition for contango and backwardation are defined on Slide 10. Unclear cases have been excluded.

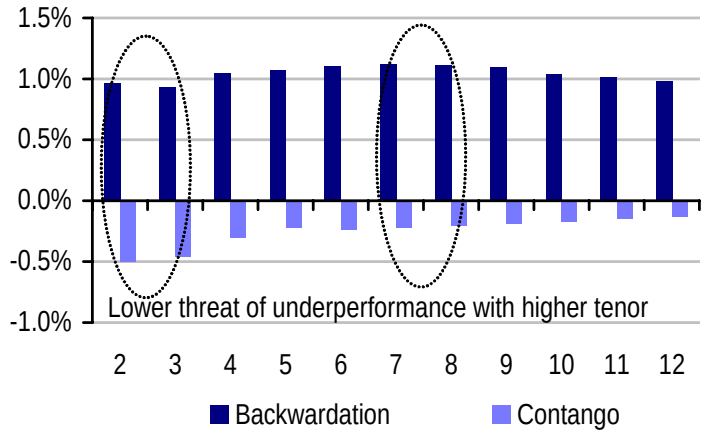
Read-through to performance bias

Brent crude oil: average roll yields on different points of the fwd curve for both contango and backwardated markets



Source: Bloomberg, UBS estimates

LME copper: average roll yields on different points of the fwd curve for both contango and backwardated markets



Source: Bloomberg, UBS estimates

- The oil curve shows that a higher tenor will achieve better performance in a contango market, but more importantly, only modest underperformance in a backwardated market
- The copper curve shows that a higher tenor will achieve better performance in a contango market and in fact outperformance as well in a backwardated market

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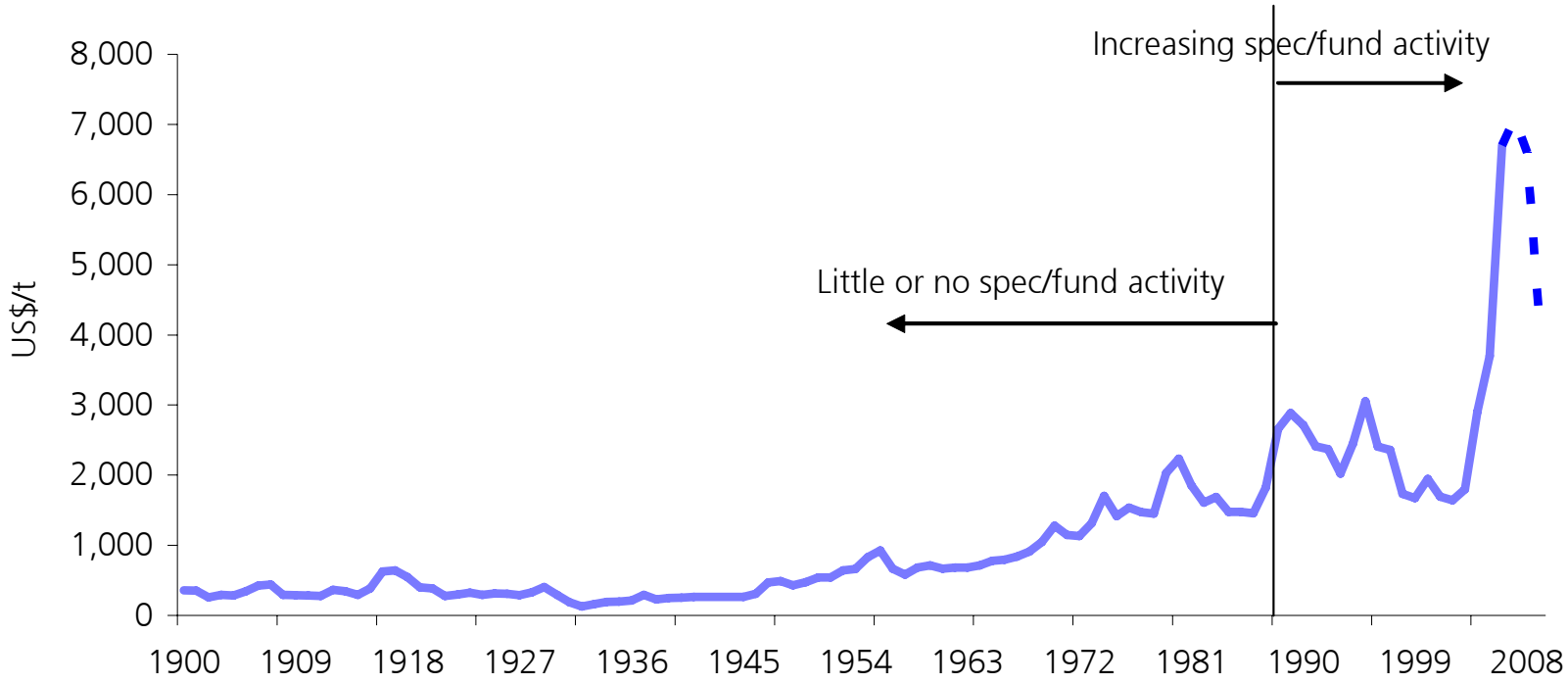
Financial investors in Cu – a new phenomenon?

Copper spot price trend (nominal) – from 1900



Source: USGS, LME, UBS estimates

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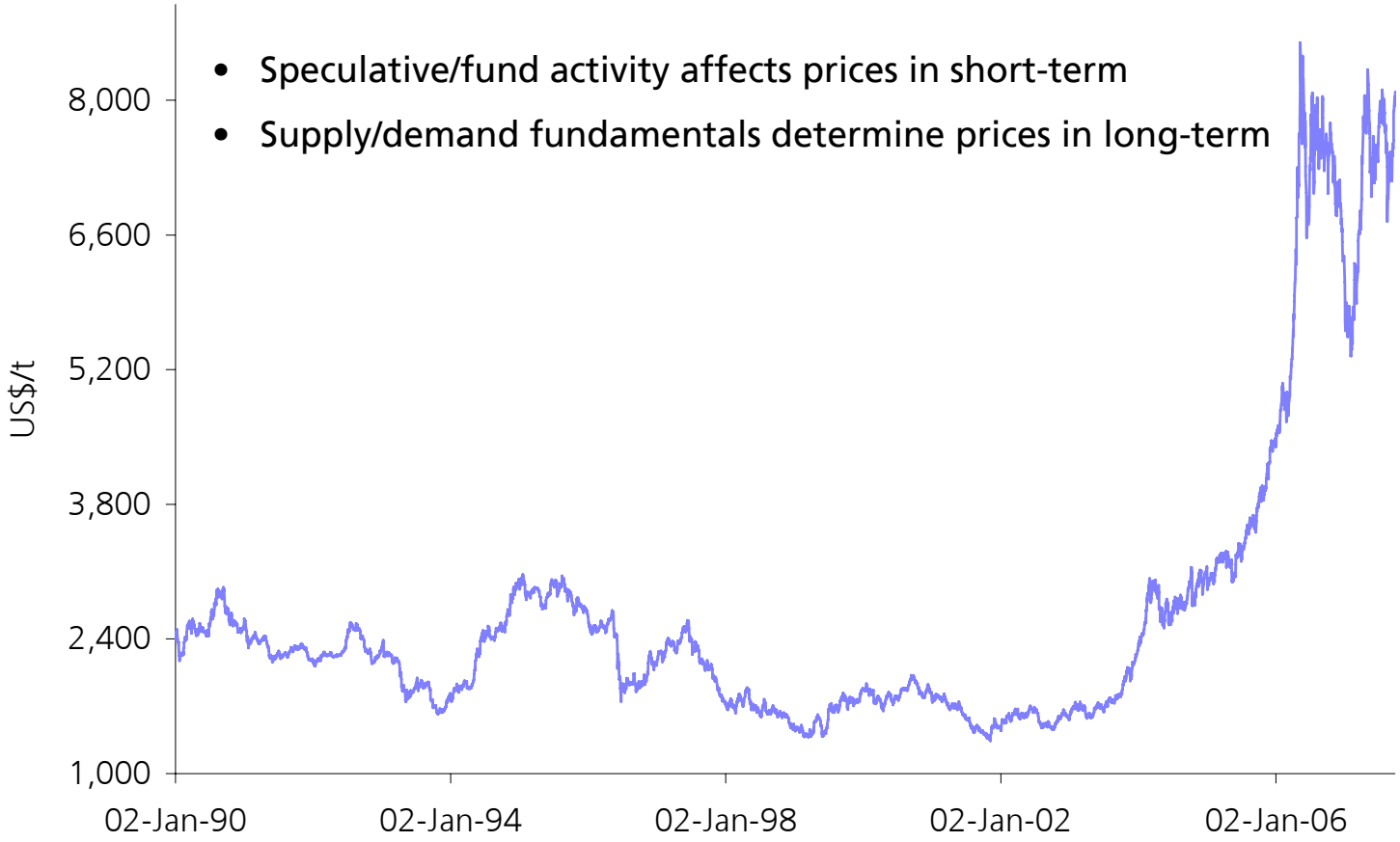
Speculators influence short-term prices…

