Citi GPS

# INVESTMENT THEMES IN 2016

## New Normal or No Normal

**Citi GPS: Global Perspectives & Solutions**

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# INVESTMENT THEMES IN 2016

## New Normal or No Normal

**Kathleen Boyle**
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We are pleased to present our investment themes for 2016, and we wish all readers of our Citi GPS series successful investing in the year ahead. A tradition at the beginning of each year is to make a New Year's resolution — a vow to change something for the coming year in an act of self-improvement — be it eat less, exercise more, worry less, or save more. Inevitably, these resolutions either get forgotten or fail within the first 30 days, but the purpose is to try and take control of one portion of your world and essentially bring things back to normal.

Since the Great Financial Crisis, central banks have been making resolutions at least once a year in the hopes of effecting change that will positively drive economic growth back to 'normal' levels. Interest rates have been lowered, inflation targets have been set, and fiscal belts have been tightened, yet global economic growth has remained stubbornly sluggish at below 'normal' levels.

What if the problem is that there's just too much to change? Perhaps we have just hit a new normal or maybe the concept of normal just does not exist anymore. In general, most advanced economies are maintaining extraordinarily loose monetary policy, but some are now even allowing negative nominal policy interest rates, a tool that had been used very rarely in the past but is now being embraced by four European countries. The US Fed is bucking the easing trend and is starting to creep interest rates forward, but at a rate that is far different from any other hiking cycle. Emerging markets are facing conditions where all three main sources of GDP growth — exports, public and private domestic spending — are constrained, and China could either be a positive investment shock for EMs or the single-largest risk to global growth. Commodity markets remain volatile as investors grapple with conflicting signals of whether and how rapidly supply/demand fundamentals are shifting to normal balance.

Sluggish economic growth has led to the emergence of new socio-economic risks, including a lack of trust in elites, growing income inequality, and widespread youth unemployment. The convergence of these new risks with older geopolitical risks could lead to an increase in events like mass protests and government collapse becoming systemic instead of episodically disruptive, thereby undermining globalization. Migration, either due to civil wars and failed states or people moving for economic and social reasons, is on the rise or could be destabilizing, particularly in Europe. Although the economic drivers of migration — rising prosperity in low-income countries plus large income disparities between countries — will remain intact, we doubt that migration is likely to provide the cure for the low potential growth rates and sluggish actual growth rates seen in many advanced economies.

But not all change is worrisome. In this report, we also look at some areas where we see change as a positive, particularly through technology. We believe, for example, that the development of virtual and augmented reality will create a major new market that could replace the smartphone market and develop into an overall $600 billion opportunity by 2025 while the increase in adoption of electric vehicles and technology advances in grid-scale battery storage are both positives for lithium-ion batteries. We see big data increasingly becoming a tool in investment management, which could enhance quantitative fundamental models such that the line is blurred between quantitative and discretionary fundamental trading. Finally, we look at the importance of blockchain and its potential for being a disruptor in the banking industry.

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The Fed began the process of policy rate normalization by raising the Fed Funds Target rate in December — the first hike since July 2006. In addition, average headline inflation in the advanced economies looks set for the first annual increase since 2011, while we forecast emerging market (EM) growth to pick up (modestly) in 2016 for the first time since 2010.

However, we think that those hoping for a return to a 'normal' world of robust growth, positive real interest rates, inflation close to central bank targets and normalizing monetary policy are likely to be disappointed. Global growth — which we expect to come in at 2.6% in 2015 at market exchange rates and based on official statistics — is probably below 2½% and at its lowest level since 2009, once we adjust for 'true' Chinese growth. Furthermore, we think there is little prospect of a major pickup of global growth in 2016 and there are material risks of a global recession (defined as a negative global output gap and a growth rate of global output below its potential growth rate).

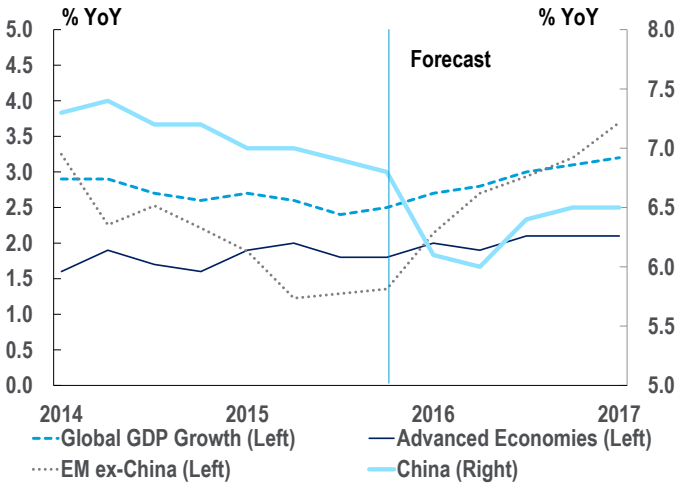
EM's are in dire need of a new growth model

Weak growth — and risks of a further slowdown — are mainly EM-centered and we think that the drivers of weak growth in EMs are at least in part structural. Many EMs are in dire need of a new growth model.

We expect long standing trends of low inflation and extraordinarily easy monetary policy in AEs to persist

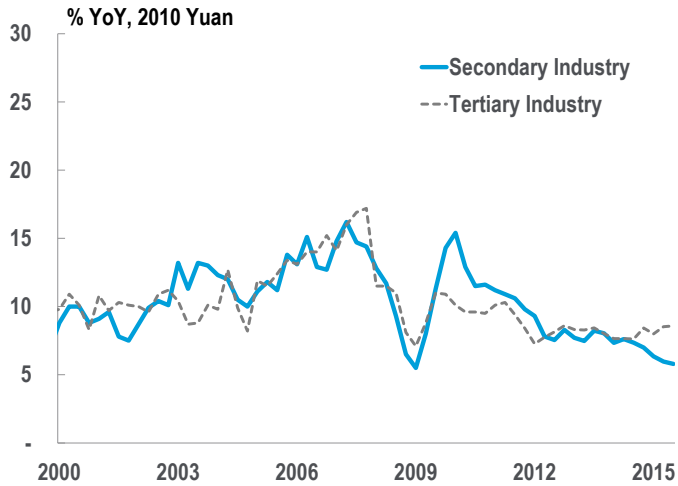
Growth in most advanced economies (AE) seems relatively robust in comparison. Nevertheless, we expect the two long-standing trends of low inflation and extraordinarily easy monetary policy in AEs to persist. Even though the domestic drags on activity and inflation are diminishing, domestic inflationary pressure remains weak and external disinflationary pressure (through weak external demand from EMs, continued weakness in commodity prices and in some AEs — notably the US and the UK — currency appreciation) is generally rising, capping the prospects for a sustained rise in AE inflation or policy rates.

**Figure 1. Another Year of Slow Global Growth, Despite a Pick-Up in EM Ex-China**




Source: Citi Research

**Figure 2. Is China Rebalancing or Simply Slowing?**




Source: CEIC, Citi Research

## Another Year of Sluggish Global Growth

We expect global growth to be 2.8% in 2016, only slightly higher than our 2015 forecast of 2.6% growth

We expect global growth (at market exchange rates and based on official statistics) to be 2.8% in 2016, slightly above the 2.6% growth we expect for 2015 and similar to growth in previous years. Adjusted for 'true' Chinese growth (which we estimate at 4-5% in 2015 and 2016), global growth in 2016 would be around 2.5% (and 2.3% in 2015). According to our forecasts, 2016 will be another year of slow growth in EMs, with growth at 4.0% (on the official numbers), compared to the 2001-08 average of 6.1% per year and the 2009-14 average of 4.9% per year. In the advanced economies, we expect growth to be a tick higher in 2016 than in 2015 (at 2% vs 1.9%) and not much short of the 2001-07 average of 2.2% per year.

Our best guess of global potential growth is around 3% at market exchange rates, implying that the global output gap, likely already negative in view of the persistent global disinflationary pressures, will be rising again (in absolute value) during 2016.

## EM Weakness is Here to Stay

We expect a modest pickup in EM growth but most is due to mean reversion from countries that faced serious slowdowns in 2015

With our latest point forecast for 2015 growth in EMs at a mere 3.5%, our forecast for EM growth in 2016 (4.0%) implies that we expect EM growth to be higher in 2016 than in 2015. However, there is little to cheer about. The modest pickup in activity forecast for 2016 mainly reflects our expectation that a number of countries that faced a serious slowdown in activity during 2015 will likely stabilize or, in some cases, mean-revert. For instance, in Russia we expect growth to be 0.5% in 2016, after a 3.7% contraction in 2015, while in Brazil we expect a 2.2% contraction in 2016 following a 3.2% contraction in 2015.[1]

For most EM countries, we expect similar to lower growth in 2016 due to a continued challenging growth environment

For most other EM countries we expect similar or lower growth in 2016 than in 2015. This is because the growth environment for EMs remains very challenging. This is true in the near term where it reflects the slowdown in EM exports, a lower capacity to leverage up and, for commodity exporters, a major adverse shock to the terms of trade. It is, however, equally true for structural reasons. We believe that the growth model for many EMs is 'broken'. One way to characterize the strong growth of many EMs over the last two decades is that they followed one of three fundamental growth strategies: (1) the (manufacturing) export-led growth approach (usually dubbed the 'Asian Tiger' approach); (2) the commodities export model (with China as the major growth engine and driver of the commodity super cycle); and (3) growth driven by (economic and institutional) integration with the EU or the US. All three growth strategies face serious challenges.

## The China Factor

Chinese economic growth slowed significantly during 2015

Even though there is significant uncertainty about the data, there is little doubt that the Chinese economy has slowed significantly during 2015. Our best guess places true Chinese growth currently at 4-5%. Some estimates are even lower (e.g. the Conference Board estimates growth at 3.7% year-over-year in 2015) while other proxies put true growth at higher rates (anywhere from 5-6.5% year-over-year).

[1] The most striking contrasts take place in Ukraine where the estimated -12.7% is forecasted to be followed by a 13.8% expansion, or in Venezuela, where a 9.5% contraction is followed by the slightly more moderate -5.6% according to our projections.

Chinese growth forecasts reflect some degree of rebalancing in the economy

Virtually all estimates of Chinese growth, including ours, reflect some degree of rebalancing in the economy. Many 'old sectors' face significant difficulties (excess capacity, excessive leverage, loss of competitiveness, etc.) leading the primary and secondary sectors to a sharp slowdown. Meanwhile, services have probably continued to grow at a relatively healthy pace (although real output in this sector is particularly poorly measured).

Policy could help boost prospects for a cyclical recovery in Chinese activity, but we see little prospect of major policy easing in 2016

A key question is how resilient the service sector can be. Given the large size of the struggling 'old' sectors, spillovers to the rest of the economy are likely to be significant (the historical beta between growth in the Secondary and Tertiary sectors is 0.9, see Figure 2). At least historically, it would be highly unusual for growth in the service sectors to accelerate seamlessly and spontaneously while the cyclical sectors (manufacturing, extractive industries) are slowing down. For the service sectors to be able to compensate for slower industrial growth (and for consumption and net exports to compensate for stalling investment), a significant policy stimulus to aggregate demand is required. Policy space (including through fiscal easing, further monetary easing or weakening the exchange rate) probably exists and, if used, could help boost prospects for a cyclical recovery in Chinese activity. But we see little prospect of major policy easing in China in 2016.

We believe the risk of a further slowdown in Chinese growth is higher than the likelihood of a similarly-sized recovery

Our concern that China is at risk of a further slowdown is based on a number of observations. The first is the modest and poorly directed policy responses thus far, and the risk of further policy mistakes. The second concerns the size of the imbalances in the Chinese economy, including a highly-leveraged corporate sector, a financially crippled local government sector and a banking sector with vulnerable balance sheets due to its large exposures to the post-2008 Chinese investment binge led by the local authorities and the state-owned enterprises (SOEs). The third is the fact that fixed investment still accounts for nearly 45% of GDP — an unsustainable level. We therefore think that the risk of a further slowdown in Chinese growth is higher than the likelihood of a similarly-sized recovery. And, even a recovery in activity may not be quite the boon for commodity exporters and manufacturing supply chain denizens that previously counted on a voracious Chinese import demand: rebalancing in China means growth is now less commodity- and import-intensive; in addition a (cyclically) weak level of Chinese domestic demand may push Chinese firms to gain export market share.

## The New Normal for Commodity Prices

We expect commodity prices to remain low in 2016

Low growth and rebalancing in China are clearly bearish for commodity prices. On the whole, we expect commodity prices to remain low in 2016 with average Brent oil prices to be slightly below 2015 levels. Low oil prices will therefore continue to be a concentrated negative force for oil exporting countries — hence the sharp downturn in Saudi Arabia, Venezuela, Nigeria and Russia, amongst others. Oil importers (including China and India as well as a large number of advanced economies including the Eurozone and Japan) and notably consumers should benefit, but the boost to consumption from low oil prices has underwhelmed almost everywhere. In contrast with pre-financial crisis behavior, households in most advanced economies are now saving part of the windfalls they get.

## Weak World Trade

Export growth in EMs hasn't recovered despite modest recovery in AEs and an upturn in nationalist and regionalist sentiment has decreased economic integration

Despite the modest recovery in AEs, EM exports are not benefitting much. In 2014-15, AE import growth has recovered somewhat, yet EM export growth has not picked up significantly. The major exchange rate depreciations experienced by many EMs over the last two years may have compressed import demand, but have so far failed to stimulate activity in EMs. With world trade languishing, counting on export growth to AEs seems like a forlorn hope.

Meanwhile, even though the Eurozone is growing and closing the output gap, recent history (the global financial crisis, euro-periphery crisis and the resulting long recession) has lowered popular support for European economic integration, and damaged the legitimacy of the EU political arrangements and institutions. Poor performance, the challenges posed by the refugee crisis and the fear and uncertainty created by the 'war with ISIS' have reinforced a rising tide of anti-establishment, nationalist, regionalist, populist and nativist sentiment. The road via Brexit to a disintegration of the EU is not the most likely one to be traveled, in our view, but it represents more than a tail risk.

## Is AE Low-Flation Going to End?

Low inflation in AEs isn't going away anytime soon

Briefly put: not anytime soon. Core inflation (consumer price index (CPI)-ex food and energy) has been below 2% on average in OECD countries since 2009, while headline CPI inflation in the advanced economies has been below 2% since 2009 (except in 2012), according to data from the International Monetary Fund (IMF). Indeed, core inflation is around one percentage point or more below the central bank's inflation target in a range of economies, including the Eurozone and Japan, but also China. Headline and core inflation remain very low in the Eurozone and Japan, despite their large recent currency depreciations.

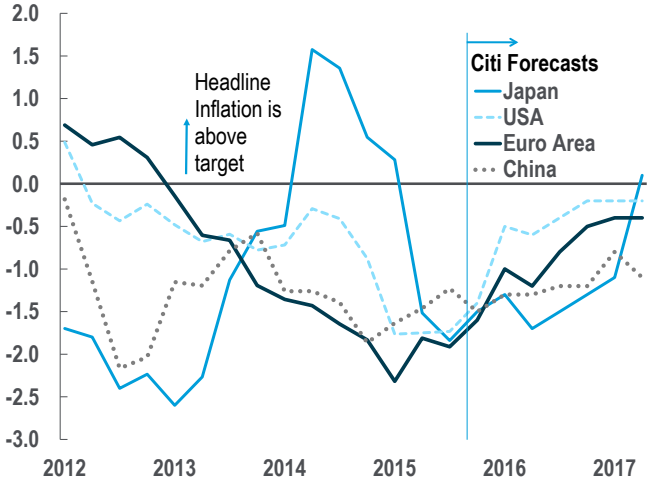
Combined with short-term drivers like the decline in energy prices and import prices, the size of the output gap continues to be an important determinant of low-flation

How persistent should we expect low-flation to be? The answer given by Fed Chairman Janet Yellen recently seems to be 'not very persistent.' This view is based on an exercise she carried out for the US — and which we have extended to the euro area and Japan. Her results suggest that the inflation undershoot in the US in 2015 was mostly driven by temporary factors, such as the decline in energy prices and import prices.[2] Factors that had the potential to generate a more persistent downward drag on inflation, such as the size of the output gap and inflation expectations, also played a role in her results, though the magnitude of economic slack she estimated was quickly declining. In our estimates, the output gap remains a more important determinant of low-flation and, while declining, it is likely to continue to be a force throughout 2016 and even 2017.[3]

[2] The approach is based on a simple bivariate model decomposing headline inflation into core and food & energy. Core inflation is regressed on long-term inflation expectations, economic slack and imported prices and the obtained sensitivities and the observed values for the regressors are used to decompose the deviation of headline inflation from the target. We emulate Yellen's approach though we modify the definition of slack, utilizing the output gap calculated by the OECD (to have a more comparable metric across countries) rather than the distance of unemployment for an estimated non-accelerating inflation rate of unemployment (NAIRU).

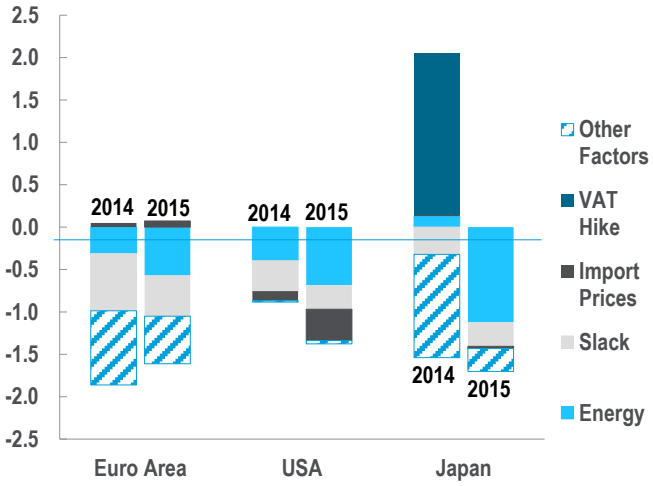
[3] We predict US real GDP growth to be 2.5% in 2016 and 2017, and estimate the growth rate of US potential output to be 1.5% in both years. The current output gap is just over -2% in absolute value.

**Figure 3. Inflation Below Target, A Long Standing Phenomena**
Headline inflation, percentage point deviation from target




Source: Citi Research

**Figure 4. Decomposition of Factors Driving Inflation**
Percentage point contribution to deviation from inflation target




Source: Citi Research

Wage pressure in AEs has been slow to build despite falling unemployment

The recent experience in a number of countries, including the US and the UK, where unemployment has been falling consistently, is that wage pressure has been slow to build up, a result consistent with a relatively flat Phillips curve or a downward shift in the Phillips curve (and hence with a lower-than-expected natural unemployment rate or output gap).[4] Therefore, even if the pace of closure of output gaps were to rise (or if gaps were narrower) it is likely that inflationary pressures would be fairly slow to rise.

We expect inflation to remain considerably below target in most AEs

Year-over-year inflation will mechanically increase (through 'base effects') in 2016 across the advanced economies, though it is likely to remain considerably below target in most AEs. Oil prices fell sharply in 2014-15 and are unlikely to fall by the same (percentage) margin in 2016 and beyond. Nevertheless, our Commodities colleagues suggest that there is little prospect for sustained increases in oil prices, given ongoing supply increases and tepid demand growth at best. Furthermore, even if oil prices increase at a faster pace than expected, their effect on inflation is likely to be relatively moderate: we estimate that an increase in energy prices can lead to a spike in quarterly inflation but that it dissipates rapidly and, after three quarters, is barely noticeable.

The effect of the exchange rate movements is also unlikely to continue at the same pace as over the previous year. Yet, weakness in emerging markets is likely to keep external demand weak and AE currencies strong (though to varying degrees, with the US dollar leading the appreciators), except during periods of large monetary interventions.

Low inflation is not exclusively an AE phenomenon. In China, the producer price index (PPI) continues to fall sharply. Core CPI inflation was 1.5% year-over-year in October, roughly on a par with headline inflation at 1.3%. This is because energy inflation has shown remarkable stability in China as only a small fraction of the lower oil prices has been passed through to consumers. Precisely because there was less downward pressure from energy prices this year, we anticipate that any

[4] A third possible explanation is declining inflation expectations, perhaps driven by low and/or falling headline inflation driven by falling commodity prices and an appreciating US dollar exchange rate.

pick-up in oil prices next year is unlikely to boost inflation significantly: the pass-through to consumer prices will again be muted. With growth slowing and the output gap becoming more negative, we anticipate that core and headline inflation will decline further in China, absent a more effective policy response than we consider likely. Barring an effective fiscal stimulus (say 3% of GDP for a year, mainly targeted at public and private consumption, funded by the central government and monetized by the People's Bank of China), China may well be the first large emerging market where the central bank encounters the zero lower bound.

## No Room for Much Monetary Policy Divergence

The Fed's rate hike in contrast to the European Central Bank's (ECB's) and Bank of Japan's (BoJ's) more likely easing reinvigorate the debate about monetary policy divergence. In our view, continued extraordinarily easy monetary policy remains a more dominant theme than monetary policy divergence.

Expect the Fed to remain cautious in this hiking cycle

**The Fed is likely to remain very cautious.** We expect the Fed to raise interest rates only very gradually. We expect the Federal Funds Target rate to rise by only 75 basis points to 1.0% by end-2016 and 50 basis points further to 1.5% by end-2017. By contrast, in the last three Fed hiking cycles, policy rates rose by 200 basis points in the first year alone, with the trough-to-peak difference in the post-1971 cyclical recovery typically around 500 basis points, with a similar magnitude peak-to-trough Federal Funds target rate. The very likely gradualist approach by the Fed is based on three main considerations. First, even though unemployment in the US has fallen steadily, domestic inflationary pressures remain weak. Second, the external environment if also not conducive to a normal Fed hiking cycle. Third, the fact that the Fed is in some respects embarking on its hiking cycle in unchartered territory will likely reinforce its caution: at $4.5 trillion, the Fed's balance sheet size (and the level of bank reserves) are at multiples of the levels that prevailed when the Fed hiked rates in previous cycles.

Monetary policy is expected to remain loose for most AEs

**Still lower for longer for most AE central banks.** In general, monetary policy is likely to remain extraordinarily loose for most AEs. Indeed, with inflation low and below target almost everywhere, activity mostly weak and fiscal policy mostly stuck (even though less of a headwind than in previous years), we expect additional monetary easing in a number of countries. In the Eurozone, we expect an extension and expansion of the ECB's asset purchase program as well as a cut in the Discount Rate (and eventually in the refi rate) and the Lending Rate, as inflation continues to undershoot the target. In Japan, we also anticipate an expansion of the BoJ's quantitative easing (QE) program, probably early in 2016. Other advanced economies where we expect further monetary policy easing include Australia, Israel, New Zealand, Sweden, Norway and Switzerland. China will also likely continue to ease monetary policy to contain its ongoing slowdown.

**Other Emerging Markets face a more tightly constrained set of choices.** In a few countries, central banks maintain their ability to conduct counter-cyclical policies as they face low growth and low inflation (e.g. Korea, Poland and even Indonesia). Others are increasingly pushed towards pro-cyclical policies as inflation has risen because of weakness in the external value of the currency. Inflation targeting over a medium-term horizon would normally require letting the exchange rate perform its adjustment while keeping rates unchanged, if expectations remain well anchored. However, the problem in many EMs is that inflation and exchange rate depreciation expectations have started drifting up, forcing central banks to tighten policies (recently Chile, Colombia and South Africa moved in this direction).

## Fiscal Headwinds are Easing in AEs

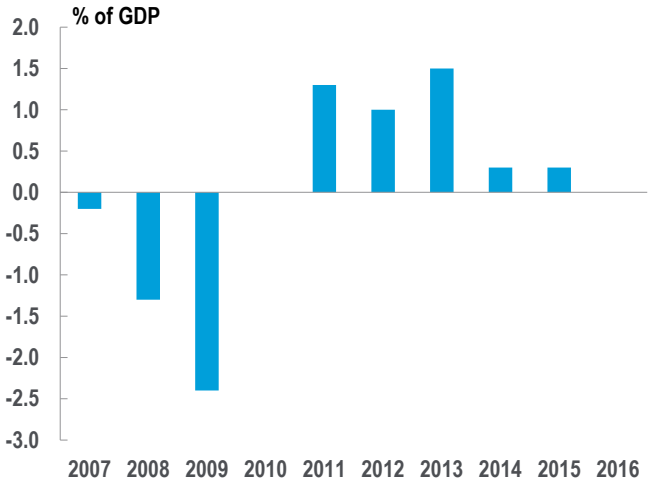
Fiscal policies in AEs should be roughly neutral in 2016…

Fiscal headwinds in the AEs are easing as pro-cyclical fiscal policies have turned close-to-neutral this year and should be roughly neutral (or even mildly counter-cyclical) in 2016. The OECD predicts that 2016 will be the first year since 2010 when the change in the cyclically-adjusted primary general government balance (CAPB, one measure of fiscal tightening) will be zero for the OECD as a whole. With modest easing in the euro area, a neutral stance by the US and tightening planned in the UK and Japan. In 2011-15, the average increase in the CAPB was 0.9% of GDP, with major tightening in the UK in 2010-11, in the euro area in 2011-13, in the US in 2013 and in Japan in 2014. The large degree of fiscal austerity in AEs in recent years was probably one important source of disinflationary pressure — one that is now fast receding.

…driven by higher spending on refugees in Europe and the arrival of less fiscally-conservative governments plus deliberate attempts to loosen policy and lack of pressure for austerity from public markets

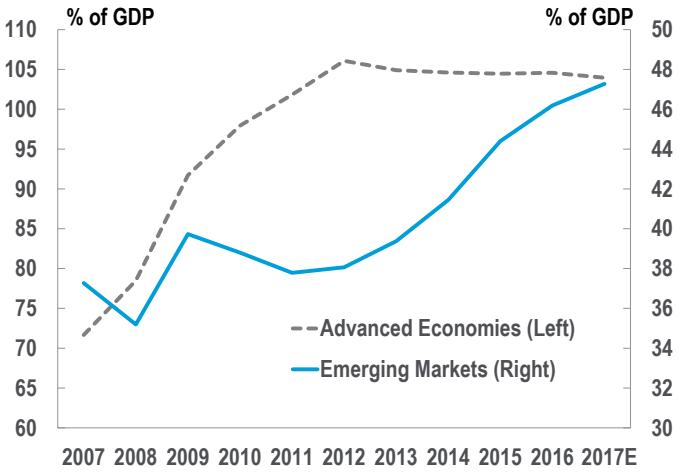
There are various reasons why fiscal policy in AEs is gradually getting less tight, including higher spending on refugees (and probably defense and security more generally) in Europe, the arrival of some less fiscally-conservative governments (e.g. in Canada, Portugal and Poland), deliberate attempts to loosen policy to safeguard popular support (e.g. in Italy and Spain) and the lack of pressure from financial markets to reduce budget deficits further. If anything, it is possible, in our view, that AE fiscal policy in 2016 will turn out slightly looser than currently predicted.

**Figure 5. AE – Change in Cyclically – Adjusted Primary Balance (% of GDP, 2007-16E)**




Note: Positive figures denote tightening, negative figures denote loosening.
Source: OECD, Citi Research

**Figure 6. World: General Government Gross Debt (% of GDP, 2007-17E)**




Note: 2017E = IMF Forecasts
Source: IMF, Citi Research

## Fiscal Policy is Slipping in the EMs; Balance Sheets are Weakening

In EM, however, after years of loosening, fiscal policy is gradually tightening

With moderate growth in the advanced economies, despite a modest fiscal easing, general government gross debt levels (relative to GDP) are likely to stabilize and slowly fall in coming years. By contrast, in EMs after years of modestly widening CAPBs, fiscal policy is gradually becoming less loose, on average, with a few exceptions (such as Indonesia). Over 2012-15, the average EM CAPB fell by cumulatively more than 1 percentage point of GDP, while it is likely to be unchanged on average in 2016. Rising interest rates and slow growth imply that the resulting rising public debt levels in EMs are increasingly public sector balance sheet vulnerabilities. According to the IMF, the average gross general government debt in EMs is likely to reach 48% of GDP in 2017, an increase of 10 points since 2011. Of course, average debt levels are much higher and have risen much faster in AEs — in 2015 average AE public debt is estimated to be 104% of GDP, up from 72% of GDP. Given the downside risks to growth in EMs and the large buildup of EM private sector debt in recent years — which has a habit of partially transitioning to public sector balance sheets during downturns — we suspect that public debt levels in EMs could rise faster than current projections imply.

