

A·U·G·U·R

*Challenges for Europe and the world in 2030*

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### Abstract

We do not know the future and do not aspire to predict it. But we have to consider future possibilities and seek to clarify potential consequences of alternative policies and patterns of development. The purpose of the AUGUR project is to provide food for thought about development of the global economy, the role of governments and social impacts over the next 20 years considering not only Europe but other world regions, all of which must ultimately coexist and deal with numerous problems and challenges, local, regional and global, despite their having very different economic structures and income levels.

One of the main objectives of the AUGUR project is to define alternative governance frameworks as a way of giving coherence to different assumptions about policies and behaviour in each area of economic activity such as consumption, investment, trade, finance, employment and migration and in each part of the world.

This paper presents a baseline projection and four alternative 'governance' scenarios constructed with a macro-model of world regions<sup>1</sup> in order to illustrate inter-related challenges confronting the contemporary world and ways in which the challenges may be managed, depending on norms of market behaviour and government intervention at different levels, national, regional and global.

Although governance scenarios have been the subject of some preliminary discussion by AUGUR participants, this paper is a first attempt at a systematic presentation of assumptions and their implications. It therefore represents work in progress and is intended to elicit comments from participants working on specific topics (finance, trade, energy, demography, well-being, global governance and politics). As studies in each domain are integrated, assumptions and results presented here will undergo substantial change.

The baseline projection provides a review of the main challenges, indicating how Europe and other parts of the world may be affected if there are no major changes in the existing governance pattern. Topics covered include global financial imbalances, problems of government debt and loss of jobs in the US and parts of Europe, ageing populations and limitations on government services, global GDP growth, energy sources and carbon emissions, trends in export markets and relocation of industrial production, opportunities for commodity exporters and the global distribution of income per capita.

Remaining sections examine potential consequences of changes in governance at the global, regional and national level. The first scenario contemplates a progressive reduction in the role of government, particularly in higher income regions of the world. This may have important social impacts in the medium and long term if populations in these regions experience growing insecurity and, at the same time,

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<sup>1</sup> The macro-model relies on a historical databank with annual time series for 130 countries and country groups from 1970 to 2009 from which series are aggregated to generate results for the world divided into a number of blocs. Blocs distinguished in this paper include Europe as a whole and five regions within it (the UK and four country groups - North, Central, East and South) as well as four large countries (the US, Japan, China and India) and ten regional groups in the rest of the world (Central and South America, the CIS, West Asia, North Africa, Other Africa, Other South Asia, East Asia High Income, Other East Asia and Other Developed). See AUGUR D1.1 and Appendix A.

income growth in low and middle income regions of the world is very unequal. Thus, for example, lack of jobs and government services could substantially change internal migration patterns in North America and Europe while shifts in global industries could change the balance of advantage between groups of developing and emerging market economies in America, Africa and South Asia and East Asia, not necessarily to the benefit of the latter. Although this scenario is to some extent symptomatic of current political trends in many parts of the world, it is not clear that such trends can continue over longer periods if the reduced role of government and increased market pressures has severe effects on vulnerable populations in high as well as low income regions of the world.

The second scenario considers a more effective role for government reinforced by mutual cooperation between the US and China. The aims of such partnership would include stabilisation of financial conditions including exchange rate management, mitigation of sensitive problems such as job losses and high levels of government debt in the US and Europe on the one hand and on the other hand the need to improve living standards in China without generating overheating and inflation. Although this scenario implies some reduction in social and economic risks in high income regions of the world and somewhat better prospects for growth of world income and trade, the benefits for low and middle income blocs are likely to be uneven and even with strong support from Europe cooperation between the US and China is unlikely to change global energy trends on the scale required to reduce CO<sub>2</sub> emissions. Thus the US-China partnership may be found lacking when measured against demands for environmental sustainability, improving living standards and social justice on the part of the large majority of the world's population who face a difficult struggle over many decades into the future. The consequences of failure to generate sustainable development and long-run convergence are hard to assess but failure in this area will surely generate pressures for political change across low and middle income regions of the world.

The third scenario provides a more optimistic and perhaps less plausible vision of wider global cooperation to deal with some of the most pressing issues arising in the scenarios already mentioned. Governments and business in all regions of the world are assumed to cooperate in energy saving, development of new energy sources and reduction of emissions. At the same time considerable advantages are provided to low income regions of the world through guarantees (underwritten by higher-income regions) with regard to resources for economic development, including infrastructure, health and education as well as market access and financial support in case of currency instability. This scenario demonstrates the possibility, at least in principle, for the world community to achieve long-term convergence of living standards in a sustainable manner and without sacrificing employment and social benefits in high income areas.

