

A collection of scenario implications of research done in WP3

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International spillovers in a world of technology clubs (by Roman Stöllinger/wiiv)

Implications of the results for the Augur scenarios

One dimension in the AUGUR scenarios – reduced government (consolidation), bipolar world, multipolar world and regionalisation – is the promotion of convergence. Obviously, the scenarios differ with respect to the efforts made to integrate previously marginalised countries in the world economy and initiate or strengthen catching-up processes.

This paper was intended to highlight the huge differences in the innovative and absorptive capacity of countries which we associated with R&D and human capital. Our cluster analysis showed these differences by forming three groups of countries or clubs. In the regression analyses, we concentrated more on the role of absorptive capacities and our results suggest that countries had had a rather differentiated experience with regards to technological catching-up over the past 30 years. According to our results countries with at least intermediate levels of human capital experienced strong growth effects from international spillovers (due to their technology gaps). In contrast, countries with very low absorptive capacity these growth effects from technological catch-up is much more modest, despite the fact that these countries tend to have large technology gaps which potentially give rise to strong spillover effects. The results for the growth effects for model countries with club average values of human capital and the productivity gap are summarised in Table 4 for each of the three clubs.

Table 4: Growth effects from technological catch-up by technology club

	human capital	productivity gap (club average)	catch-up term	estimated coefficient of catch-up term	predicted growth effect from catch-up	actual average growth (1980-2009)
low regime	2.62	0.97	2.54	0.0206	0.052	0.163
medium regime	6.15	0.83	5.10	0.0338	0.173	0.180
high regime	9.86	0.45	4.43	0.0271	0.120	0.144

We believe that our results are helpful for shaping the scenarios for at least two reasons. Firstly, we believe that the scenarios should reflect that strengthening the catching-up process of middle income regions such as South America or Other South East Asia should be much easier to achieve than initiating a convergence process in countries that so far were technologically left behind. This element seems to be absent in the scenarios. Secondly, our results suggest that next to physical capital, the development of human capital – indirectly through the catch-up mechanism – also plays a crucial role for the growth process. The role of the skill structure of the labour force and more generally the educational level is one of the topics debated in recent work on the possible transition of the Middle Eastern and North African (MENA) countries. Havlik and Richter (2011) for example point out the very different initial situation of the MENA region in this respect in their comparison of the transition phase of the Central, East and South East European countries with that of the potential transition of the MENA countries.

Common to all scenarios is that the *international* channels through which *income* convergence of poorer region takes place are: (i) inducing foreign direct investment in low and middle income

regions and (ii) increasing the regions' exports. According to our understanding, in the CAM model this will come about mainly by 'directly modelling' an increase in the export market shares of the respective region. The topic of our paper – technology and human capital – is linked to these activities in the sense that advances in technology should induce more investment in *physical* capital which in turn increases the export base.¹

We relate the insights from this paper to the individual scenarios using the following three factors:

- Relevant technological frontier
- Investment in education and human capital
- Free flow of technology spillovers

Consolidation Scenario

In this scenario the relevant technological frontier is global in scope. Multinational firms continue to operate globally with foreign direct investment (FDI) flowing to most profitable markets (with acceptable political risk). Also, the trade flows between major trading partners and emerging markets will continue to intensify as remaining tariff and non-tariff barriers will be further reduced or entirely dismantled. The promotion of convergence among countries will be less of an issue as civil society organisations (CSO) and social movements will not be influential enough to induce or lobby for supportive measures (partly because government will also save on expenditure for CSOs).

This scenario may be beneficial for emerging regions which are already involved in trade in manufactures and also target markets for FDI as the channels for technology flows remain open. On the other hand little efforts are made to involve marginalised countries that are far behind the technological frontier and that also lack locational attractiveness therefore receiving only little amounts of FDI.

Investment in education and human capital will not be a high priority in this scenario. The cuts in public expenditures characterising this scenario will negatively affect investment in education slowing down or even halting the global upward trends in educational attainments (such as years of schooling, school enrolment rates,...). However, to the extent that the consolidation scenario only foresees reductions in public expenditures in developed countries, the existing gaps in educational attainments between low and middle income countries and developed countries may be reduced. Factors that could counteract a potential convergence in human capital are that development aid, including aid for education, will be reduced and that in developed countries the private sector may more readily compensate reductions in educational investments than in low income countries.

Most problematic from the perspective of technology catch-up in this scenario could be that knowledge flows and technology spillovers are hampered by institutional factors. More precisely, we mean the design the intellectual property right regimes. Obviously, the longer is the duration of patent protection and the lower are the novelty requirements for innovations the more likely it is that the free flow of spillovers are curtailed. As the this scenario assumes that multinational companies have a big say in forging international trade, investment and intellectual property

¹ Investment in human capital could be reflected in government spending.

rules, strong protectionism in this area is to be expected. Moreover, as the scenario implies further liberalisation of international investments, banning ownership restrictions, foreign direct investment may more often take the form of wholly owned subsidiaries instead as joint-ventures with local firms.

Bipolar Scenario

The current description of the bipolar scenario does not make any statement on whether convergence promotion will be an issue. On the one hand, China and the US will be mainly concerned with the welfare of their own countries. On the other hand, if the scenario is envisaged to be not fully harmonic but entail a great deal of rivalry – the most plausible case – then both the US and China will try to support strategically important countries. In this respect we could envisage the bipolar scenario as being similar to the situation that prevailed during the period of the Cold War but replacing the U.S.S.R with China. Moreover, we would assume that Europe manages to “stay neutral” in this situation and is capable to remain friendly relationships with both the US and China. This scenario could also foresee an R&D race between the US and China.

In this framework the relevant technological frontier could be seen as ‘semi-global’ with countries in the sphere of influence of the USA drawing on the US technology and allied countries and countries in the Chinese sphere of influence drawing on the Chinese technological frontier. This would imply that US multinationals mainly invest in ‘allied countries or regions’ (presumably Other Developed Countries, Central America and South America) and also that trade relations will be tightened with those regions. A similar situation prevails for China which will be active mainly in Asian regions and Africa. An important (dividing) issue in this context could be the definition of product standards which each of the two major Blocs following their own (non-compatible) standards.

In this scenario investment in education and innovation will be a major issue as both the US and China will strive for the technological lead in major industries (e.g. automotive, aerospace, nano-electronics and environmental technologies) and science in general. Expenditures in R&D – which are rapidly increasing in China – could experience a boost, partly offsetting the fact that a ‘global technological frontier’ ceases to exist.

In a bipolar world, the US and China will presumably provide bilateral development assistance to allied countries and regions, in particular to countries that are deemed geo-strategically important. Development assistance may take the form of direct grants and military support (e.g. provision of arms) but ‘aid for education’ will probably not be very high on the agenda (the US are traditionally the donor country with the smallest share of education aid in total aid provided).²

The exchange of technologies will be stronger within the partners of the respective spheres of influence and they will also be fewer barriers to such technology flows. Intellectual property rights could be one of the controversial issues in the bipolar scenario. The US will demand increasingly strong protection of intellectual property. China’s position on this issue could be selective as it will continue to be dependent on foreign technologies but at the same time may get interested in protection of its own patents and copyrights.

