22 February 2016 | 18 pages

Telecommunications Operators
Global

Notes from the FTTH Conference 2016

How 'I WANT FIBRE' could boost or damage incumbent value

Dalibor Vavruska
+44-20-7986-4276
dalibor.vavruska@citi.com

Dilya Ibragimova
dilya.ibragimova@citi.com

Vibhor Kumar
vibhor.kumar@citi.com

- **Last week we attended the FTTH Conference 2016 in Luxembourg,** a leading industry event organized by the FTTH (fibre-to-the-home) Council Europe.
- **I WANT FIBRE: could the telecom revolution be triggered in the countryside?** The main slogan of the conference, I WANT FIBRE, is, in our view, a political message based on the alleged significant positive long-term externalities of FTTH, such as a boost for digital innovation, benefits of remote working, efficiency boost in farming and other businesses, revival of the countryside etc. Issues discussed at the Conference are quite relevant in the ongoing digital policy reviews, including those in the UK, Turkey and Europe as a whole. Such reviews are also looking into whether policymakers should actively promote building 'future-proof' fixed-line access networks and opening such networks to the widest possible types of use. In its message the Council emphasizes mainly rural coverage, although resulting policies could, in our view, have a broader structural impact on telecoms.
- **Potential new policies aimed at improving broadband access in Europe and beyond could be quite relevant for telcos.** Through its structural and EFSI funds, the EC could potentially influence hundreds of billions in Euro broadband investments in upcoming years. Anthony Whelan of the EC said that while its policy review is unlikely to impose an entirely new Europe-wide telecom industry structure, the EC is giving lots of thought, for example, to embedding wholesale-only fixed-line model in its policy framework. Barring major breakthroughs in wireless technologies we think that utility-type, local FTTH monopolies may be the ultimate outcome in fixed-line access in the very long-term, particularly in more affluent areas. While competition should remain instrumental in innovative infrastructure, digital services, international digital markets and, in some instances, perhaps in tenders for building FTTH networks (including subsidized ones), we see the natural-monopoly economics of FTTH, together with ongoing policy, interference possibly moving fixed-line access further away from 'free market' competition in a long-term.
- **We see crucial scale economies of fixed-line incumbents increasingly challenged; we think that deeper opening or structural separation of access networks may in some cases offer value-accretive solutions.** Global OTTs tend to have better service scale economies in an all-IP environment vs. the incumbents, smaller local companies are often able to build FTTH more efficiently, passive infrastructure opening may threaten the incumbents in the most lucrative areas and open access regulation undermines their convergence scale economies. Finding ways to deter infrastructure competition and reach potential subsidies is, in our view, crucial for incumbent value preservation. We think that opening/separating of access networks could, in many instances, create better conditions to achieve this.
- **In CEEMA we think amicable solutions on deep fixed-line network sharing or separation might boost value, particularly at Orange Polska/Turk Telekom.**

The FTTH Conference 2016

A leading European event to promote fibre to the home

The FTTH Conference 2016 was a leading European telecom conference and exhibition organized by the FTTH Council Europe, industry association promoting construction of fibre networks directly connecting residential properties. The event took place between 16-18th February 2016 in Luxembourg. It was attended by approximately 3,000 delegates, mainly FTTH companies, cable operators, their financiers, vendors, local and European regulators and industry experts from Europe and beyond. We contributed to the event with our presentation FTTH Conference 2016 Presentation - Impact of digital revolution on telecom business models on 17/2/16. We also noticed that the leading incumbent telecom operators were largely absent from the Conference, although a number of them are accelerating their fibre investments in some cases including FTTH. Nonetheless, the incumbents were represented through their industry association, ETNO.

A political message: I WANT FIBRE

I WANT FIBRE is, in our view, a political message based on potentially significant positive externalities of FTTH

The main slogan of the conference, I WANT FIBRE, is in our view a political message aimed at the policymakers including the European Commission (EC), who are currently undergoing crucial reviews of digital markets policies with the aim to boost global digital competitiveness of national economies. The message in our view reflects alleged significant positive externalities of FTTH deployment for local communities and the broader economy. In this sense the message could be compared to statements such as ‘I want a clean environment’ or ‘I want safe streets’. There are a number of similarities between FTTH, on one hand, and the environment or safety on the other, such as:

- Local communities usually either have the opportunity to access FTTH or they do not, in a similar way that they either enjoy clean and safe environment or they do not. Such an opportunity cannot be purchased by their members individually.

- Short-term needs for FTTH are far less obvious than long-term ones; many consumers may not immediately realize how much they may need it. Similarly, certain types of pollution and safety risks are not immediately obvious.

- In a similar way to environment and safety, policies as opposed to pure demand have been crucial in driving FTTH development across different countries (leading to, for example, a very high FTTH advancement in developed Asian countries).

- FTTH can be seen as a public utility, which is hard to build. However, similarly to a clean environment and safety its availability increases the attractiveness of residential areas, potentially boosting regional economies.

- Determined local communities sometimes have opportunities to make a difference to the environment, safety but also FTTH availability in their areas by their own actions.

- Based on the above, some policymakers see a merit for public funding contribution to FTTH rollouts similar to public funding of improvements to environment and safety.

The FTTH Council's message is focused on rural investments, a key development priority for policymakers in what is a less important market for incumbents

The FTTH Council Europe is focusing its message largely on rural areas. Again, we think that this approach has political reasons, because rural development and bridging the digital divide is increasingly becoming a priority for governments. Meanwhile, promoting potentially disruptive subsidized investments in areas where private investment so far could not have been attracted (as opposed to areas where investments have already been made) naturally causes less tension with the existing telecom and cable operators. We also heard arguments at the conference that rural FTTH investment is more valuable for the overall economy on a per household basis, because it significantly enhances opportunities for rural residents in a number of ways — including entertainment, more efficient farming, remote working etc., it may limit rural residents' need for travel and it could, in fact, be instrumental for retaining population in the rural areas, hence preserving those areas.

Increased role of government targets and political decision-making about capital allocation would likely move the fixed-line broadband industry further away from free market competition

The EC has significant plans to use public money to partially or fully subsidize broadband rollout, particularly in rural areas, which include in particular Structural Funds (Euro 21bn, material part of this for the CEE countries) and European Fund for Strategic Investments (EFSI), also a so called the 'Junker-plan', with highlighted investment capacity of up to Euro315m (private investment partially subsidized by public funds provided through a leveraged vehicle). In addition, infrastructure rollout could also be funded from national and local budgets. Although it is currently hard to estimate how much public money will actually be used for broadband network rollouts within a given period of time and with what effect, increased role of public funding, government targets and political decision-making about capital allocation may in our view inevitably move the fixed-line broadband market further away from 'free market competition'.

Regulators may naturally lean towards supporting wholesale-only FTTH solutions, but it is far from clear how aggressively this might be done

Policies will therefore be crucial in fixed-line broadband. Although the EC is not yet in position to reveal any firm conclusions at this stage of its digital policies review, the EC's current position could be summarized as follows:

- **Technological neutrality and competition.** The EC has a firm view that it should not be openly promoting specific technologies including fibre. Senior EC representatives are also stressing importance of competition in general terms.

- **A gigabit society.** Despite technological neutrality, the EC could, however, promote 'time-proof' solutions, i.e. solutions that would ensure sufficient capacity for the future decades as opposed to years, offer symmetrical high speeds, very low latency and very high reliability. Commissioner Oettinger for example speaks about a Gigabit society. This could for example indirectly imply availability of public subsidies only for fiber-based technologies.