Copper daily LME 3m price trend (nominal) – from 1990



Source: LME, UBS estimates

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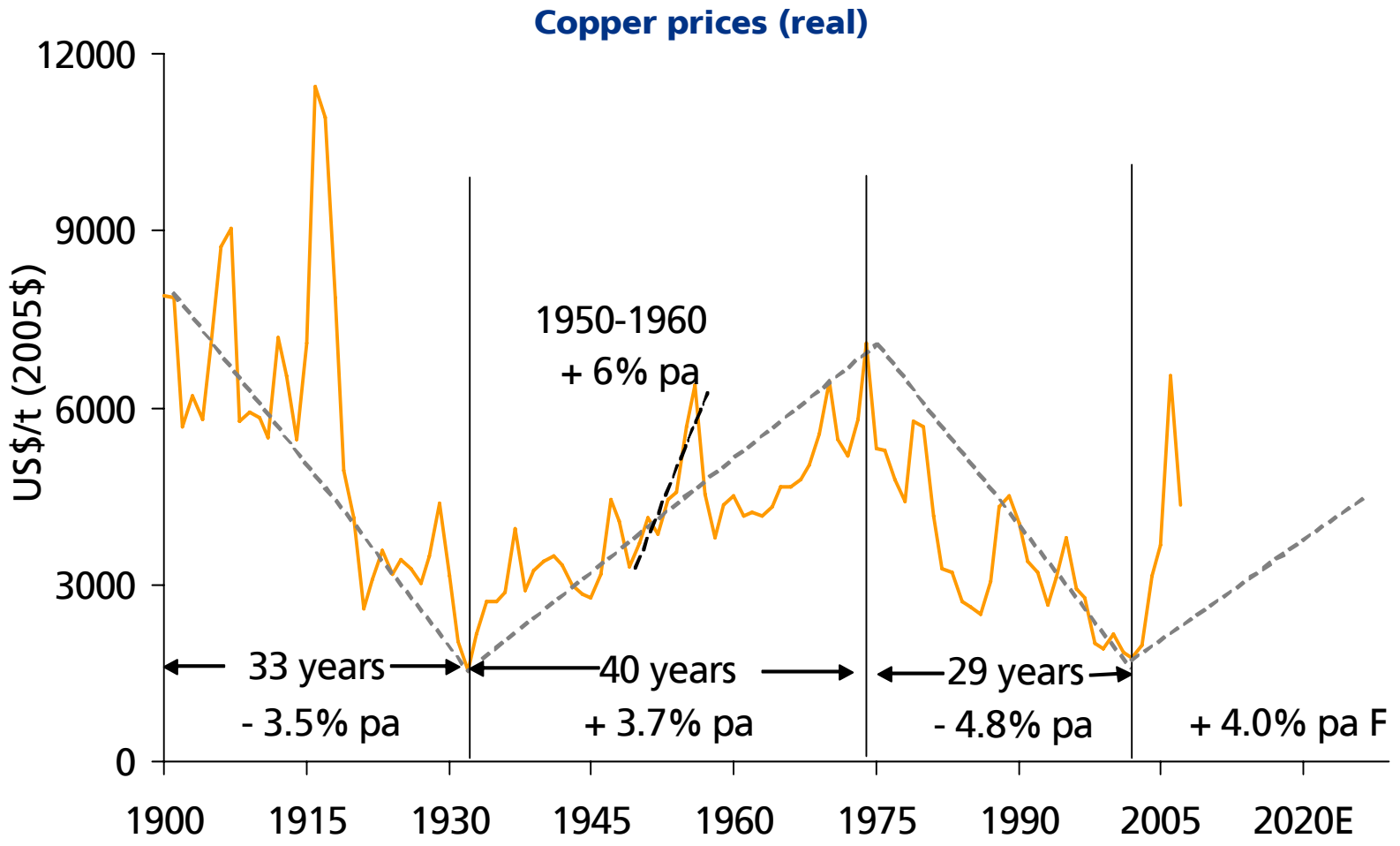
…but no impact long-term



- No escape from cyclical decline

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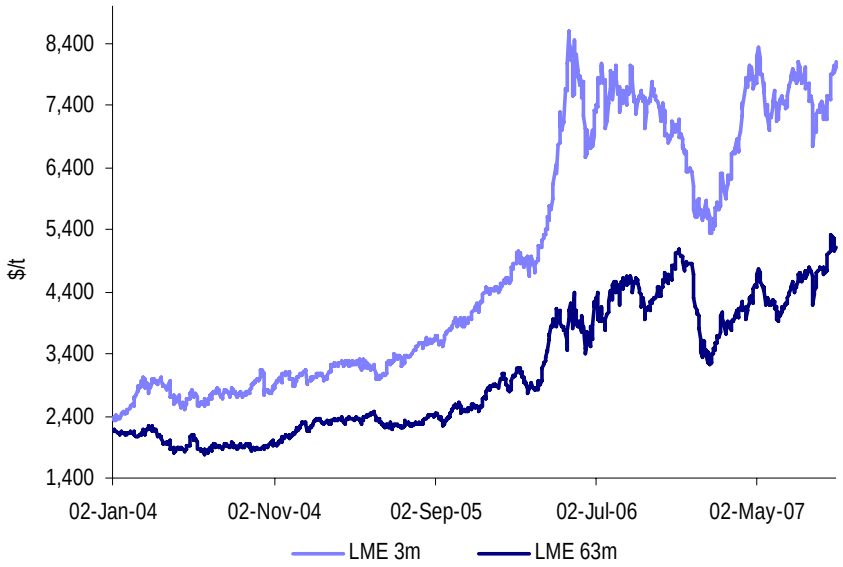
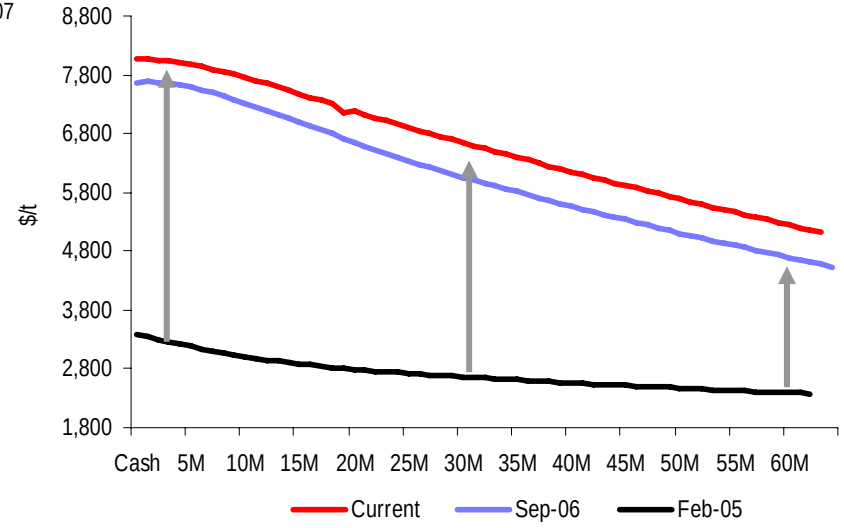
Source: Brook Hunt, USGS, UBS estimates

‘Stronger for longer’ implied by far forward prices

LME 3m & 63m copper prices



Forward curve



Source: LME, UBS

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Why has copper been so strong?

Demand, demand, demand.....

- **Synchronized global economic growth**
  - Strong growth in China allied with cyclical economic recovery in the OECD countries.
  - Underpins robust copper consumption growth.
- **Demand surprises**
  - Robust end-use demand.
  - Strong Chinese demand growth has raised global demand growth far above expectations.
  - The market deficits have become so large that demand "destruction" has been necessary to reduce actual consumption to below potential consumption.
- **Investor/speculative buying**
  - Attractive returns
  - Portfolio diversification
- **Further Industrialization & Urbanization of Asian countries**
  - China and S.E. Asia as a whole, is likely to become a longer term global economic power that will lead to massive raw material and processed goods consumption.
  - Developed world less important.