² In the period 2001-2002 aid to education amounted to only 3.6% of total aid provided by the US, whereas for New Zealand the share was more than a third.

Multipolar Scenario

In the multipolar world countries can draw on the global technological frontier. Income convergence and technological catching-up is an issue in global governance, and particularly in global trade and investment negotiations.

In this scenario the optimistic view that all countries can overcome existing poverty traps in human capital prevails. National education programmes could be supported by educational aid programmes the budget of which will increase significantly as Official Development Assistance will finally reach the long term target of 0.7% of GDP of donor countries. In middle income countries such educational programmes could, for example, take the form of One Laptop per Child (OLPC)-type of projects where the international donor community would cover the costs for the computers, training and maintenance.³ Ideally, such projects are designed like the Indian Sakshat programmes where the low-cost tablet computers for children are also produced in India.

Technology flows from developed regions to low and middle income regions are explicitly supported by stronger co-operations in the field of research and investment in human capital. The World Intellectual Property Organisation (WIPO) will set global standards for patents and other trademark laws, including less generous provisions on the maximum duration of patent protections. Moreover, developed countries may agree to renounce on intellectual property rights on chemical substances, including pharmaceuticals, boosting access to technology in the field of agriculture, health and others areas.

The reduction in patent protection reduces the incentive to undertake R&D, above all in developed countries. This impact, however, need not be very large as innovators still benefit from their innovations due to the imitation lag, reputational advantages and the head start in reducing production costs from through learning effects. Moreover, R&D will receive increased public funding. Governments will also –pushed by CSOs – increasingly adopt open source software. This will provide a great stimulus to the development of open source software.

International investment rules will be flexible for low income countries to give them sufficient policy space. In particular, ownership restrictions in FDI projects are possible and implemented to foster joint-ventures between multinationals and local firms. At the same time such restrictions tend to reduce the amount of FDI received.

Regionalisation Scenario

In the regionalisation scenario the relevant technological frontier is assumed to be mainly regional in scope. This is because the deadlock at the multilateral stage along with intensification of regional integration processes (EU, ASEAN, NAFTA, MERCOSUR) will strengthen regional trade and investment flows, even if the scenario takes the form of an “open regionalism”. Convergence is an issue, primarily at the regional level. For a limited group of countries, i.e. the East European region and Other East Asia may benefit most in a regionalisation scenario with

³ In Uruguay such a programme (Plan Ceibal; Education Connect) has started and was fully implemented by October 2009 involving 362,000 pupils and 18,000 teachers. The cost to the state is reported at \$260 per child, including maintenance costs, equipment repairs, training for the teachers and internet connection. The annual cost of maintaining the programme, including an information portal for pupils and teachers, will be US\$21 per child. See http://en.wikipedia.org/wiki/One_Laptop_per_Child.

respect to spillovers as their main trading partners and sources of such spillovers are within their (wider) region. For regions that do not include technology leaders or only very few (i.e. Africa South, Africa North, West Asia, India and Other South Asia as well as the CIS region).

Explicit efforts to improve educational systems will be institutionalised only in the EU which could extend this to selected neighbourhood regions (Africa North, non-EU East Europe). In all other regions developments would rather resemble the baseline scenario.

Regional technology flows will be supported by the setting of common technological standards, facilitating trade and investment flows. Moreover within the EU a single European Union-wide patent system could finally emerge. Within the regional Blocs that are successful in their integration efforts (mainly NAFTA, the EU and ASEAN +JA, CN, EAH) there will also be increased international R&D co-operation both between public institutions and between firms. Moreover, supranational institutions may also implement (or increase) funding for R&D and explicitly foster co-operations.

Conclusions

In this paper we first showed that countries can be clustered into three distinct groups of countries on the basis of their innovative and absorptive capacities. In line with theoretical models of technology clubs we termed these clusters innovation club, imitation club and stagnation club. Obviously the mean values of the variables used in the clustering process are very different, with larger differences in the human capital variable between the stagnation and the imitation group on the one hand, and more pronounced differences along the R&D dimension between the innovation and the imitation groups.

In the second part of the paper we used a growth equation to show that poorer countries (which have larger technology gaps) tend to grow faster and that this catch-up element is dependent on their level of human capital – our proxy for absorptive capacity. Countries with higher absorptive capacity benefit more from international spillovers and hence have a larger growth effect from their technology gap.

The threshold regression technique allowed us to add a further dimension to this result by allowing different coefficients for the catch-up term for different groups of countries, with the thresholds that distinguish the groups being determined by the data. This adds a further non-linearity in the catch-up effect which is already present due to the fact that the catch-up term is an interaction term. The results from the threshold regressions suggest that the growth effects from the technology gap are strongest for countries with an intermediate level of human capital. In contrast, countries with very low levels of absorptive capacity benefit to a much lesser extent from such catch-up effects. We see this result as further support for the central role of human capital for the catch-up process of countries. Moreover, our results are also in line with the idea of technological convergence clubs, implying that there could be a group of countries that are left behind due to initially unfavourable conditions and the inability to absorb foreign technologies.

Innovation and Technology Transfer across Countries (by Neil Foster/wiiw)

The AUGUR Scenarios

In this appendix we use the descriptive analysis above and the results from the existing literature on innovation and technology diffusion to present possible implications of the different AUGUR scenarios for innovation and diffusion.

Initially, it would be worth stating that some patterns of innovation and diffusion are likely to be independent of the scenario. In particular, regardless of which scenario we consider it is highly likely that innovation will still be highly concentrated amongst a small number of countries in 2030. This group will include the advanced countries that currently conduct the majority of R&D (USA, Japan, Germany, France and the UK) along with other large and fast growing developing countries, such as China, Russia and the Republic of Korea. While this is likely to be the case differences may still arise in terms of the relative importance of these countries, in the extent of R&D collaboration and the offshoring of R&D, and R&D specialisation patterns across different scenarios

In terms of the first of these differences we present below three different projections of R&D based on the UNESCO R&D data. The results from these projections lead to highly different conclusions regarding the importance of China in world R&D in 2030, as well as the importance of European countries. In the first projection we take the average growth rates of innovation from the UNESCO database over the period 1996-2008 and use these to project forward to 2030. When we do this we observe that China, the USA and Japan conduct around 75 percent of world R&D, with these three countries plus Germany, France, the UK, the Republic of Korea, India and Russia conducting 87 percent of world R&D. Using this projection we would also observe that China would overtake the USA as the leading innovator in terms of R&D spending, as can be observed in Figure A1. In this figure we can also observe that the Republic of Korea would overtake both France and the UK in terms of R&D spending.