- **Structurally separated (wholesale only) solutions.** Anthony Whelan, Director of Electronic Communications, Networks and Services at the EC, said at the Conference that European policymakers are unlikely to adopt radical solution such as enforcing structural separation of fixed-line networks across all markets. However, he also said that the EC is giving quite a bit of thought to embedding wholesale-only models in its regulatory

framework. This is in line with our thinking that such models may not emerge as a result of direct demands by the regulators, but the regulators may encourage their spontaneous emergence. In this respect developments in the Czech Republic (whether structural separation of O2 CZ may soon be followed by ownership separation), Spain (execution of Telefonica's plans for structural separation) and the UK (Ofcom's upcoming policy announcement and the industry response to it) may be particularly interesting. The structurally separated model was discussed in a number of occasions at the Conference. Representative of ECTA (European Competitive Telecommunications Association) made rather supportive comments in this regard, which was not echoed by a representative of ETNO (European Telecom Network Operators' Association).

Could the countryside unleash a telecom revolution?

We have recently seen political initiatives in the UK and Turkey, explicitly calling on the regulators to force structurally separated (wholesale only) fixed-line access, which could, in fact, lead to FTTH access monopolies. These initiatives tend to be backed by rural area interest groups. Although this may represent a relatively small percentage of the current telecom market, any radical solutions adopted there (such as well functioning FTTH open networks), if successful, may, in our view, create a powerful precedent.

European policymakers have reason to act

So the question remains, are the policymakers likely to adopt or trigger radical solutions, which would change dynamics of the industry? Well, the EC has some reasons to act. Firstly, although there are major differences between countries, overall Europe does not appear to lead the developed world in terms of digital infrastructure, services and R&D — here the US and the more developed Asian economies tend to lead. It therefore feels global competitive pressure to improve. Secondly, while European politics is experiencing a challenging time, the issue of building a digital society could, to some degree, be perceived as a unifying force. The key steps, which we believe the European policymakers can adopt, include the following:

- Simplification of regulation
- Encouragement of scale benefits through the Digital Single Market, i.e. unified regulation
- Encouragement of competition, particularly for innovative infrastructure and services
- Encouragement of sharing and opening of basic utility-like infrastructure particularly when infrastructure competition is failing
- Subsidies of futureproof open basic infrastructure

Prospects of utility-like FTTH monopolies in long-term

There is a growing consensus that FTTH could become a wide-spread, long-term solution, but there is a heated debate about how and when this may happen

Quite a number of speakers from different backgrounds have agreed at the Conference that FTTH may be a long term solution for most if not all regions, particularly in the developed markets. However, the timeframe when this could be achieved (some speakers mentioned 10-15 years) and how this may be achieved (straight FTTH investments vs. gradual expansion of the existing incumbent or cable networks) is subject to a debate with often contradicting views.

FTTH is seen as 'future-proof'

The FTTH technology has the following features, which are making it comparable to utilities including water and electricity:

- **'Future-proof' solution with practically unlimited speed and capacity.** Unlike any other currently known technologies, data volumes and speeds, which can be transmitted on fibre cables to and from homes, are practically unlimited (tens of Gbits/second can normally be transmitted over one fibre channel now). Future upgrades can therefore be done only by changing active equipment such as the modems without a need to install new infrastructure. It is therefore possible to say that the final part of the last mile of the FTTH networks is literally fully future-proof. The last mile itself is also future-proof for a point-to-point FTTH, when each home has its dedicated fibre connection to the nearest exchange. The alternative is GPON, a tree structure fibre network with optical splitters, which may theoretically require some further investments to make it future proof. However, the most expensive last end of the last mile is future-proof in both cases.

- **Symmetry, the lowest possible latency, distance is less of an issue.** Download/upload speed asymmetry is not an issue for FTTH. Meanwhile, FTTH can achieve the best latency from the currently known technologies and it is far less sensitive to transmission distance compared to other technological alternatives.

- **Established, low-tech and non-innovative (utility-like).** Invention of the physical principal of fibre communication dates to the 19th century. The fibre technology has been commercially used for decades. Installing physical fibre infrastructure into the local loops requires construction and perhaps real estate expertise, but limited technological know-how. While setting up and operating active equipment in the FTTH networks requires technological know-how, absence of any active equipment in the local loops (such as street cabinets between homes and nearest exchanges) significantly reduces need for maintenance and technological expertise when operating the FTTH networks. This also boosts reliability of the FTTH networks vs. other technologies.

- **Expensive to build and cheap to operate.** FTTH networks are expensive to build, but as mentioned above, they are likely to last far longer and be cheaper to operate compared to alternative technologies.

- **Easy open access.** Absence of active equipment in the local loop makes FTTH networks highly suitable for open access, i.e. multiple access providers sharing FTTH infrastructure.

FTTH rollouts are expensive, but three points may boost their economics

Given high rollout cost, questions of economic case for FTTH rollouts (vs. other technological alternatives) are often raised. While analyzing such a case would go beyond the scope of this report, we can point out that in general the FTTH case can be currently boosted by:

1. **Cost of capital.** Low cost of capital driven by low interest rates and potential attractiveness of larger projects to international infrastructure investors.

2. **Demand.** Envisaged demand for symmetrical and highly reliable communication from 4G/5G small cells, Internet of Things, security solutions etc.

3. **Externality-driven subsidies**. Willingness of certain communities, regional and national government to provide funding and in kind benefits for FTTH rollouts.

In the very long-term, FTTH could become a monopoly, utility — like water or electricity…

As we said earlier, given the natural constraints of wireless technologies and expected major growth in demand for quality bandwidth, FTTH may become a universal solution in the very long-term. Given the lack of economic justification for building parallel competing FTTH networks and easiness of operating FTTH networks on a wholesale-only (open) basis as utilities, it is not impossible to imagine that (barring unexpected breakthrough in wireless technologies) FTTH access will in the very long-term become utility-monopoly such as water and electricity (also see our GPS report Re-birth of Telecom Monopoly from November 2014).

… which does not mean that forces of competition will stop driving progress

Assuming that the above thesis is right, we are talking about infrastructure competition in fixed-line access essentially as a temporary phenomenon until FTTH utility-type of networks are fully built and the industry consolidates (this could take a long time, though). Even if this happens, the forces of competition will still encourage continued progress, in our view. Infrastructure competition may shift to more innovative areas (e.g. wireless, small cells), digital service competition would thrive under open access FTTH while focus in fixed-line access may shift towards tenders for building (potentially subsidized) regional infrastructure and competition between countries for leading infrastructure globally. As we said, we see this vision as reasonably realistic in the long-term, barring breakthroughs in wireless technologies that would permanently eliminate the need for fibre in the last part of the local loop.

Challenges facing the incumbents

Scale economy of the incumbent fixed-line business is being challenged on all fronts

As for any large for any large companies, the business case for the incumbents is based on scale economies. We think, however, that the current industry trends including a potential boom in FTTH that could undermine the incumbents' scale economies in three different areas:

- **OTTs threaten viability of fixed-line service.** All-IP environment tends to favor global OTT players over any national players in terms of scale economies. This can be already observed in communication services (e.g. Skype, WhatsApp), content services (e.g. Netflix, YouTube), social media (e.g. Facebook, Twitter) etc. With substantially enhanced bandwidth, it could be even harder for the incumbents to stay relevant on the B2C fixed-line service market.

- **Local competitors threaten the economics of network expansion.** As mentioned above, there is limited scale economy in FTTH last mile rollout. The most capital intensive skill needed in this area is local planning and construction, which includes overcoming multiple administrative barriers at the local level. Experience shows that local businesses, communities and small flexible businesses may have cost and timing advantage when rolling out FTTH at the local level. Such advantage grows further if local communities are willing to provide extra funding or in kind benefits to such projects. Examples of such projects from around the world discussed at

the Conference (including the US, the UK, Sweden, Germany, Italy, South Africa, Brazil, Oman, the Czech Republic and many other countries) show that such independent FTTH rollouts can be successful. Although such companies have so far been still far from leading force on broadband markets in the respective countries, they are often leading investors in FTTH. Such projects also enjoy political backing in the US, including support of the US Presidential administration. Some US cities have even introduced special taxes to fund them. Separately, in urban areas the incumbents often face cable TV competitors with more advanced cabling in the local loop (DOCSIS 3 on coax cable), which could also invest into fibre and have a good chance to stay competitive even if the incumbents' copper networks are upgraded using gFast.