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Why has copper been so strong? (2)

But where is the supply response?

- **Lack of Capital Investment**
  - Last major investment cycle was in the 1970's.
  - Incentive pricing continues to rise.
  - Deterioration in the quality and quantity of available resources.
  - Exploration spending has picked-up but discoveries are few.
  - Long lead times to develop a mine.
- **Supply response much slower than expected**
  - Supply delays/disappointments, opex/capex cost increases, equipment and spare parts shortages (trucks, tyres), more militant labour.
  - Industry consolidation has led to better supply side discipline leading to preservation of higher prices for longer.
  - Cash generation put to use in M&A rather than in the ground.
  - It is not easy building or expanding new capacity.
  - Analysts continue to over-forecast supply.
- **Inventories under pressure**
  - Strong demand growth and very muted supply response has resulted in running down of inventories to historically low levels causing shortages (or risks of shortages).
  - Most visible LME inventories being drawn down to within days of consumption but trends occurring also throughout industry.

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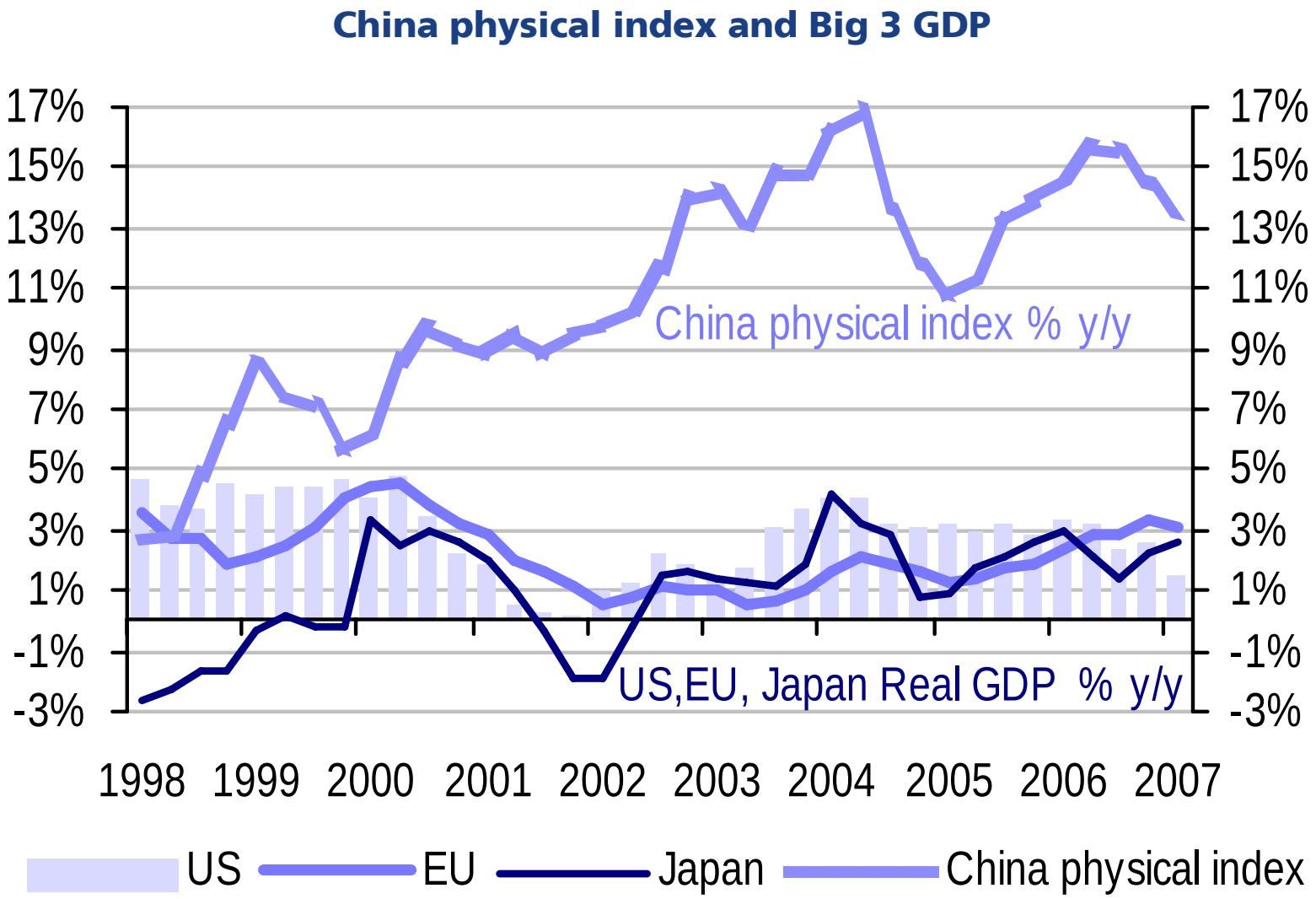
Global economic readings showing breadth & resilience



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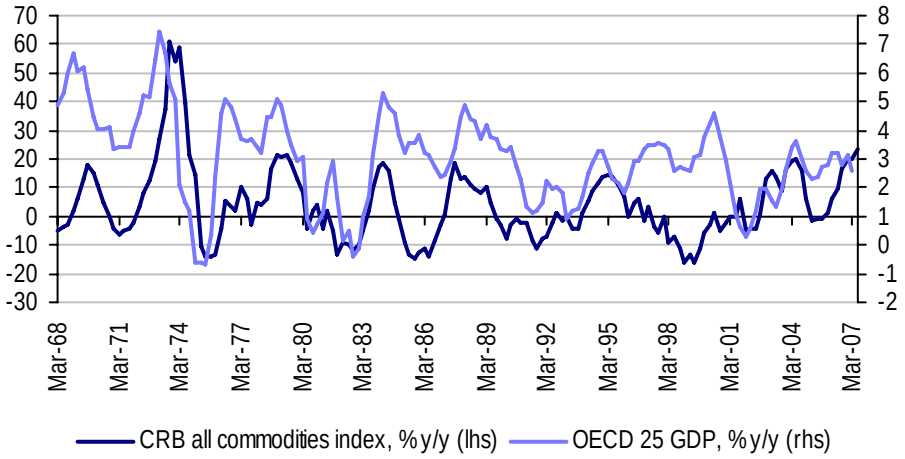
Source: Thomson Financial, CEIC, US DoC, UBS

US slowdown in context

OECD GDP growth and commodity prices



UBS IP growth projections – selected regions

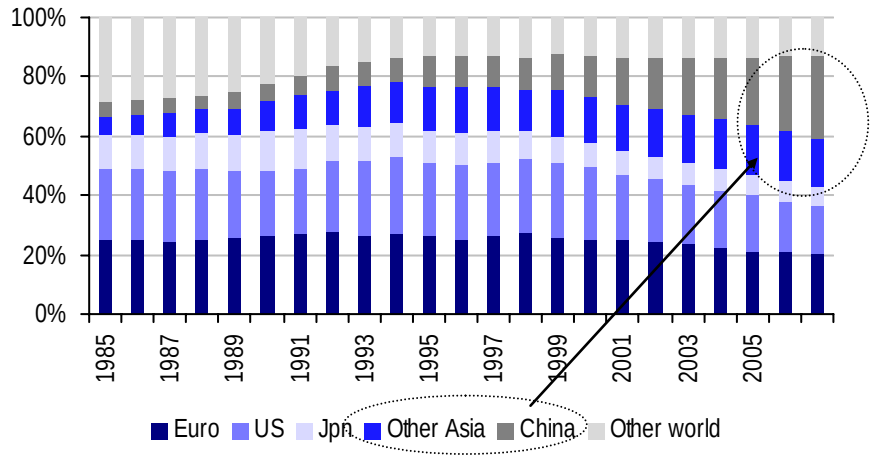
	2006	2007E	2008E
Advanced economies	4.0	2.5	2.7
China	16.6	17.0	15.1
India	11.0	9.7	11.0
Russia	3.9	6.0	7.0
Brazil	2.8	4.5	4.5
Eastern Europe	6.6	7.3	7.2
Global	6.5	5.7	5.6

- Strong historic correlation between western world growth and commodity prices
- How weak is global growth likely to get?!
- Asian dominance of materials consumption a key consideration; questioning of relevance of US slowdown
- Global bulk materials, steel markets appear strong

Source: Haver, UBS estimates

Economic sensitivity of metals demand

Regional split - global base metals consumption



- Magnitude of Asia vs. US… the gap is widening
- Our assumptions include: a 24% contraction in US housing starts and destocking
- Metals growth remains firm