The above is obviously an extreme example with the high rates of growth of innovation in countries such as China unlikely to continue once their level of R&D crosses some unknown threshold. We thus consider a second projection based on a simple regression of average growth rates over the period 1996-2005 on initial R&D spending. Using this projection suggests that long-run R&D growth in China would be 4.4 percent per annum with that in the USA being 1.4 percent. With these figures we would observe that R&D in the USA would increase by around 60 percent between 1996 and 2030 and by around 340 percent for China over the same period. With this projection the USA, Japan, Germany, France and the UK would conduct around 69 percent of world R&D in 2030, with these five countries plus China, the Republic of Korea and Russia conducting a little over 75 percent of world R&D. The projection using these figures is shown in Figure A2.

Finally, we consider a projection of R&D expenditure using simple ARIMA time-series models for each of the largest R&D spenders. It should be emphasised that these results are based on a very small sample of observations (a maximum of 14) and – as with the above figures – forecasts based on these estimates are likely to become increasingly inaccurate the further into the future we project (i.e. the confidence intervals around the forecasts become larger the further we project into the future). The projected levels of R&D expenditure using these time series models are reported in Figure A3. The figure indicates that R&D in Japan and the USA will continue to grow steadily, while that in the larger European countries will generally be stagnant, though some growth will be observed in Germany. R&D spending in China will increase rapidly however and will overtake the level of R&D spending of both Japan and the US by 2030 according to these forecasts. India will also see a rapid growth in R&D expenditures and by 2030 will have overtaken the UK and France to become the fifth largest spender on R&D.