Rising government debt is likely to result in a downward trend in sovereign and private sector ratings and a higher cost of funding

Although we do not anticipate a material imminent EM debt crisis, EMs are likely to face a downward trend in sovereign and private sector ratings and a higher cost of funding. Perhaps the most serious consequence, for now, of weaker sovereign balance sheets is the risk of potential downgrades and the loss of investment grade ratings for a number of EM sovereigns. The process started with Russia; now Brazil is on a tightrope and South Africa and Turkey might follow. A loss of investment grade has large discrete impacts on countries and could result in long-lasting increases in funding costs. In turn, this may lead to a reduction in long-term growth rates.

## What if China Sneezes? An Adverse Scenario

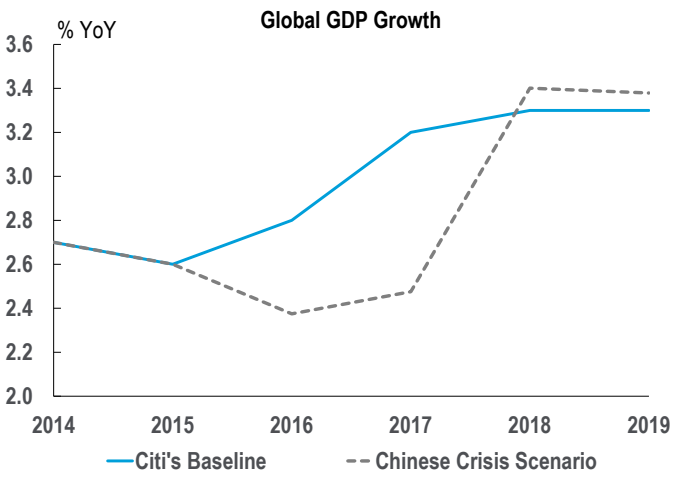
The single largest risk to global growth is that activity in China slows sharply

In our view, the single largest risk to global growth is that activity in China slows more sharply than we currently predict and takes the world with it. Here, we consider an adverse scenario for global growth, simulated using the Oxford Economic Forecasting model centered around a shock to domestic demand in China.

We model a scenario for global growth based on a number of shocks that would plausibly cause a downturn in China

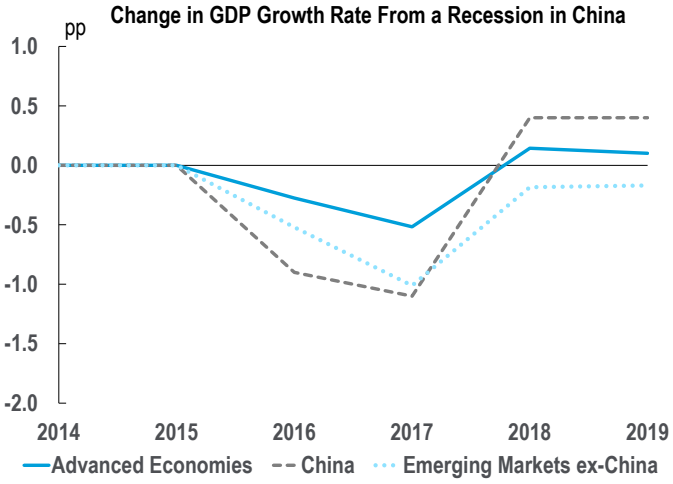
We model our scenario of a further China slowdown as a combination of autonomous forces that shape a set of domestic and external policy responses that we consider plausible under a ‘China downturn’. The shocks include: (1) a 1 percentage point lower domestic demand in China relative to our baseline over the course of 2015; (2) declines in house prices, (3) inward foreign direct investment (FDI) and stock prices in China as well as an increase in non-performing loans (NPLs), (4) a 5% renminbi (RMB) depreciation and a 2% depreciation of commodity prices (oil and metals); and (5) a shock to global business and consumer confidence, EM funding costs and to investment and commodity exports in Australia and Canada. The model then endogenously generates responses for most macroeconomic variables, including monetary policy based on historical sensitivities. The spillovers from the China shock go beyond those implied by direct trade channels.

Figure 7. Global GDP Growth, Baseline and the Impact of China Growth Recession




Source: Citi Research

Figure 8. Advanced Economies, China and Non-China EM Growth Derivations from Baseline (




Source: Citi Research

Under our adverse scenario, global growth would be 0.4ppts weaker vs. our baseline 2016 forecast and 0.7ppts weaker in 2017

Figure 7 presents the evolution of global growth (at market exchange rates) under the adverse scenario along with our baseline. The adverse scenario implies global growth would be 0.4 percentage points (ppts) weaker than our baseline in 2016 and 0.7 percentage points in 2017, enough to push the world economy into a recession according to our definition.[5]

Under this scenario, Chinese growth would be roughly 1 percentage point weaker in both 2016 and 2017 than in our baseline. But growth in EM ex-China would also be seriously impacted (by 0.5 percentage points in 2016 and 1% in 2017). Advanced economies would also not escape unscathed, with growth 0.5 percentage points lower in 2017 and a more most hit in 2016, despite additional monetary accommodation (or slower hiking) than in our baseline.

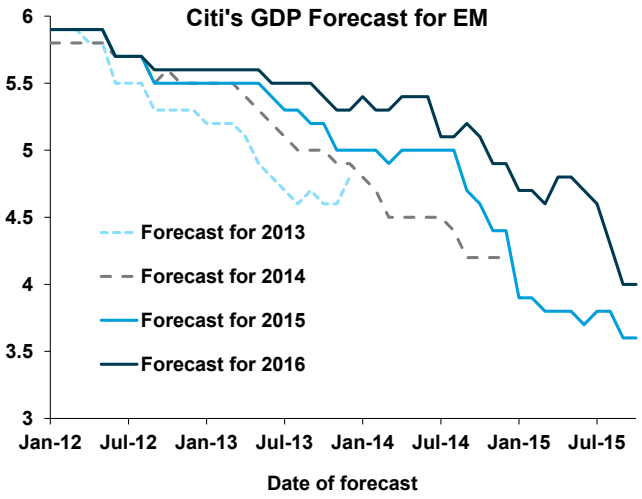
[5] Global real GDP growth at market exchange rates would be at 2.5%, below our estimate of around 3% for global potential real GDP growth. Our b est guess is that the global output gap is either negative already (hence the global disinflationary pressures) or close to balance currently).

# 2. China and Emerging Markets: Broken Growth Model?

**David Lubin**
Head of Emerging Markets Economics

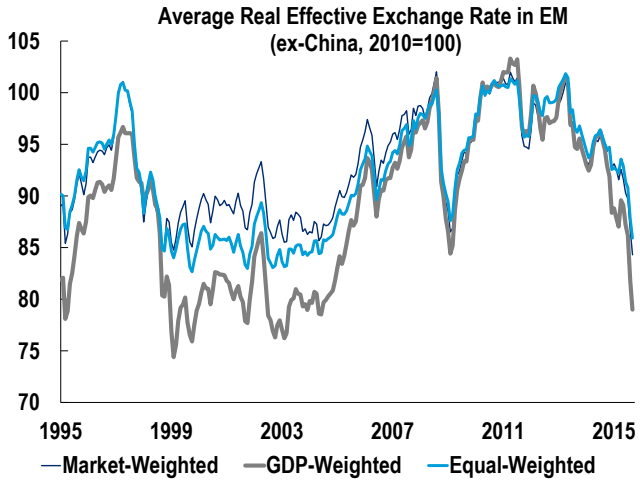
Emerging economies' growth prospects look damaged in several respects. The central fact facing emerging markets (EM) is the negative external shock that results from weak global trade growth and a collapse of Chinese import growth. This brings to an irreversible end the period of rapid, investment-led Chinese growth and strong global trade growth which had supplied EM with a once-in-a-generation positive external shock during the years between 2002 and 2013. All this helps to create a 'broken growth model' for many countries, because neither fiscal policy nor domestic credit policy can help to offset the negative external shock that they are facing. Fiscal policy is tight across EM because private capital markets seem quite intolerant of rising public debt levels in EM. Even in countries that are actively trying to loosen fiscal policy — Indonesia or Korea, for example — the loosening is quite modest. In addition, domestic credit conditions remain tight in many countries across EM, because many countries already have had a domestic 'credit boom', and this means that risk appetite is low in domestic credit markets across EM. So, all three main sources of GDP growth — exports, public and private domestic spending — are constrained. The persistence of this problem has led us, alongside many other forecasters, to underestimate the EM slowdown consistently over the past four years (see Figure 9).

**Figure 9. The EM Slowdown has Caused Us to Revise Down Our GDP Growth Forecasts in Almost Every Month Since Early 2012**




Source: Citi Research

**Figure 10. …And the Slowdown has Caused Real Exchange Rates to Fall to Extremely Weak Levels by Historical Standards**




Source: Citi Research. Countries included: Brazil, Chile, Colombia, Mexico, Peru, Hungary, Poland, Russia, South Africa, Turkey, Indonesia, Malaysia, Philippines, Thailand

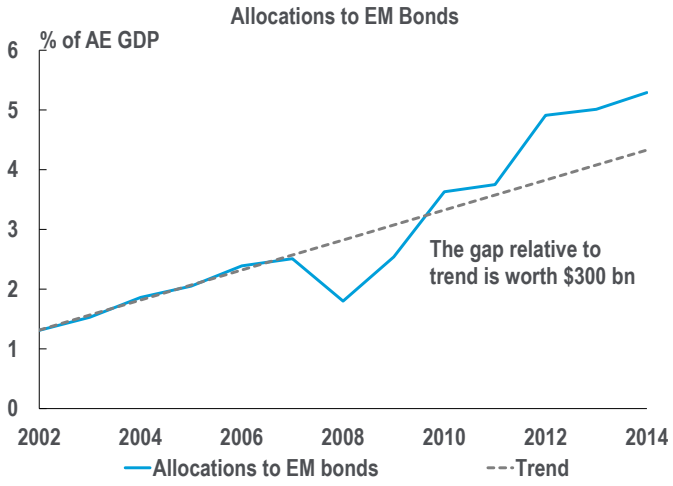
The EM crisis this time around has more diverse roots — it is a crisis of growth vs. a crisis of balance of payments

And plenty of financial vulnerabilities remain. One important difference between this crisis and previous ones in the 1980s and 1990s is that EM crises in the past were more or less entirely located in the balance of payments, while this crisis has more diverse roots: it is as much about a crisis of growth as it is about weakness in the balance of payments. But it is true that there are important balance of payments fragilities in EM. Some countries (e.g. South Africa) have stubborn current account deficits, and a number of countries — Brazil, Russia, Turkey, China, India, Indonesia — saw their corporate foreign exchange indebtedness rise sharply in recent years.

Two threats continue for EM — consequences from the lifting of US Fed rates and China

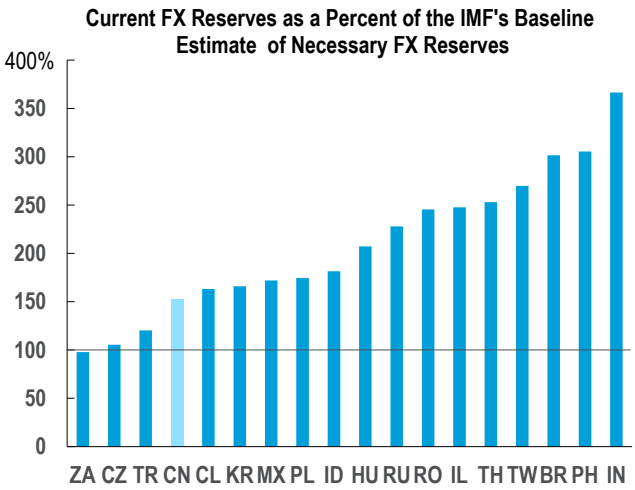
While EM currencies look exceptionally cheap by historical standards it is impossible to say that EM is 'out of the woods'. This is because of two remaining threats. One is the consequences of "Fed lift-off" and the other from China. Higher US rates do still threaten capital flows to EM, largely because some of the 'excess' inflow to EM in the past five years will have had cyclical characteristics, and could therefore be vulnerable as US rates rise. Figure 11 shows IMF data which suggest that inflows to EM bonds have risen from 3.6% of AE GDP in 2010 to 5.3% of GDP in 2014, and that there may be a $300 billion 'excess' inflow relative to trend. China too remains a risk for EM, either because of an accelerated slowdown, or because of the risk of continued capital outflows. China's stock of reserves may not be large enough to support heavy capital outflows (Figure 12), and if the renminbi (RMB) must weaken as a result — even in a controlled way — then risk appetites towards EM would be negatively affected: a weaker RMB constitutes a negative shock to EM competitiveness.

**Figure 11. Inflows to EM Bonds have Risen by More than the Trend Would Suggest, With Some $300bn of Inflows Possibly 'At Risk'**




Source: IMF, Citi Research

**Figure 12. We Think that China's Reserves Adequacy is Rather Low, Which Could Bias the PBOC Towards Further Currency Depreciation**




Note: In approximate terms, the IMF's model suggests that a country should have sufficient FX reserves to finance the sum of (1) 10% of exports; (2) 10% of portfolio liabilities; (3) 10% of M2; and (4) 30% of short-term external debt.
Source: Citi Research

We find EM currencies are undeniably cheap…which could be good for growth

In spite of these challenges it is possible to begin thinking about how growth in EM might recover. While EM currencies might well get cheaper, they are already undeniably cheap. And this fact could forge a possible path towards better growth outcomes in EM. There is a reasonable amount of evidence to suggest that cheap currencies can be good for growth.[6][7] Just as a strong currency can crowd out manufacturing capacity through 'Dutch disease', a weak currency can do the opposite. The IMF argues that a 10% depreciation of the real effective exchange rate (REER) implies on average a 1.5 percent of GDP increase in real net exports.[8]

[6] Dani Rodrick, "*The real exchange rate and economic growth*", Brookings Papers on Economic Activity, Fall 2008.
[7] Barry Eichengreen, *"The real exchange rate and economic growth*". UCB Manuscript, July 2007.
[8] IMF, "*Exchange rates and trade flows, disconnected?"*, WEO Chapter 3, October 2015.

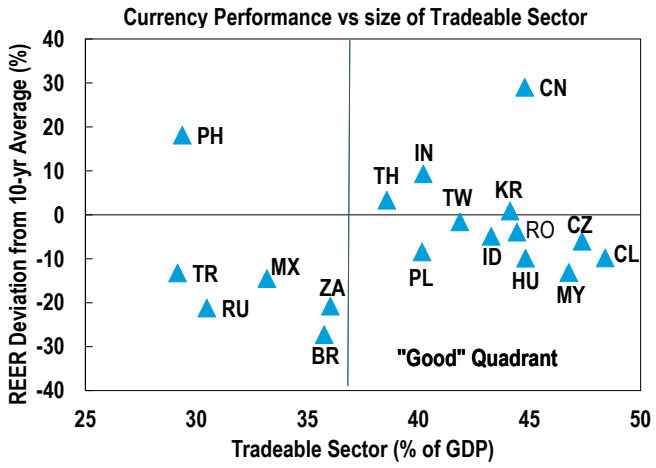
The existence of cheap currencies in EM might leave the door open to a recovery based on import-substitution

**It might not be an export-led recovery that results from having a cheap currency these days.** Consider two points. First, the value to country x of having a cheap currency might be relatively diminished these days because so many other countries also have cheap currencies. And second, the value to country x of having a cheap currency might be diminished because global import growth seems so weak. These factors make it difficult to be optimistic about an export-led recovery from EM. But the existence of cheap currencies in EM might leave the door open to a recovery based on import-substitution, which equally takes advantage of the fact that the tradeables sector of the economy gets a shot of competitiveness from a weak exchange rate.

Two conditions under which a depreciation of the exchange rate might support import-substituting economic recovery is the size of the depreciation and the size of the tradeables sector

Import-substitution could support growth in EM, and we think it will be worth watching for signs of this where currencies have weakened a lot. Actually we think there are two main conditions under which a depreciation of the exchange rate might support an import-substituting economic recovery: one is the size of the exchange rate's depreciation, and the other is the size of the tradeables sector (see Figure 13). But other factors will be important too, and chief of these is whether or not policymakers are doing what they can to enhance the investment climate. Unfortunately, there are rather few countries in EM these days where there is a wholehearted commitment to the structural reforms likely to improve business confidence. So whatever recovery might be available to EM through this route might well be a shallow one.

**Figure 13. Large Tradeables Sector Plus Weak FX — In the Bottom Right Quadrant — Could Lay the Ground for Import-Substituting Recovery**




Source: Citi Research

**Figure 14. Though Russia is Hoping that Protective Barriers Might Help Create the Conditions for an Import-Substituting Recovery**

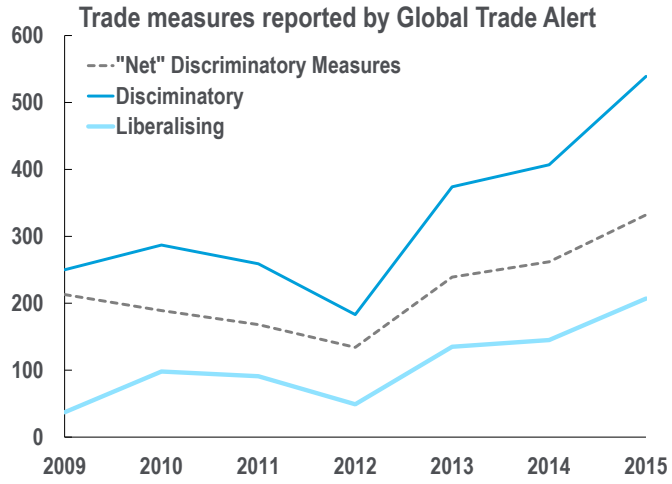

Source: Citi Research

The closest example to an import-substituting recovery is Russia

**Evidence of an import-substituting recovery is hard to find in EM just yet.** The country in which an import-substituting recovery is most frequently discussed (and hoped for) is Russia. One reason for this is that Russian policymakers have positively welcomed the exchange rate's depreciation as a way of giving life to a new growth model. But another reason is that Russia has relied on a time-honored ingredient to help support import-substitution: namely, protectionism, particularly in response to the sanctions Russia was faced with in the context of last year's crisis in Ukraine. A more recent example of this kind of policy is a decree which bans the purchase of foreign-made software by government institutions.

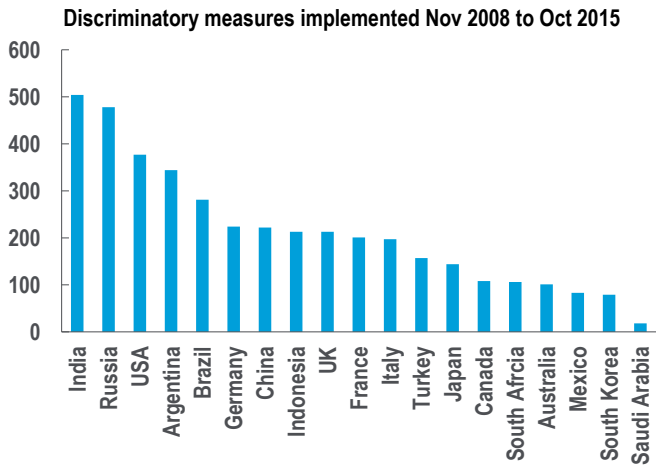
Protectionism seems to be on the rise, partly in an effort to create supportive buffers for domestic manufacturing. In Russia's case, the 2014 restrictions on food imports have often been referred to as a stimulus for import-substituting activity. But Russia is not the only country where protectionism seems to be on the rise, as Figure 15 and Figure 16 show. India has also, it seems, relied on more protectionist measures. A recent assessment[9] argues that protectionist measures – import restrictions for example, or home bias in awarding public procurement contracts – may have contributed to the global trade slowdown that's been evident since 2012.

**Figure 15. Protectionism Seems to have Risen Since 2012, Which Coincides With a Sharp Fall in Global Trade Growth**




Note: "Net" measures is simply 'discriminatory' minus 'liberalizing'.
Source: The 18th Global Trade Alert Report, by Simon Evenett and Johannes Fitz, Citi Research

**Figure 16. Large EMs are Among the Worst Offenders**




Source: The 18th Global Trade Alert Report, by Simon Evenett and Johannes Fitz, Citi Research

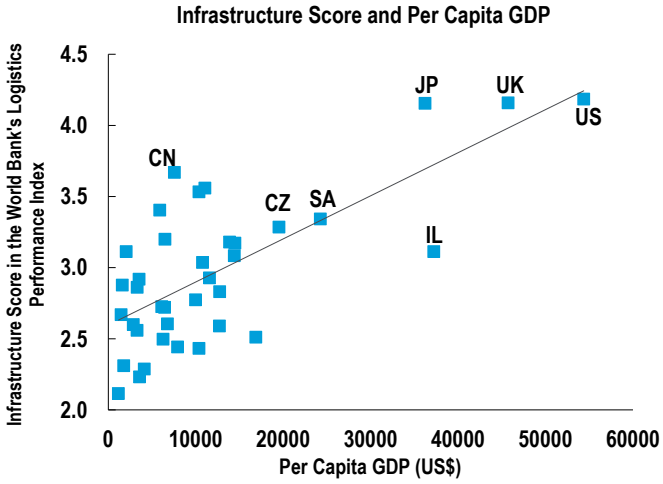
**Back to the future? Let's hope not.** If protectionism becomes more fashionable as a way to support import-substituting activity, there might be an unpleasant echo of the 1950s and 1960s, when Import-Substituting Industrialization (ISI) was an explicit development strategy. Then, faced with relatively stagnant demand for primary products, policymakers in Latin America introduced a range of measures to support import-substituting industrialization: protective tariffs; special preferences for firms importing capital goods for new industries; public efforts to build infrastructure required to support new industries. In the end, ISI was almost universally understood to have failed as a development strategy, as it paid little attention to different countries' comparative advantage, and because of the absence of any economies of scale: in the late 1960s, Latin America had 90 firms producing cars![10] So while it is very unlikely that a new growth strategy will be built on protectionism, there is a risk that it becomes a more visible part of the toolkit for EM policymakers.

[9] Simon Evenett and Johannes Fitz, "*The tide turns? Trade, protectionism and slowing global trade growth*", CEPR, November 2015.
[10] Werner Baer, "*Import Substitution and Industrialisation in Latin America: Experiences and Interpretations*", Latin America Research Review, 1972, Vol 7 No 1.

Infrastructure could provide an additional path towards recovery for EM

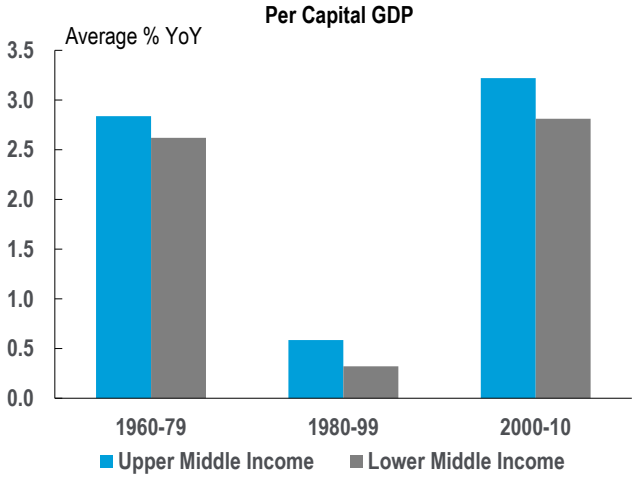
Infrastructure could provide an additional path towards recovery for EM. While import-substitution might provide some of the stimulus needed for a revival in EM's growth prospects, another might come from infrastructure. EM has a substantial deficiency of infrastructure, and it is also the case that EM public sector balance sheets are still, by historical standards, relatively robust. This is relevant because infrastructure spending tends to be a publicly funded endeavor. So, faced with a 'broken growth model', an argument is often made that EMs should increase spending on infrastructure, since that would have a 'super-Keynesian' effect,[11] releasing bottlenecks and, in the end, financing itself because of a positive effect on growth. In practice it's not easy to draw a firm conclusion about causation: just as infrastructure might 'cause' growth, growth also 'causes' infrastructure as, after all, demand for infrastructure is a function of income.[12] That said, there is clearly a renewed interest in infrastructure across EM, since it appears to be reasonably correlated with per capita GDP (Figure 17).

**Figure 17. Infrastructure is Attracting Renewed Interest Across EM, as It Could Provide a 'Super-Keynesian' Answer to the Growth Problem**




Source: World Bank, Citi Research

**Figure 18. Growth Rates in EM are Not Destined to Return to Those of the 2000s, When the External Environment Was Uniquely Favorable.**




Source: Angus Maddison, Citi Research

China could be a positive investment shock for EM due to availability of infrastructure financing and its OBOR strategy

China could be a positive investment shock for EM, even though it has clearly become a negative trade shock. The immediate obstacle in hoping for an infrastructure-led recovery in EM is the difficulty in answering the question: 'who will finance it?'. One of the constraints that EM faces these days is that private capital markets seem to have very little tolerance for increases in public debt levels across EM: that's one of the reasons, as we said earlier, why the 'growth model' is 'broken'. But one source of optimism about the availability of infrastructure financing is China, and the mechanism is One Belt, One Road (OBOR). OBOR is China's strategy to 'promote the connectivity' of a group of countries that are included in two separate initiatives announced by President Xi in 2013. One is the 'Silk Road Economic Belt' — aimed at facilitating trade across the Eurasian landmass that connects China with Europe — and its sister project is the '21st Century Maritime Silk Road'.

[11] Justin Lin, "*Beyond Keynesianism: Global Infrastructure Investments in Times of Crisis*", World Bank Policy Research Working Paper 5940.
[12] Stephane Straub, "Infrastructure and growth in developing countries: recent advances and research challenges", World Bank Policy Research Working Paper 4460.

In the past few months China has mobilized some hefty financial resources to support investments in infrastructure projects within OBOR. The most visible of these are Asian Infrastructure Investment Bank (AIIB), with an initial capital base of $100 billion (of which $40 billion comes from China) and the New Development Bank ('BRICS bank'), with initial capital of $50 billion (of which $20 billion comes from China). But there are others: a new Silk Road Fund with $40 billion to spend; a new subsidiary of China's sovereign wealth fund with a target of $100 billion; recapitalizations of China Development Bank and China Exim Bank, each close to $50 billion. Since OBOR has become such a central preoccupation of Beijing, there will undoubtedly be more to come, and this could have a multiplier effect: the Asian Development Bank, for example, seems to be more willing to expand its balance sheet, and the Japanese government has pledged to accelerate official development assistance (ODA) disbursements. And the London-based European Bank for Reconstruction and Development (EBRD) (to which China has applied to become a shareholder) has committed to exploring co-financing arrangements with the AIIB. Asia seems likely to benefit disproportionately from this trend.

Developing countries' growth rates are highly sensitive to the global external environment, which is forecast to be weaker over the next few years

While there are some visible paths towards an EM recovery, growth rates will be relatively low if the external environment is weak. One important observation, we think, is that developing countries' growth rates are — by definition? — highly sensitive to the global external environment that these countries are faced with. The external environment during the period from 2002 to 2013 was exceptionally favorable, given the persistence of rapid, investment-led growth in China and a strong average rate of global trade growth during this period. With a weaker external environment more likely in the next few years, growth expectations for EM should be adjusted accordingly. This point is captured to some extent in Figure 18, which shows EM growth rates through a broader sweep of history. The 1960s and 1970s were, like the 2000s, a period of strong gains in per capita GDP growth for middle-income developing countries. But each of these periods were characterized by a favorable external environment: the 1960s because of post-war reconstruction; the 1970s because of the new availability of external financing from commercial banks; and the 2000s because of China. Without a strong global environment, potential growth in EM will be relatively weak, even if import-substitution and infrastructure might help things along.