- **Open network nature of FTTH threatens convergence synergies.** Telecom incumbents could aim at benefiting from their ownership of mobile and content assets in their effort to boost scale economies of their fixed-line access businesses. Such strategies may be problematic in our view in long-term. The natural-monopoly and utility nature of FTTH means that areas, where the incumbents succeed in building FTTH and gain high market share as a result of it, are likely to attract regulatory attention, forcing such incumbents to share or even separate their fixed-line access networks.

Passive infrastructure opening and subsidies of rural competitors pose further challenges for the incumbents

Two other potential challenges facing the incumbents are: (1) forced opening of passive infrastructure and (2) government subsidies of rural broadband rollouts. The former, if fully implemented, could be highly disruptive as competitors would effectively get an opportunity to cherry pick the most lucrative locations and roll out fibre including FTTH there. The latter means a risk of competing entities winning state subsidies and building monopoly high speed networks in the rural areas. If successful, this may trigger pressures from customers in the cities to demand FTTH and open access networks as well.

Potential solutions for the incumbents

The market has, so far, not seen the described challenges facing the incumbents as fatal

Stock market investors in European incumbents have so far not seen the above-mentioned challenges as fatal. On the contrary, valuations of the incumbents have often benefited from low cost of capital, lack of large-scale disruption so far by smaller FTTH competitors as well as selective regulatory easing in fixed-line access (for example in regions where the incumbents are no more market leaders). That said, we already see the incumbents responding to the above-mentioned threats by actual and planned Capex hikes. So far, the market has been giving the incumbents some benefit of the doubt in the sense that the new investment would bring improvement in growth trends and returns, instead of being purely defensive.

Outlook for the incumbents depends on government policies about open infrastructure, subsidies, but also state ownership of the incumbents and desires to protect their workforce

The actual situation around the incumbents is quite complex and it substantially depends on regulation. Policymakers' desire to build infrastructure and the digital economy as fast and as efficiently as possible may lead to pressure to share and open certain infrastructure and to use public funds to subsidize infrastructure rollout in some areas. Meanwhile, some governments' policies may also be 'conflicted' by their shareholdings in the incumbents and possible interests of the incumbents' workforce (FTTH is an efficient technology with lower maintenance needs, which may have a long-term negative impact on the need for workforce).

We see two key possible strategic responses of the fixed-line incumbents, both aimed at deterring infrastructure competition

We believe that the incumbents are unlikely to avoid the above-described challenges, although their impact may vary from country to country. We think that any successful incumbent response should be focused primarily on deterring infrastructure competition. We see two key potential strategic responses.

Response 1: Gradual fibre expansion using gFast

gFast adoption may buy time and possibly deter competitive FTTH investments

This is a less radical approach, which may, in our view, buy the incumbents time, i.e. give them the ability to provide sufficiently competitive service for the time being, and hence possibly deter some competitive FTTH investments. gFast could deliver hundreds of Mbps on the existing copper lines for loops long possibly several hundreds of meters. Since gFast does not require rewiring of the last part of the last mile, it could be deployed quicker and cheaper than FTTH. It is also technically more challenging to unbundle the gFast local loops vs. the FTTH local loops, which the incumbents may find appealing in terms of deterring competition. However, gFast speeds are asymmetrical, they cannot be guaranteed and they will vary from customer to customer. Overall, the gFast network will inadvertently have lower capacity, latency and reliability, but also materially higher maintenance costs compared to an FTTH network.

gFast opportunity crucially depends on regulation …

… some regulators may wish to tolerate gFast's imperfections in exchange for relatively quick network quality gains …

… while others may see it as long-term inefficient diversion of funds with a potential to deter healthy FTTH competition and they may choose to discourage gFast by promoting future-proof solutions

gFast's ability to boost the quality of the copper last mile to temporarily sufficient levels can deter smaller FTTH competitors. gFast may also appeal to managements of incumbents, who lack incentive to consider more radical strategic options. Finally, gFast appears advantageous for the incumbent workforces, because of its increased demand for network maintenance. However, the true scale of the gFast opportunity for the incumbents in our view depends on regulatory policies as much as on the technology itself. Regulators, who primarily target long-term global competitiveness of national economies, may see gFast as resource diversion from inevitable 'future-proof' solutions. They may also not appreciate gFast's ability to deter otherwise commercially viable FTTH investments. Such regulators may choose to discourage gFast deployment for example through public subsidy policies, which demand features hard to be met by gFast. Meanwhile, regulators who target short-term solutions and who may be concerned about potential disruption of their domestic incumbents' businesses and impact of such disruption on the incumbents' workforce, may choose to temporarily tolerate high market share of vertically integrated incumbents with possibly more difficult unbundling. Such approach could make gFast rollouts economically highly attractive for the incumbents.

Response 2: Deeper opening or structural separation of fixed-line access combined with FTTH investment

FTTH investment lead can bring an advantage, although it does not mean guaranteed commercial success

Those who believe that utility-style FTTH monopolies are the ultimate long-term future in fixed-line access may be tempted to see such vision embedded in the incumbents' strategies as well. If such a vision is correct, as we discussed earlier, infrastructure competition is essentially a temporary phenomenon aimed at bringing FTTH to urban homes as fast as possible. Since duplication of utility-like FTTH infrastructure often makes little sense, the first operators to cover areas with FTTH may gain advantage in potential future consolidation (that said multiple cases of competition-driven urban infrastructure overbuild show that rolling out FTTH is not a guarantee of commercial success). Meanwhile, rural areas are likely to evolve into fibre-based monopolies, built with participation of public funds, using FTTH or (potentially competitive) wireless connection for the local loop.

Deep opening or structural separation of fixed-line access may provide a strategic solution for the incumbents

Unless the incumbents can secure privileged access to the subsidies or potential exemption from the natural need to open up their access networks (or at least their dominant parts) we think that the above-mentioned challenges could become quite fundamental for them, particularly in countries where national and local governments are keen to see FTTH rollout. One possible solution is voluntary deep opening or structural separation of the incumbents' fixed-line access networks. This may have in our view the following benefits for the incumbents and their shareholders:

1. **Future consolidation.** It may put them into a strong position of future consolidator of utility-like FTTH networks.

2. **Access to subsidies.** It may allow them to more easily claim government subsidies for rural rollouts.

3. **Reasonable regulation.** Policy-makers may see such open networks as 'strategically important' for the countries, they may see supporting their investments (as opposed to investment by wide range of small companies) as having benefits such as reduced technological/ownership fragmentation of infrastructure and better scale economies for the digital service companies. Hence it may not be in the policymakers' interest to regulate such open infrastructure companies too harshly, at least in the initial stage.

4. **Access to cheaper and longer-term capital.** Infrastructure investors would be willing to provide cheaper longer-term funding to structurally separated fixed-line access networks, which may help them to mitigate some of the above-mentioned disadvantages vs. smaller competitors.

5. **Deterrence of competition.** Due to the above, such a model may deter potential competitors willing to roll out alternative (possibly FTTH) infrastructure either fully independently or otherwise using access to the incumbents' passive infrastructure.

Examples of opening or separating incumbent fixed-line access infrastructure are beginning to emerge

Fixed-line access network structural separation first emerged in New Zealand a few years ago (eg, Spark). Further examples of fixed-line incumbent access network opening or structural separation or discussions about it began to emerge at an accelerated pace as of last year. They include:

- O2 CZ full voluntary structural separation in the Czech Republic (the case may become even more interesting if we see full separation of control of the two entities, which according to some local press may occur as soon as next month)

- Strategic overhaul at Telkom SA emphasizing commercial separation (open access) to its fixed-line access network

- Announced intention of Telefonica to separate its infrastructure in Spain

- Part of the Swedish incumbent fixed-line access (FTTH) network is operated as an open network

- The imminent decision of Ofcom, the UK regulator, about digital policy review, which according to some press reports may eventually directly or indirectly lead to deeper infrastructure opening up to structural separation

- Ongoing discussions in Turkey where such structural separation is being demanded by Turk Telekom's key competitors and discussed by the regulatory authority.