Figure A1: Projected R&D Spending – Scenario 1

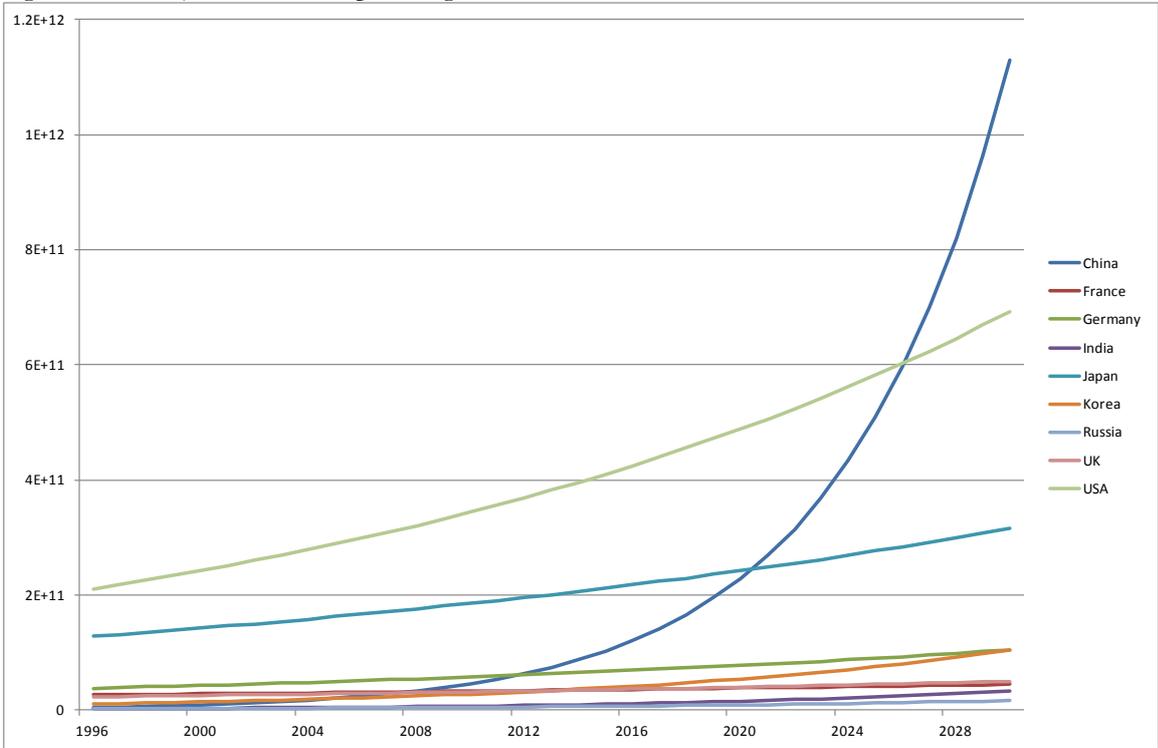


Figure A2: Projected R&D Spending – Scenario 2

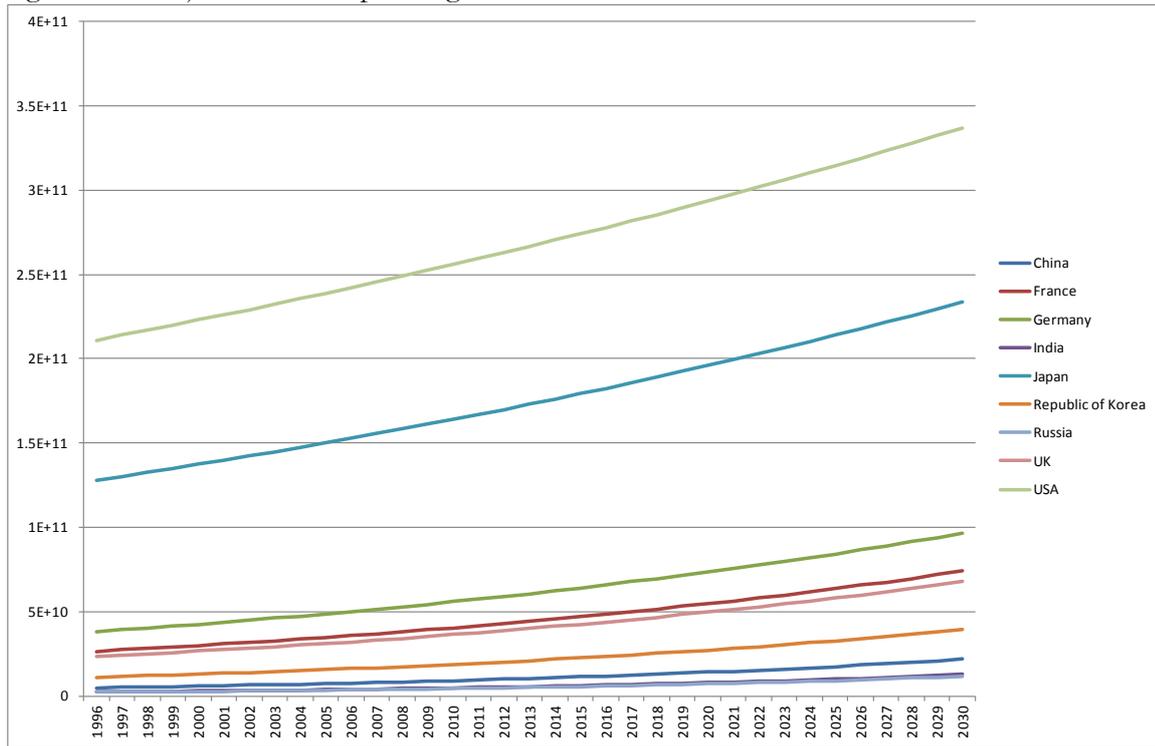
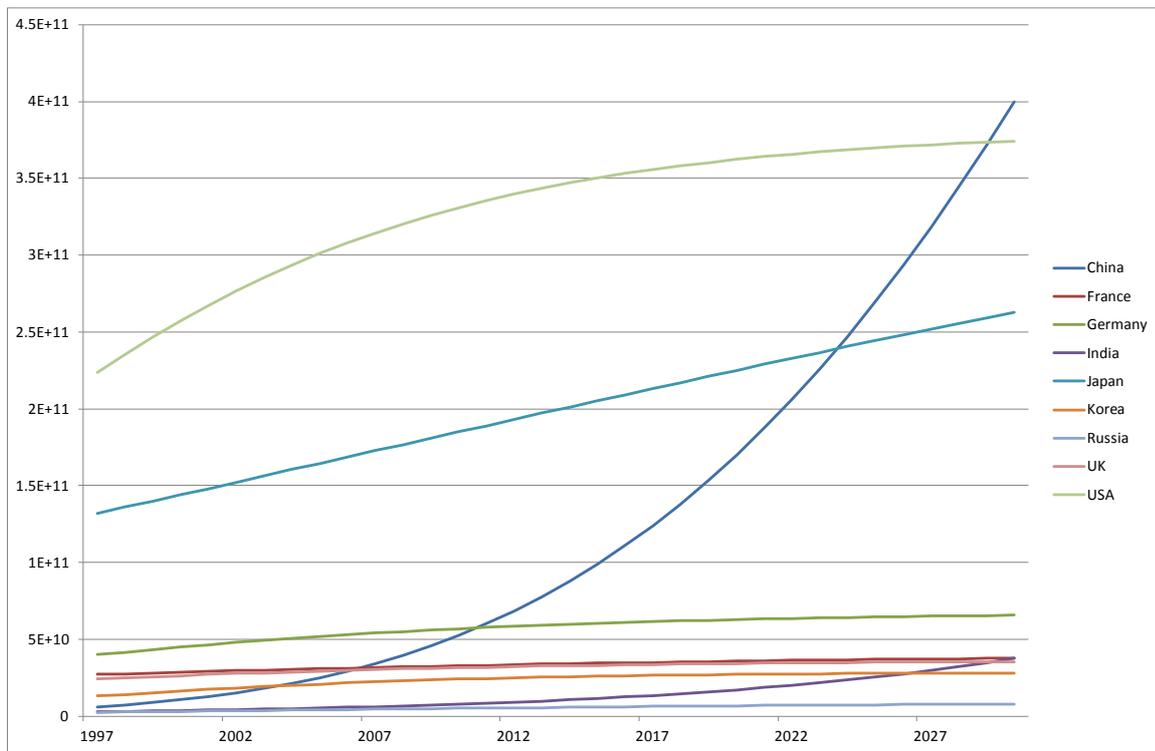


Figure A3: Projected R&D Spending – Scenario 3



In terms of technology diffusion, we would expect that the patterns and extent of technology diffusion would to a large extent depend upon what happens to the patterns and extent of trade and FDI given the literature above indicating that these flows can be an important channel of

diffusion. Future developments in country's IPR regimes are also likely to have an impact upon the type and extent of technology diffusion that takes place.

We now turn to the specific scenarios and briefly discuss what we may expect to happen to innovation patterns, technology diffusion, and IPR regimes.

Reduced Government (Consolidation)

In a world where large firms dominate we would expect there to be a high level of competition between countries to attract foreign direct investment from these firms. While this may lead to a weakening of regulation in a number of areas, we would expect that countries would offer increased levels of IPR protection as a means of attracting the innovative activities of such large firms. While this would be expected to increase levels of trade and FDI and potentially encourage technology diffusion, it would also increase the market power of firms significantly, which may limit the spread of ideas. The R&D activities of firms would become more footloose, with countries competing to host the R&D activities of firms. In addition to IPRS one would expect that R&D would be attracted to locations with the required resources (most notably human capital and infrastructure) and where the cost of R&D is cheap. We may see a partial reallocation of R&D expenditure from the developed world to developing countries with low wages and large stocks of educated people.

Collaboration between the US and China (Bipolar World)

What happens to innovation in this bipolar world will depend to a large extent on whether China and the USA co-operate or compete. In a co-operative bipolar world we may expect greater cooperation in terms of R&D, which may include increased exchange of researchers and research ideas. The extent of R&D offshoring may be enhanced, leading to a lower cost of R&D (as R&D moves to regions with relatively cheap research staff, etc) and therefore increased world innovation, as well as increased technology diffusion. An increase in the exchange of research ideas may also limit unproductive R&D duplication. Collaboration is likely to lead to further increases in trade and FDI, which would be expected to impact positively upon the extent of technology diffusion. Cooperation between these two large innovating countries is likely to lead to increased demands for stronger IPRs, limiting the extent of imitation, but encouraging technology diffusion through formal channels.

If, on the other hand, a competitive bipolar world develops we may expect less R&D cooperation and exchange as well as increased R&D duplication (and redundancy of R&D spending). This may lower the global return to innovation. R&D races – such as the space race during the cold war – may increase overall levels of innovation however. Increased barriers to trade and other forms of exchange between the two blocs would likely limit the spread of technology through formal channels. Competition between blocs may also create incentives to copy or steal innovative ideas from the competing bloc, so the level of IPRs offered to firms from competing blocs may decrease, further diminishing the diffusion through formal channels, though encouraging imitation.

Global Collaboration

Under the global collaboration scenario we would expect there to be increased collaboration in terms of R&D, and in particular increased internationalisation of R&D. The lower cost of R&D under this scenario may lead to increased global innovation levels, and may limit the concentration of R&D in a handful of countries. Under this scenario trade and investment barriers are likely to further fall, encouraging increased trade and FDI flows. Such changes would be expected to increase the extent of technology diffusion. While one would expect that there may be increased pressure to adequately protect researchers' innovative activities, thus leading to increased IPR protection, one may also expect that developed countries would begin to take their responsibilities under Article 7 of the TRIPS agreement seriously and implement measures to encourage technology diffusion to developing countries. As such, we may expect a weakening of IPRs with respect to developing countries.

Regionalisation

A tendency for countries to integrate further into regional blocs is likely to impact upon both the benefits from innovation and technology diffusion. The majority of innovative activities in 2030 are most likely going to be undertaken by the US and China, with other countries (Japan, Germany, France, UK and Korea) also likely to be significant innovators. Regionalism that limits contact with countries outside of the region is likely to limit the benefits of R&D conducted in other regions, both in terms of the extent of R&D collaboration and R&D offshoring, and with respect to the diffusion of technology from countries outside of the region.