# 3. Negative Interest Rates

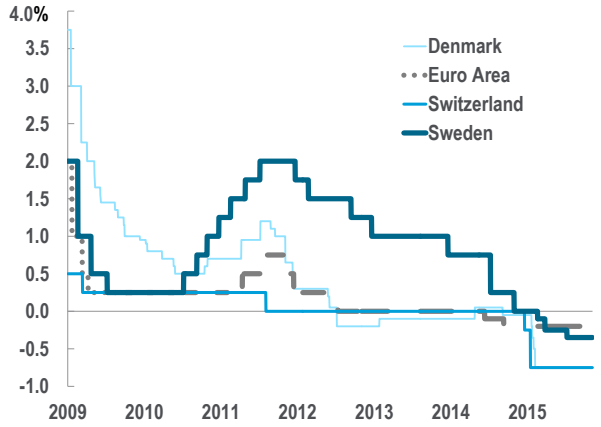
**Willem Buiter**
Global Chief Economist

**Ebrahim Rahbari**
Global Economist

**Michael Saunders**
Head of West European Economics

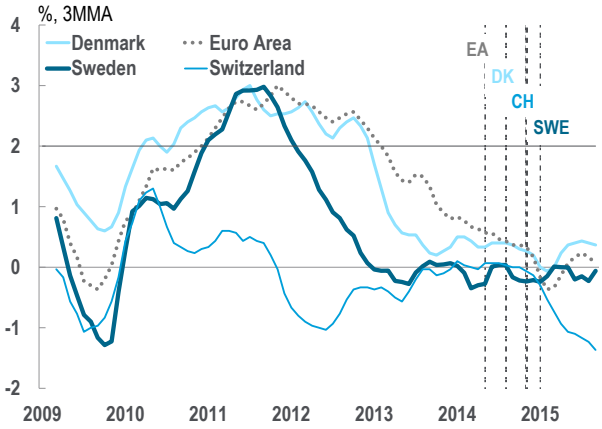
Negative nominal policy interest rates have been very rare until recently — indeed, we are not aware of any central bank that imposed a negative policy rate prior to July 2009 when the Swedish Riksbank lowered its deposit rate to -20 basis points (bp).[13] As of December 2015, four central banks had negative policy rates: the ECB's overnight deposit rate is at -20bp, the Swiss National Bank (SNB)'s 3-month LIBOR target rate is at -75bp, the Danish Nationalbank's 7 day-Certificate of Deposit (CD) rate is also at -75bp and the Swedish Riksbank's repo rate is at -35bp (with its deposit rate at -110bp, see Figure 19).

**Figure 19. Selected Countries – Selected Monetary Policy Rates (%), 2009-2015**




Source: DNB, ECN, Riksbank, SNB, Citi Research

**Figure 20. Selected Countries – Consumer Price Inflation (% YoY, 3-mth Moving Average), 2009-2015**




Source: National Statistical Offices, Citi Research

## Why Negative Interest Rates Now?

Negative interest rates have emerged based on a mix of persistent inflation target undershoots and a risk that FX appreciation would extend the inflation undershoot further

The recent decisions of central banks to impose negative policy rates have generally been based on a mix of persistent inflation undershoots of the target (and even outright mild deflation, see Figure 20) coupled with risks that foreign exchange (FX) appreciation (either actual or feared) would extend the inflation undershoot further. The Danish Nationalbank maintains a fixed-exchange-rate policy for the Danish Krone vs. the euro (with a band of +/- 2.25%). The cut of its policy rate into negative territory in January 2015 followed major reserve accumulation as the DNB attempted to cap the Krone (see Figure 24). The SNB pursued an exchange rate floor vs the euro of 1.20CHF/EUR from September 2011 to January 2015 and set a negative policy rate when the required interventions soared in late 2014 (and then cut the policy rate further and abandoned the exchange rate floor in January 2015, which resulted in a sharp appreciation of the Swiss Franc).

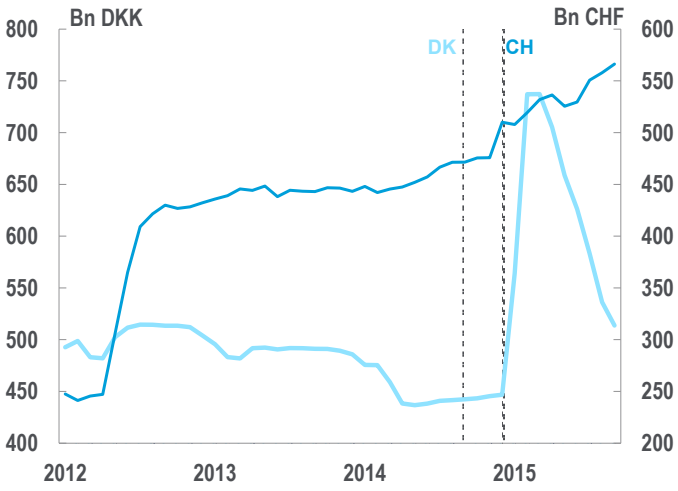
The Riksbank does not have an exchange rate target, but concerns about excessive Krona appreciation clearly carry a lot of weight in their thinking. Likewise, the ECB first cut the deposit rate into negative territory after the euro had strengthened in real effective (trade-weighted) terms by roughly 10% over the course of less than two years (see Figure 22).

[13] The deposit rate is not one of the primary policy rates of the Riksbank. With all main policy rates at positive values, the negative deposit rate had limited direct effect on market rates at the time. The Swiss government also imposed nominal negative deposit rates on Swiss Franc-denominated deposits owned by foreign entities at various times during the 1970s.

Although viewed in some countries as an alternative to asset purchases, negative rates and asset purchases are not mutually exclusive

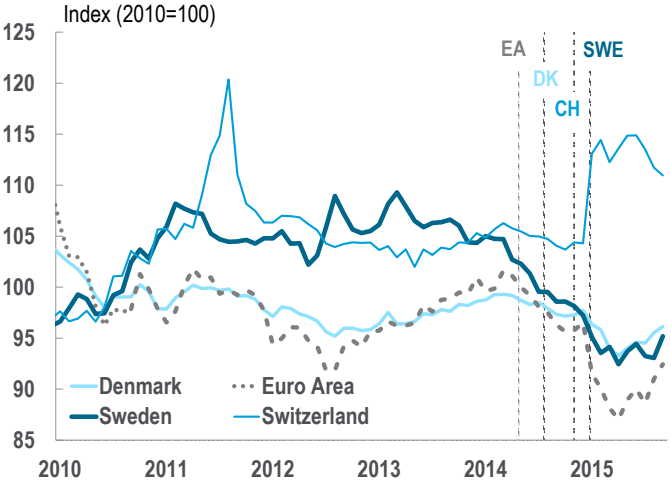
In Denmark and Switzerland, the central bank has viewed negative rates as an alternative to asset purchases, judging that negative rates are at times more effective to limit FX appreciation.[14] However, in the euro area and Sweden, the central bank has opted for negative rates alongside asset purchases. The tools of asset purchases and negative rates are clearly not mutually exclusive. In general, we suspect that negative rates may be more effective than asset purchases in pushing down the (spot) exchange rate, while purchases of usually longer-duration assets may be more effective in lowering long yields — but the combination of the two is likely to be more powerful than either alone.

**Figure 21. Denmark and Switzerland – Foreign Exchange Reserves, 2012-2015**




Note: Vertical lines indicate when policy rates turned negative. In Denmark, they were also negative from July 2012 to April 2014.
Source: DNB , SNB, Citi Research

**Figure 22. Selected Countries – Broad Real Effective Exchange Rates (2010=100), 2010-2015**




Note: Vertical lines indicate when policy rates turned negative. In Denmark they were also negative from July 2012 to April 2014.
Source: BIS, Citi Research

Other countries with inflation undershoots have not opted for negative rates due to institutional obstacles

Of course, other central banks (e.g. the Fed and the BoE) have also faced persistent inflation undershoots in recent years, but have not opted for negative rates. However, those central banks faced institutional obstacles. For example, in 2009 (when it launched QE), the Bank of England feared that further rate cuts would destabilize some building societies, who (because of tracker mortgages linked to the Bank Rate) would be obliged to fully pass on rate cuts to borrowers but, because of fear of losing deposits, would be unable to fully pass on rate cuts to depositors and are constrained in their ability to use wholesale (i.e. non-deposit) funding. Likewise, the Fed's reluctance to go negative may have partly reflected worries that negative policy rates would post an existential threat to the business model of constant net asset value money market funds in the US.

Such constraints matter less in the European economies. In addition, the actions of each individual central bank in moving rates below zero have encouraged others to move. This partly reflects the evidence that negative rates are technically possible and also reflects a competitive 'race to the bottom', with each country seeking to use negative rates to prompt FX depreciation (or at least to resist FX appreciation) against its neighbors.

[14] In Denmark, the government also reduced the issuance of government bonds on the recommendation of the central bank.

Implementation of negative rates differs slightly across countries

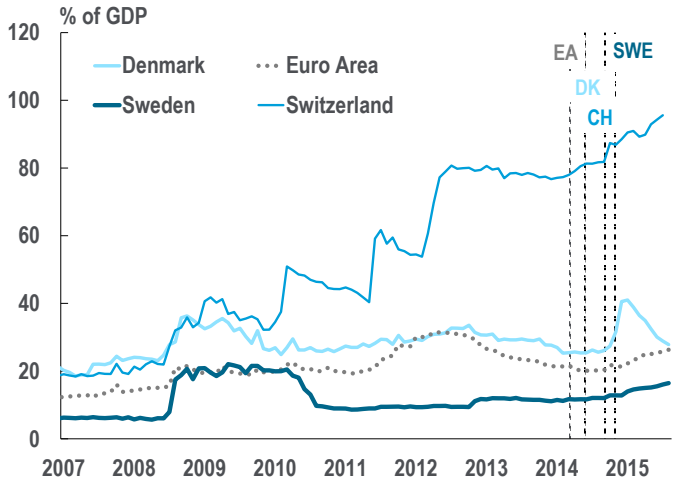
The central banks differ slightly in the implementation of negative rates. In the euro area, Denmark and — especially — Switzerland, a significant portion of reserves that banks hold with the central bank are exempted from the negative policy rate (and instead earn a zero rate in Denmark and Switzerland, or the refi rate in the euro area).[15] These strategies aim to weaken the pressure on banks to pass through the negative policy rate to household and corporate bank deposits — in effect creating more downward pressure on interbank rates than on retail interest rates.

## Have Negative Interest Rates Worked?

Negative interest rates were introduced alongside other policy measures making identifying their direct effects difficult

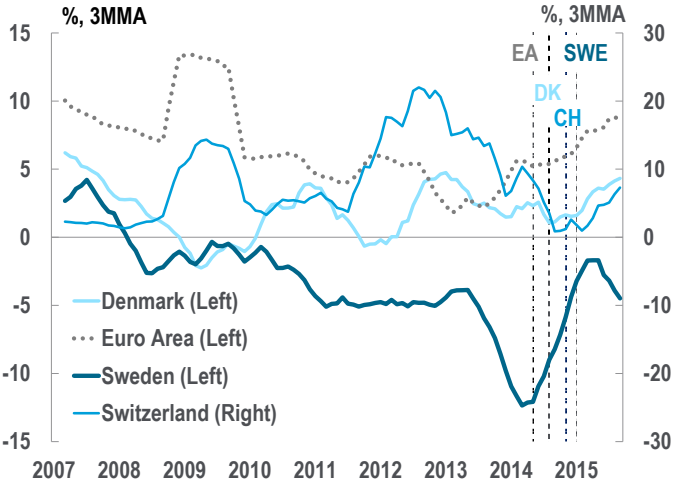
Identifying the effects of negative policy rates is not straightforward, as they were often introduced alongside other policy measures (e.g. all four central banks also carried out major asset purchase programs or foreign exchange interventions during the periods when they have set a negative policy rate) and in response to developments and shocks beyond the control of the central banks. The counterfactual (in the absence of a negative policy rate) is also unobservable. Yet in our view, the available evidence still provides some useful information.

**Figure 23. Selected Countries – Central Bank Balance Sheet Size (% of GDP), 2007-2015**




Source: National Central Banks, Statistical Offices, Citi Research

**Figure 24. Selected Countries – Currency in Circulation (% YoY, 3-Mth Moving Average), 2007-2015**




Source: DNB, ECB, Riksbank, SNB, Citi Research

Growth in currency in circulation has picked up slightly

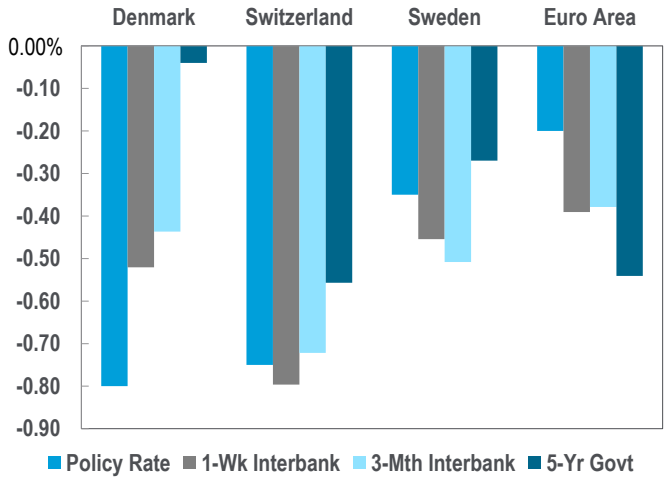
**Currency substitution.** Growth in currency in circulation — a bearer instrument that pays a zero nominal return — has picked up somewhat but so far remains within historical norms (see Figure 24). It is possible that moral suasion by the central banks, supervisors and regulators in Sweden, Denmark and Switzerland may have convinced banks in these countries not to invest heavily in large safety deposit boxes. Moreover, in Switzerland, banks are penalized for holding more currency than prior to the introduction of the negative deposit rate through a reduction in the level of reserves the bank holds with the central bank that is exempted from the negative policy rate.

[15] In Switzerland, the negative rate is applied for domestic banks to reserves held with the SNB above 20 times the reserve requirement. In Denmark, banks have individual limits on deposits they can hold in the DNB's current account (where the interest rate is zero), with a combined current account limit of DKK63.1bn. Excess liquidity ('earning' the negative deposit rate) is usually roughly DKK120bn.

The pass-through of negative rates to short-term money markets has been quite fast

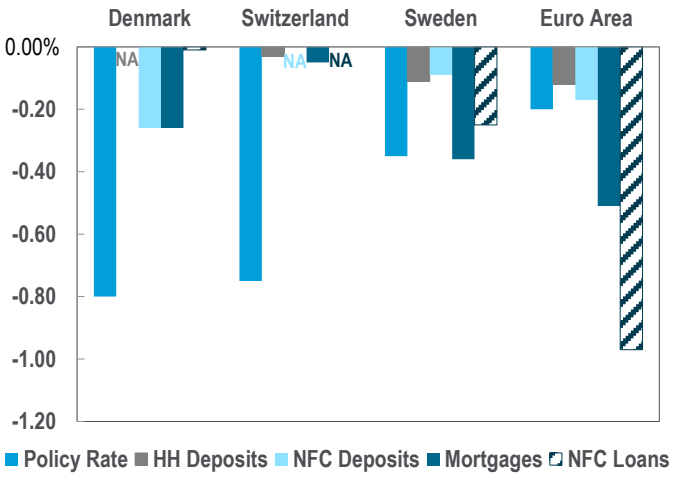
**Market interest rates.** Pass-through to short-term money markets (e.g. to overnight, 1-week or even 3-month interbank rates) has been quite fast and relatively complete (see Figure 25).[16] Interbank rates are indeed negative in all four economies at least for durations of up to three months and even for durations of more than a year in Denmark and Switzerland. Pass-through to government bond yields has been smaller than for interbank rates, except in the euro area. Of course, this may be affected by other factors (e.g. the ECB's asset purchase program). Moreover, long-term yields will also be shaped by expectations of whether policy rates might rise.

**Figure 25. Selected Countries – Change in Policy Rates (%), Interbank Rates (%) and Government Bond Yields (%) Under Negative Policy Rates**




Note: Average in October 2015 vs. average rate in month prior to negative policy rate (May-14 for euro area, Aug-14 for Denmark, Nov-14 for Switzerland and Jan-15 for Sweden)
Source: DNB, SNBH, Riksbank, ECB, Reuters, Citi Research

**Figure 26. Selected Countries – Change in Policy Rates (%) and Interest Rates on Loans and Deposits (%) Under Negative Policy Rates**




Note: Average in October 2015 vs. average rate in month prior to negative policy rate (May-14 for euro area, Aug-14 for Denmark, Nov-14 for Switzerland and Jan-15 for Sweden). NFC loans and mortgages with maturity of 1-5 years where available. Deposit rates are overnight.
Source: DNB, SNB, Riksbank, ECB, Citi Research

The pass-through of negative policy rates to bank deposits and lending rates has been relatively limited as banks appear reluctant to impose negative deposit rates on customers

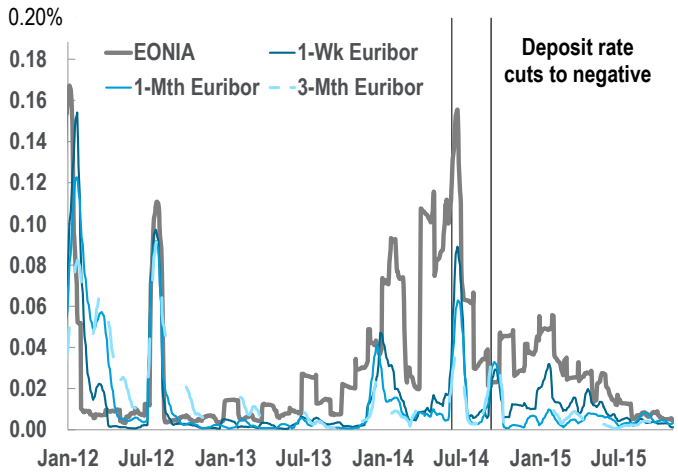
**Household and corporate interest rates.** The pass-through of negative policy rates to bank deposit and lending rates has generally been limited (see Figure 26). This is particularly true for retail (demand) deposit rates, which have fallen by at most around 10bp across the four economies since policy rates went negative — and with very limited pass-through in countries that already had a very low level of retail deposit rates (and more in countries with higher deposit rates, see Figure 27). Banks appear reluctant to impose negative deposit rates on retail customers, although in some cases banks may have opted to charge a fee rather than a negative interest rate. It is possible that some central banks have discouraged banks from imposing negative deposit rates on their retail customers, just as they are likely to have leant on banks themselves not to substitute currency holdings for deposits held with the central bank. The limited extent of negative deposit rates for households may in part explain the moderate increase in currency in circulation.

[16] "*Interest Rate Passthrough and the demand for cash at negative interest rates*", Nationalbank Monetary Review, Q2 2015.

The pass-through to deposit rates for corporate and institutional investors has on average been higher than for household rates and there is plenty of anecdotal evidence that banks now sometime set negative rates for such deposits (indeed, average overnight deposit rates for non-financial corporates are now negative in Denmark, as are those for time deposits which exceed CHF100k, in Switzerland).[17]

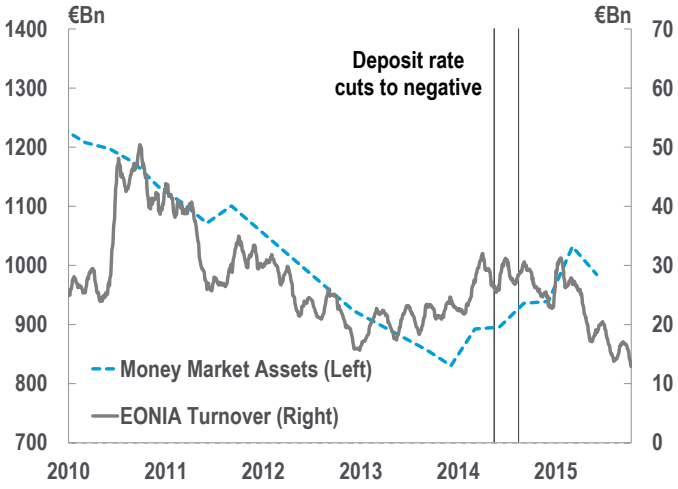
The pass-through of the rate cuts to bank lending rates has generally been limited, both for lending rates to corporates and households (including for mortgages[18]). Only in the euro area have bank lending rates come down significantly with negative policy rates, but this may reflect major additional credit easing measures (including the targeted long-term refinancing operations (TLTROs) announced in June 2014) introduced alongside the policy rate cuts. Bank lending rates mostly remain positive virtually everywhere and bank lending spreads remain well above typical levels before the global financial crisis.

**Figure 27. Euro Area – Volatility of Money Market Interest Rates (%), 2012-2015**




Note: Standard Deviation. The first line indicates when the Deposit Rate turned negative; the second line denotes the further cut.
Source: Bundesbank, Citi Research

**Figure 28. Euro Area – EONIA Turnover (Monthly Average, €bn) and Total Assets of Euro Area Money Market Funds (€bn)**




Note: the first line indicates when the Deposit Rate turned negative; the second line denotes the further cut. EONIA = Euro OverNight Index Average.
Source: ECB, Citi Research

Negative rates have put downward pressure on exchange rates

**Effects on the exchange rate.** The available evidence suggests that negative policy rates have tended to put downward pressure on exchange rates, probably reflecting the high pass-thorough from negative policy rates to wholesale deposit rates. For example, the euro has weakened by roughly 6% in nominal trade-weighted terms since the deposit rate went negative, the Swedish Krona has been broadly stable against the backdrop of QE in the Eurozone and weaker EM currencies since January 2015 and the required FX interventions in Denmark to keep the Krone stable reversed sign, with the authorities buying Danish Krone instead of selling them. Only in Switzerland has the negative policy rate not ostensibly had the desired exchange rate effect: the Swiss Franc strengthened significantly and FX reserve accumulation continues to be large, even though both effects may have been even larger in the absence of a negative policy rate.

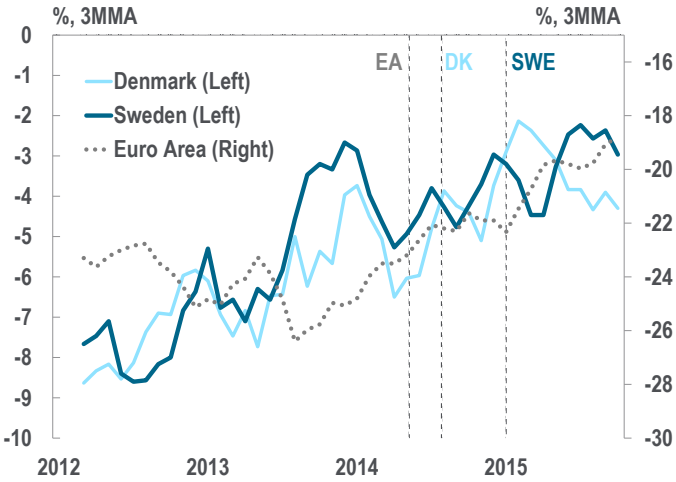
[17] See e.g. "Banks Urge Clients to Take Cash Elsewhere", Wall Street Journal, 7 December 2014. The move for large deposits is also related to regulatory changes in the application of the liquidity coverage ratio (LCR) which obliges banks to hold up to 40% of some corporate deposits and up to 100% of some deposits by financial institutions in liquid assets.

[18] Among the exceptions are a small number of floating rates, including for mortgages that have on occasion turned negative (implying a payment from lender to borrower).

But there has been no major legal of operational complications with negative policy and market interest rates to date…

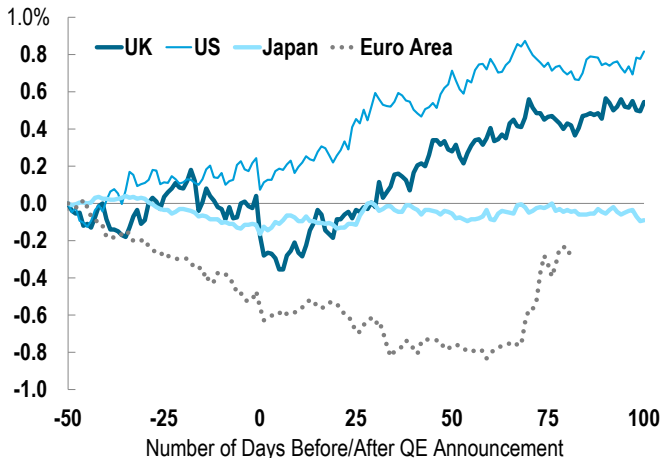
**Legal and operational issues and market structure.** To our knowledge there have not been any major legal or operational complications with negative policy and market interest rates to date.[19] The volatility of money market rates, which had risen in the run-up of the ECB easing measures (including the first cut of the deposit rate into negative territory in June 2014), as banks repaid their take-up of the ECB's 3-year long-term refinancing operations, has been falling since, but relatively slowly (see Figure 27). Meanwhile, activity in euro money markets has been relatively subdued, even though total (and euro-denominated) assets of Euro money market funds have been quite resilient (see Figure 28). In Denmark, interbank activity also fell following the introduction of a negative policy rate in 2012.

**Figure 29. Selected Countries – Major Purchase Intentions Over Next 12 Months (% Balance), 2012-15**




Note: Vertical lines indicate when policy rates turned negative. In Denmark, they were also negative from July 2012 to April 2014.
Source: European Commission, Citi Research

**Figure 30. Selected Countries – Change in 10Y Government Bond Yield Before and After Announcements of QE/Asset Purchases, 2009-15**




Note: For each country we show the average for all of the cycles of asset purchases announced since the start of 2009. For the Euro Area, we use a weighted average of all countries 10-year sovereign bonds.
Source: DataStream, Haver, Citi Research

We expect that, as experience with negative interest rates grows, technical issues should become less of a concern in the future, although there may be as yet untested issues that arise if policy rates are cut so far — or for so long — as to produce negative interest rates across a wide range of household and corporate interest rates.

…nor has there been a change in savings patterns

**Effects on saving.** Nor is there evidence that negative policy rates have altered the monetary transmission mechanism (i.e. the risk that people might choose to save more to achieve a target level of savings). Survey-based evidence on major purchase intentions in the economies in question have generally trended upwards throughout the relevant period (see Figure 29).

## Negative policy rates and asset purchases

A negative policy rate is likely to interact with other monetary policy measures, especially asset purchase programs. The interaction works in both directions. The large amount of excess liquidity that asset purchases generate helped to anchor short-term market rates close to the policy rate in the Eurozone and probably capped risks of money market volatility. And a negative policy rate combined with

[19] See "*How far can the repo rate be cut?*" Riksbank, Sept 2015 and Danish Nationalbank "*Interest Rate Pass-Through and the Demand for Cash at Negative Interest Rates*", Monetary Review, Q2 2015.

big asset purchases reinforces the 'hot potato' effect of these measures and should imply stronger transmission of monetary policy to asset prices and the FX rate. Indeed, at least initially, the effects of the ECB's asset purchase program on government bond yields, bank loan spreads and the FX rate were generally larger than for the asset purchase programs in the US, UK or Japan.[20]

What has been striking is how unspectacular the move to negative rates has been

Overall, the striking point is how unspectacular the move to negative rates has been. Money has not flooded out of the banks, exchange rates have not plunged, thrift has not been destroyed, and inflation has not soared. After many years in which it was virtually unthinkable for interest rates to go below zero, the evidence suggests that there is no discontinuity at the zero bound. As the then Vice-Chairman of the SNB Governing Board, argued in May 2015 "I would like to address the belief that, because of the so-called 'zero lower bound', nominal interest rates cannot become negative. This belief has clearly been proved a fiction by current developments, with the SNB lowering its policy target rate into negative territory…At first glance negative rates violate the intuition that savings must be remunerated. However, this intuition is misleading. The interest rate reflects the price of today's consumption in terms of consumption in the future. It is a relative price. There is nothing untenable in tomorrow's consumption being more valuable than today's."[21]

## How low could policy rates go?

The effective lower bound on policy interest rates should be determined by the point at which banks are indifferent between holding central bank reserves and currency

The Riksbank, ECB and DNB have all signaled the possibility that rates could fall further, with the DNB stating that "the lower bound on monetary policy rates in Denmark is lower than the current interest rate on certificates of deposit of -0.75%." Since holders of central bank reserves can in principle shift into currency, the effective lower bound on policy interest rates should be determined by the point at which banks are indifferent between holding central bank reserves and currency. That point is below zero, due to the 'carry cost of currency', the cost of safely storing, moving and handling currency (including insurance costs), and including the cost of using currency. Conventional estimates of these carry costs are usually not more than 50bp, at least for banks that can benefit from economies of scale — but the central banks of Denmark and Switzerland have already shown that it is technically possible to go below that level (especially with the Swiss model which limits banks' incentives to switch reserves into currency).[22]

Currently, there is a sense that negative rates are only a temporary aberration…

The substitution of currency for deposits (both in terms of banks' dealing with their customers and banks' payments assets at the central bank) may have been limited so far by moral suasion, and a sense that negative interest are only a temporary aberration — and hence it is not worth incurring the startup costs of a much greater shift to cash payments. Nevertheless, even though the effective lower bound on policy interest rates is clearly not zero, we doubt that current institutional arrangements allow for much lower policy interest rates without significant incentives for currency substitution. To allow an effective pass-through of even lower policy interest rates, say of -2% or even -5%, institutional changes would probably be needed, such as abolishing currency, taxing currency or creating a variable exchange rate between currency and central bank reserves.