There has been limited number of structural separation examples, but shareholders returns so far appear encouraging

While most of the incumbents remain either silent or openly opposed to the opening/separation idea, it is worth highlighting that the two so far completed cases of voluntary incumbent structural separation, in New Zealand and the Czech Republic, have produced encouraging returns to the shareholders. So did BT's functional separation in the past decade.

The concept of open fixed-line access is being promoted by some policymakers to speed up digital innovation and rural development, but it is also supported by some media/telecom companies and infrastructure investors

Business model of open (wholesale-only) infrastructure is being increasingly promoted not only by policymakers looking at better scale economies in digital services and infrastructure development in the rural areas, but also by some providers or to-be-providers of digital services (for example, media or mobile companies) as well as some infrastructure investors looking for opportunities to invest into pure telecom infrastructure. We also see established telecom operators increasingly opening up about the need for 'disruptive strategic moves', which may include selected infrastructure opening/disposals and investment into services. This includes for example Verizon in the US, NTT DoCoMo in Japan, Vimpelcom and Megafon in Russia, but a number of others.

CEEMEA investment implications

We think that the market should attribute some valuation premium to incumbents open about strategic options and willing to decide based on shareholder value

Despite the universal logic of the discussed challenges and opportunities facing the telecom incumbents, attractiveness of strategic moves such as fixed-line access network opening or structural separation will naturally vary market by market, depending on the existing infrastructure, regulation, competition etc. In general, we believe that incumbents with open-minded management, willing to pragmatically assess all strategic options, their long-term implications and potential for deals with competitors and regulators, may deserve a valuation premium compared to the ones, which are not open to such discussion for reasons other than shareholder value (e.g. due to interests of other stakeholders). Below we give our more detailed thoughts about two CEEMEA incumbents, Orange Polska and Turk Telekom.

Orange Polska Orange Polska SA (OPL.WA; Zl6.20; 1)

One of the first European incumbents that considered voluntary structural separation, but current management is not supportive of such move

Orange Polska is one of the first European incumbents, which three years ago seriously considered structural separation of its fixed-line business. The project was subsequently abandoned. Today, management says that it sees value in keeping the vertically integrated structure, because vast majority of the data traffic is still on the fixed-line network, an argument which we do not entirely understand.

We think that free cash flow weakness and industry trends could bring separation back to the agenda at some point, which may provide a catalyst

We see, however, potentially strong value creation case in Orange Polska's fixed-line business separation. Let's briefly explain why. The company's mobile business is reasonably strong in terms of network, spectrum as well as commercial operations. Meanwhile, Orange Polska continues losing ground in its fixed-line business following more than a decade's worth of largely unsuccessful attempts to revive it. This includes building more than 700k FTTH connections last year after de-regulation of the access market in several regions. We think that Orange Polska's fixed-line network may need further fundamental investments along with a different approach towards selling its fixed-line products, possibly coupled with

content upgrade. All this would require potentially substantial investments with uncertain returns. Meanwhile, Orange Polska's fixed-line network remains the country's key fixed-line infrastructure asset, access to which may be quite desirable to several competitors keen to offer converged services. We therefore believe that from a shareholder value point of view it may be hard to justify sacrificing the valuation premium that Orange Polska's fixed-line business may attract outside the group by intra-group synergies. Although management says that it is currently not considering structural separation as a strategic option, we think that free cash flow weakness, together with potentially weak upcoming fixed-line performance and overall industry trends may bring such question back on the agenda at some point (that said we acknowledge that the parent company's potential lack of strategic support could be an issue). In any case we think that potential return of such issue on the agenda, if it happens, may form a catalyst for the stock.

Turk Telekom (Türk Telekomünikasyon AS) (TTKOM.IS; TL5.72; 2)

Competitors have recently proposed shared infrastructure for Turkey

Turk Telekom currently dominates Turkey’s fixed-line infrastructure and business and it has been benefiting from such dominance financially. In the past few months Turk Telekom's main competitors have become vocal about the potential benefits of shared infrastructure for the overall economy. The authorities are currently looking at such a model. In December of last year, Turk Telekom's CEO dismissed the idea of fully separating the fibre network, highlighting Turk Telekom's high historical investments into it. That said, in the 4Q15 results conference call, he expressed some openness about shared infrastructure projects in rural areas.

Benefits of infrastructure separation are less straightforward for Turk Telekom than for Orange Polska…

The competitors' case centres on the argument that Turkey deserves deep FTTH coverage while building parallel networks would be highly uneconomical. It also focuses on expiry of Turk Telekom's regulatory holidays in fibre this year, which means that Turk Telekom would be obliged to open its fibre network to a higher degree than before anyway. It is currently hard to predict the specific moves of the Turkish authorities and their timing. However, let's highlight that political power in Turkey is currently quite centralized, the country's leadership tends to have high ambitions in regard to technologies (note the country President's last year’s comments about 5G) and it pays lot of attention to cost efficiency of infrastructure investments. We think that the most likely outcome is some negotiated deal among the major Turkish telecoms about some form of infrastructure sharing. Its potential benefit for Turk Telekom's shareholders is in our view somewhat less clear than in case of Orange Polska, simply because unlike Orange Polska, Turk Telekom has so far been quite successful in selling fixed-line services and dominating the market.

... but such an arrangement would still bring benefits, including deterrence of competition and sustainable regulation; any further clarity on possible deals would serve as a catalyst

That said our cautious investment case on Turk Telekom assumes that Turk Telekom's local loop advantage may be eventually undermined by competition anyway, including one using LTE. If Turk Telekom negotiated a favourable infrastructure deal, its shareholders could theoretically get rewarded for low cost of capital of its infrastructure network, its sustained monopolistic nature and more predictable regulation, growth opportunities along with deterrence of infrastructure competition, which may otherwise occur. Unlike for Poland, this issue is already on agenda in Turkey, so any catalyst would need to be based on further clarity about a possible deal.

Orange Polska SA

(OPL.WA; Zl6.20; 1)

Valuation

Our DCF-based 12m ex-div target price for Orange Polska is PLN7.6. We use a sliding WACC in the range of 4.7-8.6% and zero terminal growth, which implies a 4.6x terminal year EV/EBITDA multiple.

Risks

Risks to the target price relate primarily to operating performance.

Downward risks: It is related to uncertain competitive situation affect both the fixed line and mobile businesses. In addition, accelerating mobile cannibalisation could lead to faster-than-expected erosion in fixed line segment revenues.

Upside risks: 1) strong positive impact of improving macro trend on overall voice/data usage, and 2) significant market share gains in fixed broadband market with faster FTTH roll out.

If the impact of these risk factors is more/less negative than we anticipate, then the share price might fail to reach/rise above our target price.

Türk Telekomünikasyon AS

(TTKOM.IS; TL5.72; 2)

Valuation

Our target price for Turk Telecom is TL5.30. Our 12-month ex-div target price is derived from the DCF fair value adjusted for time value of money and dividend. Our 11-year DCF model assumes terminal growth of 3% and WACC in the region of 12.4%-15.0%.

Risks

We see the following risks to achievement of our target price.

Upside risks: Lesser aggressive price competition from alternative fixed and mobile operators may result in lower line losses and better mobile revenues. Higher-than-expected revenue from ADSL with limited impact of LTE/wireless and better TV business performance.

Downside risks: Further TL depreciation against US$ will put more pressure on net income and dividend payout.