Output from economic sensitivity model – metals demand read-through

	IP Growth f'cast (2007)	Global weight	Sensitivity*	Calc'd cons growth	Global growth contribution	Growth with inventory change
Western Europe	2.3%	20.4%	1.52	3.5%	0.7%	1.4%
US	2.1%	16.0%	1.40	-2.4%	-0.4%	-6.8%
Japan	2.4%	6.3%	1.26	3.0%	0.2%	-3.0%
Asia ex-Jp/Ch	7.0%	16.4%	1.22	8.5%	1.4%	8.5%
China	17.0%	28.0%	0.80	13.6%	3.8%	14.2%
Other global	3.0%	12.9%	1.24	3.7%	0.5%	1.6%
Total global IP	5.8%	100.0%	1.20	6.2%	6.2%	4.6%

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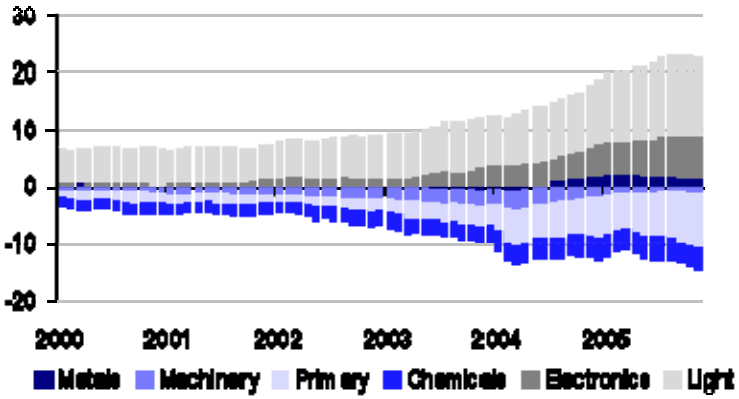
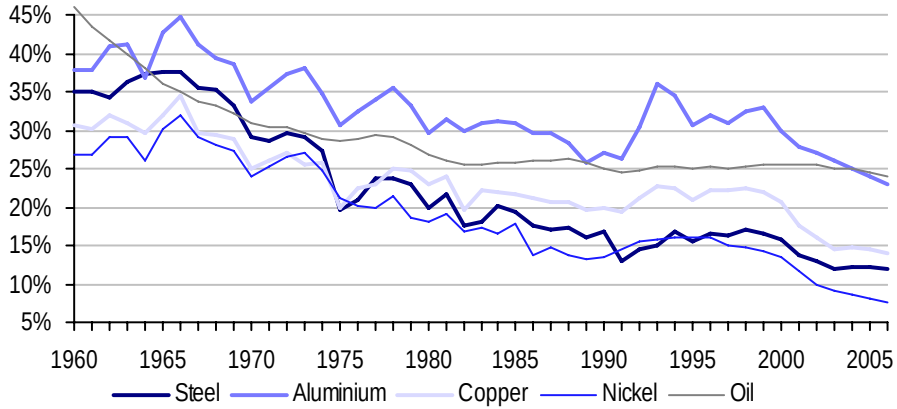
Source: Brook Hunt, UBS estimates

How important is the US?

China trade balance (US$bn)



US share of global apparent consumption



- What if US consumption of Chinese products slows?
- China trade not very 'heavy'
- 2001/2002 trade dip left materials relatively unaffected
- Urbanisation/industrialisation insulating materials consumption

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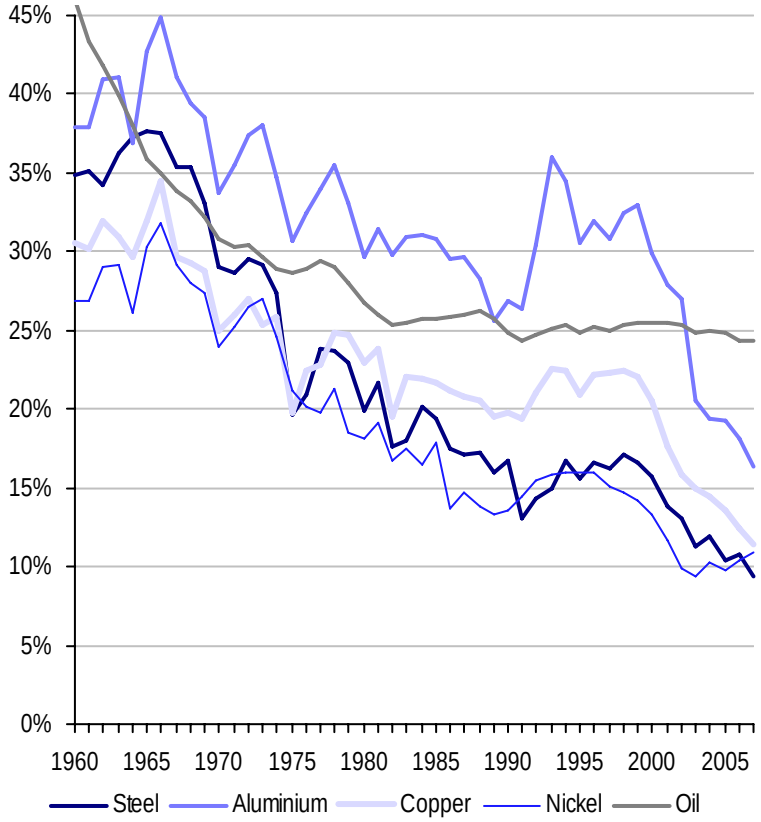
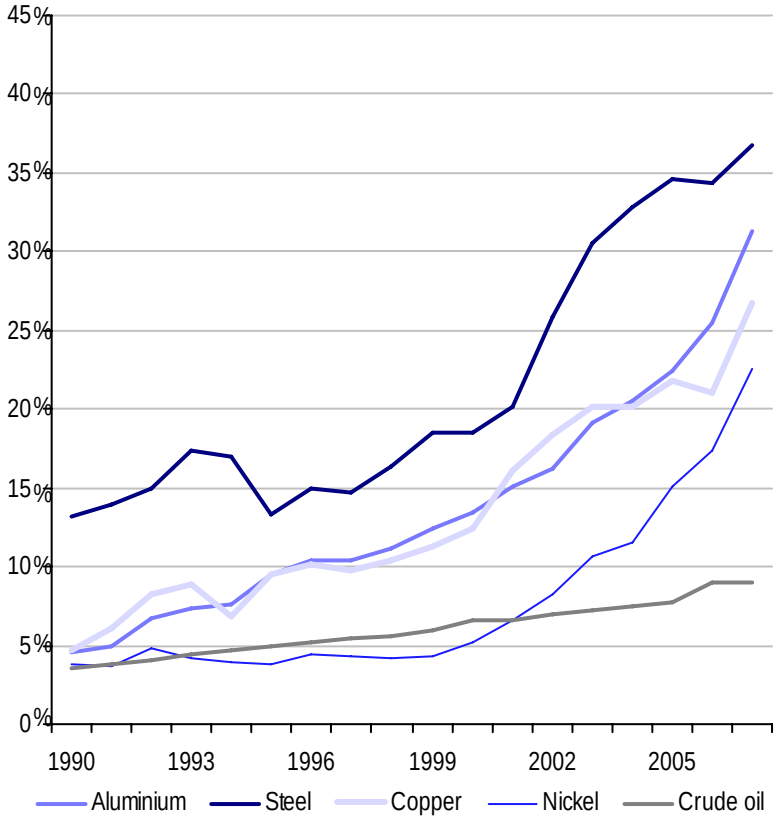
Source: CEIC, IISI, US Census Bureau, USGS, UN, UBS estimates