[20] See also "*Spillovers from the ECB's APP Economic Outlook and Strategy*" and the ECB's November 2015 Economic Bulletin.
[21] See speech "*Swiss monetary policy facts…and fiction*", 2015, SNB.
[22] See Jackson (2015), "*The International Experience with Negative Policy Rates*", Bank of Canada Staff Discussion Paper. In Switzerland the incentive for banks to shift into cash is limited by the inclusion of banks' cash holdings in the total assets that are exempt from the negative policy rate.

…however, if central banks revisit the effective lower bound periodically in the next years and decades to come, the cultural resistance could be abandoned

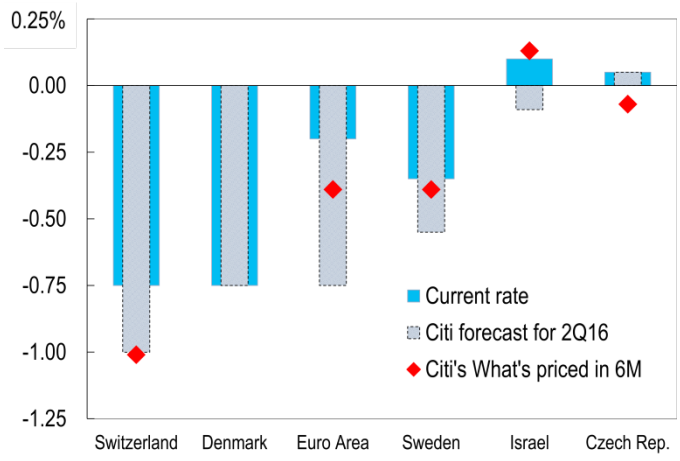
We expect that the 'cognitive' and cultural resistance of retail depositors and retail banks to negative retail deposit rates, is likely to be a transitory phenomenon. If central banks revisit the effective lower bound periodically in the years and decades to come, the social learning required to strip the number zero of its special significance when it represents the cost of borrowing or lending money is likely to take place.

## Policy rate expectations

We think all four central banks with negative policy rates may well cut further…

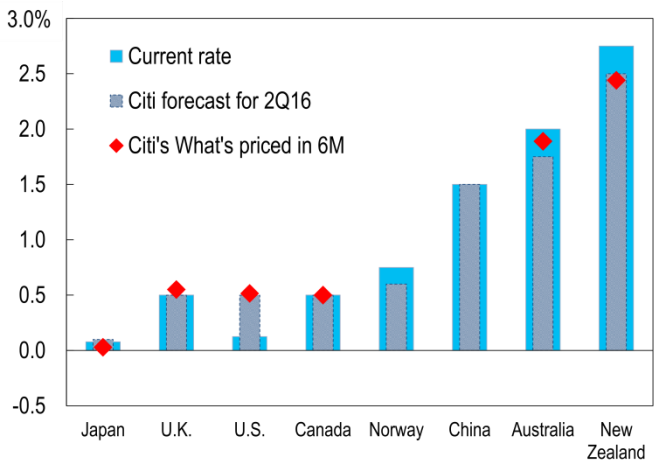
In our view, all four central banks with negative policy rates — the ECB, Denmark's Nationalbank, the Riksbank and the SNB — may well cut further. Currently, we expect the ECB to cut its deposit rate by 20bp at its next policy meeting and another 40bp to -0.75% in the first half of 2016, while we also expect another 30bp rate cut in Sweden by end-2016. Israel could well be the next country to join the 'negative policy rate club' (we expect the Bank of Israel to cut its policy rate by 20bp by mid-2016). The Czech National Bank and the BoJ are also candidates for negative policy rates in the not too distant future, even though they are not part of our base case currently.

**Figure 31. Selected Countries – Policy Rates and Forecasts (%), 2015-2Q 2016E**




Note: Data as of 11 November 2015. Market implied rates are constructed from forward rates.
Source: Bloomberg, Citi Research

**Figure 32. Selected Countries – Policy Rates and Forecasts (%), 2015-2Q 2016E**




Note: Data as of 11 November 2015. Market implied rates are constructed from forward rates
Source: Bloomberg, Citi Research

…and the list of countries that could impose negative policy rates is much larger

Over a longer horizon, the range of countries that may choose to impose negative policy rates is much larger. Some countries, such as Canada, China, Norway or Australia, may yet reach negative policy rates during their current easing cycle should macroeconomic conditions turn out much weaker than currently expected. (even though negative policy rates are only one option for further monetary easing). For many others, negative policy rates may become relevant during the next cycle. Over the last 15 years, the ECB, Fed and BoE have all made two big interest rate-cutting cycles: one started in 2000/01 and one began in 07/08. In the first, policy rates fell by an average of 315bp over two years, and in the second they fell by an average of 450bp. Current market prices imply that policy rates are unlikely to be at 3% or above over the next 5-10 years for most advanced economies (including the US and UK).20 It is therefore likely that previously unconventional monetary policy measures are likely to be needed if there is another downturn, and experience to date suggests that negative policy rates are likely to feature alongside asset purchases as a policy instrument of choice in many cases.

# 4. Migration: Cause & Economic Effect

**Michael Saunders**
Head of West European Economics

While some aspects of globalization (e.g. world trade growth, cross-border capital flows) have stalled or reversed, globalization in terms of people — via migration — continues to reach new highs.

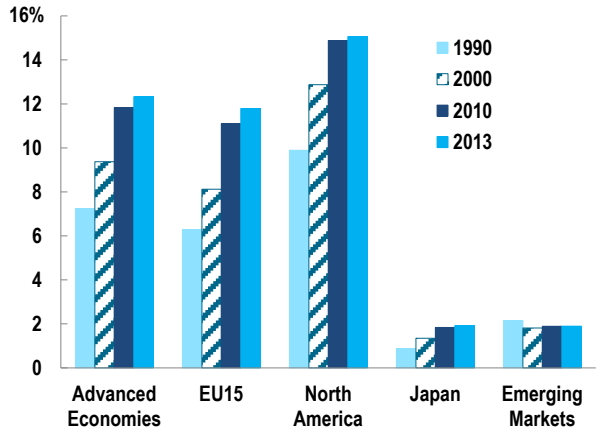
The global stock of migrants was up to 232 million in 2013, or 3.2% of the global population

According to UN data, the global stock of migrants (defined as people living outside the country of their birth) is up from 102 million people in 1980 (2.3% of the world's population) to 154 million in 1990, 175 million in 2000, 221 million in 2010 and 232 million in 2013 (3.2% of global population).[23] For advanced economies as a whole, the stock of migrants is up from 7.2% of the population in 1990 to 9.4% in 2000 and 12.3% in 2013. Partial data (covering EU countries) hint at a further rise since then. The migrant share is relatively high for EU15 countries (11.8% including intra-EU migration), North America (15.1%) and Australia (27.8%), but below 1% for China, below 2% for Japan and below 3% for Korea. Among emerging markets as a whole, the migrant share of population has been fairly stable at around 2% over the last 20 years, although it is much higher in some Asian city-states (e.g. HK, Singapore). The gross inflow of migrants to advanced economies has averaged 4.7 million people per year over 2006 to 2013, versus 2.7 million per year on average in 1985 to 2000, implying a slightly slower growth rate in percentage terms in the migrant stock in recent years.

This forecast excludes illegal migration plus refuges and asylum seekers which could add nearly 50 million to that figure

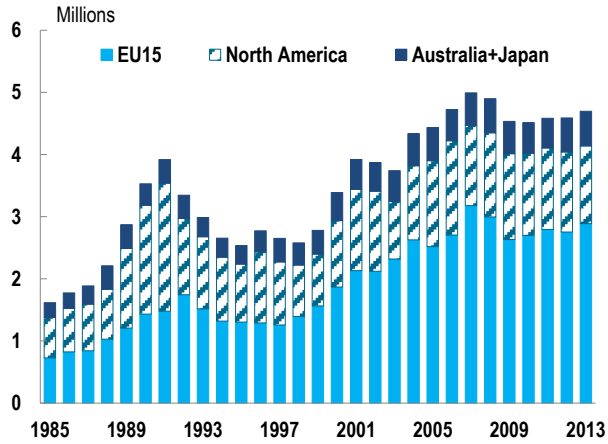
These figures only count people who are (1) officially counted and (2) classed as migrants, and exclude illegal migration plus refugees and asylum seekers. It also excludes supposedly temporary migrants like foreign students, foreign seasonal workers in agriculture, etc. The UN estimates that at end-2014 there were 19.5 million international refugees, nearly 2 million asylum seekers and 38 million internally displaced people. In the first ten months of 2015, the numbers of new asylum seekers surged to 1.5 million, more than twice the pace of the same months of 2014. And these figures probably greatly understate the true scale, given that in many cases refugees have not yet lodged proper asylum applications.

**Figure 33. Global – Stock of Inward Migrants as % of Population (1990-2013)**




Source: UN, Citi Research

**Figure 34. Global – Inflow of Migrants to Advanced Economies (m), 1985-2013**




Source: OECD, Citi Research Note: EU15 data exclude Portugal before 1992, Ireland before 19974 and Austria before 1996

[23] World Bank data show a slightly higher rise, from 216 million in 2010 to 247 million in 2013.

## Why is this Happening?

Migration occurs due to wars but also reflect people moving for economic and social reasons

In the last year or two, various wars, civil wars and failed states have prompted large numbers of refugees and asylum seekers — especially from Syria, Afghanistan, Iraq and recently, Yemen. But, although the numbers of refugees have surged in 2015, over the past 10 years as a whole only 7% of the migrant inflows to advanced economies have been asylum seekers. Most migration flows are not refugees, but reflect people moving for economic and social reasons, mostly from low income countries to higher income countries. For example, 86% of migrants come *from* countries with GDP per head below 50% of the US level, but 57% of migrants now *live in* countries with GDP per head above 50% of the US level. In particular, two-thirds of the rise in migration since 1990 has been from emerging markets (EMs) to advanced economies (AEs).

Some causes include lower costs of travel and financial remittances, climate change and EU enlargement

A range of social and economic factors are probably behind this long-term trend of higher global migration rates. Costs of travel and financial transfers (for remittances) have come down, while widespread use of mobile phones and Internet access makes it easier for people to find out about opportunities elsewhere and to keep in touch with home. Climate change, leading to global warming and extreme drought, may be fueling conflicts and increasing refugee flows — especially in low-income countries with heavy dependence on agriculture. At the same time, EU enlargement has expanded the pool of countries with free movement of people. Among the countries that joined the EU from 2004 onwards, the stock of inward migrants as a share of the population has risen only slightly, from 3.1% in 2000 to 3.5% in 2013; but the stock of outward migrants has surged from 6.5% of the population in 2000 to 11.2% in 2013. In 2013, nearly half of the flow of inward migrants in the EU15 countries came from other EU member states.

Increasing prosperity in low-income countries has raised people's ability to migrate while differentials in per capita GDP between countries has raised the incentive for people to migrate

In addition, a key factor is the combination of increasing prosperity in low-income countries (which raises people's *ability* to migrate) combined with persistent large differentials in per capital GDP between countries (which raises *incentives* to migrate).[24] The effects of rising prosperity in low- and middle-income countries on people's tendency to emigrate are complex. On one side, higher income levels might in theory reduce people's incentives to migrate in search of a better life, given the greater opportunities at home. On the other side, rising income levels increase people's *ability* to emigrate — to afford the expenses of travel and tolerate the income uncertainties of migration. In addition, rising national income tends to be associated with improved educational attainment, hence making people more employable in other countries and reinforcing the incentive to emigrate. In particularly, the emigration rate of people with tertiary (i.e. university) level education is well above average, especially in low-income countries.[25] Conversely, at very low income levels, many people are living from day-to-day and are simply too poor to emigrate (unless forced to move by natural disaster, war, etc.)

Emigration rises at relatively low income levels and peaks when incomes hit around 50% of the US level

The balance of these effects is that the tendency of people to emigrate (i.e. the stock of outward migrants as a share of each country's population) tends to rise at low relative income levels and peaks at income around 50% of the US level and falls thereafter.

[24] See "Does Development Reduce Migration?", Michael Clemens, Center for Global Development Working Paper 359, 2014.

[25] World Bank data show that the emigration to OECD countries of people with tertiary education is 12.5% in low-income countries, 7.7% in middle-income countries and 3.9% in high-income countries.

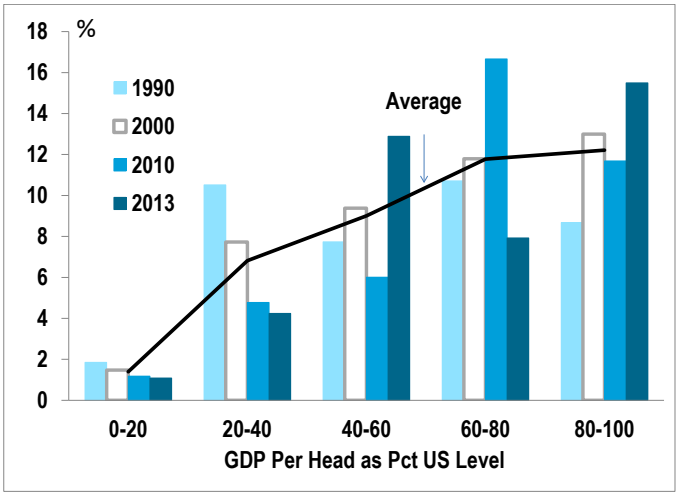
The key change over time is that there are more people with the means and educational attainment to emigrate

This general pattern has been fairly stable over time. Averaged across the data for 1990, 2000, 2010 and 2013, the emigrant/population ratio rises from 2.8% for countries with per capita income below 20% of the US level (weighted by population), to just above 5% for countries with an income level of 20-40% of the US, with a peak of 6.7% for countries with an income level of 40-60% of the US, declining to 5.0% at the 60%-80% income level and 2% in countries with average incomes at 80-100% of the US level. The key change over time is that there are more people with the means and educational attainment to emigrate. For example, in 2000 only 17% of the world's population lived in countries in which per capita GDP was more than 20% of the US level: now, 25% do.

Rising prosperity in lower income countries is associated with higher emigration while rising prosperity in relatively high income countries is associated with reduced emigration

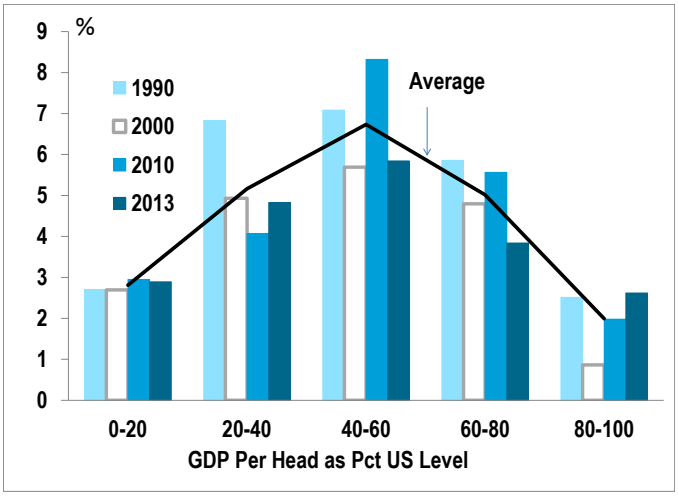
The link between incomes and tendency to emigrate holds over time for individual counties, as well as in a cross-section sense. For example, among countries where GDP per head in 2000 was 20-50% of the US level, the correlation between the change in relative income over 2000-13 and the change in the outward migration stock over 2000-13 (as a share of the population) is highly positive, at 28%. Conversely, among countries with GDP per head at 50-100% of the US level, the correlation is highly negative, minus 35%. In other words, rising prosperity in lower-income (but not very low-income) countries (20-50% of the US level) has tended to be associated with *higher* emigration, while rising prosperity in relatively high income countries tends to be associated with *reduced* emigration. In addition, small countries (in population terms) tend to have relatively high rates of outward migration (likewise, smaller countries tend to have higher trade shares), and in some countries there are heavy political constraints towards outward migration.

**Figure 35. Global: Stock of Outward Migrants as % of Population for Individual Countries, Ranked by Income Per Head, 1990-2013**




Note: We show the weighted averages for countries in each income category.
Source: UN, Citi Research

**Figure 36. Global – Stock of Inward Migrants as % of Population for Individual Countries, Ranked by Income per Head, 1990-2013**




Note: We show the weighted averages for countries in each income category.
Source: UN, Citi Research

Migration flows have become more highly skewed to countries with high income levels

Conversely, the ratio of inward migrants to population tends to rise with relative income levels. Indeed, migration flows have become more highly skewed to countries with high income levels, especially those with average income per head at least 80% of the US level.

## Effects of the Expansion of Global Migration

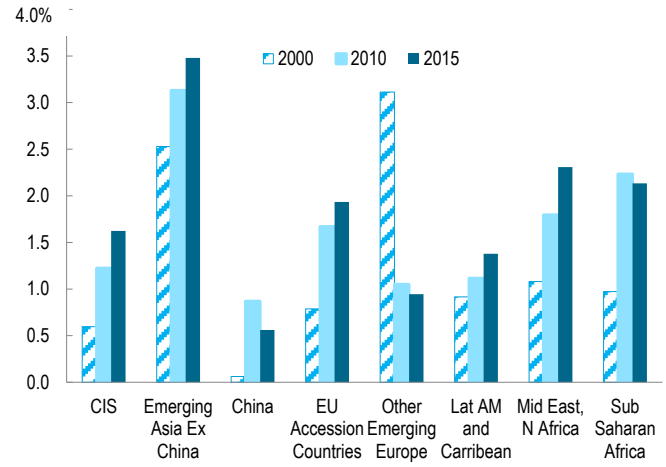
The expansion of migration has also led to an increase in remittances, to roughly $586 billion in 2015, or 0.8% of global GDP

The expansion of global migration affects the economies that are the source of migration and those that receive it. Globally, the annual gross flow of remittances has surged from $127 billion (0.4% of global GDP) in 2000 to $457 billion (0.7% of GDP) in 2010 and, according to the World Bank, roughly $586 billion (0.8% of global GDP) in 2015.[26] This compares to global flows of official aid of roughly $150 billion in 2013 (World Bank data). Twenty five years ago, gross global remittances were roughly the same size as official aid flows, whereas now remittances are nearly four times as big as aid flows and hence have become a powerful economic factor in emerging markets (using the IMF's definition) and receipts of remittances average 1.8% of emerging market GDP, with relatively high levels in emerging Asia ex China (3.5% of annual GDP), Middle East and North Africa (2.3% of GDP), Sub-Saharan Africa (2.1% of GDP) and the EU Accession countries (1.9% of GDP). Remittance inflows have also risen rapidly in the CIS countries. By contrast, remittance inflows remain low for China and actually have fallen as a share of GDP for emerging Europe ex the EU Accession countries.

Remittance flows chiefly go from relatively high-income countries to very low-income ones

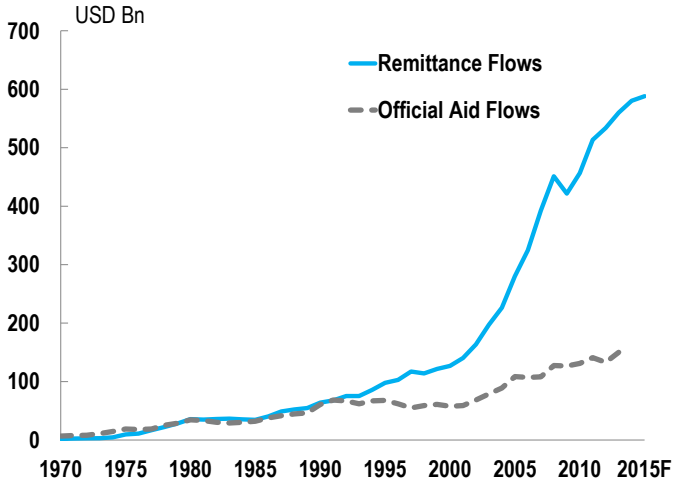
Remittance flows chiefly go from relatively high-income countries to very low-income ones: fully 73% of remittance receipts are in countries with GDP per head less the 20% of the US level, while 54% of remittance outflows are from countries with GDP per head at least 80% of the US level. For Sub-Saharan Africa and Middle East North Africa (MENA), net remittance inflows now substantially exceed typical net inflows of foreign direct investment (FDI) and portfolio capital, while for EM Asia (ex China) net FDI inflows are only slightly ahead of remittance inflows. Moreover, remittance flows tend to be far more stable than private capital flows.

**Figure 37. EM Countries – Annual Receipts of Remittances from Outward Migrants, % of GDP, 2000-15**




Note: The EU Accession countries are those that joined the EU in 2004 or later.
Source: IMF, World Bank, Citi Research

**Figure 38. Global – Remittance Flows and Official Aid Flows, US$bn, 1970-2015E**




Note: the figure for remittance flows in 2015 is the World Bank's forecast.
Source: World Bank, Citi Research

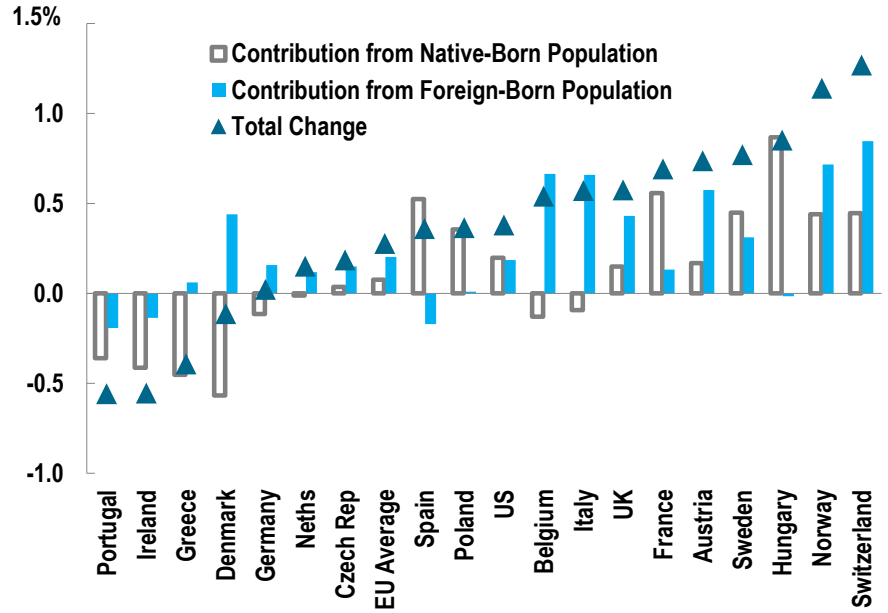
Net migration inflows have become a key driver of population and workforce growth in advanced economies

On the other side, among many advanced economies, net migration inflows have become a key driver of population growth and workforce growth — and hence a major factor in potential economic growth. For the US, 48% of workforce growth since 2007 reflects net inward migration, while for the EU15 as a whole, foreign-born workers account for 69% of workforce growth since 2007. Foreign-born

[26] See "*Migration and Development Brief*", World Bank, April 2015.

workers account for more than half of total workforce growth in two-thirds of EU countries. Moreover, although most migration flows are from lower income countries to higher income ones, migrants typically do not have lower average educational attainment than people in the countries they move to. For example, in the EU and US, the share of migrants with tertiary level education (29% and 31% respectively in 2014) is similar to the share of native-born people with tertiary-level education (26% in the EU, 32% in the US). Indeed, the share of migrants with university-level education is very high (above 40%) in Estonia, Ireland, Luxemburg, Poland and the UK — and well above the share of domestic citizens with university-level education.

**Figure 39. Selected Countries – Average Annual Workforce Growth 2007-15**




Source: Citi Research

The wider economic effects on countries with migration inflows are complex and mixed

The wider economic effects on countries with migration inflows are complex. In theory, an increase in inward migration adds to labor supply (more workers) — hence lifting potential growth — while also boosting demand (more consumers, more demand for housing, plus knock-on effects to investment). Effects on fiscal balances also are ambiguous, with potential increases in tax revenues balanced by increased pressure on public services and social support.[27] The greater availability of foreign workers may have helped cap pay growth below historic norms in advanced economies in recent years, reinforcing the effects of low inflation expectations and high jobless rates. Other aspects of globalization (e.g. trade, offshoring and capital flows to EMs) push in the same direction.

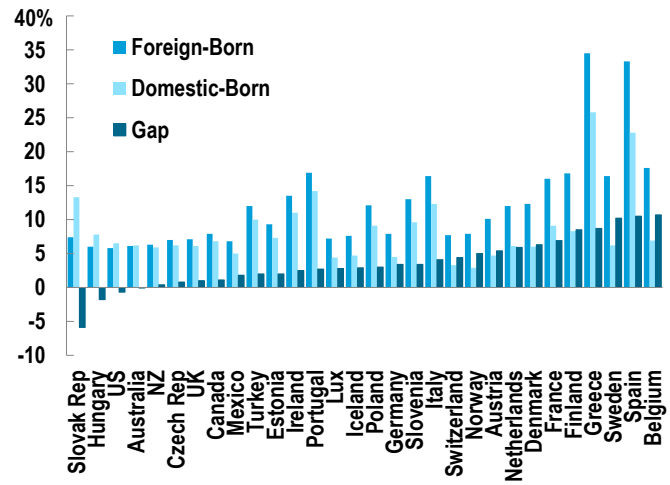
The extent to which migrants integrate effectively into work varies greatly between countries

The balance between these potential positives and negatives probably rests on the extent to which migrants integrate effectively into work, and this varies considerably between countries. On average among OECD countries, the jobless rate among migrants is roughly 4 percentage points above that for domestic-born people (mirrored by a lower employment rate and with little difference in aggregate

[27] See, for example "The Fiscal Effects of Immigration to the UK", Christian Dustmann and Tommaso Frattini, 2013. This paper found a positive net fiscal impact from EU migrants and a negative net impact from non-EU migrants for the UK.

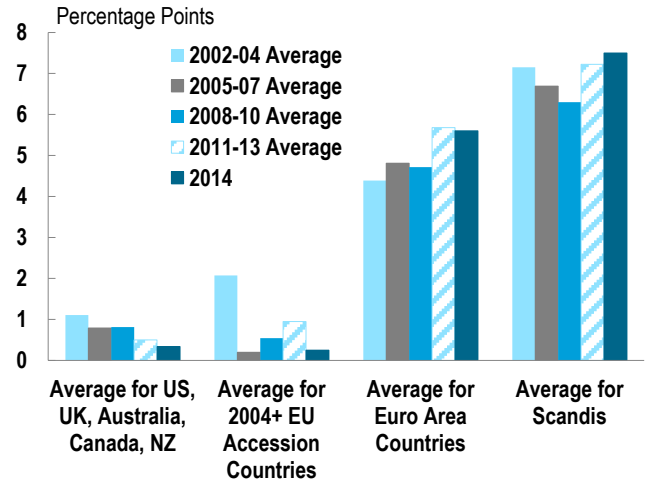
participation rates[28]). But within this average, the jobless rate of foreign-born people is at least two percentage points higher than that for native-born people in every single Euro area country (bar Slovakia). The gap is at least five percentage points in all of the Scandi's (Sweden, Denmark, Finland and Norway). Indeed, this gap exceeds 10 percentage points in Sweden, Spain and Belgium. Conversely, the jobless gap between foreign-born and native-born people is *below* 2 percentage points in the US, Australia, NZ, the UK, Canada, Hungary, Czech Republic and Slovakia. Indeed, in the US, Hungary and Slovakia, the migrant jobless rate is slightly *below* that for people born in those countries.

**Figure 40. OECD Countries – Jobless Rates of Foreign-Born and Domestic-Born People, 2014**




Source: OECD, Citi Research

**Figure 41. OECD Countries – Gap Between Jobless Rates of Foreign-Born and Domestic-Born People, 2002-14**




Source: OECD, Citi Research

Moreover, these disparities are not just cyclical, but have widened over time. In what might be loosely termed the 'anglo-saxon' economies (US, UK, Canada, Australia, NZ), the unweighted average of the jobless rate gap between migrants and domestic-born people did not widen in the recession and has fallen from 1.2 percentage points in 2002 to just 0.3ppt in 2014. Among countries that joined the EU from 2004 onwards, this gap has shrunk from 2.1 ppts in 2002-04 to 0.2ppt in 2005-07, with little change since then. Conversely, among Euro area countries, the average has gone up to 5.6ppt from 3.8ppt in 2002 (and among the Scandi's it has risen to 7.5ppt from 6.1ppt). it is striking that these relative unemployment rates of migrants are particularly high in countries that are often deemed to be relatively welcoming to migrants. For example, on the Migrant Integration Policy Index, the EU countries with the highest (i.e. most favorable) scores are Portugal, Norway, Sweden and Finland.