Appendix A-1

Analyst Certification

The research analyst(s) primarily responsible for the preparation and content of this research report are named in bold text in the author block at the front of the product except for those sections where an analyst's name appears in bold alongside content which is attributable to that analyst. Each of these analyst(s) certify, with respect to the section(s) of the report for which they are responsible, that the views expressed therein accurately reflect their personal views about each issuer and security referenced and were prepared in an independent manner, including with respect to Citigroup Global Markets Inc and its affiliates. No part of the research analyst's compensation was, is, or will be, directly or indirectly, related to the specific recommendation(s) or view(s) expressed by that research analyst in this report.

IMPORTANT DISCLOSURES

Türk Telekomünikasyon AS (TTKOM.IS)

Ratings and Target Price History
Fundamental Research

Analyst: Dalibor Vavruska

	Date	Rating	Target Price	Closing Price
1	07-Oct-11	Stock rating system changed		
2	03-May-13	*3	*7.60	8.84
3	18-Jul-13	*2	*7.00	6.90
4	03-Feb-14	2	*6.00	5.46
5	18-Jul-14	2	*6.20	6.28
6	02-Feb-15	2	*6.80	7.37
7	26-Mar-15	*3	*6.20	7.18
8	17-Sep-15	*2	*5.80	6.10
9	20-Jan-16	2	*5.30	4.99

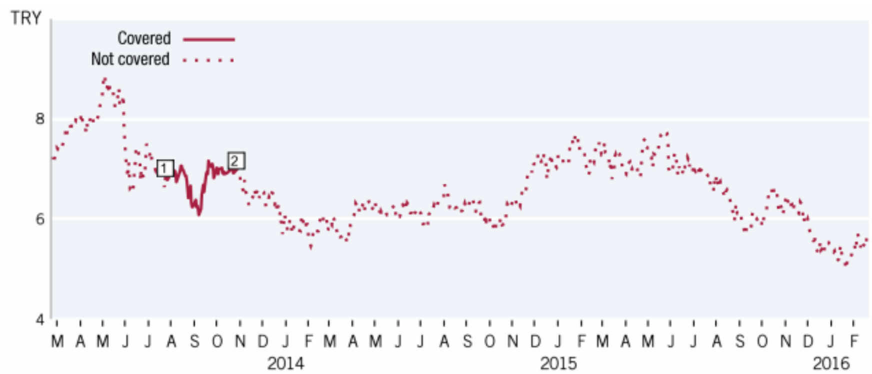
*Indicates Change

Rating/target price changes above reflect Eastern Standard Time

Türk Telekomünikasyon AS (TTKOM.IS)

Ratings and Target Price History
Best Ideas Research
Relative Call (3 Month)

Analyst: Dalibor Vavruska



	Date	Rating	Target Price	Closing Price
1	23-Jul-13	*ADD LP	-	6.80
2	25-Oct-13	*REM LP		

*Indicates Change

Rating/target price changes above reflect Eastern Standard Time

Orange Polska SA (OPL.WA)

Ratings and Target Price History
Fundamental Research

Analyst: Dalibor Vavruska

	Date	Rating	Target Price	Closing Price
1	07-Oct-11	Stock rating system changed		
2	14-Aug-13	*2	*7.90	7.14
3	27-Jan-14	*1	*12.40	9.70
4	04-Apr-14	1	*11.80	10.19
5	05-Sep-14	*2	*11.30	10.78
6	08-Oct-14	2	*11.20	10.71
7	13-Feb-15	2	*9.10	9.40
8	08-Jun-15	*3	*8.20	9.41
9	10-Jul-15	*2	*8.00	7.74
10	17-Dec-15	*1	*7.60	6.54

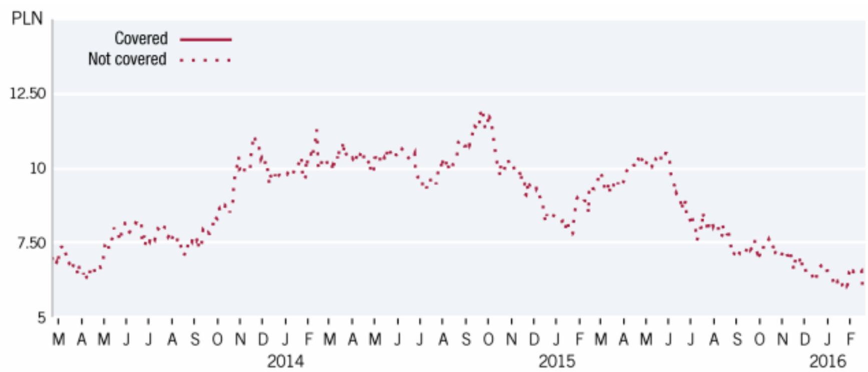
*Indicates Change

Rating/target price changes above reflect Eastern Standard Time

Orange Polska SA (OPL.WA)

Ratings and Target Price History
Best Ideas Research
Relative Call (3 Month)

Analyst: Dalibor Vavruska



*Indicates Change

Rating/target price changes above reflect Eastern Standard Time

DMBH is a market maker in the publicly traded equity securities of Orange Polska SA. DMBH rating distribution versus Investment Banking service provision in the past 12 months as at 31st of December 2015 is as follows: Buy (1) representing 31% of the DMBH coverage 0% of which are IB clients, Hold (2) representing 41% of the DMBH coverage 0% of which are IB clients, Sell (3) representing 28% of the DMBH coverage 0% of which are IB clients.

Citigroup Global Markets Inc. or its affiliates has received compensation for investment banking services provided within the past 12 months from Türk Telekomünikasyon AS, Orange Polska SA.

Citigroup Global Markets Inc. or an affiliate received compensation for products and services other than investment banking services from Türk Telekomünikasyon AS, Orange Polska SA in the past 12 months.

Citigroup Global Markets Inc. currently has, or had within the past 12 months, the following as investment banking client(s): Türk Telekomünikasyon AS, Orange Polska SA.

Citigroup Global Markets Inc. currently has, or had within the past 12 months, the following as clients, and the services provided were non-investment-banking, securities-related: Türk Telekomünikasyon AS, Orange Polska SA.

Citigroup Global Markets Inc. currently has, or had within the past 12 months, the following as clients, and the services provided were non-investment-banking, non-securities-related: Türk Telekomünikasyon AS, Orange Polska SA.

Citigroup Global Markets Inc. and/or its affiliates has a significant financial interest in relation to Türk Telekomünikasyon AS. (For an explanation of the determination of significant financial interest, please refer to the policy for managing conflicts of interest which can be found at www.citiVelocity.com.)

Analysts' compensation is determined by Citi Research management and Citigroup's senior management and is based upon activities and services intended to benefit the investor clients of Citigroup Global Markets Inc. and its affiliates (the "Firm"). Compensation is not linked to specific transactions or recommendations. Like all Firm employees, analysts receive compensation that is impacted by overall Firm profitability which includes investment banking, sales and trading, and principal trading revenues. One factor in equity research analyst compensation is arranging corporate access events between institutional clients and the management teams of covered companies. Typically, company management is more likely to participate when the analyst has a positive view of the company.

For securities recommended in the Product in which the Firm is not a market maker, the Firm is a liquidity provider in the issuers' financial instruments and may act as principal in connection with such transactions. The Firm is a regular issuer of traded financial instruments linked to securities that may have been recommended in the Product. The Firm regularly trades in the securities of the issuer(s) discussed in the Product. The Firm may engage in securities

transactions in a manner inconsistent with the Product and, with respect to securities covered by the Product, will buy or sell from customers on a principal basis.

For important disclosures (including copies of historical disclosures) regarding the companies that are the subject of this Citi Research product ("the Product"), please contact Citi Research, 388 Greenwich Street, 28th Floor, New York, NY, 10013, Attention: Legal/Compliance [E6WYB6412478]. In addition, the same important disclosures, with the exception of the Valuation and Risk assessments and historical disclosures, are contained on the Firm's disclosure website at https://www.citivelocity.com/cvr/eppublic/citi_research_disclosures. Valuation and Risk assessments can be found in the text of the most recent research note/report regarding the subject company. Historical disclosures (for up to the past three years) will be provided upon request.