What we have observed in recent times is that IPRs are becoming increasingly important in regional and bilateral trade agreements, with developed countries asking for levels of IPR protection in excess of those specified by TRIPs when concluding regional and bilateral agreements with developing countries in particular. Increased regionalisation therefore may encourage stronger levels of IPR protection at the regional level. While there may be an incentive to limit IPR protection on innovative products from other regions the effect of increasing IPRs at the regional level will be to increase global levels of IPRs since countries in the WTO would be required by the MFN principle to offer the same levels of IPR protection to all WTO members. This may be expected to increase global innovation levels as well as the level of trade and FDI flows both within and across regions, though its overall impact on technology diffusion need not be positive due to the increased monopoly power of innovators globally.

Global patterns of trade specialisation and club convergence: Past and current patterns of trade specialisation (by Roman Stöllinger/wiiv)

Implications for Scenario Building

The optimistic view on development, still held by renowned macroeconomists, is that backwardness and low incomes of countries and whole regions – and associated with that marginalisation in global exchanges including trade – is a transitory phenomenon. In this view all countries will in the long run make the take-off and embark on a more favourable growth path, implying a catch-up process to richer countries.

We believe that the analysis of merchandise trade over the past 30 years does not support the optimistic view that with time all countries will be well integrated in the global economy. Certainly, globalisation provides great opportunities and the ‘growth miracles’ of the last decades which were observable in South East Asia were made possible mainly by exported growth (and inward foreign direct investment granting access to new technologies and export goods). At the same time it is obvious that several regions do not benefit from trade to the same extent. The gains which countries can reap from globalisation depend on countries’ initial export specialisation as well as domestic policies.

With respect to the five scenarios of the AUGUR project this implies that in the *baseline scenario* as well as the *reduced government scenario* and the *US-China collaboration scenario* nothing ensures that all regions embark on a catch-up process with regards to export market shares. In contrast it is most likely that the currently more marginalised regions, including most of the commodity exporting regions, will not gain significant export market shares in manufactures, apart from the least-technology intensive goods.

In a similar manner, this also applies to the *regionalisation scenario*, at least for those countries that (i) do not have a technologically advanced regional power within its region and (ii) have over the recent past shown no tendency to build up an industrial base. Hence, while the regionalisation scenario may well lead to the strongest increase in global trade (both in absolute terms and in relation to GDP), stronger catching-up in the area of exports – and in particular of manufacturing exports – is to be expected in the *global collaboration scenario*. Deliverable 1.3 on the ‘Macro-model governance scenarios’ reflects this. However, some more differentiation between regions that form part of a functioning regional trade agreement (e.g. European countries, East and South-East Asian region, North America) and regions in which such arrangements cannot be expected should be made. As shown above, emerging regions seem to benefit strongly from regional trade agreements with more advanced countries/regions but successful trade integration cannot be expected to happen in each and every region. In particular for AFS⁴ but also AFN and West Asia it is hard to imagine a strong regional trade integration

⁴ The only country with some industrial and technological base is South Africa but it is doubtful whether it can be the locomotive for the entire AFS region.

process emerging. These regions have no 'leading industrial power' and their exports are mainly commodities reducing the chances for high intra-regional trade. This is in line with the literature on regionalism which is also pessimistic with regards to gains from that regional integration among low-income countries developing countries (e.g. De Melo – Panagariya – Rodrik, 1993).

In line with the assertion in Deliverable 1.3 that "The main chances for escape from the poverty trap are exploitation of natural resources [...] and to a lesser extent tourism and development assistance" (p. 12), the global-collaboration scenario is the only one which should lead to significant increases in trade in manufactures and export shares in the poorest regions. This is because only in this scenario a considerable resource transfers across wider regions is supposed to take place. Moreover, in this scenario technological-upgrading of the most backward regions is also more likely as they could be supported by industrial policies and trade policies. For example, solutions could be found in the field of intellectual property rights which ensure that patents and copyrights do not prevent technological upgrading in emerging markets. Patent rights are intended to protect inventors from competitors in a similar way that tariffs may protect firms from competition at the initial phase of industrialisation. Hence, the payment of royalties and licencing fees could be limited the same way as tariffs are limited.

In some respect, the bipolar or US-China collaboration scenario could be the opposite of the global collaboration scenario. With the US concerned about losses in global export market shares – a trend which is projected to continue also in this scenario, particularly in high-tech manufactures, global trade rules – if predominantly set by the US and China – maybe tilted in favour of incumbent technology leaders. This certainly depends on the position of China on these matters but with China developing its own R&D capacities it becomes less and less dependent on foreign technologies. This scenario may also see the US imposing border tax adjustments as some uncertainty with regards to the WTO compatibility of such regimes exist. More generally, in this bipolar scenario the chances of protectionist and unequal trade regimes are higher than in the other scenarios. If unemployment remains high in the US (and elsewhere), barriers for firms on outsourcing may be imposed, i.e. more of the 'buy national' type of rules may be expected. Other developed countries, particularly in Europe may follow this example. Hence, the US-China collaboration scenario may turn out to be the least trade-friendly of all the scenarios.

With regards to the reduced-government scenario the current trends in global trade will continue – much like in the baseline scenario. Economic policy will not set special trade preferences favouring poorer regions. China and the rest of South-East and East Asia will continue their upgrading of their export baskets and become less depend on the US and Europe for the absorption of their exports of final goods. Brazil and South America may also expand their export market shares and move into manufactures and away from commodity exports. Trade (and also foreign direct investment) flows will flourish but fair competition may be an issue leading to tensions between countries and regions or their multinational firms respectively.

Conclusions

This paper suggested 25 facts related to the structure of global trade, most of which do not emerge from the CAM model. In particular we stressed the fact that the participation in global trade has broadened since the 1980 with emerging regions gaining considerable export market shares (above all China) and that this broader geographical participation in trade is not limited to low technology exports. In contrast, several successful emerging regions, notably in South East and East Asia but also in East Europe, managed to quickly upgrade their export structure shifting towards industries with higher technology intensity. At the same time, several regions, including the whole of Africa but also Other South Asia and West Asia remain technologically marginalised. A similar picture emerges when investigating the degree of vertical specialisation and international production sharing. This type of international trade, which constitutes a deep form of trade integration, is very important in South East and East Asia which is also due to the region's specialisation in the electronics industry. It also has a strong regional focus. Vertical specialisation is also important for the European regions and the United States and its NAFTA partners. However, in both Europe and the Americas international production sharing has a regional and a global dimension due to strong FDI activities in important industries such as the automobile industry. Again, several low income regions and/or resource-rich regions do not (yet) participate in this deeper form of trade integration, presumably due to their insufficient economic and political capabilities to excel in such activities.

By using an empirical measure for the sophistication of a country's export basket we showed that the export specialisation matters for the subsequent growth experience of the Augur countries. This implies some challenges for a large number of African and South Asian countries with their unfavourable specialisation in natural-resources and low technology manufactures such as textiles.