Among EU countries, that average jobless rate for non-EU migrants (19.6% in the second quarter of 2015) is far above that for intra-EU migrants (10.2%), with particularly high disparities in Sweden, France, Greece and Belgium.

[28] Among EU countries, the 2014 participation rate among people aged 25-64 years was 76.7% for the foreign-born, versus 78.8% for the native-born. In the US, the participation rate among people aged 16+ years was 65.5% for the foreign-born but 62.0% for the native-born. Foreign-born people on average tend to be younger than native-born (which tends to raise the average participation rates) but in the EU have a lower workforce participation rate at each age group than the native-born population.

Factors behind disparities between jobless rates of migrants and native-born population include regulation of labor markets, dispersion of pay levels, levels of public social spending and migrant education level

Many factors probably lie behind these disparities between jobless rates of migrants and the native-born population. In general, it appears that the absorption of migrants into employment is much greater in countries with relatively deregulated labor markets, a wide dispersion of pay levels, low levels of public social spending and which a high share of migrants have tertiary (i.e. university) level education. For examples, across a sample of 30 OECD countries, the gap between the jobless rate of foreign-born people and native-born people is highly correlated (40%+) with each of (1) the OECD's index of labor market regulation; (2) the gap between the share of migrants and nationals with tertiary level education; and (3) income inequality (measured by the ratio of earning for the 9th decile to the first decile); and (4) the level of public social spending as a share of GDP. A simple model using these four variables explains roughly three-quarters of the cross-country variation in the relative jobless rates of foreign-born and native-born people.

Visa criteria are also important

Of course, this list is not exhaustive, and other factors probably also matter. For example, in non-EU countries, the selection criteria for visas limit migrant inflows to people who are more readily employable. Moreover, it may well be easier to integrate migrants in countries where the domestic language is widely-spoken at a global level (for example English vs. Swedish[29]). In addition, in EU countries, the share of migrants with tertiary-level education cannot be controlled by the EU governments (because the EU has free movement of labor for all citizens). Hence, in the EU, some countries may have a high share of highly-educated migrants because of a range of features (e.g. tax rates, industry structure, cultural openness) that make those countries more attractive to migrants with high educational attainment (and also make it easier for migrants to integrate into the workforce).

There is a fairly close link between the ability of different countries to absorb migrants into their workforce and potential GDP growth

In turn, since these supply-side factors are quite closely linked to potential GDP growth, there is a fairly close link between the ability of different countries to absorb migrants into their workforce and potential GDP growth. For example, using the OECD's estimates, the gap between the jobless rate of migrants and the native-born population averages 6.6ppts in countries with potential GDP growth over 2015-17 below 1% year-over-year. But this gap falls to 3.3ppts in countries with potential GDP growth between 1% and 2% year-over-year and falls to 1.2ppts in countries with potential GDP growth of more than 2% year-over-year. This link probably works both ways: an improved ability to integrate migrants probably boosts potential growth, while the attributes that produce high potential growth (e.g. openness, supply side flexibility) probably also makes it easier for migrants to integrate into employment. Homogenous societies may be more comfortable but less innovative than societies with a large number of (educated) migrants, with abundant evidence in the US that migrants are more likely to start a new business or obtain a patent than the native-born population.[30]

[29] If we use a dummy for English-speaking countries alongside these other factors, it is insignificant in statistical terms.

[30] See, for example, "*The wider economic implications of high-skilled migrants: a survey of the literature for receiving countries*", Max Nathan, 2014. "*The Economic Facts About Immigration"*, The Hamilton Project, 2010. See also "*Ten Ways Immigrants Help Build and Strengthen Our Economy*", US Government, July 2012.

## Prospects for Migration

The economic drivers of migration are likely to remain intact and will probably intensify

The extent to which pressure from wars, natural disasters, etc. will continue to lead to refugee flows is inherently unpredictable. But, we suspect that the economic drivers of migration — rising prosperity in low-income countries plus large income disparities between countries — will remain intact and indeed will probably intensify. We suspect that many millions of people from North Africa and the Sahel (mid-Africa) will seek to go to Europe, as refugees or as economic migrants, in part because of global warming and other manifestations of climate change. As a result, migration flows are likely to remain high unless curtailed by must greater constraints in advanced economies.

We doubt that migration will provide a cure for low potential growth rates and sluggish actual growth rates in advanced economies…but migration reinforces the tendency for successful economies to attract the best and the brightest

However, apart from a few exceptions, we doubt that migration is likely to provide the cure for the low potential growth rates and sluggish actual growth rates seen in many advanced economies. As noted above, advanced economies with low potential growth (e.g. Japan, Italy, France, Denmark, Austria, Greece, Finland and Portugal all have potential growth of 1% year-over-year or less in 2015, according to the OECD) tend to either have low rates of inward migration (e.g. Japan) or are relatively poor at integrating migrants into employment. Germany might be an exception in that the country has fairly low potential growth (1.3% year-over-year according to the OECD) but is not too bad at integrating migrants into work (in the first quarter of 2015, the jobless rate of migrants was 9.0% versus 4.3% for native-born population). But the main impact of sustained high migration rates around the world is likely to widen disparities among advanced economies, reinforce the tendency for successful economies to attract the best and the brightest — and hence do even better.

# 5. Commodities: Down But Not Out

**Ed Morse**
Head of Global Commodity Research

2016 is shaping up to be a critical transitional year for commodities, a year of volatile and ongoing 'W-shaped' price adjustments, as the market grapples with conflicting signals of whether and how rapidly supply/demand fundamentals are shifting to balance for many commodities. This transition predicates a more persistent price recovery by 2017 for oil and natural gas as well as base metals, and possibly agriculture. The damping of economic growth in China combined with a structural shift in the Chinese economy to less commodity-intensive growth plus the slowdown in growth in other emerging markets is the core of the problem confronting commodities. But the accelerated postponement of new investments and the shutting in of plants that are marginally or negatively profitable are serving to bring forward the time when balances will turn negative.

The rising US dollar will continue to be an ongoing headwind for commodities priced in nominal US dollar

The rising US dollar should be an ongoing headwind for commodities priced in nominal US dollars, though the sector impacts will vary and seem strongest for gold on a tactical basis but almost meaningless for commodities like soybeans. Additionally, while the forecasts and markets project a stronger US dollar in the year ahead, the scale and pace of further US dollar appreciation could be more muted compared to the extraordinary broad-based gains seen during the late 2014-2015 timeframe.

Nevertheless, producer currency depreciation against the US dollar and persistent underlying cost deflation across commodities keep pushing cost curves down, making a call on the bottom slippery. Few analysts or companies anticipated the rapid and radical depreciation of commodity currencies this past year let alone their impact in reducing both operating and capital costs in local currencies.

Lower prices have accelerated the search for greater efficiencies and higher productivity

In some cases, like for gold, the lowered rand cost for mining gold has been setting increasingly lower marginal costs and hence a lower bottom for the market; in other cases like Russia the result has been a rise in oil production rather than the production forecasted at the start of 2015 of declining output. Continued dollar appreciation indicates that the process is not over. On top of that, whether in exploitation of iron ore or shale resources in the US but also in metals, lower prices have accelerated the search for greater efficiencies and higher productivity. There is no sign that this era of cost deflation is even near being over.

We expect a modest recovery in commodity prices after sharp underperformance in 2015

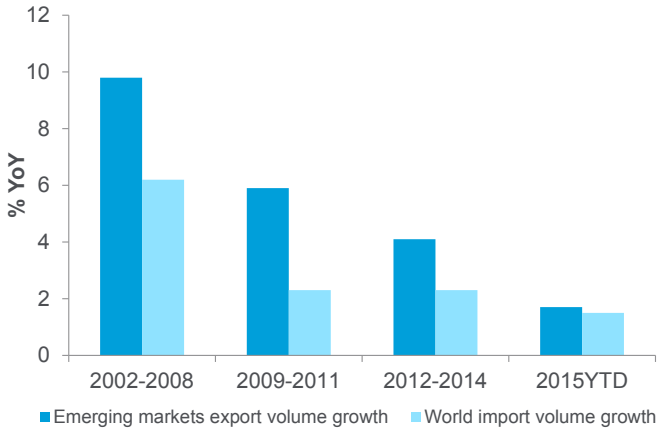
Given the sharp underperformance of commodities in 2015, and especially in the second half, it's tempting to look for a bottom; that looks fine for a number of sectors, but should not work across the complex. Citi's outlook for end-2016 projects a modest recovery in commodity prices. Significant headwinds remain in the near term including persistent oversupply, expected continued US dollar appreciation, potential further China weakness and continuing negative sentiment toward commodities. The oversupply and resulting negative sentiment stem from the robust and somewhat exuberant capex spend in the last decade unleashing a wave of new commodity supplies just as the global economy turned and Chinese growth rates plunged. Global growth pessimism and foreign exchange could be a further drag. But to what extent is this already 'priced-in'?

## Stagnating Commodity Trade Unlikely to See 2016 Reprieve

Global trade has been weak…

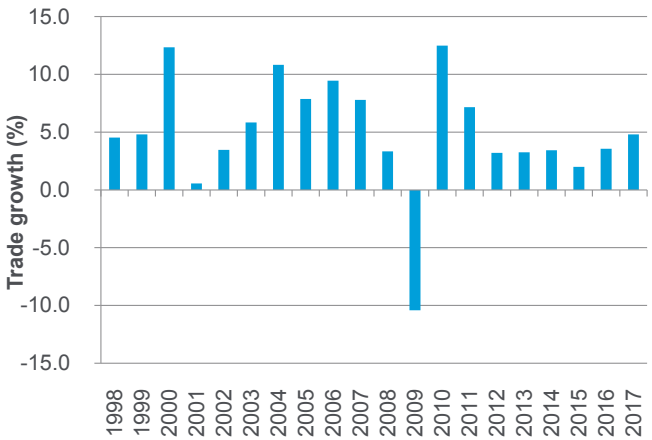
This decade was predicted to be a period of booming global trade growth of more than 6% per year, picking up from the robust expansion of global trade before 2008-09. But instead trade has been weak after an initial blockbuster recovery into 2010, falling closer to a 3% annual average.

**Figure 42. Emerging Market Export Growth vs. World Import Growth**




Source: OECD, Haver Analytics, Citi Research

**Figure 43. Trade Growth is Forecast to Recover a Bit**




Source: OECD, Haver Analytics, Citi Research

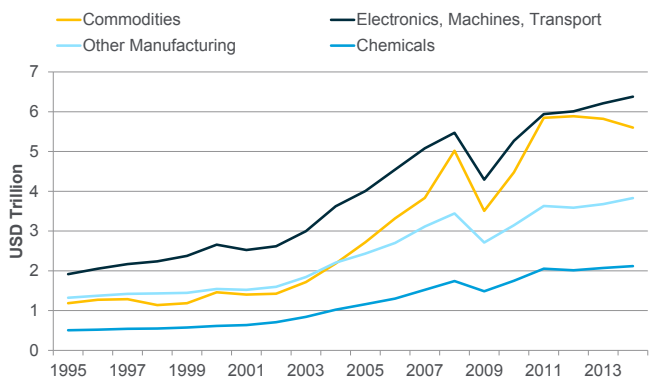
…with commodity trade most disappointing since the start of the decade

Most disappointing of all has been commodity trade, which has been contracting since the start of this decade, triggered in part by a significant decline in commodity prices since then, even if the surge in oil prices post 2010 is taken into account. Some of this contraction can be explained by the combination of China's drop in GDP growth and the structural changes in that economy as it moved from commodity-intensive fixed asset investment to a more service- and consumer-based economy. But not all of it can.

But despite slowing, commodities continue to dominate international trade

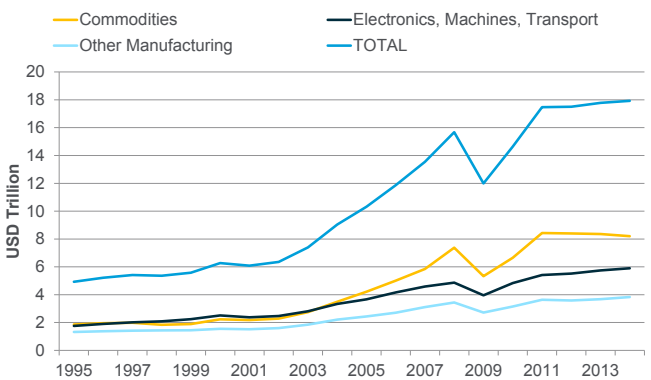
Even so, commodities continue to dominate international trade and the stagnation and decline in commodity trade has been the largest factor in the lower growth of trade globally. This is especially vivid if one combines raw commodities with processed and derivative goods based essentially on commodities. These are conventionally seen within manufacturers (e.g. petrochemicals and food products).

**Figure 44. Commodities in Particular Have Felt The Impact of Declining Global Trade**




Source: CPB, OECD, Haver, Citi Research

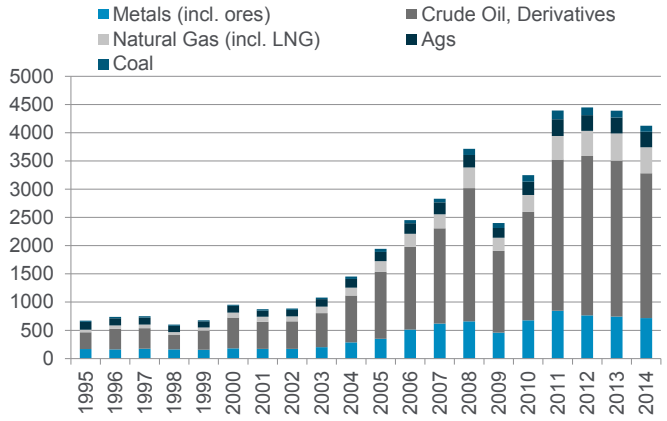
**Figure 45. Commodities in Total Trade Still Remains Dominant**




Source: CPB, OECD, Haver, Citi Research

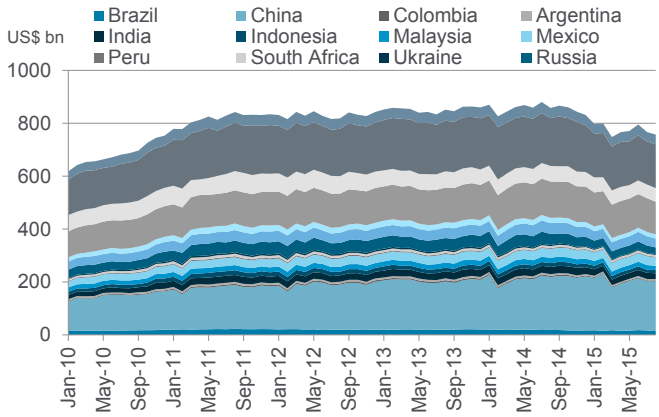
The decline in commodity trade in turn has dampened GDP growth in commodity countries and is likely to remain a drag on growth going forward. To be sure those Asian economies that had relied on supplying resources to China have been challenged by a multiplicity of factors – a drop in GDP growth in Asia Pacific (ex-China, India, Japan) to 2.5% or below combined with a sustained period of currency depreciation. This should lead to less trade across the board.

**Figure 46. Annual Global Commodity Exports: Started to Fall in2013**




Source: CPB, Haver, Citi Research

**Figure 47. Total Seasonally-Adjusted Monthly Value of Exports in Key Countries: Plateaued in 2011-14 Before Falling**




Source: Citi Research

Most amazing perhaps has been the peaking of the thermal coal trade in 2013 and a projected peaking of crude oil trade in a few years to come. The peaking of thermal coal demand is linked to its peaking in China and a slowdown in demand growth elsewhere, plus the development of local resources in China. This particularly hits hard the two largest exporters – Australia and Indonesia – and they're the more marginal producers as well. Oil trade is slowing down dramatically and is structurally shifting from crude oil to product trade, a further blow to OPEC's ability to manage markets.

## New Patterns of Commodity Trade are Also Emerging Rapidly

Traditional commodity trade patterns are set to change in the coming year

The super cycle of the last decade was characterized by China anchoring rapid global demand growth that outpaced supply, with trade flows more often than not pointing to China. In the coming decade, Citi expects that pattern to break down and instead expects:

- Slowing global trade flows as global demand growth slows in response to slower population growth, China's transition and increased oil efficiency and for oil as demand growth reorients from net importers (China, the US and Europe) to net exporters (Middle East and Latin America).
- Downstream shift by natural resource exporters as they seek to capture more of the value chain in the face of slower global demand growth and lower prices (e.g. build out of Middle Eastern oil refining capacity, and Indonesia's ban on unprocessed mineral exports).
- The US energy revolution which is turning the US from the largest importer of crude oil and petroleum products to the world's largest exporter of products and perhaps eventually a net exporter of crude. It is also expected to revolutionize international natural gas markets and is depressing coal markets.

- Reorientation to the "Emerging 5" (India, ASEAN, Middle East, Latin America, Africa) which will become increasingly important at the expense of the US, Europe and China — particularly India for oil, natural gas and coal; ASEAN for oil, coal, metals and grains; the Middle East for metals; and Latin America for natural gas.

## The Beginning of the End of the Bear Market in Oil

Following a tough 2015, Citi expects underwhelming oil demand increases as the negative implications of low oil prices for EMs predominate and persist

The oil market looks set to stumble across the end-2015 finish line in feeble fashion. Crude and distillates (the seasonal product leader) are both significantly oversupplied and in robust contango (i.e. the future price is higher than the prevailing spot price). Citi expects the second half of 2016 to be materially better, with non-OPEC declines and Saudi Arabia's production to roughly flat-line and Iraq slowing growth from current levels. Our forecast is for demand growth of 1-m b/d points to a balanced market with higher prices by end-2016. But first, the market will have to accommodate the abrupt return of Iranian barrels, most likely in the first quarter of 2016. Asian congestion is already spilling over into the Atlantic Basin and the addition of another ~0.5-m b/d of crude makes things worse.

Citi's base case for 2016 is that demand is underwhelming at 1.0-m b/d. 2015 saw the impact of a 50% drop in prices in oil demand which is now fading, while 2016 should see the negative macro implications of the low oil price for EMs to predominate and persist. The supply side is more constructive, with non-OPEC supply forecast to fall by 760-k b/d, with the US accounting for 430-k b/d of this on an annualized basis. The return of Iran drives the OPEC liquids supply growth forecast to +700-k b/d. This leaves global supply flat year-over-year, while demand is up. Yet 2015 is ending with the oil market oversupplied by somewhere between 500-k b/d and 1-m b/d, hence 2016 looks better for the bulls, but not by much.

### Near-term Oil Outlook: Even at $45, It's Not Time to Get Bullish yet

Three 'relief valves' of lower domestic supply, higher domestic demand and stronger-out-of-region pull all look capped heading into 2016

Brent, the bell weather for global crude prices, ended the year under heavy pressure from an increasingly sloppy Atlantic Basin physical market due to a large overhang of West African crude, very cheap alternative Russian supplies and increasing regional competition from Saudi Arabia and Iraq. And the three 'relief valves' of lower domestic supply, higher domestic demand and stronger out-of-region pull all look capped heading into 2016.

- Atlantic Basin supplies ended 2015 on a high in Russia and the North Sea, with output declines not expected to set-in until at least the second half of 2016. High European inventories, the 50-m barrel West African overhang and Saldanha Bay oil storage close to full add further weight to regional supplies.

- Brent-Dubai continues to widen in early 2016 as an increasingly congested Asian crude market is seeing Saudi Arabian and Kurdish crude make its way to Northern Europe. The likely return of Iranian oil should help keep the pressure on Brent-Dubai whilst the tax rebate change to South Korean non-Middle East imports may reduce the pull of North Sea barrels in the near-term.

- Despite a narrow WTI-Brent spread, LLS-Brent is only at parity and the combination of a gradually slowing US output, Canadian pipeline imports and PADD III (Gulf Coast) January maintenance make a strong US import pull unlikely in the first half of 2016.

- European refinery runs are already high, after a light maintenance season. The upside potential is minimal vs. December and the outlook for first quarter margins is subdued as both gasoline and distillate cracks are expected to compress.

## Dangers to Political Stability in Petro States Loom Over the Market

Low oil prices have increased geopolitical risks, especially to governments over-reliant on oil and gas revenues

Low oil prices have brought new geopolitical risks, as governments over-reliant on oil and gas revenues scramble to meet domestic needs. The risk of further supply disruptions is ever present on the horizon, even as deferred prices continue to reflect very little in the way of supply risks.

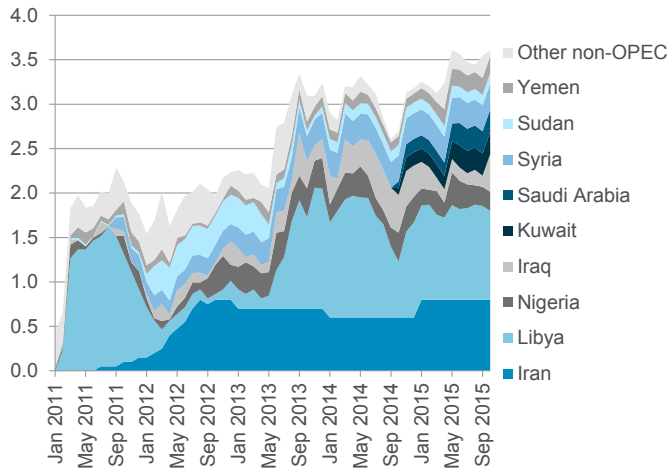
Saudi Arabia's increased production to over 10-m b/d has also reduced the supply cushion available to meet new supply curtailments, as major OPEC producers, including Iran, Nigeria and Venezuela are confronting severe governance issues and, in two cases, fragmentation risk.

In this structurally over-supplied market, energy geopolitics remains zero-sum but the focus has moved from a producer-consumer face-off or 'I win, you lose' to a producer vs. producer setting of winners and losers.

More generally, the dominance of three major producers — Russia, Saudi Arabia and the US — with their combined ~38-m b/d of liquids supply looks more critical than OPEC as a whole. Two of the three giants are petro states suffering severe financial pain with an urgent need to diversity their economies.

The battle among producers for access to markets outweighs the battle with non-OPEC suppliers. Asia looks to set the stage of severe competition involving Russia and the Middle East producers for years to come. Meanwhile, key producers are involved in critical interactions in the Middle East where resolving Syrian succession might be more important than formal OPEC meetings in setting future supply levels.

**Figure 48. Global Supply Disruptions Still at a High (2011-15, m b/d)**




Source: EIA, IMF, Citi Research

**Figure 49. Fiscal Breakeven Prices a Moving Target**

| | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|
| Algeria | 125 | 111 | 130 | 111 |
| Bahrain | 119 | 125 | 123 | 94 |
| Iran | 98 | 116 | 102 | 93 |
| Iraq | 103 | 115 | 107 | 71 |
| Kuwait | 49 | 42 | 57 | 47 |
| Libya | 63 | 111 | 206 | 215 |
| Oman | 80 | 98 | 108 | 94 |
| Qatar | 63 | 61 | 59 | 59 |
| Saudi Arabia | 78 | 89 | 111 | 103 |
| UAE | 70 | 70 | 74 | 73 |
| Yemen | 237 | 215 | 160 | 164 |
| Russia | 106 | 108 | 100 | 85 |
| Venezuela | 175 | 108 | 161 | 150 |

Source: EIA, IMF, Citi Research

## The Composition of Oil Demand Growth Gives Cause for Concern

In 2014, global oil demand grew at 0.8-m b/d with a global economy growing at 2.7% and an oil price of $100/bbl. In 2015, oil demand growth is estimated to have been about 1.7-m b/d at an average oil price of $53/bbl and despite a global economy growing at just 2.6%. Yet, looking deeper at the breakdown of oil demand, growth shows underlying structural weaknesses that should cap demand growth going forward:

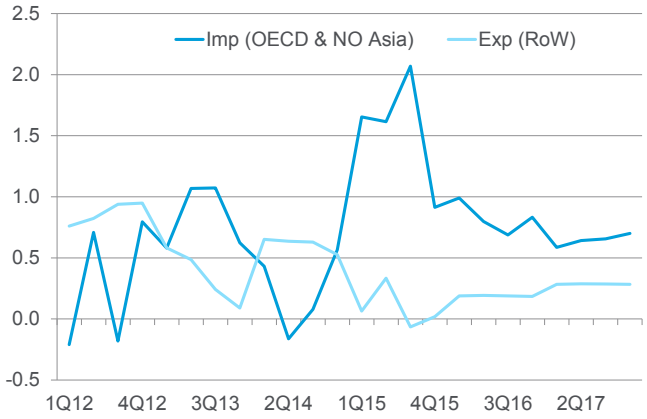
The perception that a falling oil price was an EM positive was misplaced. Aside from non-OECD Asia, all other non-OECD regions are oil exporters and are reeling from the lower oil price. Oil demand growth has buckled in 2015 and the bleak outlook for EM economies (in large part due to lower commodity prices) should keep oil demand prospects muted.

Oil importers have benefitted through the 'price-effect', which should dissipate in 2016. The US and Europe show signs of economic growth but Chinese 'apparent demand' growth of 0.6-m b/d in 2015 should be under the additional pressure of a slowing economy that is increasingly less reliant on fossil fuels for growth.

Consumption-led products (gasoline, jet, petrochemicals) have seen strong one-off growth due to lower prices but industrial activity-led products (fuel oil, distillate) have struggled.

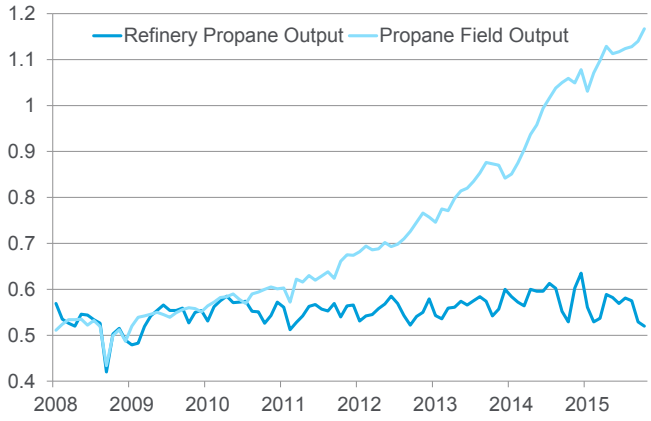
An increasing amount of oil demand growth is coming from liquefied petroleum gases (LPGs) which are coming from gas production. This means that figures captured in headline oil demand aren't coming from sources of "real" oil supplies.

**Figure 50. Oil Importers vs. Exporters YoY Oil Demand Growth (m b/d)**




Source: IEA, EIA, Citi Research

**Figure 51. US Propane Production by Source (m b/d)**




Source: IEA, EIA, .Citi Research

All in all, 2016 is likely to see significant price volatility and a price path that should look like a series of W's with an end-of-year upward bias. But probabilities are higher for a more bearish than a more bullish price path, given Chinese demand and growth possibilities and a likelihood of supplies from Libya coming back into the market. To be sure there are bullish possibilities, led more by potential supply disruptions from crippled petro states than from an unexpected surge in demand.

# 6. 'Old' Geopolitical vs. 'New' Socio-economic Risk

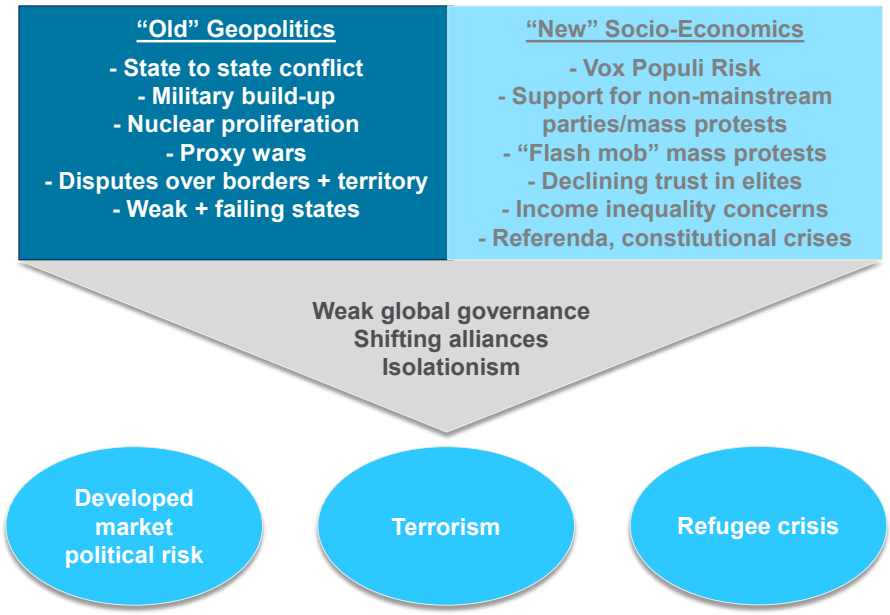
**Tina Fordham**
Chief Global Political Analyst

After a number of years when geopolitical and *Vox Populi* risks have gained strength but failed to become systemic, investors should be prepared for the convergence of rising 'old' geopolitical risks with evolving 'new' socio-economic risks. Such outcomes are already in evidence with the burgeoning refugee crisis and the spike in terrorist activity, symptoms of profound foreign policy failures colliding with shortcomings in global governance. Together, these risks may form a toxic brew that exceeds the capacity of central bank liquidity to mask them.