Citi Research Equity Ratings Distribution

	12 Month Rating		
Data current as of 31 Dec 2015	**Buy**	**Hold**	**Sell**
Citi Research Global Fundamental Coverage	48%	40%	12%
% of companies in each rating category that are investment banking clients	64%	64%	59%

Guide to Citi Research Fundamental Research Investment Ratings:

Citi Research stock recommendations include an investment rating and an optional risk rating to highlight high risk stocks.

Risk rating takes into account both price volatility and fundamental criteria. Stocks will either have no risk rating or a High risk rating assigned.

Investment Ratings: Citi Research investment ratings are Buy, Neutral and Sell. Our ratings are a function of analyst expectations of expected total return ("ETR") and risk. ETR is the sum of the forecast price appreciation (or depreciation) plus the dividend yield for a stock within the next 12 months. The Investment rating definitions are: Buy (1) ETR of 15% or more or 25% or more for High risk stocks; and Sell (3) for negative ETR. Any covered stock not assigned a Buy or a Sell is a Neutral (2). For stocks rated Neutral (2), if an analyst believes that there are insufficient valuation drivers and/or investment catalysts to derive a positive or negative investment view, they may elect with the approval of Citi Research management not to assign a target price and, thus, not derive an ETR. Analysts may place covered stocks "Under Review" in response to exceptional circumstances (e.g. lack of information critical to the analyst's thesis) affecting the company and / or trading in the company's securities (e.g. trading suspension). As soon as practically possible, the analyst will publish a note re-establishing a rating and investment thesis. To satisfy regulatory requirements, we correspond Under Review and Neutral to Hold in our ratings distribution table for our 12-month fundamental rating system. However, we reiterate that we do not consider Under Review to be a recommendation. Investment ratings are determined by the ranges described above at the time of initiation of coverage, a change in investment and/or risk rating, or a change in target price (subject to limited management discretion). At other times, the expected total returns may fall outside of these ranges because of market price movements and/or other short-term volatility or trading patterns. Such interim deviations from specified ranges will be permitted but will become subject to review by Research Management. Your decision to buy or sell a security should be based upon your personal investment objectives and should be made only after evaluating the stock's expected performance and risk.

Prior to May 1, 2014 Citi Research may have also assigned a three-month relative call (or rating) to a stock to highlight expected out-performance (most preferred) or under-performance (least preferred) versus the geographic and industry sector over a 3 month period. The relative call may have highlighted a specific near-term catalyst or event impacting the company or the market that was anticipated to have a short-term price impact on the equity securities of the company. Absent any specific catalyst the analyst(s) may have indicated the most and least preferred stocks in the universe of stocks under consideration, explaining the basis for this short-term view. This three-month view may have been different from and did not affect a stock's fundamental equity rating, which reflected a longer-term total absolute return expectation.

NON-US RESEARCH ANALYST DISCLOSURES

Non-US research analysts who have prepared this report (i.e., all research analysts listed below other than those identified as employed by Citigroup Global Markets Inc.) are not registered/qualified as research analysts with FINRA. Such research analysts may not be associated persons of the member organization and therefore may not be subject to the FINRA Rule 2241 restrictions on communications with a subject company, public appearances and trading securities held by a research analyst account. The legal entities employing the authors of this report are listed below:

Citigroup Global Markets Ltd	Dalibor Vavruska; Dilya Ibragimova
Citigroup Global Markets India Private Limited	Vibhor Kumar

OTHER DISCLOSURES

Many European regulators require that a firm must establish, implement and make available a policy for managing conflicts of interest arising as a result of publication or distribution of investment research. The policy applicable to Citi Research's Products can be found at https://www.citivelocity.com/cvr/eppublic/citi_research_disclosures.

Citigroup Global Markets India Private Limited and/or its affiliates may have, from time to time, actual or beneficial ownership of 1% or more in the debt securities of the subject issuer.

Citi Research generally disseminates its research to the Firm’s global institutional and retail clients via both proprietary (e.g., Citi Velocity and Citi Personal Wealth Management) and non-proprietary electronic distribution platforms. Certain research may be disseminated only via the Firm’s proprietary distribution platforms; however such research will not contain changes to earnings forecasts, target price, investment or risk rating or investment thesis or be otherwise inconsistent with the author’s previously published research. Certain research is made available only to institutional investors to satisfy regulatory requirements. Individual Citi Research analysts may also opt to circulate published research to one or more clients by email; such email distribution is discretionary and is done only after the research has been disseminated. The level and types of services provided by Citi Research analysts to clients may vary depending on various factors such as the client’s individual preferences as to the frequency and manner of receiving communications from analysts, the client’s risk profile and investment focus and perspective (e.g. market-wide, sector specific, long term, short-term etc.), the size and scope of the overall client relationship with the Firm and legal and regulatory constraints.

Pursuant to Comissão de Valores Mobiliários Rule 483, Citi is required to disclose whether a Citi related company or business has a commercial relationship with the subject company. Considering that Citi operates multiple businesses in more than 100 countries around the world, it is likely that Citi has a commercial relationship with the subject company.

Securities recommended, offered, or sold by the Firm: (i) are not insured by the Federal Deposit Insurance Corporation; (ii) are not deposits or other obligations of any insured depository institution (including Citibank); and (iii) are subject to investment risks, including the possible loss of the principal amount invested. The Product is for informational purposes only and is not intended as an offer or solicitation for the purchase or sale of a security. Any decision to purchase securities mentioned in the Product must take into account existing public information on such security or any registered prospectus. Although information has been obtained from and is based upon sources that the Firm believes to be reliable, we do not guarantee its accuracy and it may be incomplete and condensed. Note, however, that the Firm has taken all reasonable steps to determine the accuracy and completeness of the disclosures made in the Important Disclosures section of the Product. The Firm's research department has received assistance from the subject company(ies) referred to in this Product including, but not limited to, discussions with management of the subject company(ies). Firm policy prohibits research analysts from sending draft research to subject companies. However, it should be presumed that the author of the Product has had discussions with the subject company to ensure factual accuracy prior to publication. All opinions, projections and estimates constitute the judgment of the author as of the date of the Product and these, plus any other information contained in the Product, are subject to change without notice. Prices and availability of financial instruments also are subject to change without notice. Notwithstanding other departments within the Firm advising the companies discussed in this Product, information obtained in such role is not used in the preparation of the Product. Although Citi Research does not set a predetermined frequency for publication, if the Product is a fundamental equity or credit research report, it is the intention of Citi Research to provide research coverage of the covered issuers, including in response to news affecting the issuer. For non-fundamental research reports, Citi Research may not provide regular updates to the views, recommendations and facts included in the reports. Notwithstanding that Citi Research maintains coverage on, makes recommendations concerning or discusses issuers, Citi Research may be periodically restricted from referencing certain issuers due to legal or policy reasons. Citi Research may provide different research products and services to different classes of customers (for example, based upon long-term or short-term investment horizons) that may lead to differing conclusions or recommendations that could impact the price of a security contrary to the recommendations in the alternative research product, provided that each is consistent with the rating system for each respective product.

Investing in non-U.S. securities, including ADRs, may entail certain risks. The securities of non-U.S. issuers may not be registered with, nor be subject to the reporting requirements of the U.S. Securities and Exchange Commission. There may be limited information available on foreign securities. Foreign companies are generally not subject to uniform audit and reporting standards, practices and requirements comparable to those in the U.S. Securities of some foreign companies may be less liquid and their prices more volatile than securities of comparable U.S. companies. In addition, exchange rate movements may have an adverse effect on the value of an investment in a foreign stock and its corresponding dividend payment for U.S. investors. Net dividends to ADR investors are estimated, using withholding tax rates conventions, deemed accurate, but investors are urged to consult their tax advisor for exact dividend computations. Investors who have received the Product from the Firm may be prohibited in certain states or other jurisdictions from purchasing securities mentioned in the Product from the Firm. Please ask your Financial Consultant for additional details. Citigroup Global Markets Inc. takes responsibility for the Product in the United States. Any orders by US investors resulting from the information contained in the Product may be placed only through Citigroup Global Markets Inc.