US decline and China rise in materials consumption

US metals/oil consumption of world total % to 2007E



China metals/oil consumption of world total % to 2007E



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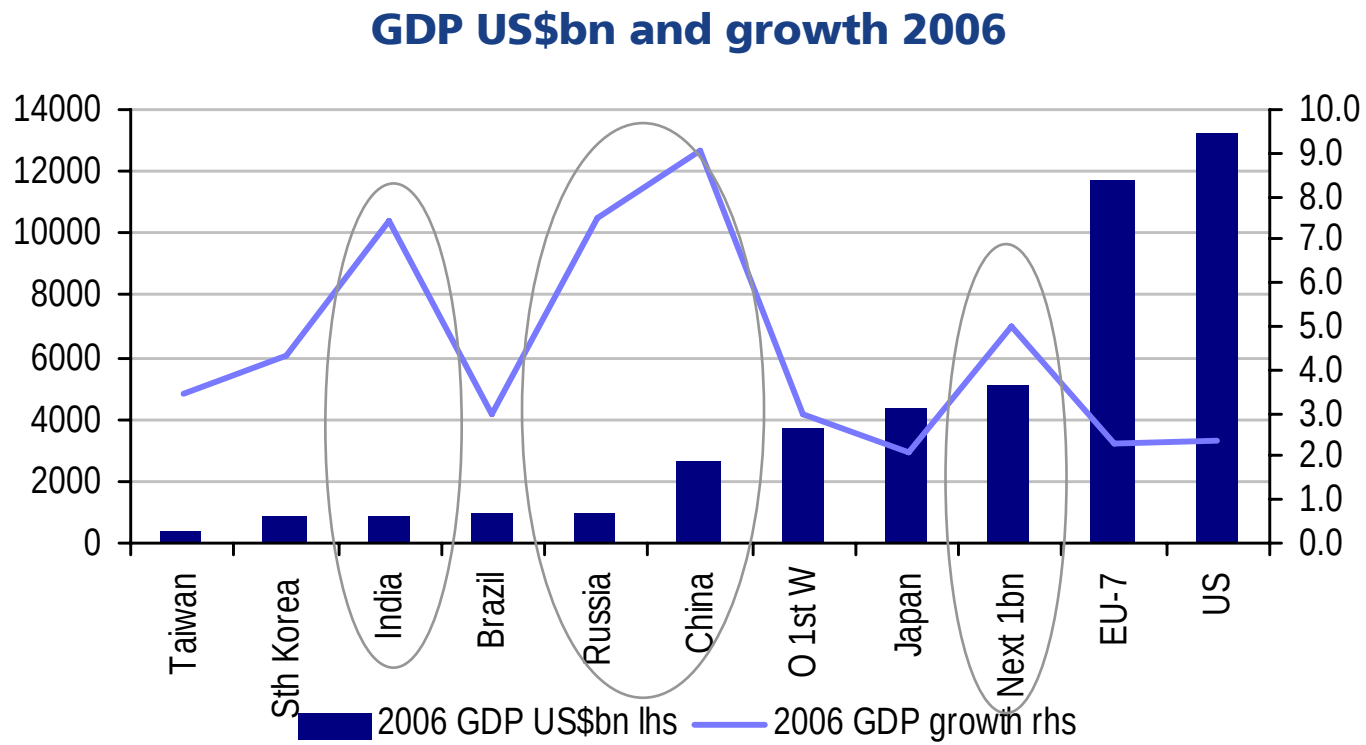
Source: IISI, US Census Bureau, USGS, United Nations, WBMS, CEIC, UBS estimates

Composition of global growth and materials demand



- Developing world growing faster with greater materials demand elasticity
- Aggregate 'Next 1 bn' (Middle East, Mexico, Turkey, Indonesia, Poland, South Africa, Thailand, Argentina, Venezuela, Malaysia, Chile, Czech, Philippines, Hungary, Egypt, Algeria) the surprise in 2006

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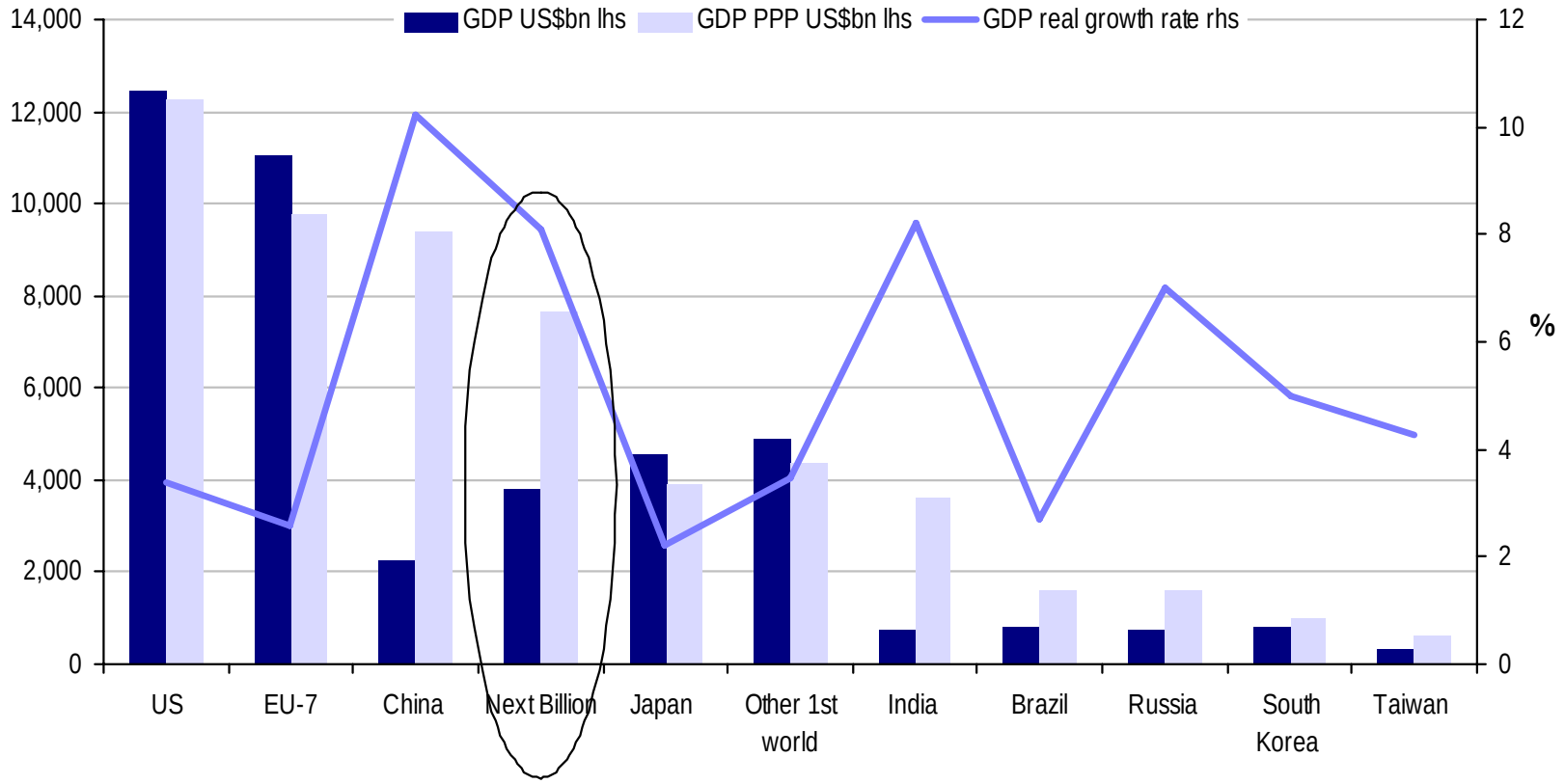
Source: Datastream, EIU

Demand has been the biggest surprise, not only in China

Regional GDP in real and PPP terms



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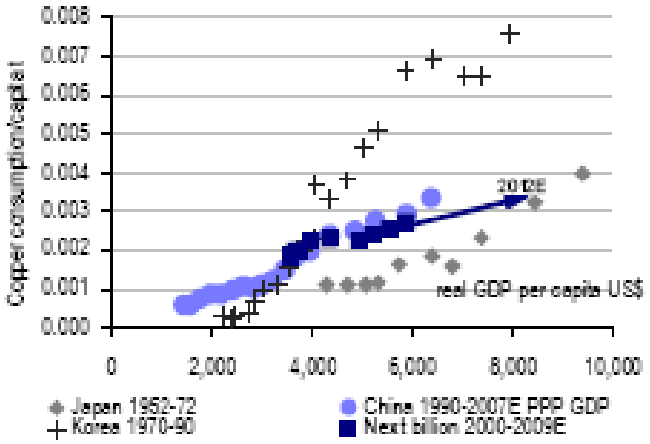
Source: IMF World Economic Outlook Database, 6 September, UBS