Global patterns of trade specialisation and club convergence: Past and current patterns of services trade specialisation (by Olga Pindyuk/wiiw)

Conclusions and implications for AUGUR scenarios

Though the global services exports in 2007 were concentrated in developed countries, primarily the EU (around 50% share), and US (14%), there have been changes in the geographic structure of the global services trade as compared with 1999 – shares of Japan, US, and Other Developed countries have declined, while China, India, high-income East Asia and West Asia have been increasing their importance as global services exporters. India and China stand out as countries with the fastest growth of services exports during 1999-2007 – striking 26% and 20% on average per annum respectively. Though these regions at the moment account for low shares of global services exports, if a trend of skyrocketing services exports growth continues, they will increase their importance at the global services market quite fast. Such changes have been already happening in exports of some services sectors, the best example being India, that increased its share of the global market of computer and information services from almost zero in 1999 to 21% in 2007.

Future services trade developments will be largely depending on the liberalization of services trade and expansion of global production chains of MNCs and off-shoring.

Though free of import tariffs, services trade usually is subject to non-tariff barriers which impose significant trade costs on service providers. Even in case when services regulations are not discriminatory and were designed to meet legitimate economic or social objectives, they may they still hamper trade as regulatory requirements in a given export market are additional to the ones a service provider faces at home and other export markets. Several existing estimates of NTBs in services trade show that barriers to services trade are quite high, even in the EU, where the treaty establishing the European Community guarantees freedom of establishment of service companies and freedom to provide services on the territory of another EU Member State.

Recent studies also show growing importance of global value chains and off-shoring in international trade. Dynamics of many types of producer-related services is closely linked to developments in FDI and off-shoring activities.

Thus, different assumptions on barriers to services trade and capital flows will be used to model developments of services trade in different scenarios.

The **reduced government** scenario will most likely imply a slowdown in the services trade liberalization. Concurrently, investments will be more likely to flow to countries with already established business-friendly investment environment, thus implying hindrance to development of producer-related services trade in those regions, which will continue to have poor investment climate.

In the **US-China collaboration** and **regional liberalization** scenarios services trade liberalization will most likely occur inside regional groups, and global production chains will become increasingly fragmented. Thus, intra-group services trade is likely to develop faster than trade between regional groups.

The **global collaboration** scenario implies the lowest barriers to services trade and capital flows, and we expect global services trade grow the fastest under this scenario.

The role of business organisation in international integration, innovation activity and technology transfer (By Gabor Hunya/wiiw)

Research finding shaping future growth and the role of Europe in international business

An important conclusion is that Europe is in a wait-and-see position. It has by and large preserved its standing as regards to FDI and corporate growth over the past 10 years. The decline in Europe's global FDI share in 2008-2009 was due to the financial crisis but this may be only temporary. The impact of the more recent euro crisis is not yet reflected in the FDI data. It can at least prolong the weak international investment activity of European firms especially if the banking system is weakened.

The case of the other two developed regions the US and Japan is different from Europe in the way that they have lost shares in global FDI already for a longer time not only related to the 2008 crisis. Expectations confirm this trend to continue, although the US will preserve its top position according to the size of the FDI stock.

Emerging regions in terms of FDI in recent years include China and South-East Asia as well as South America but this is not a very long trend and may partly be associated with the recent crisis in the developed world. The invested amounts of these countries outside their home regions are still low. China, India and Brazil may become more important international investors in the future but will, on the whole, not endanger the dominant position of US and European companies. The share of emerging economies, especially of China and Brazil is expected to grow slowly in global business to the detriment of the US and Japan. This expresses a gradual shift in relative corporate power in the world.

Inward FDI is linked to the development of trade, and trade is linked to the growth of demand. High growth of demand and production has concentrated recently in Asia especially China and also some Latin American countries grew faster than the world average. Developed country multinationals have to follow this shift of main markets and low cost production locations. The example of Nokia shows that missing to benefit from cheap Asian sourcing and building Asian markets for products together with sluggish innovation in the home country can undermine the stability of large corporations (Seppälä, 2010).

The summary of research on international sourcing showed that only a small number of companies source internationally and also those stay mostly within their home region. This refers first of all to European firms and to Asian firms. The value chain of IT production is the most segmented. The component industry is spread around South-East Asia while the assembly is done mainly in China (see also Thorbecke, 2010). The whole industry is based on innovation done in the advanced Asian countries. The final products are exported outside the region which contributes to a big trade surplus with the US. But this is only one of the industries, one with high

unit value not sensitive to transport costs. Other industries, like the automotive industry is more evenly spread in the countries with high demand.

The main motivations of international sourcing are cheap inputs (mainly based on labour cost) and strategic access to markets and resources. The intensity of international sourcing between the main trading blocks has been weak. US firms have been sourcing from longer distances than others from Asia but there is a trend to source more from the Americas.

The main barrier to international sourcing in manufacturing is identified as distance, expressed transport cost. Surveys have shown that high price oil in recent years have driven back US companies from outsourcing to Asia. For services this factor is less important than cultural distance. Still, the dominance of India and China has been diminishing and other destinations have become important especially if they have the same time-zone as the developed countries (for the US Latin America, for Europe Egypt and South Africa).

All sourcing is associated with risk which may itself be linked with transport, culture etc. In the aftermath of the 2008 crisis, low trust and high perceived risk hinders international flow of capital, goods and services. Some expect the post-crisis development will be associated with less international sourcing.

For European firms the US, China and India are the most important single destinations of FDI, outsourcing and also the main export markets. A disruption of links with these destinations can hinder development. A disruption of Europe's links with the US may hinder access to technology and markets, with China and India markets and cheap sourcing are at stake. Cheap sourcing from closer countries may be an alternative for Europe (MENA and CIS). Regional integration with the wider Europe can be an alternative to far-shoring. Development of production and skills as well as free trade in this region is especially necessary to match the needs of European multinational corporations.

Global FDI has grown more rapidly in the past twenty years than exports and GDP. The latter two have been associated with the increase of FDI. Also in corporate strategies, the penetration of new markets very often involves FDI. There has been a slow global shift in the outward FDI as US companies have lost shares and China together with Hong Kong expanded. Europe has by and large kept its position.

FDI flow data confirm that investments go in the direction of high-growth regions. Following high rates of growth emerging economy companies become able to invest internationally. In the last few years the BRICS have benefited from such development. But in a 20 year comparison the share of developing countries in outward FDI has not been increasing permanently. The reason is that a major driving force of FDI has been mergers and acquisitions between firms of the developed countries. M&As undertaken by Chinese investors were high only in 2008.

A main problem with FDI data is that they are measured by countries and not by regional blocks and one cannot distinguish between intra and extra-block FDI. The exception is the European

Union where intra EU-15 FDI has had growing share in both inward and outward FDI stock. The share of extra-EU-15 FDI declined first of due to relatively low FDI to and from the US. The share of Asia as European FDI destination is small but increasing.