Important Disclosures for Bell Potter Customers: Bell Potter is making this Product available to its clients pursuant to an agreement with Citigroup Global Markets Australia Pty Limited. Neither Citigroup Global Markets Australia Pty Limited nor any of its affiliates has made any determination as to the suitability of the information provided herein and clients should consult with their Bell Potter financial advisor before making any investment decision.

The Citigroup legal entity that takes responsibility for the production of the Product is the legal entity which the first named author is employed by. The Product is made available in **Australia** through Citigroup Global Markets Australia Pty Limited. (ABN 64 003 114 832 and AFSL No. 240992), participant of the ASX Group and regulated by the Australian Securities & Investments Commission. Citigroup Centre, 2 Park Street, Sydney, NSW 2000. Citigroup Global Markets Australia Pty Limited is not an Authorised Deposit-Taking Institution under the Banking Act 1959, nor is it regulated by the Australian Prudential Regulation Authority. The Product is made available in Australia to Private Banking wholesale clients through Citigroup Pty Limited (ABN 88 004 325 080 and AFSL 238098). Citigroup Pty Limited provides all financial product advice to Australian Private Banking wholesale clients through bankers and relationship managers. If there is any doubt about the suitability of investments held in Citigroup Private Bank accounts, investors should contact the Citigroup Private Bank in Australia. Citigroup companies may compensate affiliates and their representatives for providing products and services to clients. The Product is made available in **Brazil** by Citigroup Global Markets Brasil - CCTVM SA, which is regulated by CVM - Comissão de Valores Mobiliários ("CVM"), BACEN - Brazilian Central Bank, APIMEC - Associação dos Analistas e Profissionais de Investimento do Mercado de Capitais and ANBIMA – Associação Brasileira das Entidades dos Mercados Financeiro e de Capitais. Av. Paulista, 1111 - 14º andar(parte) - CEP: 01311920 - São Paulo - SP. If the Product is being made available in certain provinces of **Canada** by Citigroup Global Markets (Canada) Inc. ("CGM Canada"), CGM Canada has approved the Product. Citigroup Place, 123 Front Street West, Suite 1100, Toronto, Ontario M5J 2M3. This product is available in **Chile** through Banchile Corredores de Bolsa S.A., an indirect subsidiary of Citigroup Inc., which is regulated by the Superintendencia de Valores y Seguros. Agustinas 975, piso 2, Santiago, Chile. The Product is distributed in **Germany** by Citigroup Global Markets Deutschland AG ("CGMD"), which is regulated by Bundesanstalt fuer Finanzdienstleistungsaufsicht (BaFin). CGMD, Reuterweg 16, 60323 Frankfurt am Main. Research which relates to "securities" (as defined in the Securities and Futures Ordinance (Cap. 571 of the Laws of Hong Kong)) is issued in **Hong Kong** by, or on behalf of, Citigroup Global Markets Asia Limited which takes full responsibility for its content. Citigroup Global Markets Asia Ltd. is regulated by Hong Kong Securities and Futures Commission. If the Research is made available through Citibank, N.A., Hong Kong Branch, for its clients in Citi Private Bank, it is made available by Citibank N.A., Citibank Tower, Citibank Plaza, 3 Garden Road, Hong Kong. Citibank N.A. is regulated by the Hong Kong Monetary Authority. Please contact your Private Banker in Citibank N.A., Hong Kong, Branch if you have any queries on or any matters arising from or in connection with this document. The Product is made available in **India** by Citigroup Global Markets India Private Limited (CGM), which is regulated by the Securities and Exchange Board of India (SEBI), as a Research Analyst (SEBI Registration No. INH000000438). CGM is also actively involved in the business of merchant banking, stock brokerage, and depository participant, in India, and is registered with SEBI in this regard. CGM's registered office is at 1202, 12th Floor, FIFC, G Block, Bandra Kurla Complex, Bandra East, Mumbai – 400051. CGM's Corporate Identity Number is U99999MH2000PTC126657, and its contact details are: Tel:+9102261759999 Fax:+9102261759961. The Product is made available in **Indonesia** through PT Citigroup Securities Indonesia. 5/F, Citibank Tower, Bapindo Plaza, Jl. Jend. Sudirman Kav. 54-55, Jakarta 12190. Neither this Product nor any copy hereof may be distributed in Indonesia or to any Indonesian citizens wherever they are domiciled or to Indonesian residents except in compliance with applicable capital market laws and regulations. This Product is not an offer of securities in Indonesia. The securities referred to in this Product have not been registered with the Capital Market and Financial Institutions Supervisory Agency (BAPEPAM-LK) pursuant to relevant capital market laws and regulations, and may not be offered or sold within the territory of the Republic of Indonesia or to Indonesian