Geopolitical risks have the potential to disrupt…but socio-economic risks could undermine the global system

In terms of event risks, geopolitical risks likely bear the greatest potential to disrupt markets in terms of event risk in the year ahead. But failure to address new socio-economic risks — such as lack of trust in elites, income inequality and youth unemployment — runs the arguably much greater risk of undermining the functioning of the global system, creating a negative feedback loop. There is also the potential for geopolitical risks to intersect with economic fragility in the event of a downturn, amplifying both. That said a range of possible outcomes and 'silver linings' may also emerge.

**Figure 52. "Old" Geopolitics vs, "New:" Socio-economics : What Matters Most for Markets?**




Source: Citi Research

## What Do 2015 Elections Tell Us About the State of *Vox Populi* Risk and the 2016 Political Outlook?

2015 saw approximately 15 geopolitically or systemically significant national elections. Of these, incumbents were re-elected in seven cases, while eight brought about changes in government. Overall, center-right parties have been the main beneficiaries in 2015's elections, winning in 10 of our 15 country cases; we think this could be the beginning of a trend that bears watching.

Support for non-mainstream political parties has continued despite modest improvements in economic growth

Despite modest improvements in economic growth in many cases, support for non-mainstream parties has continued, testing the assumption that economic downturns prompt voters to gravitate away from the mainstream; we see this evolution as part of a longer-term structural trend away from mainstream political parties. In 11 of the key elections we tracked, non-mainstream parties received over 10% of the vote, while in five cases they received over 20% of the vote.

But despite their popularity, non-mainstream political parties are rarely winning outright at the polls

Non-mainstream parties have benefited from declining public trust in elites, unevenly distributed benefits of growth, and the perceived irrelevance of mainstream party politics. At this junction, non-mainstream political parties are rarely winning outright at the polls (Greece's Syriza is a rare exception), but they are contributing to more fragmented governments and influencing the political debate with their often unorthodox policy ideas.

## Before Paris, After Paris

The Paris attacks mark a turning point with global implications

The November terrorist attacks in Paris took place in a year that saw a significant uptick in the nature and the extent of the risk of terrorism, mainly at the hands of ISIS. In our view, the Paris attacks mark a turning point with global implications. In a tactical sense, the attacks marked a new stage in ISIS's approach, being a series of coordinated attacks, perhaps centrally planned and, crucially, outside of ISIS's field of operations (the self-proclaimed 'Caliphate'), where it has thus far sought to establish its parallel state and expand its territorial reach. It remains to be seen whether the group has the capacity to launch other attacks in developed market capital cities, with Brussels having been subject to a police lockdown for a period of days in November.

Terrorism is not a new risk, but levels, frequency and the number of countries affected are all on the rise

Terrorism is not a new risk. But levels, frequency and the number of countries affected are all on the rise with as much as an 80% year-over-year increase in deaths from terrorism in 2014 — the largest yearly increase in the past 15 years. Although five countries accounted for 78% of deaths in 2014 due to terrorism (Syria, Iraq, Nigeria, Afghanistan and Pakistan), a majority of countries experienced a terrorist incident. Private citizens are also increasingly targeted, with a 172% year-over-year increase in deaths.

Maintaining open borders has never seemed under greater threat in the post-Cold War era

There has also been a 120% increase in the past year in the number of countries that have experienced more than 500 deaths due to terrorism. Overall, levels of violent conflict are at a post-Cold War high, according to the Uppsala Conflict Data Program, which tracks three types: armed conflicts between states, conflicts between non-state groups and civilian massacres. ISIS's shift away from the symbolic soft targets of Al Qaeda's 'spectaculars' to mass shooting incidences in capital cities will be difficult to combat. With the flow of foreign fighters to and from Syria continuing, maintaining open borders has never seemed under greater threat in the post-Cold War era.

## For 2016, Fewer Systemically-Significant Elections

2016 holds few scheduled political signposts with the potential to influence global markets

There are — perhaps mercifully — relatively few systemically significant scheduled political signposts with the potential to influence global markets in 2016. The most impactful include US presidential elections in November and the UK referendum on EU membership (due by end-2017 but likely earlier). Taiwanese general elections and South Korean parliamentary elections will also take place, with Taiwan especially closely watched given the country's relationship with China. Other government collapses and/or snap elections may also emerge, of course, where governments fall under pressure.

The political significance of 2016 may be less about election results but how economic and political conditions will influence the coming constellation of systemically significant elections in 2017

Instead of the usual focus on election watching, it may be that the political significance of 2016 will not be about election results, but in how economic and political conditions in the year ahead will influence the coming constellation of systemically significant elections in France and Germany in 2017 and the context for scheduled leadership transitions in China and Russia.

**Figure 53. Selected 2016-2018 Elections and Political Signposts**


Source: Citi Research

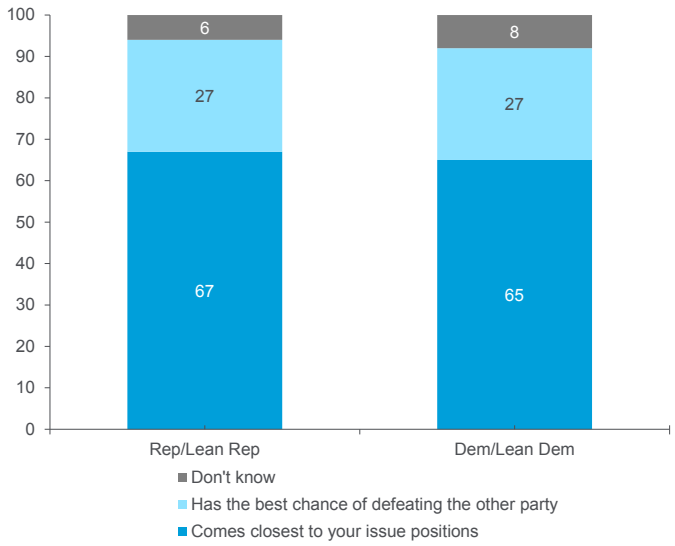
## US Elections – The Rise of Anti-Establishment Candidates

Anti-establishment candidates have emerged in the US with American supporters, but will they actually vote for them?

Candidate after candidate so far in the US presidential campaign has made blunders that would, under other circumstances, have cost them public support. This time, Americans seem to be rewarding candidates who depart from the usual political scripts with their support, suggesting a US variation on anti-establishment sentiment, manifested as support for non-mainstream candidates rather than new political parties. But will Americans vote for these candidates in the ballot box, or return to establishment candidates? With just under a year to go, the US political establishment and markets have not been overly concerned, with most treating the race as rather colorful political theater, but we suspect that will change as the primary process begins.

An October 2015 survey by Pew Research found that, of likely US primary voters, 65% of Republicans want a candidate who offers "new ideas and a different approach" over "experience and a proven record", up from 36% in March. Voters also want a candidate who shares their views. Majorities of Republicans (67%) and Democrats (65%) say it is more important to pick a candidate who comes closest to their views on issues — rather than electability. Just 27% in both parties say it is more important to choose a candidate who has the best chance of winning in the general election.

Figure 54. Rise of Political Narcissism? Views Like Me vs. Electability




Source: Citi Research, Pew Research center (survey conducted Sept 22-27, 2015)

Figure 55. Key Dates for US Presidential Election

| Date (2016) | Event |
|---|---|
| 1-Feb | Iowa caucus |
| 9-Feb | New Hampshire primary |
| 20-Feb | Nevada caucus (Dem), South Carolina primary (GOP) |
| 23-Feb | Nevada caucus (GOP) |
| 27-Feb | South Carolina primary (Dem) |
| 1-Mar | Super Tuesday - Alabama, Alaska (GOP), Arkansas, Colorado caucuses, Georgia, Massachusetts, Minnesota Caucuses, Oklahoma, Tennessee, Texas, Vermont, Virginia |
| 15-Mar | Florida, Illinois, Missouri, North Carolina, Ohio primaries |
| 18-21-Jul | Republican National Convention |
| 25-Jul | Democratic National Convention |
| 8-Nov | US Presidential Election |

Source: Citi Research, MSNBC, NY Times, www.uspresidentialelectionnews.com

With elections in the US not until November, watchers should be prepared for a long and winding road

US election-watchers should be prepared for a long and winding road to November 2016. Party conventions and nominations do not take place until the summer, leaving plenty of opportunity for campaign gaffes, grandstanding, scandals and debate. Whatever the outcome, there will likely be broad continuity of US foreign policy under either party leadership, a trend that has held for some time. We do not expect, for example, to see a shift to a significantly more interventionist foreign policy approach under the leadership of either a Democrat or a Republican president, though a more hawkish tone could emerge.

## Could the UK Vote to Leave the EU? Rising Brexit and UK Breakup Risk

A UK vote for Brexit was once a tail risk, but support is on the rise and if it transpires, would likely prompt a wider unraveling within Europe

Could the UK vote to leave the European Union? Once no more than a tail risk, in our view Brexit risk is on the rise, with perhaps a 20-30% probability. The pro-EU lead has fallen in recent months to roughly 3 percentage points. Could Brexit really happen? It is far from impossible — we consider Brexit risk to be one of the top global political risks; if it transpires, it would likely prompt a wider unraveling within Europe.

A vote to leave the EU would have implications beyond the future of Britain in the EU. Firstly, Brexit would likely lead to the breakup of the United Kingdom, as the Scottish National Party-led government of Scotland have indicated that they would hold a second referendum on independence. And secondly, Brexit followed by Scottish independence could hasten the unraveling of other nation-states, with other separatist movements, such as Catalonia, pursuing independence with greater vigor. It is also unclear what the effect of the first EU member state to vote to leave would be on the political debate within and among the remaining members.

## The Refugee Crisis and EU Political Risk: Welcome Refugees, Goodbye Merkel?

The refugee crisis is emerging as a significant source of political risk and will test cohesion between EU member states

European policymakers are struggling to resolve the refugee and migration crisis, which follows in the wake of a list of challenges — from the Greek debt crisis, the Russia-Ukraine conflict and the broader challenge of reforming the Eurozone and EU architecture — and is emerging as a significant source of political risk. In addition to influencing election outcomes, the refugee crisis will test cohesion between EU member states, requiring burden-sharing on a topic much more unpopular with their voters than bailouts: immigration. The potential for the refugee and migration crisis to destabilize the EU could eventually overshadow Grexit (in any case a lower risk for 2016 than in previous years). Could it also be the undoing of the European politician who has done the most to attempt to address it?

For the first time in a decade in power, German Chancellor Angela Merkel's political future is in question. Her approval ratings have fallen sharply since the refugee crisis accelerated, from 67% in August to 49% in November 2015. Although in our view the Chancellor could very well weather yet another test of her leadership and go on to win a fourth term, we regard a Merkel-exit ahead of German elections (due in 2017) as one of the most destabilizing political risks for the EU, and one with the potential to impact markets.

Even before the refugee crisis accelerated in the second half of 2015, elections in Denmark and Finland earlier in the year saw strong support for anti-immigration parties. The refugee crisis and terrorism risks are also highly likely to influence the outcome for French national elections in 2017.

Anti-immigration parties have seen a rise in voting percentage across Europe even before the refugee crisis accelerated

In 11 out of 17 recent European elections, anti-immigration parties have seen a rise in voting percentage. The Finns Party and Golden Dawn in the January Greek election were the only parties with an anti-immigration platform to lose votes this year. However, the Finns Party was able to join the government for the first time and Golden Dawn saw an increase in votes in the second Greek election (held in September). It is possible that the decline in votes seen in Norway, the Netherlands, Bulgaria, Italy and Belgium were due to elections being held before 2015 — when the refugee crisis became such a huge concern for European publics.

On the EU periphery, anti-establishment parties more generally (typically anti-austerity) have also continued to perform strongly in 2015. Syriza is the only non-mainstream party to have won the largest share of the vote in European elections in 2015, but the new Leftist coalition government in Portugal is another potential source of political risk to watch in the year ahead. Led by the Socialist Party (PS) in alliance with the Left Bloc (BE) and the Communist Party (PCP), the coalition's emergence came as a surprise, making the first Portuguese government to include a far Left party since the emergence of democracy in 1974. To what extent the new government will maintain its commitment to austerity is unclear.

## Geopolitical Outlook: Syria Conflict in its 5th Year and Iran Sanctions

The Syrian conflict endures and the security situation has worsened

As the Syria conflict enters its fifth year, Europe's political imperative to stem the flow of refugees and Russia's expanded military intervention in Syria are altering the regional political calculus, forcing Washington's hand as the US enters an election year. The Obama Administration's decision in November of 2015 to send approximately 50 'special advisors' highlights the degree to which the security situation has worsened, compelling President Obama, who came to power promising to extricate US forces from these conflicts, to revisit the US stance.

It is difficult to envision a durable political solution emerging soon

What will be the impact of these moves: will the conflict expand, or could the refugee crisis and Paris attacks provide the impetus for international cooperation that will pull the Syria conflict out of its downward spiral — and potentially lead to a rapprochement between Russia and the West? Although diplomatic differences have narrowed encouragingly, it is difficult to envision a durable political solution emerging soon. The November Turkish-Russia military incident underscores the risk of so many actors, with often competing interests, operating in an increasingly crowded military theater.

We are not optimistic that Russia's cooperation on Syria will lead to a lifting of Russian sanctions

Following the burgeoning cooperation between Paris and Moscow over fighting ISIS in Syria, hopes have grown for a 'Grand Bargain', where cooperation on Syria will lead to the lifting of Russian sanctions. We do not share this optimism however, given that the main condition of the Minsk II accord — respect for Ukraine's territorial integrity — has not been met. Furthermore, official US statements have stressed avoiding 'linkage' between the two disputes. With this in mind, and despite opposition from some EU member states, we maintain our view that Russia sanctions will be extended likely through most of 2016.

## Silver Linings

Is it all doom and gloom? Definitely not. 2016 could see cooperation between Turkey and the EU to address the refugee crisis, potentially reviving broader relations including Turkey's long-stalled EU membership bid, with the first glimmers of progress in this direction beginning to emerge. Increased cooperation between Russia and the West over the Syria crisis is possible in 2016, potentially leading to an improvement in ties that dropped to their worst level in decades.

2015 has also witnessed a number of diplomatic and trade breakthroughs, from the Iran deal to the end of the Cuba embargo highlighting the power of diplomacy. The US and 11 other nations reached a deal on the Trans-Pacific Partnership after five years of negotiations — potentially tying together 40% of the world's economy and eliminating 18,000 tariffs. Most importantly, the US-China relationship — arguably the most important bi-lateral relationship in the world — is on a solid and professional footing, the "frenemies" element of competition and occasional friction notwithstanding.

The US Congress, previously a source of significant political risk for financial markets with threats over stand-offs on raising the debt ceiling, fiscal cliff concerns and more, also seems likely to fade as a catalyst for market risk in the months ahead of the November 2016 election.

## Conclusion

We are more worried than at any time in recent memory about the risk of military accidents and close encounters

Although state-to-state conflict is not our base case scenario, we are more worried than at any time in recent memory about the risk of military accidents and close encounters — as evidenced by the November 2015 downing of a Russian military jet by Turkey, an incident that has sparked trade sanctions and inflammatory rhetoric. Other risks to watch include the potential for large-scale unconventional terrorist attacks, i.e. using chemical, radiological or nuclear weapons.

A number of other concerns persist, such as the militarization of the South China Sea and the stability of the opaque and brittle regime in North Korea, while the future of the US role in regional security is being questioned despite the formal US-Japan security guarantee.

Failures to address socio-economic issues increases the likelihood that *Vox Populi* risk could undermine globalization

Over the long term, failure to devise policies to address middle class anxiety and declining living standards increases the likelihood that *Vox Populi* risk — including mass protests and government collapse — could move from being episodically disruptive to systemic, undermining globalization in the process. And we are deeply concerned that the political capital necessary to stem the refugee crisis and terrorist threat, perhaps best characterized as the collision between previous foreign policy failures and current governance capacity, exceeds that available to government leaders, who have relied upon central banks to manage the lion's share of global crises over the past several years. 2016 could be a very political year for markets.

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# Industry Themes

# 7. Virtual & Augmented Reality

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**Christopher Danely**
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What will be the next new device likely to develop a market comparable to smartphones, a market said to be worth $400 billion annually? We believe virtual reality and augmented reality (VR/AR) will create major new markets that replace the smartphone, eventually developing into a combined terminal market of $19 billion by 2035. VR and AR overlap in part with the concept of the Internet of Things (IoT). These are new spheres of technology likely to have a major impact on the future of e-commerce and mobile commerce, believed to be worth $3 trillion annually.

## What are VR and AR?

Virtual reality and augmented reality refer to the experience of a high-resolution graphics environment through a cutting-edge device (such as a headset or eyeglass-type terminal) that draws on advanced displays, graphics semiconductors, motion sensors and headphone technologies. VR and AR allow users to take in new information via recognition of artificially created objects.

Virtual reality involves a goggle-type display that completely covers the field of view. Wearing the display, users experience the illusion of inhabiting an artificial space. Users see computer graphics that move in tandem with movements of their head, neck and body, and hear sounds in the virtual world through headphones. If the quality of the graphics is high enough, users come to accept the idea that they are actually within an artificially created world.

Augmented reality, while similar, does not necessarily immerse the user in a virtual space. Instead, users experience AR through computer generated images superimposed over their view of the real world. AR is characterized by the use of computer graphics while recognizing the real world at the same time. AR allows computer graphics to appear like real images within real spaces. Perhaps the most important feature of AR is that it allows mobility.

## Technology Barriers are Solvable

Costs of the headset in VR and reduction in power consumption in AR are key to barriers to uptake

Whether market penetration of VR/AR increases greatly will depend on technological progress and it is particularly important for the initial cost to come down. For VR, the cost of the headset is likely to be some $450, and it will be necessary to connect it to a high-end PC costing around $1,000. This is because a high–performance graphics card is needed to process the computer graphic that is projected onto the VR headset display. In the case of AR, mobility is the key to market uptake. For this, the performance of the semiconductors and other electronic components in today's smartphones would be ample for the key components in AR headsets, but reducing power consumption is the critical determinant of mobility.

PS4 already provides hint to solution of cost problem

We are optimistic regarding the cost problem. In the technology world, innovation has repeatedly reduced the cost of realizing the required functionality and performance. In addition, the PlayStation4 will be used as the computer graphic processing computer for the PlayStation VR headset to be launched in 2016, and the price cut in 2015 means that a machine with 1,830GFLOPS (single precision) of processing can be bought for $349.

Improvement in GPU performance key to market uptake of VR/AR

We think that in the future all necessary functions for VR and AR will be built into the headset. But during the transition period over the next 10 years, the speed of computer graphic processing by the graphics processing unit (GPU) and other components, and the extent to which power consumption can be reduced will be important. Our analysis concludes that technological development will be insufficient

in the next 10 years for the GPU processing capacity necessary for VR to be powered by a battery. Nevertheless, the cost of a PC to connect with using a cable will fall sufficiently.

Ample room for development of VR/AR displays

The displays currently used in VR/AR do not fully satisfy requirements. For VR, liquid crystal displays (LCDs) or organic light-emitting diode (OLED) displays are used. Only a few products currently use a refresh rate sufficiently high to ensure users do not experience motion sickness. In AR, Google Glass uses a prism, but this is a transitionary technology and a transparent display will ultimately be adopted so that AR computer graphics can be displayed on a wider field of view. We think that if it becomes possible to manufacture high-performance transparent displays at low cost, the VR/AR headset market will take off rapidly. We would see a figure of around $20 as one benchmark, enabling cheaper headsets and extending battery life.

## Headsets to Drive VR/AR Market Growth in Near Term

Focus on headset market expansion over the next five years

Attractive hardware as well as context and software are necessary for the VR/AR market to expand. Widely distributed personnel and elemental technologies (including services, retail, tourism, amusement parks and sporting events) are a feature of the VR/AR industry. Over the next five years, we forecast hardware, mainly headsets, will be the driver of industry growth. We expect VR headsets to become established first and we believe improving VR headset performance and lowering prices will be key to getting the market off the ground.

Headsets is the key

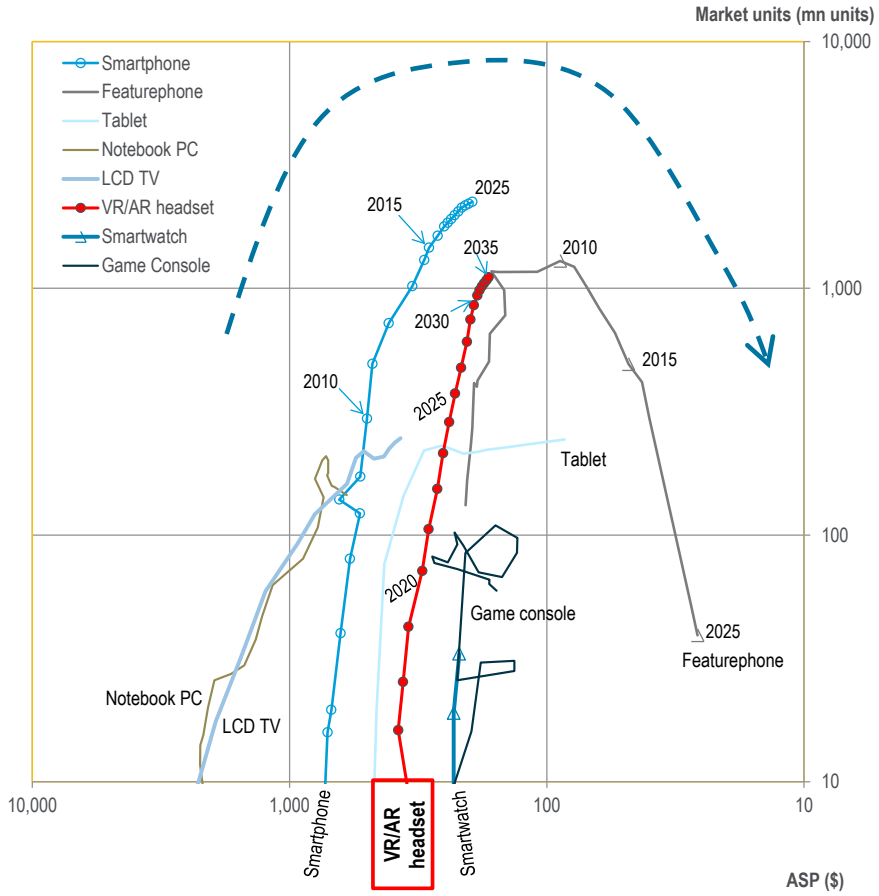
Why do we think hardware – particularly headsets – will be vital for the overall VR/AR market in the short-term? The e-commerce market did not take off until PC uptake was sufficient. The market has now hit $1 trillion and has been growing at 10%-20% annually. Within e-commerce is the growing field of mobile commerce using mobile phones. This market has been expanding in line with the uptake of smartphones, with little difference in timing between an increase in device usage and expansion for commerce. The mobile commerce market is currently around $300 billion and has been expanding at a rate of 30%-50% annually. This suggests that increasing popularity of VR/AR headsets is likely to mean rapid expansion for AR commerce at roughly the same time. In our view, the key to AR commerce expansion is headset expansion.

In addition, in terms of investment, efforts in VR/AR are not exactly new in commerce. Additional investment is necessary, but we think it will be smaller than that needed to launch the first online shop, and visibility on the future of the business is better. The psychological hurdle to spending on VR/AR content and services seems low, and we think it will expand as headset uptake does.

Headset expansion to look similar to smartphone expansion

We think market expansion for VR/AR headsets is likely to look like that for smartphones in terms of speed and scale. We also anticipate similarities in terms of application and costs for electronic components and semiconductors.

**Figure 56. Prices and Volumes for Major Consumer Electronics Products**




Source: Citi Research

## VR to Take Off First, Followed by AR and Commerce

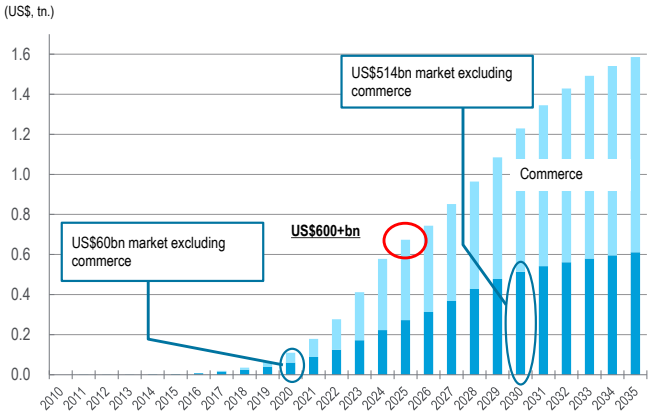
Massive markets for both hardware and software

We project long term growth in the VR/AR market to $674 billion in 2025, and further growth thereafter. The market is set to ramp up starting in 2016 and we forecast the compound annual growth rate to be 122% for the 10 years through 2025.

The market will begin to ramp up with the simultaneous launch of both VR and AR headsets, but we think that VR will be the main driver over the first five years. We forecast a market for hardware (headsets) of $85 billion in 2025, assuming sales of 375 million units in 2025 and that the average unit price declines from $342 in 2016 to $227 in 2025.

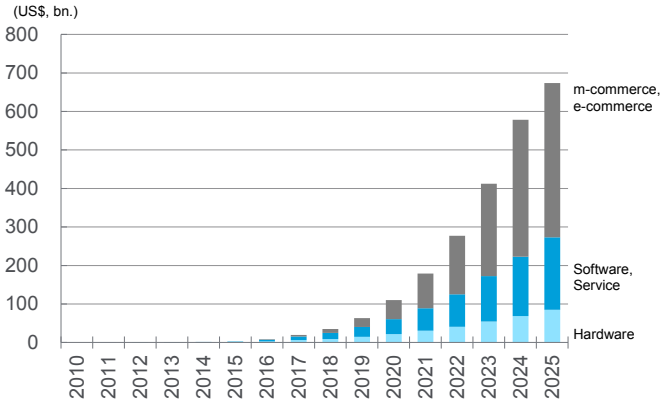
We think the primary VR content will initially be game software, but that the market will then expand to include movies, TV programs and music before broadening to encompass concerts, zoos and theme parks. We think the market will remain small, at just $3.8 billion in 2016, but we forecast growth to $29.3 billion in 2020 and $107 billion in 2025. AR is likely to be trialed in areas with special needs, such as construction sites and warehouses (material handling) and medicine from around 2020 and gradually spread from there. Thereafter, we expect miniaturization and reductions in the power consumption for AR devices (glasses, goggles and headsets) to be worn on the eyes and head to promote explosive market uptake by consumers.

**Figure 57. Estimated Market for VR/AR**




Source: Citi Research

**Figure 58. Breakdown of VR/AR Market Into Hardware, Software & Services and Commerce**




Source: Citi Research

## Can AR Eat into the Smartphone Market?

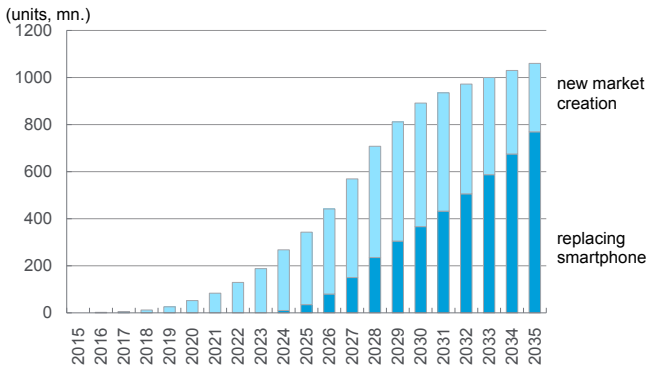
Net gains or cannibalization?