…Next Billion…the hidden materials driver

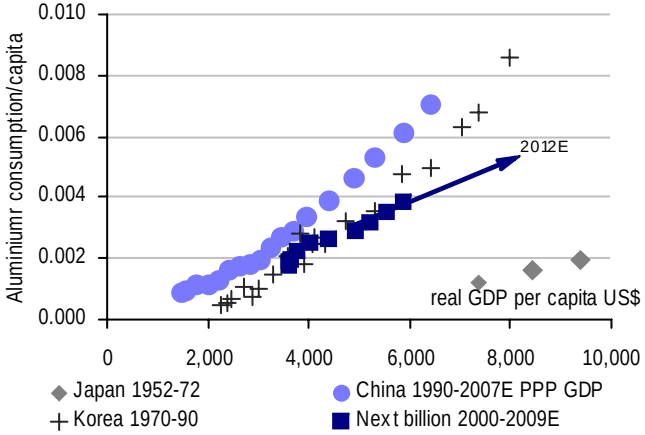
Profile of the next billion, 2005

	Pop.	GDP/cap	2005 Consumption mt/y		
	m	US$	Cement	Steel	Ally
Mexico	106	7183	33	18	0.2
Turkey	73	5000	30	19	0.4
Saudi Arabia	25	12593	25	12	0.1
Poland	38	7827	12	8	0.2
Indonesia	242	1233	29	6	0.3
Sth Africa	45	4993	12	5	0.2
Iran	68	2895	37	16	0.2
Argentina	39	4736	6	4	0.1
Thailand	64	2563	28	12	0.3
Venezuela	27	5222	3	3	0.2
Malayasia	24	5110	18	8	0.2
Czech	10	11990	4	5	0.1
Chile	16	7074	4	3	0.0
Gulf States*	9	25517	11	7	0.1
Philippines	88	1111	13	5	0.1
Egypt	78	1283	25	5	0.1
Vietnam	84	568	29	3	0.1
Total	**1034**	**3644**	**320**	**137**	**2.7**
% of world	16%		17%	13%	8%

Cu IOU



Aluminium IOU



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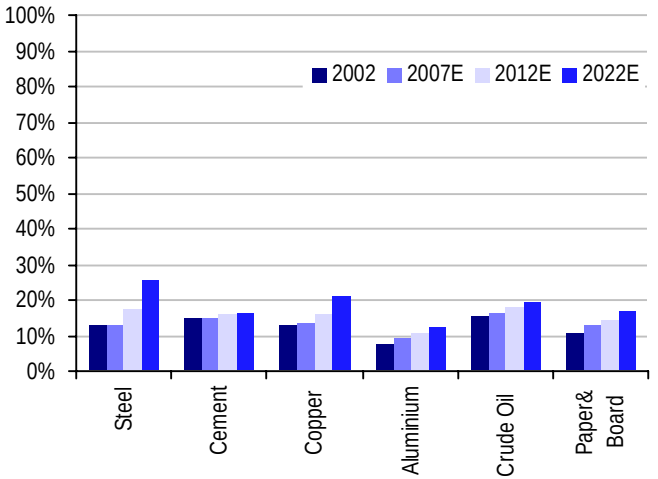
Source: US Census, USGS, IISI, CEMBUREAU, UBS

Materials growth projections for +5, +15 years

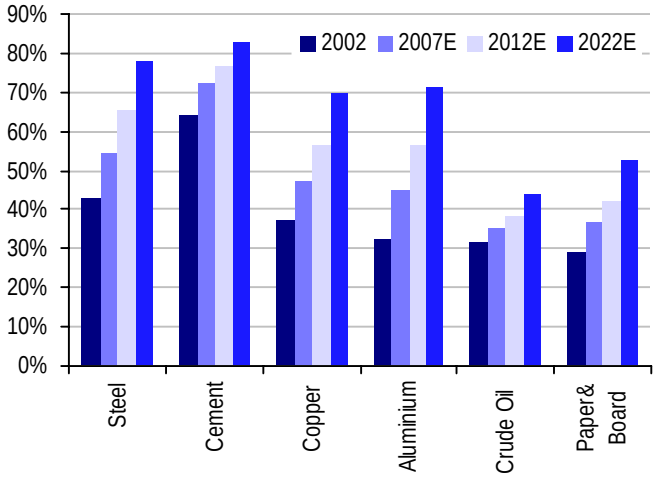
Growth projections +5, +15 yrs

	2002	2007E	2012E	2022E	2002-2007E	2007E-2012E	2012E-2022E
Next Billion		million tonnes				CAGR change in %	
Steel	111	168	284	591	9%	11%	8%
Cement	269	354	480	670	6%	4%	3%
Copper	2.0	2.5	3.7	6.6	5%	8%	6%
Aluminium	2.0	3.3	5.1	8.2	11%	9%	5%
Crude oil	550	655	759	925	4%	3%	2%
Paper & board	47	64	80	126	6%	5%	5%
China							
Steel	186	440	647	957	19%	8%	4%
Cement	719	1115	1356	1823	9%	4%	3%
Copper	2.8	4.6	7.5	11.6	10%	10%	4%
Aluminium	4.2	9.8	17.2	30.7	19%	12%	6%
Crude oil	247	371	452	607	8%	4%	3%
Paper & board	43	68	91	163	10%	6%	6%
India, Russia, Brazil							
Steel	84	98	137	246	3%	7%	6%
Cement	184	232	296	483	5%	5%	5%
Copper	0.8	1.7	2.1	3.5	15%	5%	5%
Aluminium	2.2	3.2	4.5	8.8	8%	7%	7%
Crude oil	320	367	415	532	3%	2%	2%
Paper & board	19	26	31	42	6%	4%	3%
Developed and other World							
Steel	501	586	560	501	3%	-1%	-1%
Cement	660	659	639	601	0%	-1%	-1%
Copper	9	10	10	9	1%	1%	-1%
Aluminium	17	20	21	19	3%	1%	-1%
Crude oil	2420	2560	2632	2640	1%	1%	0%
Paper & board	235	244	256	272	1%	1%	1%
World							
Steel	882	1292	1612	2386	8%	5%	4%
Cement	1832	2292	2530	3084	5%	2%	2%
Copper	15.0	18.5	23.5	30.1	4%	5%	2%
Aluminium	25.5	36.2	47.5	67.0	7%	6%	3%
Crude oil	3537	3953	4258	4704	2%	1%	1%
Paper & board	331	387	441	576	3%	3%	3%

Next Billion % world cons.



Next Billion + BRICs % world consumption



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Source: IISI, USGS, Brook Hunt, BP statistical review, RISI, FAO, UN, IMF, UBS

Materials growth projections for +5, +15 years

Cu consumption estimates for the Next Billion constituents

Thousand tonnes	2002	2003	2004	2005	2006	2007E	2008E
Mexico	383	352	393	439	411	444	479
Turkey	225	265	273	317	263	284	307
Other ME	240	240	240	240	240	259	280
Poland	246	253	274	274	269	291	314
Indonesia	109	121	188	180	177	191	206
South Africa	80	75	86	87	81	87	94
Iran	95	95	120	95	100	108	117
Argentina	20	28	33	34	31	33	36
ASEAN-3	406	370	467	498	510	551	595
Venezuela	1	1	4	4	6	6	7
Czech Republic	10	4	8	6	7	7	8
Chile	81	96	100	103	111	120	129
Egypt	36	36	45	45	45	49	52
Vietnam	29	42	56	54	71	77	83
Total	1961	1978	2288	2376	2321	2507	2708
Growth	5%	1%	16%	4%	-2%	8%	8%
Copper/capita t	0.0020	0.0020	0.0022	0.0023	0.0022	0.0024	0.0025

Projected Cu consumption estimates of Next Billion and BRIC as % of world totals

Next Billion % of world total	2002	2007E	2012E	2022E
Copper	13%	14%	16%	21%
Next Billion + BRICs % of world total				
Copper	37%	47%	57%	70%

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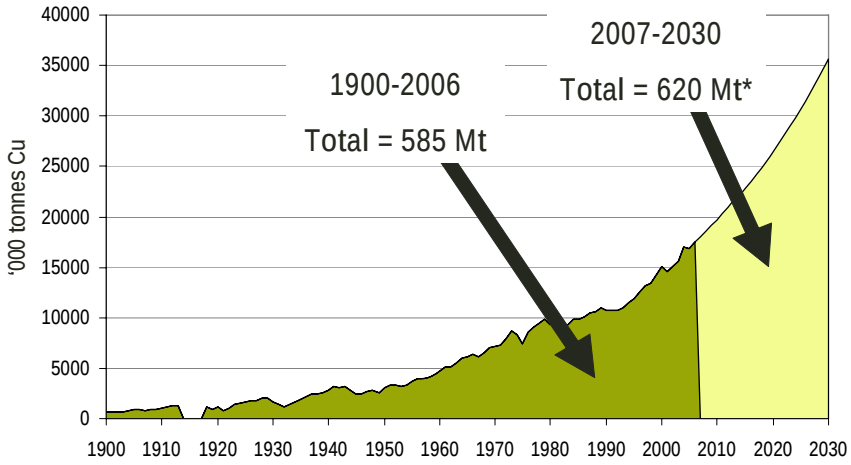
Source: IISI, USGS, Brook Hunt, BP statistical review, RISI, FAO, UN, IMF, UBS