citizens through a public offering or in circumstances which constitute an offer within the meaning of the Indonesian capital market laws and regulations. The Product is made available in **Israel** through Citibank NA, regulated by the Bank of Israel and the Israeli Securities Authority. Citibank, N.A, Platinum Building, 21 Ha'arba'ah St, Tel Aviv, Israel. The Product is made available in **Italy** by Citigroup Global Markets Limited, which is authorised by the PRA and regulated by the FCA and the PRA. Via dei Mercanti, 12, Milan, 20121, Italy. The Product is made available in **Japan** by Citigroup Global Markets Japan Inc. ("CGMJ"), which is regulated by Financial Services Agency, Securities and Exchange Surveillance Commission, Japan Securities Dealers Association, Tokyo Stock Exchange and Osaka Securities Exchange. Shin-Marunouchi Building, 1-5-1 Marunouchi, Chiyoda-ku, Tokyo 100-6520 Japan. If the Product was distributed by SMBC Nikko Securities Inc. it is being so distributed under license. In the event that an error is found in an CGMJ research report, a revised version will be posted on the Firm's Citi Velocity website. If you have questions regarding Citi Velocity, please call (81 3) 6270-3019 for help. The Product is made available in **Korea** by Citigroup Global Markets Korea Securities Ltd., which is regulated by the Financial Services Commission, the Financial Supervisory Service and the Korea Financial Investment Association (KOFIA). Citibank Building, 39 Da-dong, Jung-gu, Seoul 100-180, Korea. KOFIA makes available registration information of research analysts on its website. Please visit the following website if you wish to find KOFIA registration information on research analysts of Citigroup Global Markets Korea Securities Ltd. http://dis.kofia.or.kr/websquare/index.jsp?w2xPath=/wq/fundMgr/DISFundMgrAnalystList.xml&divisionId=MDIS03002002000000&serviceId=SDIS03002002000. The Product is made available in Korea by Citibank Korea Inc., which is regulated by the Financial Services Commission and the Financial Supervisory Service. Address is Citibank Building, 39 Da-dong, Jung-gu, Seoul 100-180, Korea. The Product is made available in **Malaysia** by Citigroup Global Markets Malaysia Sdn Bhd (Company No. 460819-D) ("CGMM") to its clients and CGMM takes responsibility for its contents. CGMM is regulated by the Securities Commission of Malaysia. Please contact CGMM at Level 43 Menara Citibank, 165 Jalan Ampang, 50450 Kuala Lumpur, Malaysia in respect of any matters arising from, or in connection with, the Product. The Product is made available in **Mexico** by Acciones y Valores Banamex, S.A. De C. V., Casa de Bolsa, Integrante del Grupo Financiero Banamex ("Accival") which is a wholly owned subsidiary of Citigroup Inc. and is regulated by Comision Nacional Bancaria y de Valores. Reforma 398, Col. Juarez, 06600 Mexico, D.F. In **New Zealand** the Product is made available to 'wholesale clients' only as defined by s5C(1) of the Financial Advisers Act 2008 ('FAA') through Citigroup Global Markets Australia Pty Ltd (ABN 64 003 114 832 and AFSL No. 240992), an overseas financial adviser as defined by the FAA, participant of the ASX Group and regulated by the Australian Securities & Investments Commission. Citigroup Centre, 2 Park Street, Sydney, NSW 2000. The Product is made available in **Pakistan** by Citibank N.A. Pakistan branch, which is regulated by the State Bank of Pakistan and Securities Exchange Commission, Pakistan. AWT Plaza, 1.1. Chundrigar Road, P.O. Box 4889, Karachi-74200. The Product is made available in the **Philippines** through Citicorp Financial Services and Insurance Brokerage Philippines, Inc., which is regulated by the Philippines Securities and Exchange Commission. 20th Floor Citibank Square Bldg. The Product is made available in the Philippines through Citibank NA Philippines branch, Citibank Tower, 8741 Paseo De Roxas, Makati City, Manila. Citibank NA Philippines NA is regulated by The Bangko Sentral ng Pilipinas. The Product is made available in **Poland** by Dom Maklerski Banku Handlowego SA an indirect subsidiary of Citigroup Inc., which is regulated by Komisja Nadzoru Finansowego. Dom Maklerski Banku Handlowego S.A. ul.Senatorska 16, 00-923 Warszawa. The Product is made available in the **Russian Federation** through ZAO Citibank, which is licensed to carry out banking activities in the Russian Federation in accordance with the general banking license issued by the Central Bank of the Russian Federation and brokerage activities in accordance with the license issued by the Federal Service for Financial Markets. Neither the Product nor any information contained in the Product shall be considered as advertising the securities mentioned in this report within the territory of the Russian Federation or outside the Russian Federation. The Product does not constitute an appraisal within the meaning of the Federal Law of the Russian Federation of 29 July 1998 No. 135-FZ (as amended) On Appraisal Activities in the Russian Federation. 8-10 Gasheka Street, 125047 Moscow. The Product is made available in **Singapore** through Citigroup Global Markets Singapore Pte. Ltd. ("CGMSPL"), a capital markets services license holder, and regulated by Monetary Authority of Singapore. Please contact CGMSPL at 8 Marina View, 21st Floor Asia Square Tower 1, Singapore 018960, in respect of any matters arising from, or in connection with, the analysis of this document. This report is intended for recipients who are accredited, expert and institutional investors as defined under the Securities and Futures Act (Cap. 289). The Product is made available by The Citigroup Private Bank in Singapore through Citibank, N.A., Singapore Branch, a licensed bank in Singapore that is regulated by Monetary Authority of Singapore. Please contact your Private Banker in Citibank N.A., Singapore Branch if you have any queries on or any matters arising from or in connection with this document. This report is intended for recipients who are accredited, expert and institutional investors as defined under the Securities and Futures Act (Cap. 289). This report is distributed in Singapore by Citibank Singapore Ltd ("CSL") to selected Citigold/Citigold Private Clients. CSL provides no independent research or analysis of the substance or in preparation of this report. Please contact your Citigold//Citigold Private Client Relationship Manager in CSL if you have any queries on or any matters arising from or in connection with this report. This report is intended for recipients who are accredited investors as defined under the Securities and Futures Act (Cap. 289). Citigroup Global Markets (Pty) Ltd. is incorporated in the **Republic of South Africa** (company registration number 2000/025866/07) and its registered office is at 145 West Street, Sandton, 2196, Saxonwold. Citigroup Global Markets (Pty) Ltd. is regulated by JSE Securities Exchange South Africa, South African Reserve Bank and the Financial Services Board. The investments and services contained herein are not available to private customers in South Africa. The Product is made available in the **Republic of China** through Citigroup Global Markets Taiwan Securities Company Ltd. ("CGMTS"), 14 and 15F, No. 1, Songzhi Road, Taipei 110, Taiwan and/or through Citibank Securities (Taiwan) Company Limited ("CSTL"), 14 and 15F, No. 1, Songzhi Road, Taipei 110, Taiwan, subject to the respective license scope of each entity and the applicable laws and regulations in the Republic of China. CGMTS and CSTL are both regulated by the Securities and Futures Bureau of the Financial Supervisory Commission of Taiwan, the Republic of China. No portion of the Product may be reproduced or quoted in the Republic of China by the press or any third parties [without the written authorization of CGMTS and CSTL]. If the Product covers securities which are not allowed to be offered or traded in the Republic of China, neither the Product nor any information contained in the Product shall be considered as advertising the securities or making recommendation of the securities in the Republic of China. The Product is for informational purposes only and is not intended as an offer or solicitation for the purchase or sale of a security or financial products. Any decision to purchase securities or financial products mentioned in the Product must take into account existing public information on such security or the financial products or any registered prospectus. The Product is made available in **Thailand** through Citicorp Securities (Thailand) Ltd., which is regulated by the Securities and Exchange Commission of Thailand. 399 Interchange 21 Building, 18th Floor, Sukhumvit Road, Klongtoey Nua, Wattana ,Bangkok 10110, Thailand. The Product is made available in **Turkey** through Citibank AS which is regulated by Capital Markets Board. Tekfen Tower, Eski Buyukdere Caddesi # 209 Kat 2B, 23294 Levent, Istanbul, Turkey. In the **U.A.E**, these materials (the "Materials") are communicated by Citigroup Global Markets Limited, DIFC branch ("CGML"), an entity registered in the Dubai International Financial Center ("DIFC") and licensed and regulated by the Dubai Financial Services Authority ("DFSA") to Professional Clients and Market Counterparties only and should not be relied upon or distributed to Retail Clients. A distribution of the different Citi Research ratings distribution, in percentage terms for Investments in each sector covered is made available on request. Financial products and/or services to which the Materials relate will only be made available to Professional Clients

and Market Counterparties. The Product is made available in **United Kingdom** by Citigroup Global Markets Limited, which is authorised by the Prudential Regulation Authority ("PRA") and regulated by the Financial Conduct Authority ("FCA") and the PRA. This material may relate to investments or services of a person outside of the UK or to other matters which are not authorised by the PRA nor regulated by the FCA and the PRA and further details as to where this may be the case are available upon request in respect of this material. Citigroup Centre, Canada Square, Canary Wharf, London, E14 5LB. The Product is made available in **United States** by Citigroup Global Markets Inc, which is a member of FINRA and registered with the US Securities and Exchange Commission. 388 Greenwich Street, New York, NY 10013. Unless specified to the contrary, within EU Member States, the Product is made available by Citigroup Global Markets Limited, which is authorised by the PRA and regulated by the FCA and the PRA.
The Product is not to be construed as providing investment services in any jurisdiction where the provision of such services would not be permitted.
Subject to the nature and contents of the Product, the investments described therein are subject to fluctuations in price and/or value and investors may get back less than originally invested. Certain high-volatility investments can be subject to sudden and large falls in value that could equal or exceed the amount invested. Certain investments contained in the Product may have tax implications for private customers whereby levels and basis of taxation may be subject to change. If in doubt, investors should seek advice from a tax adviser. The Product does not purport to identify the nature of the specific market or other risks associated with a particular transaction. Advice in the Product is general and should not be construed as personal advice given it has been prepared without taking account of the objectives, financial situation or needs of any particular investor. Accordingly, investors should, before acting on the advice, consider the appropriateness of the advice, having regard to their objectives, financial situation and needs. Prior to acquiring any financial product, it is the client's responsibility to obtain the relevant offer document for the product and consider it before making a decision as to whether to purchase the product.
Citi Research product may source data from dataCentral. dataCentral is a Citi Research proprietary database, which includes the Firm's estimates, data from company reports and feeds from Thomson Reuters. The printed and printable version of the research report may not include all the information (e.g., certain financial summary information and comparable company data) that is linked to the online version available on the Firm's proprietary electronic distribution platforms.

ADDITIONAL INFORMATION IS AVAILABLE UPON REQUEST