Research finding for the Augur Scenarios

In the following we look at each Augur scenario to see to what extent its framework conditions benefit international capital movements. Companies of which regions will dominate the world, what power shifts can be envisaged? We look at these scenarios from four aspects. (i) The impact of FDI and sourcing which benefits host and home economies via trade and employment; (ii) FDI benefits home economies by income transfer; (iii) Fuel prices influence the intensity of long-distance sourcing; (iv) International risk and barriers to investment influences the intensity of all investments.

- (i) FDI receivers can benefit from technology transfer and access to capital. Integration into corporate networks can boost trade and employment in host countries and to some extent also home countries. A decline in international investment and sourcing may slow down development. Global competition based on free trade and international capital movement stimulates R&D and technological development in general.
- (ii) We assume that regions benefiting from FDI will have higher competitiveness and more advanced technology than the others. Companies dominating the world may benefit from economic growth more than others and gain more on their investment. The gains from growth in one region may be transferred to owners established in another region. Currently headquarters concentrate in the developed regions which benefit in terms of distributed profits. Capital income may generate demand for high quality goods and services in the home countries but most of the society in developed regions may not benefit from the geographic split between ownership and economic activity.
- (iii) A specific factor shaping the future growth of outsourcing and FDI is transport costs. If fuel prices are high, less outsourcing and trade develops between regional blocks. If low, more global than regional sourcing is possible.
- (iv) The other important factor shaping international sourcing is risk. High risk of investment may curtail FDI. Governments can mitigate risk of investment by international agreements and investment guarantees. They can also do much to improve doing business conditions.

It must be noted, that the individual scenarios are available at different depth, thus information may not allow going into detail. Therefore we are not able to be very explicit on the four above aspects in each of the scenarios.

Scenario 1 “Reduced Government”

This scenario is based on the assumption of a progressive reduction of government budgets, fiscal deficits and of the role of the government especially in the high income regions of the world. It is projected that the global development and policy making will be driven by large corporations and financial institutions. These will support business friendly environments meaning both free movement of goods, services and capital and the reduction of risk of doing business. In regions

where business friendly conditions prevail, investment and trade will flourish. Global corporations will progressively react to global challenges, spread investments in less developed regions like India and South America, increase local production in Africa and increase energy production from non-carbon sources. Scenario 1 concludes that “as global business dominates international relationships, investment in production of commodities and manufactures may become less concentrated”. This is seen as a result of policy changes in low and middle income countries in favour of FDI and the integration of local business with international networks. Thus most parts of the world would become accessible and benefit from production by TNCs.

The behaviour of TNCs is a central component of this scenario. It is expected that business will replace partially the role of governments and create a more free environment under which it may flourish. As a result, in regions where the role of the government is already small in investment and demand generation, growth may accelerate. In other regions/countries, with currently large government investments and consumption, growth may decelerate if the role of government diminishes.

The question is whether government spending and investment will be fully compensated by private investment and consumer spending thus the world GDP and exports would not slow down. If no full substitution is available, per capita income will hardly increase in the high income regions including Europe. One can also expect that South America, India and Africa benefits relative to other regions. Based on the behaviour of TNCs one can expect two impacts of reduced state presence in the economy with opposing consequence on international investment.

(i) The international and domestic environment for business and FDI may become more business-friendly when the role of government is reduced. International agreements may better reflect the interest of big business and free capital movement. Barriers to FDI may diminish and capital may be flowing also to countries with up to now relatively meager inflows like Japan or India. In general the loss of protection to domestic companies may slow down growth in the first period, but increased competition and imported technology and services may enhance growth.

(ii) Growth at an advanced stage of development depends to a high extent of the availability of public services like high standard education, R&D and business infrastructure. If support to business directly or indirectly by government programmes in R&D, education, etc. is curtailed, innovation may suffer. The same impact can have reduced military spending and related innovation. Public supports have contributed to the competitiveness of companies especially at the front-line of technological development. Competitiveness enhancing policies have benefited especially European firms both through national and community support. Military and aerospace programmes supported R&D in the US. Cutting funds can derail related policies and slow down innovation. Whatever part of government support can be substituted by companies' own resources, this will increase their costs. To stay competitive they will have to reduce labour cost which will curtail demand for products in developed countries. A slowdown of global technological development may curtail economic growth especially in advanced countries. In addition, revenue side policies may also hurt companies if new taxes are introduced. Further, welfare systems will suffer if public spending is reduced and social cohesion diminishes in developed countries.

In regions with small budgets and no fiscal problems government efforts may even increase to support economic growth and technological development. This possibility may be beneficial for development in China. Chinese companies may be able to faster adapt the latest technology, accumulate revenues and invest more abroad. But some other state intervention should be curtailed to improve efficiency: diminishing political rent-seeking may add further growth stimulus to Chinese and several other Asian economies.

Free international movement of capital may increase efficiency on the whole. Enhanced competition may increase innovative efforts of companies. At the same time, without ample international rule-making the risk of international trade and investment may increase and conflicts may surface more radically. As to social impacts, the rule of corporation would lead to lower income of wage-earners thus demand may increase less and curtail economic growth globally.

Scenario 2 “China and US intervention”

The second scenario considers a larger and more effective role for government reinforced by a cooperation between the US and China. Europe and most other high and middle income region will follow their leadership. The cooperation between the two powers would stabilize international capital markets provide exchange rate management and solution to some politically sensitive issues. Successful labour market policies will be applied in developed regions. China would import more, avoid labour shortage and contain current account surplus. As a result, GDP per capita would increase in Europe faster than in the base-line scenario. Also the rest of the world would benefit except West Asia which would lose oil revenues due to international price regulation.

One can expect that if the US and China would regulate competition from the rest of the world would be to the short term benefit of the US but its corporations would be weakened on the longer run. The framework conditions would nurse Chinese companies which would grow in capital and power in a protected environment. From here they may make even more competitive takeovers than under other scenarios. On the whole, international capital movement may be slower than in Scenario 1.

Europe can have several positions under this framework. Provided the US-China relations will increase global governance and freer trade will be established between those two blocks, the EU may find itself in a weaker negotiating position. It will be up to the European corporations to make the best of this framework and the cooperation with both leading regions. They may invest more to access markets in China and invest also in the US to make use of technological innovation. Another option is that the cooperation between the two main powers will be closer to a cold war and all other regions in the world will have to choose sides. If Europe will find its place on the side of the US in this scenario, corporate integration would deepen between the two regions and give a boost to R&D and trade. Europe may also opt for strengthening its ties with China and benefit from market access there instead of technology access in the US. The role of governments and of the EC is more important under the China option than under the US option.

Scenario 3 “Regionalization”

This scenario is based on the assumption of fragmentation of the global system in continental groupings like the Americas, Africa, East Asia, Other Asia including the CIS, and Europe. These world regions would have their own internal pattern of investment and specialization. Trade and investment would decline between blocks but intensify within blocks.