Mining companies remain positive on demand

Cumulative consumption of copper to 2030



•At a hypothetical world average growth rate of 3% p.a.
Source of data: CRU, BHP Billiton

- BHP Billiton at 3% growth rate in copper, the world to consume more in the next 25 years as it did in the past 100
- Rio Tinto upgraded its Chinese GDP forecasts by 2% for 2007/08E – 10%, and c9% until 2015E
- UBS forecasts for Chinese GDP forecast - 8.9% and 9.4% in 2007E and 2008E; IP growth forecast – 15.7% and 14.8% in 2007E and 2008E

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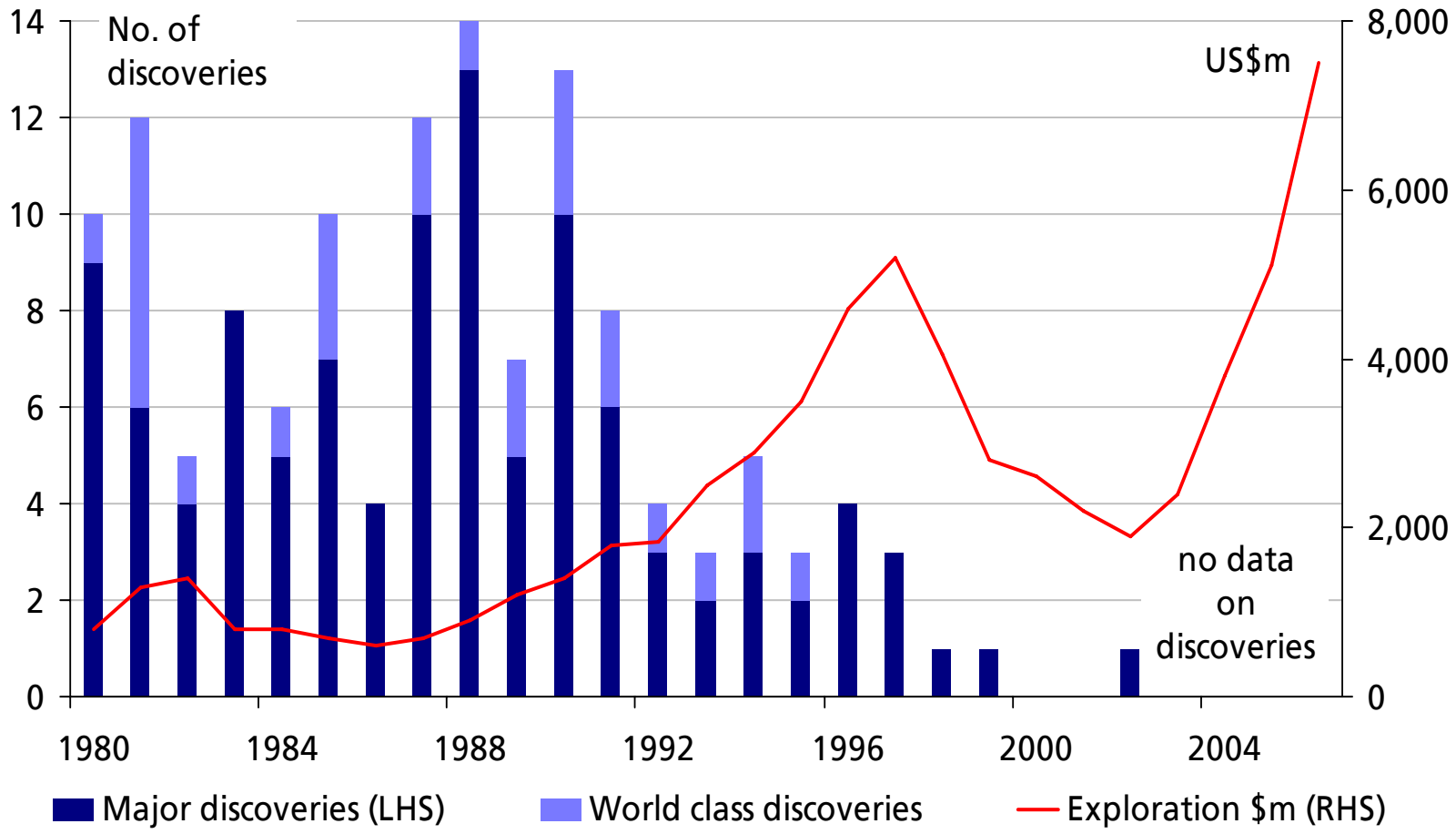
Less exploration; fewer discoveries



Source: MEG, UBS estimates

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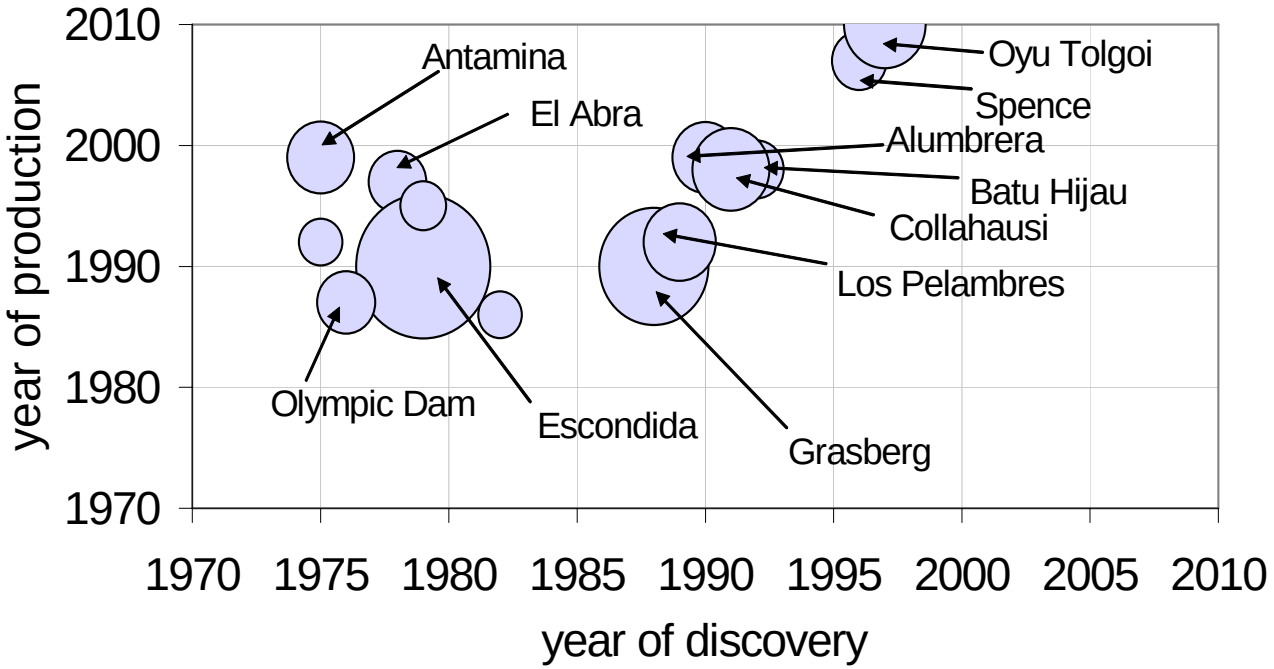
Paucity of new copper projects