When wearing a VR device, the user is typically restricted to using it in a single location. Because of this, VR devices are a new type of product that does not overlap with established consumer electronics products in terms of hardware. That is, VR devices can be considered as a genuinely new industry capable of driving net growth in the consumer electronic equipment market.

AR differs from VR as consumers can use AR in areas like mobile commerce, email, phone/texting and in mobile meeting tools at work. AR could also be used for mobile advertising, as on smartphones. In other words, the pattern of use of AR will resemble that of a smartphone. For this reason, we think AR will start to erode the smartphone market on both the hardware and software sides.

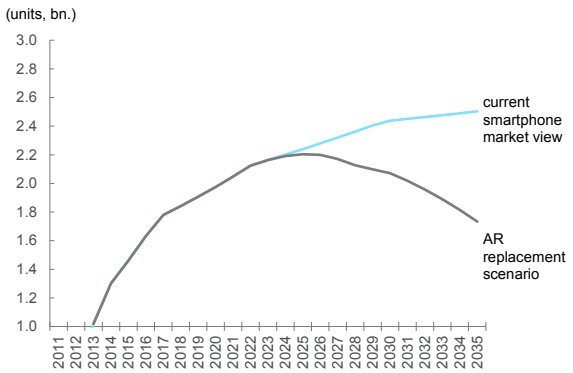
In our current market model, in working out the size of the hardware market for AR headsets, we assume that the majority of growth in the AR headset market from 2025 onward will be achieved at the expense of the smartphone market. The 2025 timing is based on anticipated progress in AR headset technology. However, the shift could happen earlier if improvements in the quality of transparent displays or the development of miniature computers gain pace.

**Figure 59. AR Headsets to Replace Smartphones?**




Source: Citi Research

**Figure 60. Smartphone Market Trends Should AR Headsets Eat Into Demand**




Source: Citi Research

VR/AR can still be a new growth driver for the consumer electronic equipment market

Even though we think AR headsets will erode some of the smartphone market, we still think VR and AR are the keys to the resumption of growth in the consumer electronics equipment market. In our simulation, we expect VR/AR headsets to play a driving role in the digital appliance industry between 2020 and 2025.

We do not expect much positive news for the consumer appliance market in the near term. We see a struggling smartphone market coupled with a headwind from PC market contraction. There is also substantial concern about negative growth for products like conventional satellite navigation systems, DVD players and TVs. Wristwatch-style wearable devices and wristband-type wearables are starting to gain traction, but with volumes of around 20 million units at the largest players the market is still some way short of the hundreds-of-million-unit scale of the smartphone, PC and TV markets. VR/AR will not offer direct support to the industry as a whole either. We therefore expect the stagnation in the hardware industry to deepen,

## VR/AR Outlook

Current market forecast models do not necessarily factor in changes to VR/AR device applications and demand for them as their performance improves. This is understandable as there are limits to how far out a meaningful roadmap can be drawn. Over the next 10 years or so, however, we believe both VR and AR devices will steadily evolve.

The three stages of VR

VR starts with users viewing a virtual scene in isolation and ultimately evolves into an immersive experience where they feel part of a virtual world. AR starts by displaying part of a users' actual field of vision in a text box. Semi-transparent landmarks, figures and other computer graphics are then introduced into the real-world scene in such a way as to appear natural. In the final stage, objects and people that have a convincing life-like quality are introduced and users are able to interact with them (move objects, talk to people, etc.)

Skype and Facetime video call services share concepts found in VR. Metal Gear Solid and other first-person shooter (FPS) video games are also close to virtual reality. But video calls/FPS video games are a far cry from immersion in a virtual world and are more accurately described as isolated experiences. The next stage is to create a virtual setting (ambience) around the user. This is done by looking at a VR headset display, rather than a laptop PC or TV screen. In the case of a roller coaster computer graphic, the user would be engulfed by the screams of the other people on the ride.

The final stage of VR evolution is the immersive experience. Users enter a virtual world in which they can roam over hills, hold business discussions with customers, or dance with their grandchildren. This is not just the sensation of watching a virtual work but of actively engaging with it. We expect this will involve users wearing a headset as well as clothing devices (gloves, shoes, pants) that enable the virtual world to respond to their movements.

The three stages of AR

We expect AR to evolve in three stages. The first stage is digital display functionality on vehicle windshields (speed, etc.). This allows drivers to know if they are travelling at a safe speed without having to divert their eyes to the dashboard. However, this type of computer graphic does not follow the driver's line of sight. The next stage is using semi-transparent images to display directions, signals, road signs, etc., in the driver's field of vision. A feature of the second stage of AR is that the computer graphic works in unison with the movement of the vehicle. The final stage is the introduction of life-like computer graphics. In ten years, we think a child's model globe could have a number of items orbiting around it.

AR to change our world

By projecting virtual objects or people in real space through the use of AR, it has become possible to intuitively convey images of objects or people that previously had to be imagined. By superimposing 3D computer-generated imagery over real-time images, AR allows users to view and touch objects from different angles in an almost realistic fashion and to use a gyroscope to adjust view and aspects. This not only offers greater convenience, it may also affect human sensibility. Put another way, humanity's desire to own material things and infrastructure could wane and the importance of objects existing physically before one's eyes could also diminish.

In the world of AR, it is also possible to superimpose text, statistics, or other information forms over real-life images or background scenes. We believe this will bring life changes similar to those triggered by the birth of the Internet. As this technology not only allows explanations of immediate events/phenomena even where there is no prior memory or knowledge, it also makes it possible to obtain information to augment existing knowledge such as up-to-date information and statistics (support ratings, sales, traffic, news, etc.). Customizing such information to an individual's needs also appears feasible, especially when linked to profiles, data sets and productivity applications relevant to that user.

# 8. Big Data and Investment Management

**Sandy Kaul**
Global Head of Citi Business Advisory Services

Big data is a catchphrase for a new way of conducting analysis. Big data principles are being adopted across many industries and in many varieties. However, adoption so far by investment managers has been limited. This may be creating a window of opportunity in the industry.

Investment managers that can harness big data could create an information edge

Investment managers who are able to harness this new approach could potentially create in information edge in their trading that would put them significantly ahead of their peers and allow them to profit from an "information arbitrage" between their expanded models and those of investment managers following more traditional analytic techniques.

Big data increase the volume of data and the velocity that data can be processed

Big data increases 1) the volume of data that can be incorporated into investment models and 2) the velocity at which that data can be processed.

- Big data is based on the blueprint laid out by Google in 2003 around the technology and architecture it developed to handle the massive amounts of data it had to process, store and analyze from retained searches and other applications.
- Big data technologies rely on file-based databases in addition to traditional relational databases. As such, they can store not only structured data, but unstructured data as well. This means that new data sets can be added to a quantitative or systematic model more easily, without a lengthy cleansing, normalization, mapping and upload process.
- Big data technologies also rely on clusters of distributed hardware for processing and on techniques that bounce inquiries from cluster to cluster to utilize any free capacity within the system. This is different than providing point-to-point inquiries to a dedicated server. Because of its distributed nature, big data technologies can process large sets of data at high speeds that facilitate the exploration and testing of new investment hypothesis.

Parallel to advances in storage and processing has been the development of new types of data

The third facet of the big data phenomenon relates to the variety of data that can now be accessed and the fact that many of these data sets did not exist a few years ago. Parallel to advances in the storage and processing of data has been the development of new types of data being created, primarily due to the growth of the Internet, the advance of social media and the emergence of new Internet of Things that provides sensory readouts on a huge variety of physical subjects. As these new content sources have developed, there has been a surge in 'datafication', which is defined as the "ability to render into data many aspects of the world that have never been quantified before."[31]

With the improved volume, velocity and variety of data inherent in the big data approach, the innovation seen in systematic trading models over the past decade could accelerate. Similarly, a wage of innovation could begin in the quantitative investment space as the differences between what used to represent quantitative versus qualitative research disappear.

[31] "The Rise of Big Data: How It's Changing the Way We think About the World", Kenneth Neil Cukier and Viktor Mayer-Schoenberger, Foreign Affairs Magazine, May/June 2013 Issue.

- Quantitative fundamental investment researchers could employ big data techniques to expand the number of variables they examine to include data around behaviors, opinions and sensory feedback, areas that were previously only the domain of discretionary fundamental researchers. This could allow for a broader model-based view of what constitutes relative, analogous, superior and inferior value using a new set of data points that are not being incorporated into more traditional investment models. This has the potential to create an information arbitrage between firms that are leveraging big data principles and firms that are not.
- Systematic trading models could process new data inputs at the same volume and speed that current programs use in reviewing price, order and transaction data. Rather than simply selecting trades based on analysis across these traditional data sets, new programs may begin to look for correlations across many inputs and thus prove able to identify new trading patterns that link price activity to non-price related variables. 'Multi-factor' systematic programs using this broader data set could realize an information edge that today's multi-system, multi-term and multi-tier systems cannot equal.
- New modeling capabilities linked to the big data approach, such as predictive analytics and machine learning, could change the nature of investment research by creating models that 'think' and are able to draw forward-looking conclusions. This could lead to a convergence of quantitative fundamental models that focus on value with systemic trading programs that focus on price. The result could be a new type of automated portfolio management that focuses on 'future values' and acts on 'likely' events that may not have yet occurred or been announced.

To understand the current state of play for investment managers regarding big data, Citi Business Advisory partnered with First Derivatives to conduct a survey of industry participants. These interviews were qualitative in nature, focusing on existing use cases, trends, expectations and predictions about where big data principles could take the industry.

For most investment managers, changes in approach are aspirational

The firms surveyed caution that for most investment managers, these changes in approach are still highly aspirational and there are still several obstacles limiting big data application.

- Currently the spectrum of big data adoption is broad. Early adopters are investing heavily in developing a whole technology stack and hiring data scientists to drive investment research and make it an integral part of the front offices. Another segment of funds is experimenting with big data by either enlisting big data techniques that extend their existing research capabilities through proofs of concept or by piloting content from third-party providers utilizing outsourced access to big data technology and new data sets. However, based on our survey, most investment firms are not yet focused on big data because they lack the institutional momentum, the skill set and the business case to build out these capabilities in the short-term.
- Experimentation and usage of big data technology is being driven by the front office and not IT. Investment firms have been seeking ways to tie big data to alpha generation. In most instances, this effort begins organically. A specific research analyst may put in a request to analyze a new data set to understand its relationship to time-series data leading IT to accommodate the request tactically. Currently this is not enough to drive wholesale change, but it is beginning to move investment managers into big data adoption. Based on feedback from survey participants, we believe that in 2016 pockets of this type of data analysis will drive a broader array of funds towards a more mature and holistic approach in supporting big data capabilities, similar to current early adopters.

- Pressure to experiment with and incorporate bit data principles into investment research will build because early adopters are already locking up access to semi-private data sets to provide their models with an information edge. Early adopters are also already using this obscure data in tandem with more readily available data set, such as social media, government and consumer transaction data. This is allowing these firms to create a real-time view of supply and demand fundamentals compared to increasingly "stale" fundamental data used in traditional quantitative models. This may provide these firms advance signals of potential changes in price which in turn gives them an information edge that they can arbitrage against more traditional models. Firms that employ big data techniques could thus gain an advantage over late adopters for some time until these techniques are utilized by more organizations.

- Efforts to accelerate the adoption of big data principles are being facilitated by a marketplace of third-party providers and data vendors that make accessing and investigating new data sets much easier than it was even 18 months ago. This allows a broader swath of investment managers to acquire some basic big data capabilities without full-scale infrastructure and staff investments. Even investment managers who do not acquire teams of data scientists and specialized technology staff will still be able to participate in the evolution of big data in other ways.

## Expansion and Transformation of Quantitative Fundamental Analysis

New investment models are beginning to emerge using big data

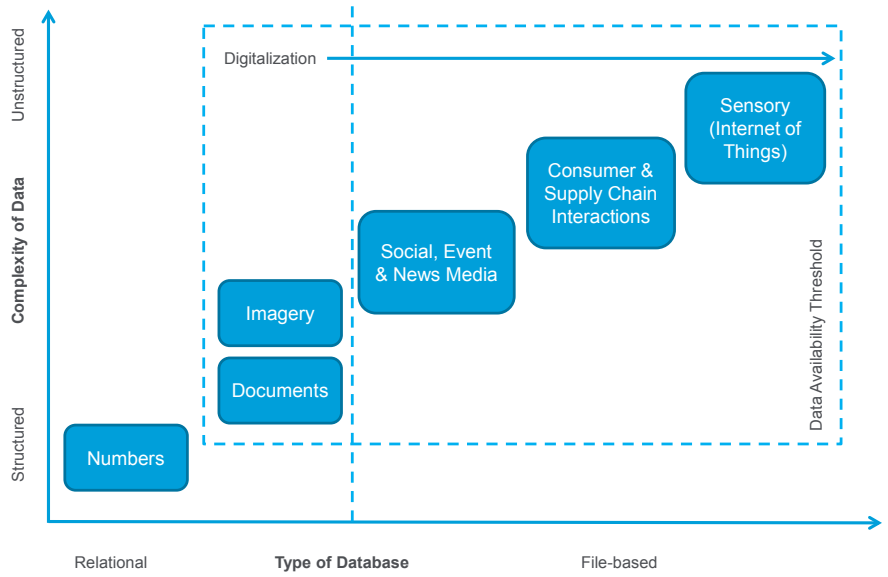
Glimpses of the new models that are being built by some investment managers that we surveyed are beginning to emerge, though nearly all firms involved in this space are very tight-lipped about their efforts. Figure 61 shows how it is anticipated the landscape will change as a result of the insights gained about new models in our survey.

By extrapolating early reports, it appears that the key to the emerging models will be the expansion in the data availability threshold to incorporate new data sources. These data sets will be used as a stand-in for the opinions, behaviors and physical responses that drive much of the discretionary fundamental 'feel' that helps inform investment decisions from these participants. It may not be fully n=all, but the extension will allow quantitative modeling to delve much more deeply into a broader set of hypothesis that were previously only used by discretionary fundamental managers. In so doing, the models will begin to come up with a set of high probability future events — events that are likely but have not yet occurred.

Consider the following example in assessing the Oil & Gas sector. Both a discretionary portfolio manager and quantitative model are likely to have created a relative ranking of key companies in the sector based on traditional data from balance sheets and financial reports. This basic relative ranking would be as far as the most current quantitative models would be able to go.

Meanwhile, a discretionary fundamental portfolio manager might be able to talk to corporate executives and pick up from their body language that they might be excited or nervous about the coming quarter. The discretionary manager could begin to read more about recent activities of the firm and perhaps even visit key offices or facilities to see if they noticed an abnormally busy or quiet level of activity. They could call contacts within the industry to see if they had been picking up any speculation or had been hearing about any interesting new personnel moves.

**Figure 61. Evolution of Systematic Investment Management**




Source: Citi Business Advisory Services

Through these efforts, the discretionary fundamental manager could determine that the CFO of Company ABC seemed more than normally optimistic in their last visit and that in news coverage of Company ABC there had been several mentions from key executives about how they have been increasing their R&D budget during the past year. Meanwhile, an old retired industry friend mentions that they saw a former protégé who works in new site development for Company ABC at a recent convention and he was exhausted because he just got back from Africa and that this was already the third time he had been there this year. This prompts the discretionary portfolio manager to pull up old reports about undeveloped oil fields owned by Company ABC, two of which are in Sub-Saharan Africa. This combination of factors could reasonably allow the discretionary fundamental portfolio to predict that Company ABC may soon be announcing that they are opening a new production facility.

Using "datafication" in a quantitative investment model vs. interpretive and predictive data

Now consider how the 'datafication' of previously interpretive and predictive data can be used to achieve the same outcome in a future-state quantitative investment model.

A linguistic program utilizing sentiment analysis flags that there has been a noticeable shift in the ratio of positive and negative words being used in regard to Company ABC over the past 18 months, with the ratio noticeably trending toward more positive and fewer negative words. In the past four months, the program flags that the pace of change towards positivity is accelerating. In reviewing any increased use of certain phrases, parsing programs identify that company executives in press releases and interviews have used the term "research & development" 182% more in the latest year versus their use of that phrase in the prior 12 months. Secondary words showing increased use include "exploration" and 'expansion'.

The quantitative model uses the correlation of these words to query public records that list the undeveloped properties owned by Company ABC to determine if any new filings have been made and to understand the locations of all previously filed fields across the globe. The quantitative model could then call up satellite imagery for each location and run a time series image analysis to determine where there were noticeable changes in topographical features.

The output of this analysis may reveal increased levels of change in both Central America and in Sub-Saharan Africa. The quantitative model could then identify individuals that work in Company ABC's new site development team based on an organization chart published in an investor presentation on Google. The model could then reference the Facebook and Instagram accounts of these employees and look at the geo-tagging of all photo postings.

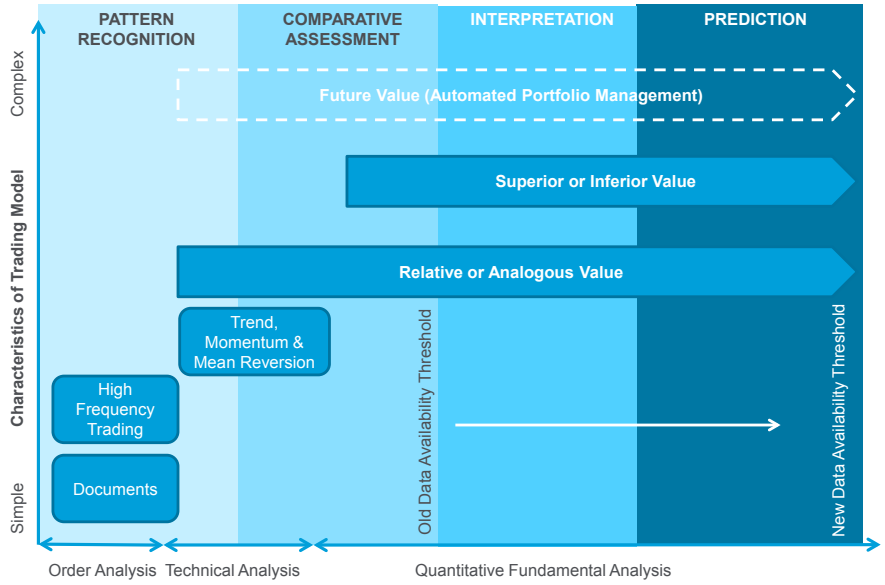
This analysis could identify that across the sample set of 20 individuals, there were 16 photos with a Sub-Saharan Africa geo-tag versus only 2 with a Central American geo-tag. This combination of factors would be fed into predictive models that indicate a high likelihood the Company ABC would be opening a new production facility. In fact, the program could go even further and say that based on the progress of the buildings on the Sub-Saharan African job site, the field is likely to open within the next 90 days.

At this point, both the discretionary fundamental portfolio manager and the quantitative model would establish a long trade in Company ABC based on a likely future event that has not yet been announced.

## New Type of 'Future Value' Model Could Emerge

As experience in building these new types of quantitative models progresses and as the ability of systematic trading programs to identify more and more correlations in pricing patterns due to the increased volume and velocity of processing improves, it is likely that the two worlds will collide. The result could be a new type of systematic portfolio management model that bases its trade selection on the likely 'future value' of a company. This is illustrated in Figure 62.

**Figure 62. Evolution of Systematic Investment Management**




Source: Citi Business Advisory Services

These future value models as described by survey participants start with a 'future event' output like the one discussed in the Oil & Gas sector example (i.e. the expectation that Company ABC will be announcing the opening of a new oil field). It would then categorize the type of future event and look for equivalent announcements from the historic record on Company ABC and its peers. The dates of these announcements would be tagged and charts for the relevant companies in the weeks leading up to and after the event would be examined.

These price pattern programs could quantify the average size and duration of a price jump in response to such news and examine how the size and duration of that move varied based on price patterns in the preceding 90 days and the preceding 180 days. It could examine the past 90 days of activity and determine which of the historic precedents it most closely parallels. It could then put on a position in anticipation of the future event most in line with that model. Each day, it could reassess the price pattern versus history and determine if the size of the position needs to be increased or decreased based on improving data.

If the event is announced as anticipated, it would close out the position when the expected size and duration of the response to the news had been realized. If the event is not announced within a certain window, it would close out the position or even close out the position earlier than that, if the predictive analysis changes and the likelihood of Company ABC making an announcement erode.

Other types of 'future value' systematic portfolio management programs could be given signals about two companies within the same sector that are both likely to have future events. The programs could thus search historic patterns to calculate how much of a price move and over what duration to anticipate for each individual company. It could then institute a pairs trade in anticipation of a change in the relative value between the two companies. In essence, this could be a forward-looking mean reversion trade.

### Other Examples of Big Data Usage

While the prior example illustrates how advanced firms might combine multiple types and sources of data to create and test a hypothesis and to allow for automated analysis in support of their investment thesis, other firms might use only one aspect of this new big data landscape to assist in their investment process as they begin to understand the applicability of new data sets.

For example, companies that have an advanced capability in analyzing social media will compare the activity of one company versus another in the same sector to determine the success of competing advertising campaigns.

Other companies might look to satellite images of construction activity in China to gauge the robustness of that economy relative to official government reports,

More commonly, investment managers may look to parse consumer transaction data from a credit card aggregation service and cross-reference that with an imaging service that counts cars in the flagship store parking lots in order to forecast retail activity ahead of official survey data.

Some of these methods are realized using the latest in file-based database technology. Others are done using traditional relational databases, but require extensive data preparation in order to allow the data to conform to a sensible tabular/columnar structure. And sometimes these aspects are outsourced to a third-party who is providing the technical expertise, the analysis, or both.

Determining a reasonable path to test new data sets and find those that can lead to potential alpha generation takes time and organizations that begin with a light-weight experimental approach are likely to slowly build to a more extensive commitment only as their success with the new data proves out.

## Opportunities for the Discretionary Fundamental Portfolio Manager

Most of the opportunities discussed in this article have focused on how big data may enhance quantitative fundamental models and allow them to operate in a manner that blurs the line between quantitative and discretionary fundamental trading. The same can be true from the other perspective, however.

Discretionary fundamental managers may prove even more adept at using the big data tool set as their ability to create hypothesis in a fluid manner is already a core skill. One good analogy to remember in this regard is that when Gary Kasparov lost to IBM's computer, Deep Blue, in a tournament chess match in 1997, it was the last time that a man working on his own was able to defeat a computer at chess. Yet, today, leading chess experts assisted with the use of a chess probabilities program can consistently beat mechanical chess programs—illustrating that the human brain remains the world's top pattern recognition tool.

Big data models built to mimic the hypothesis building that discretionary fundamental traders explore could begin to provide discretionary fundamental traders an expanded opportunity pool to assess and choose from—equaling the work of a team of analysts at a faster speed and across a broader universe.

# 9. Digital Banking: Blockchain

**Keith Horowitz, CFA**
US Banks Analyst

We do not see banks being disintermediated from blockchain technology but we do believe this technology will significantly benefit financial services at some point in the future.

Despite calls that decentralized systems such as blockchain protocol "threaten to disintermediate almost every process in financial systems", we do not see banks being disintermediated from blockchain technology

A report by the World Economic Forum released in June 2015 said "decentralized systems, such as blockchain protocol, threaten to disintermediate almost every process in financial services". One argument is that as the technology firms develop blockchain solutions, there is a risk that banks could be relegated to becoming "dumb pipes," forming only the infrastructure through which money flows, but with most of the benefits accruing to service providers. This scenario represents an occurrence similar to what happened with the telecom industry, where the rise of the Internet allowed for competition in what was formerly a highly regulated industry. Innovations like VoIP enabled tech companies like Skype to benefit from the existing physical infrastructure.

The benefits of banks include a large identifiable customer base, strong track record of safekeeping assets, strong experience handling of financial regulation and access to significant amounts of capital

Banks have some cards to play which should allow them to maintain their leadership position. First, banks have a very valuable asset in the form of their large identifiable customer-base. Second, banks benefit from a relatively strong track record of safekeeping assets, and therefore have earned a certain amount of trust and credibility. Third, they have unmatched experience when it comes to handling burdensome financial regulation — in some of our conversations with blockchain companies we found the realization lacking that bank procedures are sometimes sub-optimal because of non-trivial regulation and not because banks are unwilling to change. Finally, banks have access to a significant amount of capital, which creates a further barrier to entry to new entrants.

The benefits of blockchain include reduced costs through shared infrastructure and longer-term revenue opportunities

What blockchain technology does have is the potential to improve financial services by reducing cost, and in the longer term providing opportunities to grow revenue.

- **Primary benefit is reduced costs through shared infrastructure:** Blockchain can improve efficiencies in a market burdened by large amounts of friction because it can remove the need for intermediaries and a slew of manual processes that stem from the existing antiquated financial infrastructure. This shared infrastructure can benefit the banks by reducing costs, intraday liquidity needs and to a lesser extent capital.

- **Longer-term revenue opportunities:** Blockchain has the ability to open up new markets by making previously unfeasible or uneconomical transactions possible. Blockchain can also enable the development of new products. Individuals could issue and trade new types of assets without the need for an intermediary and with instantaneous settlement. In the longer term, blockchain can enable the seamless and automated transfer of digital assets, which could lead to a host of technological innovations, especially as it relates to the monetization of the Internet of Things.

We see small breakthroughs in blockchain technology but think it will be a long time before a majority of processes move to blockchain solutions

Although there is a lot of hype around both the technology, our expectation is that the technology will start with small breakthroughs that build on one another, and will eventually lead to more substantive use-cases. Although there is agreement that the existing financial infrastructure is inefficient, the fact that nothing is fundamentally wrong with it makes it difficult to make the argument for banks to embark on a lengthy, costly and risky system overhaul. While we firmly believe that this time is different and the technology does work and can be beneficial, we think it will be a very long time (10+ years) before the majority of processes move to blockchain solutions.

## Why All the Excitement?

The benefits of blockchain in financial services include reduced friction, increased transparency, greater security and innovation

The core concept of blockchain is very powerful and the benefits of applying this technology in financial services include:

- **Reduced friction:** Blockchain can reduce friction by (1) lowering costs through the automation of manual processes and (2) facilitating faster settlement by allowing for the near-real time movement of financial assets thanks to the transaction validators who are constantly checking transaction and updating the distributed ledger
- **Increased transparency:** The blockchain is publically viewable by all the networks participants and the ability to include much richer information with the transactions allows for greater transparency.
- **Greater security:** Blockchain offers potential for a more secure environment by operating as a distributed network — in contrast to today's systems which are controlled by a central server — and therefore there is no single point of failure. The Bitcoin blockchain has never bene successfully hacked, despite Bitcoin's occasional negative press.
- **Innovation:** Combined together, these core features allow for the development of the technology, which could lead to innovations in many different fields that include securities settlement, payments, identity management, record-keeping insurance and even the burgeoning Internet of Things.

## But Several Key Issues Still Need to be Addressed

But practical challenges for blockchain in financial use cases include: 1) identifying the business problem, 2) considering the network aspect of the technology; 3) identifying legal and regulatory obstacles and 4) evaluating technological feasibility

We believe blockchain needs to address four practical challenges when considering potential use cases and to assess the viability of different blockchain business models.

- **Identifying the business problem:** One common pushback on blockchain is that it's a "solution in search of a problem." One view is that existing technology can adequately address some of the issues that blockchain is trying to solve. Plus, our understanding is that integrating blockchain technology with legacy systems will be a significant challenge for the banks with could involve potentially large costs.
- **Consideration of the network aspect of the technology:** Blockchain is a network technology and a partnership is needed to make a permissioned blockchain work. In a critical first step, banks are experimenting with blockchain technology. The next step will be industry collaboration to set industry standards since interoperability will maximize the utility gained from the technology.
- **Identifying legal and regulatory obstacles:** Because the technology is so new and has many applications, legal risks abound. Our view is that regulators may have some incentive to favor blockchain adoption thanks to two advantages: security and transparency. The ideal situation is that commercial use cases are developed first and then banks can work with regulators to address their questions before implementation, rather than the opposite where the regulations are developed first.
- **Evaluating technological feasibility:** Technological feasibility is the ultimate determining factor. The secure handling of private keys, ensuring privacy and scaling blockchain for the needs of banks are three technological factors that will determine whether or not blockchain can represent a solution.

## A Digital Currency is Needed to Solve for the Last Mile Challenge

Blockchain asset transfers could be used to move cash until consensus a on digital currency is achieved

In order to move fiat money (a currency established as money by government regulation or law) in real time over the blockchain, the industry will need to drive consensus on a digital currency to be used in transactions. Using existing rails for the movement of cash could be a temporary solution. Although not ideal, blockchain asset transfers could be made to function with existing infrastructure for the movement of cash. Systems like Fedwire or CHIPS could be integrated with blockchain.