Regions with already advanced intra-regional cooperation may benefit less than those where such cooperation boosts business. Intra-regional FDI is most advanced in Europe. But it is increasingly also in the Americas and in East Asia. The other two regions, Africa and Other Asia are more heterogeneous with little cohesion expressed in trade and FDI. The current sourcing trends support this scenario as trading costs and investment risks are high. Closeness in terms of geography and culture will gain in importance. Also currently, East Asia undergoes deepening integration due to activity of multinational companies from the developed countries in the regions and the emerging Chinese multinationals. US investors have increasing activity in the emerging economies of Latin America.

FDI within Asia is also very intensive but relatively modest compared with Europe. The main investor, Japan is a global player with quite evenly distributed FDI in the main regions of the world⁵. Production networks are often organized with no capital involvement. We know actually very little about Chinese FDI; its high flow figures may be overestimated. Chinese FDI is done mainly to and from Hong Kong, and about 30% of it is round tripping. One cannot get more accurate data, thus we have no proof that China would have any big regional integrating power by FDI⁶. Also green-field projects of China have grown in number reaching about one third of the number of Japanese projects in 2006-2009. Chinese investment projects have been most numerous in the Asia-Pacific region supporting regionalization. They achieved but a one-time peak in Western Europe in 2009. The value of investments in Europe is rather low especially compared to Africa and Latin America which received large size Chinese projects mostly in primary activities. The annual number of greenfield projects in China was almost the same all through the years 2003-2009, at about 1300, thus it received 14% of the projects in 2003 but less

⁵ Japan's outward FDI flow was highest in 2007 with USD 131 billion, compared with 74 billion in both 2006 and 2008 (JETRO trade and investment statistics, www.jetro.go.jp). The peak was booked in the US and the Cayman Islands. In 2010 the amount of outward flow shrank to 57 billion. Asia was in all recent years in the range of USD 22 billion, and China USD 6-7 billion. In 2008 the share Asia was 18% in which China 5%; in 2010 Asia had 38% and China 12%. In 2008 Europe was equal amount to Asia; 2010 Europe fell less than US, had 26% against the 16% of the US.

⁶ In 2008 when global FDI fell by 15%, China doubled its investments to more than USD 50 billion increasing to an estimated 66 billion in 2010. State owned enterprises provided two thirds, private enterprises less than 1% in 2008 (Salidjanova, 2011). (E.g. Lenovo is owned by Beijing Province.) Most of the Chinese M&As are natural resource seeking, few of them are technology seeking. The regional distribution of Chinese FDI does not tell about the final destination of funds: 67% goes to Hong Kong, 12% to Central American tax heavens in 2009. Each 2-5 billion USD went to Australia, US, Singapore, South Africa, Luxembourg and Russia. In the inward FDI of 90 billion in 2009 USD 54 billion came from Hong Kong, 7 billion from Taiwan (tax heavens distributed between real investors). About 30% of the total FDI inflow is estimated to be round-tripping. This is about two third of the Hong Kong figure. Investors benefit of incentives for inward FDI as opposed to domestic investments which encourages round-tripping. Of the 2009 outward FDI stock 28% was in trade and 28% in manufacturing, 14% in finance; of the flow 42% went in manufacturing.

than 8% in 2010 while also the amount of invested capital declined, first of all of manufacturing projects.

One cannot see China emerging very fast as a global direct capital exporter. FDI data are just different from those indicating the country's growing role in international trade and global GDP. The reason can be that China has earned on trade accumulating capital reserves and does not need to rely on capital imports. Large and complicated value chains and component trade in the East and South-East Asia region confirm deep integration in corporate networks (Thornbecke and Salike, 2011) but these networks are more between independent than dependent firms. In addition, China's role is overrepresented in extra-regional exports as the country is the final link of the Asian value chain.

As pointed out above, regionalization is quite advanced in Europe. EU-15 FDI has become relatively more regional than global. But annual data reveal that the regionalization took place up to 2000, since then the share of extra-EU OFDI stock has stayed at about 41-43%. The distribution of investors from outside regions has changed, however. The share of North America in EU-15 OFDI shrank to one half in 11 years while growing shares were booked for Other Europe comprising the CEE and EFTA countries. As a result, Europe altogether (without the CIS) had a share as high as 72.5% of the OFDI stock of the EU-15 in 2009. The shifts in the EU-15 inward FDI stocks were quite similar to the changes in the outward stocks. But the share of intra-EU-15 stocks in inward stocks has been larger and increased more rapidly than in the outward. Investments from outside the EU-15 recorded a big decline from North America, some decline from Other Europe and slightly rising shares from other regions.

On the longer run, Europe may be too small for the size of European firm. Much of the CEECs have been integrated by takeovers and greenfield investments and markets may not grow there in the earlier expected way. Investing companies need to develop new external directions: increase technology ties with the US, increasing investment and sales in China and integrating EU borderlands in the CIS and North-Africa. It seems that European firms would suffer most in case access to other continents would become more difficult. Lower FDI and trade with the US and Asia due to protection would be a major blow to development.

If East-Southeast Asia and North-America become protectionist, European firms may increase their activity in the less integrated other two continents. Neighbourhood policies would be upgraded in this case. There is some scope for that, as the neighbouring regions Africa, CIS and West Asia are either not integrated or too little and with one-sided economic structure (fuel and other raw materials). Regions between Europe and East-South-East are not able to integrate among themselves. These neighbourhood regions can gravitate in different directions and Europe is the closest neighbour to integrate at least parts of them. Viewing at the world in terms of interest blocks will mean that strong blocks will fight for dominance over weaker non-integrated regions.

Scenario 4 “Multipolar governance”

The fourth scenario provides an optimistic vision of global cooperation. Governments and business would cooperate in all regions in the field of energy saving and development of new energy resources. Less developed regions would benefit from development programmes of the developed countries. Their faster growth would have positive feedback to the development of advanced regions. Features of Scenario 3 would be preserved in the form of governments' active labour market policy, carbon reduction stimulation and more balanced current accounts. In addition, Europe would benefit from coordinated fiscal management, which would allow the growth of public spending and the region would attain income convergence. As a result, low and middle income regions would grow faster without sacrificing growth in the advanced regions; global growth would accelerate compared with the baseline scenario. Preferential trade incentives would boost exports from low and middle income countries. Their share in global trade would increase but developed regions would also grow nominally. Among the middle income blocks South America, the CIS and China would enjoy accelerated growth. West Asia would lose out due to oil conservation policies.

Similar to scenario 2, one can expect that international corporations' headquarters would stay in developed countries. They would maintain cooperation with governments and keep international capital movements more regional than global. But lower fuel prices would allow more international sourcing and stimulate international investment. MNCs will be in the position to reap the benefits of international sourcing to a larger extent. Support programmes to poor world regions will partly be diverted by MNCs.

According to the assumptions of the scenario, weak regions in developed continents would benefit of public restructuring programmes. In a less than ideal case, they may not become competitive despite public spending as international private investment would avoid them. In the end, the expected growth benefit for Europe would not emerge. Re-introducing industrial policy measures may support growth in less competitive regions in Europe if free movement capital in and out of the region would also be restricted and directed. This could have detrimental effect on growth and innovation.