Copper mine by discovery and production year



Source: MEG, UBS estimates

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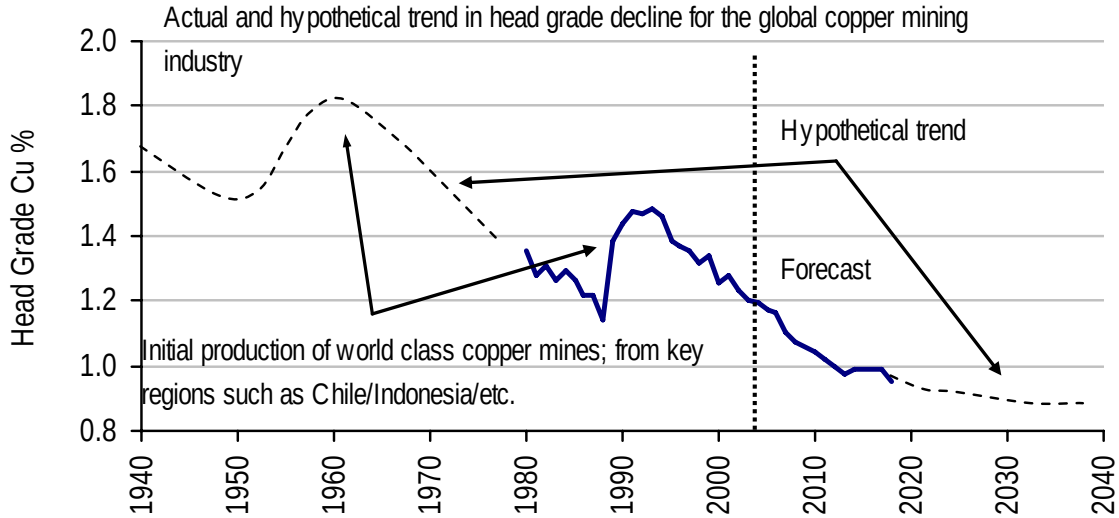
Resource quality falling – grades lower, mines deeper/remote

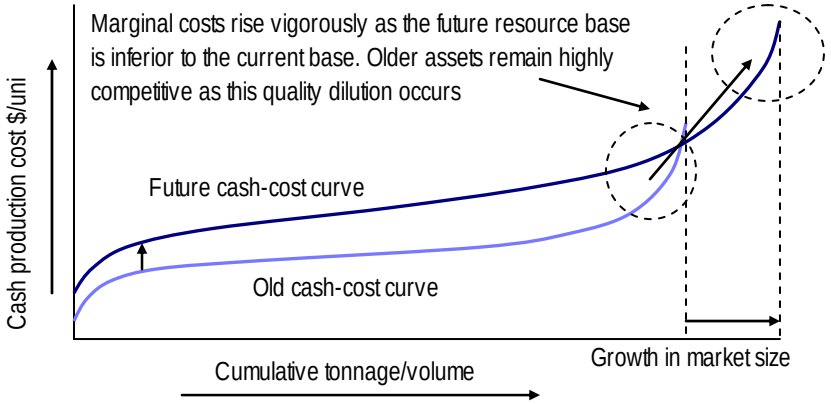
- Grades for most mined materials are falling; copper, iron ore, gold
- Mines are becoming more geologically challenging; deeper, underground, etc.
- Future mines are likely to be located in remote, higher risk areas; Congo/Russia
- Quality issues will result in rising costs; marginal cost are likely to become an increasingly important component in determining longer-term commodity prices



Source: Brook Hunt, UBS estimates

Resource quality falling – grades lower, mines deeper/remote

- Trend towards a decline in global reserves over the past 30 years
- Both quality and quantity of supply being impacted



- Potentially very significant longer-term impact on resource industries
- Dilution of quality impacts marginal cost; supports longer-term increase in pricing

Source: USGS, Brook Hunt, UBS estimates

Long-term prices: Structural pricing

Forecasting the structural price environment 2010 - 2016

		07E	08E	09E	Structural*	Long-term	Structural vs. LT
Aluminium	USc/lb.	128	140	105	145	90	61%
Copper	USc/lb.	324	300	190	225	130	73%
Nickel	USc/lb.	1765	1150	900	700	700	0%
Zinc	USc/lb.	159	150	100	80	60	33%
Lead	USc/lb.	102	100	65	60	27	122%
Iron ore	USc/ltu	80	101	111	51	45	13%
Coking coal	US$/t	95	115	100	68	60	13%
Platinum	US$/oz	1250	1350	1250	1200	800	50%
Thermal coal	US$/t	56	70	75	45	40	13%
Uranium	US$/lb.	127	196	150	50	27	85%

- Acceptance that industrialisation/urbanisation trends are long-lived
- Parallels with previous structural cycles

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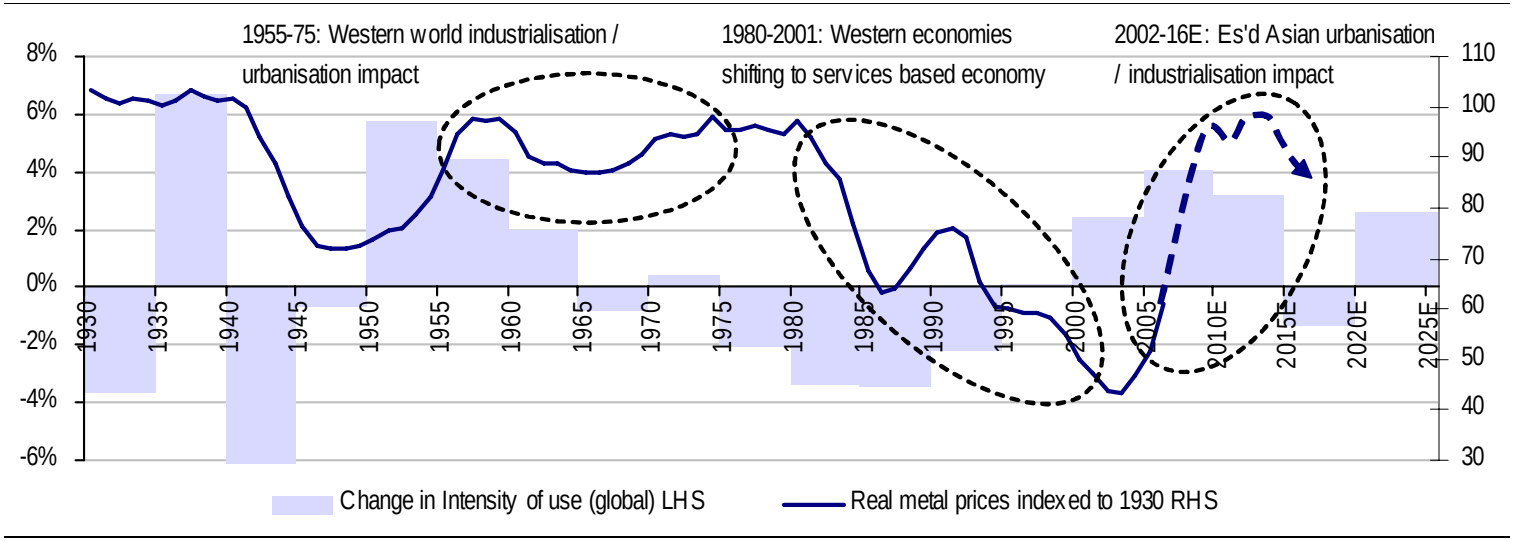
Long-term prices: Structural pricing (2)

Global intensity of use in base metals and price patterns in real terms (from 1930)



Source: UN, UBS estimates

- UBS now looking for a 15-year heightened price environment
- Strong pricing follows a 20-year period of real declines

Long-term pricing - quantification

Calculations for incentive pricing

Commodity	Units	Capital cost	Required return	Depreciation	Cash cost	Calc'd incentive price	Old long-term price	New long-term price
Aluminium	US$/t	3,750	450	188	1,316	1,953	1,500 (USc68/lb.)	2,000 (USc90/lb.)
Copper	US$/t	5,145	772	343	1,676	2,790	2,100 (USc94/lb.)	2,900 (USc130/lb.)
Nickel	US$/t	35,222	5,283	1,761	7,937	14,981	9,900 (USc450/lb.)	15,500 (USc700/lb.)
Zinc	US$/t	1,870	281	125	882	1,287	1,150 (USc52/lb.)	1,300 (USc60/lb.)
Gold	US$/oz	814	122	54	265	441	340	440
Platinum	US$/oz	1,352	264	90	443	797	490	800
Iron ore	US$/t	65	10	3	15	28	21	28
Thermal coal	US$/t	70	11	5	25	40	40	40
Coking coal	US$/t	58	9	4	45	58	60	60

Source: Brook Hunt, AME, UBS estimates

- Upside risks still exist for many commodities on long-term pricing
- Is incentive the appropriate methodology or is marginal cost superior?

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Conclusions

- Commodities are an attractive source of return and portfolio diversifier
- Long/short strategies reflect the shape of the forward curve
- Structural supply/demand issues in copper market contributing to price volatility which is being exacerbated by financial investors
- Financial investors affect short-term price cycles but have no impact on long-term prices
- Price volatility to remain a marked feature – demands more risk management products (hedging)
- Long-term price assumptions have been raised with structural pricing used for 2010 - 2016

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