Fedwire is the Fed's real time gross settlement fund transfer system and operates 21.5 hours a day on business days (excluding holidays). CHIPS is a privately owned US$ funds-transfer system, and differs from Fedwire in that it allows payments to be netted. CHIPS operates 20 hours a day on business days (excluding holidays). The securities could be moved on the blockchain on the condition that cash was sent. The problem with that this option reduces the utility of blockchain as it necessitates the use of two different systems. In addition, atomic settlement, where the cash and the asset move simultaneously, will consequently be difficult to achieve until an acceptable digital currency exists on the blockchain.

We see three ways digital currencies could be adopted — user-driven, government-driven and bank consortium-driven

It should be noted that traditional currencies exist in digital form already. Most US dollars do not exist in paper form, but in electronic ledgers. These digital dollars are not on the blockchain however, and rely on the traditional rails that link bank ledgers together. We believe there are three ways digital currencies could be adopted:

1. **User driven:** Users could drive the adoption of cryptocurrencies like bitcoin. One issue with currencies like bitcoin is the relatively small market cap (~$5.5 billion), as compared to the $1.4 trillion in circulation. This presents issues with respect to liquidity and limits transaction size. Bitcoin is probably acceptable for small payments where liquidity is not an issue. We see this scenario as the least likely of the three.

2. **Government-driven:** A government-backed digital currency could truly eliminate settlement risk. The Bank of England is at the forefront of the topic and has published a paper exploring the implications of central banks issuing digital currency. We do not believe that a government-backed digital currency is likely to be issued in the near term however, as there are a number of issues that need to be addressed (i.e. the security risk arising from being able to quickly transfer significant amounts of money).

3. **Bank consortium-driven:** A solution involving a digital coin backed by cash secured by a trusted custodian is probably acceptable. We have seen banks working on issuing their own coins, and we believe a potential solution to payment on the blockchain will involve these coins being securely backed by cash. This solution is analogous to casinos issuing the own "currency" in the form of chips, where an individual can redeem the chip for a dollar amount. These coins could gain even more traction if issued by a consortium of large banks, which would enhance credibility and value thanks to the ability to redeem the coin at any large bank. It will be important to ensure that the cash backing the tokens is secure and it is our view that an arrangement with a custody bank is one way to address this.

## Blockchain Use in Securities Settlement

Securities settlement is a logical area for blockchain to address…

Technology has generally brought about innovation in areas where there is a lot of friction and in large profitable markets. Given that, settlement is a logical problem to attack, as it involves a significant number of players and the reconciliation of disparate databases slows down settlement and results in relatively high costs. Most of the improvement resulting from the progress of technology has benefited the front office of banks, but the back-office still relies on manual procedures to handle exceptions.

… as it could replace the multiple ledgers that exist today in settlements and replace them with a single distributed ledger

The settlement process today is a combination of manual and electronic procedures that lack standardization, which is complex and inefficient. Consequently, blockchain has garnered attention in this arena because of its potential to replace the multiple ledgers that exist today with a single distributed ledger that clearly displays ownership of securities.

Players in the clearing and settlement ecosystem seem aligned and incentivized to investigate uses for the technology

The players in the clearing and settlement ecosystem seem aligned and incentivized to investigate uses for the technology. We believe that there is an incentive for each of the participants in clearing — banks (cost reduction), custody (operational efficiencies), infrastructure (defensive play and cost reduction), buy side (reduction of collateral margin requirements and back office costs), and regulators (transparency) —but see the near/intermediate term impact as more hype than substance, especially given the significant practical challenges.

Although there is a lot of hype from blockchain companies regarding potential cost savings…

There is a substantial amount of hype around blockchain, as we have found that blockchain companies may be overpromising on what the technology can currently deliver due to significant practical challenges. There have been claims that cost savings from blockchain could reach $20 billion by the end of the decade, but we think these estimates are overstated. We don't see this level of cost saving in the near term as the technology will mostly likely run in parallel with existing systems for a period.

…we don't believe large scale benefits will be seen in the near or intermediate term

We believe this hype is forcing parties to focus on blockchain for fear of being left behind. It has received so much attention in recent months that it has almost become a requirement for financial institutions executives to have a blockchain strategy. We believe this is beneficial to the development of technology, because the result of this focus is that there is a significant amount of effort invested in studying its uses.

### Syndicated Loans – Potential for Reduced Friction from Blockchain

Syndicate loans are characterized by high operational costs and increase capital costs and risk due to long settlement times

Syndicated loans are structured and managed by a central agent, usually a large bank. The agent holds the central ledger for the loan and is responsible for keeping track of all the requisite loan documents, as well as a list of all the different lenders. When a loan is sold, the agent must have the ability to update the ledger in order to make sure the correct parties receive payment. This is complicated by the fact that new documents have to be drawn up to reflect the changes. The involvement of custodians can add even more complexity by adding more parties to the process.

- **Syndicated loans have high operational costs:** Operations costs for syndicated loans are high because the process is manual and there are many moving parts when it comes to structuring the loan. Determining payments and changes in ownership requires a lot of coordination and reconciliation.

- **Syndicated loans T+20 settlement times result in capital costs and increased risk:** Today, syndicated loans can take twenty or more days to settle due to the manual process outlined above. Unlike cash securities which settle in T+3, syndicated loans attract more capital due to the increased settlement risk.
- **Loan settlement times are garnering attention from regulators:** Recently, the SEC commissioner highlighted the risk of loans taking nearly a month to settle, when ETF and mutual funds that invest in bank loans much meet the 7-day redemption requirement of the Investment Company Act. This regulatory scrutiny could provide a catalyst for the bank loan sector to reform and look to new technologies to resolve the issue.

We see syndicated loans as the one area where blockchain has potential to improve the existing business process

Syndicated loans are the one area where we see the potential for blockchain to improve existing business process. Settlement times are long due to certain manual processes related to legal procedures and due diligence, as well as the nature of loans' balance sheet usage. While we do not believe that blockchain can completely eliminate these issues, we do see its potential to reduce the friction from costs associated with manual labor and capital held during the settlement period.

- **Automating loans on the blockchain has the potential to reduce cost:** The manual processes required to syndicated loans contribute to increased costs, and blockchain is a viable solution to make the process cheaper. The loans use case coincides with the concept of distrusting parties sharing a ledger, which is why we believe that blockchain is likely to be successful in improving the current process. Loans are often highlighted as an example of antiquated settlement and there is therefore an impetus to change the way it is carried out.
- **Increased settlement speeds will free up capital and reduce risk:** The T+20 settlement times are partly due to the current manual processes. Blockchain can decrease settlement delays thanks to the automation benefit, highlighted above, which would decrease the amount of capital that banks must hld for trades pending settlement.

Syndicated loans are a good initial use case for blockchain from a network perspective since there are a relatively small number of players in this space. As a result, it will likely be easier for the players in this market to agree on how to use blockchain for settlement purposes.

# 10. Lithium: The Future is Electric

**Matthew Schembri**
Australia Metals & Mining Research

**Clarke Wilkins**
Australian Metals & Mining Analyst

Lithium-ion batteries remain the dominant technology for consumer electronics but we believe lithium going forward will also play a critical role and see strong growth from energy storage in the automotive and electricity distribution sectors. This is driven by the electrochemistry of lithium-based batteries which provides higher voltage, higher power density and lower discharge rates with no memory affect versus competing alternatives. This makes it a "go-to" technology for energy storage.

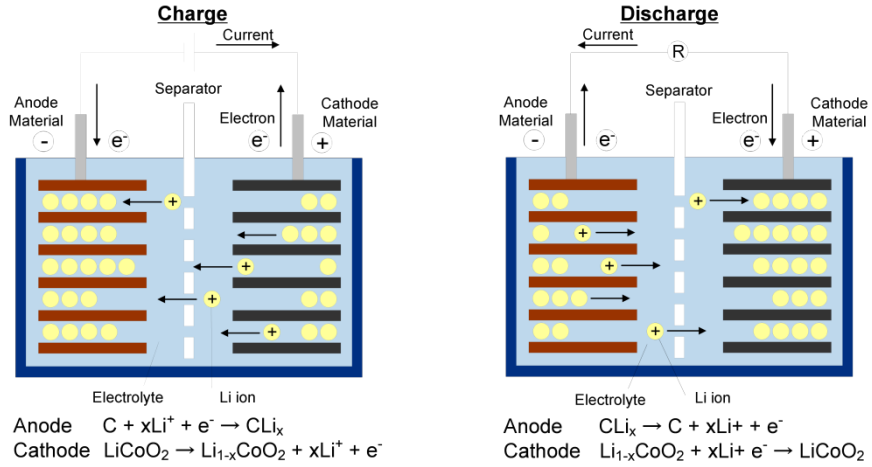
## What is a Lithium-ion Battery?

A lithium-ion battery is an electric device capable of charging and discharging. It consists of three main components:

- Electrodes – One positive charged and one negatively charged. The anode is typically a lithium compound.
- Separator – Is a thin film with many small holes that provide a passageway for lithium ions between the anode and the cathode during charging or discharging.
- Electrolytic Solution – Typically an organic electrolyte of $LiPF_6$ dissolved in an organic solvent is used to carry the lithium ions between electrodes. An aqueous solution cannot be used as it would react with the lithium-ions and form lithium hydroxide.

The basic working theory of a lithium-ion battery is demonstrated below. During discharge, a chemical reaction takes place where lithium ions ($Li^+$) are extracted from the negative anode which released an electron and the $Li^+$ flows through the separator and is inserted into the cathode. The electron flows through the external circuit generating a current.

**Figure 63. Lithium-ion Battery Basic Working Theory (Positive Electrode, Lithium Cobalt Oxide; Negative Electrode, Carbon)**

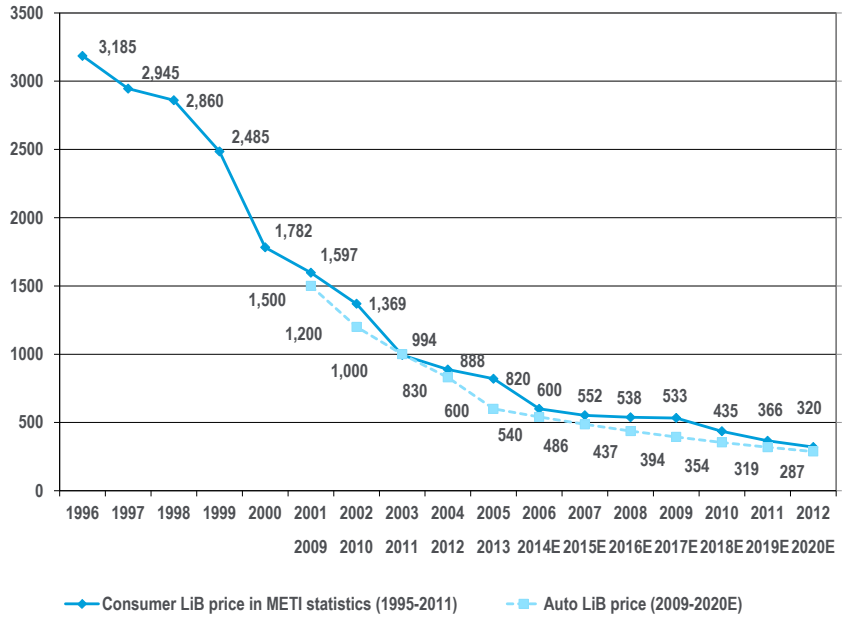



Source: Citi Research

The price of lithium-ion batteries have fallen precipitously since 1991

Lithium-ion batteries were first commercially introduced by Sony in 1991. We have seen their price in consumer goods steadily fall from over $3,000/kWh to less than $300/kWh today. The cost profile for lithium-ion batteries in auto applications has followed a similar profile, with costs dropping from $1,500/kWh in 2009 to less than $500/kWh and we expect the declining cost trend to continue in both applications.

**Figure 64. Price Declines in Consumer and Automotive Lithium-Ion Batteries**




Source: Company Data, TSR, METI, Citi Research

## Key Advantages of Lithium-ion Technology

High voltage, high power and energy densities and no memory affect are key advantages of lithium-ion technology

There are a number of characteristics that make lithium-ion batteries attractive not only for their initial intended use in consumer electronics, but also in the automotive and electricity distribution sector.

- **Voltage:** The natural electrochemistry gives lithium-ion cells a voltage of 3.6V, significantly higher than other commercial technologies, such as Nickel-Cadmium (Ni-Cd) (1.2V) which have to be placed in a series to increase their voltage for common applications in consumer electronics.
- **Power Density:** Lithium-ion technology has higher power and energy densities, with energy densities of 120-200Wh/kg compared to ~50Wh/Kg for Ni-Cd.
- **Memory Affect/ Discharge Rate:** Lithium-ion batteries have no memory affect and have a very low discharge rate of around half in comparison to Ni-Cd.

Unless there is a technological breakthrough with another chemistry, we see lithium-ion as the ‘go-to’ battery technology for the foreseeable future.

Figure 65. Types of Batteries

| Battery Type | Lithium ion | Nickel Hydrogen | Nickel Cadmium | Lead Acid | NAS | Redox Flow | EDLC | Lithium ion Capacitor |
|---|---|---|---|---|---|---|---|---|
| Discharge Potential (V) | 2.4-3.8 | 1.2 | 1.2 | 2.1 | 2.08 | 1.4 | 0.0-3.0 | 2.2-3.8 |
| Power Density (Wh/kg) | 400-4,000 | 150-,2000 | 100-200 | 100-200 | - | - | 1,000-5,000 | 1,000-5,000 |
| Energy Density (Wh/kg) | 120-200 | 70 | 50 | 35 | 100 | 30 | 20-Feb | Oct-40 |
| Cycle Life (times) | 500-6,000 | 500-1,000 | 500-1,000 | 500-5,000 | 4,500 | 10,000> | 50,000> | 50,000> |
| Charging Efficiency | 95% | 85% | 85% | 80% | 75-85% | 80% | 95% | 95% |
| Cost | Poor | Good | Good | Excellent | Poor | Poor | Very Poor | Very Poor |
| Safety | Poor | Excellent | Good | Good | Very Poor | Excellent | Excellent | Excellent |
| Cathode Material | Lithium compounds | Nickel Hydroxide | Nickel hydroxide | Lead oxide | Sulfur | Carbon | NA | NA |
| Anode Material | Graphite | Hydrogen storing alloy | Cadmium hydroxide | Lead oxide | Sodium | Carbon | NA | NA |
| Electrolyte | Lithium salt Organic solvent | Potassium hydroxide solution | Potassium hydroxide solution | Dilute sulfuric acid | βAlumina | Vanadium sulfate solution | NA | NA |
| Characteristics | Risk of combustion | Self-discharge Memory effect | Memory effect Cadmium is toxic | Easily deteriorated Cadmium is toxic | Operation at 300°C Risk of combustion | Pump circulation Vanadium is toxic | Good power density Self-discharge | Good power density Self-discharge |

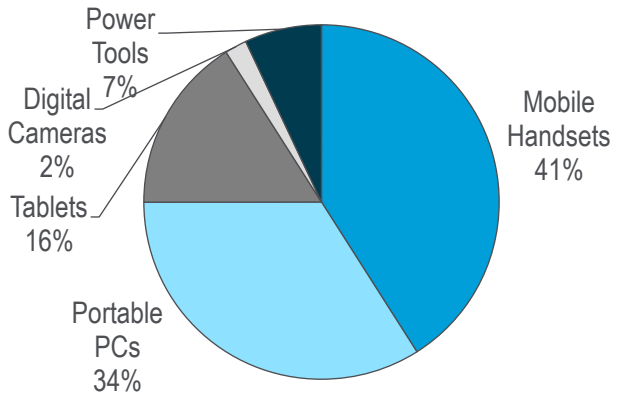
Source: Citi Research

## Consumer Electronics

Growth in consumer electronics applications is driving lithium consumption at a 4.2% CAGR

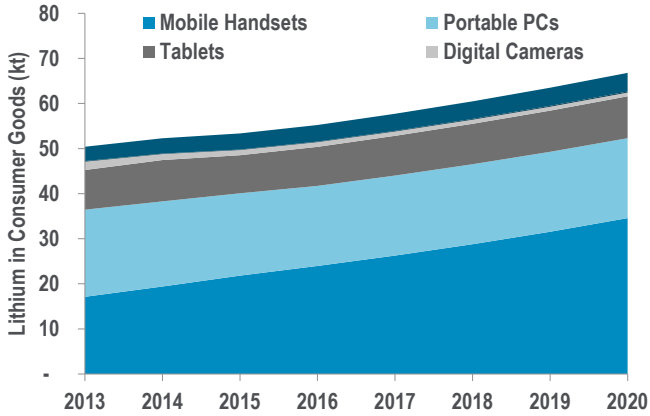
Twenty-eight percent of global lithium consumption is attributed to lithium-ion batteries within consumer goods. Their compact design, high output, and ability to discharge a high capacity current for a long period of time make them an attractive battery type for manufacturers and lithium-ion batteries remain the dominant technology for consumer electronic applications. This segment could raise annual lithium consumption from 52kt in 2014 to 67kt in 2020, representing a 4.2% compound annual growth rate (CAGR), driven by the increased power intensity of mobile handsets and the transitioning of the developing world to smartphones.

Figure 66. 2015 Use of Lithium-Ion Batteries in Consumer Goods




Source: Citi Research

Figure 67. Use of Lithium-Ion Batteries in Consumer Goods




Source: Citi Research

Mobile phones, currently 41% of the lithium-ion battery market in the consumer goods sector, are forecast to remain the fastest growing consumer of lithium-ion batteries as 1) mobile phone production continues to rise; 2) an increasing proportion of handsets are "smart" with this segment growing at 14% in 2015 and forecast to continue to grow at 8% for the rest of the decade; and 3) power capacity per handset continues to rise as performance continues to improve through higher display resolutions, LTE functionality and more powerful processors.

## Batteries in Electric Vehicles

Electric vehicles are a game changer for the lithium market

Pure electric vehicles are heralded as a game changer for the lithium market. Each car has an approximate battery capacity of between 9kWh for the Zotye Zhidou E20 to 90kWh for the upgraded Tesla and consume between 18kgs and 190kgs of lithium carbonite equivalent (LCE) per vehicle.

There are two categories of electric vehicle that can be further split into a total of four subcategories. Hybrid drive vehicles that use a combination of electric and internal combustion engine (ICE) propulsion — this includes Hybrid Electric Vehicles (HEV) and Plug-in Hybrid Electric Vehicles (PHEV). The other category is electric drive vehicles, which only use an electric motor for propulsion and includes Electric Vehicles (EV) and Electric Range Extended Vehicles (E-REV).

### Electric Drive Vehicles

As electric derive vehicles are reliant on batteries for all or the majority of the power consumption, the power capacity needed from batteries is large compared to hybrids. We estimate that power capacity has grown from ~20kWh/unit in 2011 to over 20kWh/unit in 2015.

Adoption of electric vehicles is increasing in momentum, with 665,000 electric passenger vehicles now on the roads within electric vehicle initiative (EVI) countries. The US leads with total electric vehicles of over 290,000, but Norway leads on market share, with a ~14% adoption rate in 2014. This is being incentivized by over $16 billion of spending by governments on infrastructure, fiscal incentives and R&D across governments within the EVI.

Adding to this momentum, the VW emission scandal may turn the global eco-car tide, albeit a very slow tide, towards hybrid technologies and pure electric vehicles. Whilst the early adoption of electric vehicles has been relatively flat over the last few years, we are expecting adoption to become more rapid. Production is forecast to rise from 150k vehicles in 2015 through to 290k in 2016, leading us to believe a production rate of 1.04 million electric vehicles, consuming up to 75kt per year LCE, is a realistic estimate for 2020.

**Figure 68. Outlook for Electric Drive Vehicles**

| Electric Vehicles | | | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Electric Vehicles | | (m units) | 0.08 | 0.08 | 0.12 | 0.15 | 0.29 | 0.49 | 0.7 | 0.92 | 1.04 |
| | *Change* | *%* | *0%* | *2%* | *48%* | *22%* | *90%* | *72%* | *43%* | *31%* | *13%* |
| Power Capacity | | (Wh/unit) | 23,000 | 29,000 | 30,000 | 30,900 | 31,827 | 32,782 | 33,765 | 34,778 | 35,822 |
| | *Change* | *%* | *0%* | *26%* | *3%* | *3%* | *3%* | *3%* | *3%* | *3%* | *3%* |
| Total Power Capacity | | (MWh) | 1,863 | 2,407 | 3,690 | 4,635 | 9,071 | 16,063 | 23,636 | 31,826 | 37,254 |
| | *Change* | *%* | *0%* | *29%* | *53%* | *26%* | *96%* | *77%* | *47%* | *35%* | *17%* |
| **Lithium Consumption** | | **(kt)** | **3.7** | **4.8** | **7.4** | **9.3** | **18.1** | **32.1** | **47.3** | **69.9** | **74.8** |
| | *Change* | *%* | *0%* | *29%* | *53%* | *26%* | *96%* | *77%* | *747%* | *35%* | *17%* |

Source: HIS, Continental, Citi Research

### Hybrid Drive Vehicles

Hybrid vehicles are typically more fuel efficient and emit less carbon dioxide than a conventional internal consumption engine (ICE). This is attractive for both consumers and manufacturers as consumers reduce fuel bills and manufacturers meet mandatory emission targets. Citi sees this technology being adopted more rapidly than pure EVs, as they don't suffer from the same range anxiety, and as a consequence, we see production rising from 2.7 million in 2015 to 7.6 million in 2020.

These vehicles have smaller batteries than EVs, averaging around 1.3kWh/unit vs. >30kWh/unit. They also use a range of batter technologies as the higher weight density of technologies such as nickel metal hydride (Ni-Mh) is less relevant in smaller battery configuration. We see the mass adoption of lithium-ion based technologies as the cost of production comes down.

**Figure 69. Outlook for Hybrid Drive Vehicles**

| Hybrid Vehicles | | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Total Hybrid Vehicles | (m units) | 1.20 | 1.70 | 2.18 | 2.73 | 3.61 | 4.60 | 6.30 | 7.28 | 7.56 |
| *Change* | *%* | *0%* | *42%* | *28%* | *26%* | *32%* | *27%* | *37%* | *15%* | *4%* |
| Power Capacity | (Wh/unit) | 1,300 | 1,300 | 1,300 | 1,300 | 1,300 | 1,300 | 1,300 | 1,300 | 1,300 |
| *Change* | *%* | *0%* | *0%* | *0%* | *0%* | *0%* | *0%* | *0%* | *0%* | *0%* |
| Lithium-ion Adoption | (%) | 3% | 5% | 23% | 38% | 40% | 60% | 80% | 95% | 95% |
| *Change* | *%* | *0%* | *67%* | *360%* | *65%* | *5%* | *50%* | *33%* | *19%* | *0%* |
| Total Power Capacity | (MWh) | 1,560 | 2,210 | 2,828 | 3,549 | 4,693 | 5,980 | 8,190 | 9,459 | 9,828 |
| *Change* | *%* | *0%* | *42%* | *28%* | *26%* | *32%* | *27%* | *37%* | *15%* | *4%* |
| Lithium Consumption | **(kt)** | **0.1** | **0.2** | **1.3** | **2.7** | **3.8** | **7.2** | **13.1** | **18.0** | **18.7** |
| *Change* | *%* | *0%* | *136%* | *489%* | *107%* | *39%* | *91%* | *83%* | *37%* | *4%* |

Source: Citi Research

## Battery Storage

Lithium-based batteries have application in grid scale installations and could have upside potential

Grid scale battery storage is at a very early stage, but lithium-based batteries have the capability to increase energy reliability in undeveloped grids, balance short-term grid fluctuations, reduce grid congestion and load shift power requirements form peak periods. We see the consumption of lithium in this segment as relatively modest, but it does have upside potentially. Battery storage has the following applications in grid scale installations:

- **Load shifting/peak shaving:** Load shifting stores excess energy for later use which requires the batteries to have long charging and discharging cycles. In peak shaving this load shifting is specifically targeted at reducing grid power requirements at times of peak demand. This application is applicable to both conventional grids and those with high proportions of renewable power sources.
- **Ancillary Services:** This is fast, short-term electricity balancing through frequency response, load following and voltage support. If a grid has a significant contribution of power generation from renewable sources a traditional solution would be to have spinning reserve such as diesel generators. Battery storage can replace this by providing a typically shallow but frequent discharge.
- **Energy reliability:** In areas where grid supply is unreliable such as India and parts of Africa, isolated grids can form, powered by renewable power. To provide reliable supply to critical customers such as telecommunication operators or industrial operations, batteries can be put in place to ensure continuous supply.

- **Transmission/distributions infrastructure services:** If transmission services are congested in periods of peak demand, storage sites can be placed in areas of high demand. These storage sites can be charged during periods of low demand and discharged into the area during periods of high demand therefore delaying or reducing any build in increased transmission capacity.

**Figure 70. Composition of Lithium in Grid Scale Battery Storage**

| Battery Storage | | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|
| Total Electric Vehicles | (m units) | 168 | 168 | 368 | 636 | 970 | 2210 | 2510 |
| *Change* | *%* | | *0%* | *119%* | *73%* | *53%* | *128%* | *14%* |
| Lithium-ion Adoption | (%) | 30% | 30% | 40% | 50% | 60% | 60% | 60% |
| *Change* | *%* | | *0%* | *33%* | *25%* | *20%* | *0%* | *0%* |
| **Lithium Consumption** | **(kt)** | **0.1** | **0.1** | **0.3** | **0.6** | **1.2** | **2.7** | **3.0** |
| *Change* | *%* | *0%* | *0%* | *192%* | *116%* | *83%* | *128%* | *14%* |

Source: Citi Research

## Lithium Supply-Demand Balance

Based on supply and demand, we see a tight market for lithium throughout the decade

As a base case, Citi has probability-weighted new supply and uses internal Citi forecasts towards industrial applications, consumer electronics and electric vehicles from various global teams to gauge demand. This base case scenario sees production of lithium rise from ~189kt/yr in 2015 to 308kt/yr by 2020. Demand is forecast to rise from 188kt/yr in 2015 to 308kt/yr, predominantly driven by electric vehicle production. As a consequence, we see a tight market for lithium throughout the decade.

**Figure 71. Lithium Supply Demand Balance**

| kt LCE | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|
| **Supply** | | | | | | | | | |
| ***Existing Producers*** | | | | | | | | | |
| Brine | 89 | 84 | 89 | 89 | 101 | 105 | 108 | 110 | 113 |
| Mineral | 82 | 81 | 95 | 100 | 100 | 100 | 100 | 100 | 100 |
| Total Existing Producers | 171 | 166 | 184 | 189 | 201 | 205 | 207 | 210 | 212 |
| ***New Supply*** | | | | | | | | | |
| Unrisked | 0 | 0 | 0 | 0 | 10 | 49 | 112 | 186 | 265 |
| Probability Weighted | | | | | 8 | 30 | 58 | 82 | 106 |
| Total with New Producers (Not Weighted) | 171 | 166 | 184 | 189 | 211 | 254 | 319 | 396 | 477 |
| Total with New Producers (Weighted) | 171 | 166 | 184 | 189 | 209 | 235 | 265 | 293 | 318 |
| | | | | | | | | | |
| **Demand** | | | | | | | | | |
| Industrial Applications | 112 | 115 | 119 | 123 | 127 | 131 | 136 | 140 | 145 |
| Batteries: Consumer Electronics | 48 | 50 | 52 | 53 | 55 | 58 | 60 | 64 | 67 |
| Batteries: Electric Vehicles | 4 | 5 | 9 | 12 | 22 | 39 | 60 | 82 | 93 |
| Batteries: Grid Storage | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 3 | 3 |
| Total Demand | 164 | 171 | 180 | 188 | 204 | 229 | 258 | 288 | 308 |
| | | | | | | | | | |
| Half Electric Vehicle Growth | 4 | 5 | 9 | 12 | 17 | 26 | 30 | 35 | 38 |
| Total Demand with Half EV Growth | 164 | 171 | 180 | 188 | 199 | 213 | 227 | 242 | 253 |
| | | | | | | | | | |
| **Base Case** | | | | | | | | | |
| Supply-Weighted | 171 | 166 | 184 | 189 | 209 | 235 | 265 | 293 | 318 |
| Demand-Base Case | 164 | 171 | 180 | 188 | 204 | 229 | 258 | 288 | 308 |
| Surplus/ (Deficit) | 8 | -5 | 5 | 1 | 5 | 6 | 7 | 4 | 10 |

Source: Citi Research

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