The final scenario introduces what might be considered a second-best assumption, namely fragmentation of the global system into continental groupings each of which is large enough to develop its own pattern of investment and specialisation. This implies faster growth of internal industrial and service trade in each continent with continued global exchange of raw materials and energy products. Although it is hard to envisage how financial relationships would be managed in this scenario it could be assumed, for example, that monetary authorities in each continental grouping would cooperate to stabilise internal real exchange rates in a pattern consistent with development objectives promoting long-term convergence of member countries within the group. This scenario has potential benefits in terms of economic

## WP1 macro-model: governance scenarios to 2030



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performance and social objectives in each continent but is again unlikely to achieve a global reduction in CO2 emissions between now and 2030.

Appendix A describes the macro model and Appendix B details work to develop the model for this project and Appendix C documents specific assumptions used to generate the baseline and the four governance scenarios.



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## Introduction

This paper presents a baseline projection and four different 'governance' scenarios constructed with a macro-model of world regions. Although governance scenarios have been the subject of prior discussion by AUGUR participants, this paper is a first attempt at a systematic presentation of governance assumptions for the world as a whole and their economic and social implications in each region.

To make the project as a whole coherent AUGUR researchers have to reach a common understanding about the logic and main assumptions of each governance pattern investigated and the main challenges to be examined as well as taking account of specific contributions in each domain (finance, trade, energy, demography, well-being, global governance and politics). As studies in each field are integrated, assumptions and results presented here will undergo substantial change.

## Concepts and coverage

The macro-model encourages researchers to examine historical developments as a basis for construction of alternative scenarios for the future in which different assumptions are made about trends, shocks, policy objectives and responses. The world economy is divided into blocs using a flexible system of geographical aggregation that allows researchers to specify the number of blocs and the grouping of countries in each bloc. The model has a relatively detailed coverage of international transactions including trade and the balance of payments with distinct subsystems for the analysis of exchanges of primary products, energy, manufactures, services, income and transfers and capital movements that make it possible to investigate the influence of changes in terms of trade, market shares and financial flows on each bloc. Capital flows and exchange rate movements feed back to trade and prices of imports and exports. The model is closed by assumptions about adjustment of domestic spending, budgets, monetary expansion and inflation in each bloc to GDP growth, the current account and the accumulation of reserves and external investments and debt.

## Local policies and global policy coordination

One of the main interests of a global model lies in the potential for estimating transmission effects that escalate the interplay of policies and outcomes to the world level. On the basis of historical evidence it is not possible to be confident that endogenous mechanisms in the economic and financial system will ensure that the outcome for each bloc is optimal or even satisfactory in the long run. At the same time globalisation has created a situation in which governments in each bloc may not have sufficient influence to determine the outcome for their own national economies by unilateral policy action. This applies not only to small countries but also to very large ones including the US and potentially, China and India.

Different types of policy coordination are represented in the model by specifying new rules or reaction functions involving more than one country or region. Participating blocs institute policies with respect to variables such as the exchange rate and domestic demand and credit expansion in response to undesired movement of target variables such as the level of activity or the balance of payments. In a burden-sharing scheme, member blocs commit themselves to work together towards a common end such as, for example, a reduction in global carbon emissions. Such schemes may be modelled by specifying explicit targets and adjusting policies in



participating blocs in a synchronised fashion to secure the desired result. Alternatively parallel trend adjustments may be introduced for a number of blocs that taken together have a significant impact on the global outcome.

When targetted policy changes are introduced into the model, it is necessary to set limits on the scale of changes to past behaviour that can plausibly be introduced in a scenario. The macro-model measures such changes against the standard deviation of historical residuals for the relevant blocs and variables. A 95% probability limit is usually applied.

### World regions and blocs

For the purposes of this project the macro-model has been set up to distinguish five groups of European countries (North, Central, East and South Europe and the UK<sup>2</sup>) and fourteen groupings in other world regions (USA, Japan, East Asia High Income, Other Developed, CIS, West Asia, Central America, South America, China, Other East Asia, India, Other South Asia, North Africa and Other Africa). Tables 1 and 2 show the composition, size and average income level of the regions and blocs.

Table 1 World regions

Region	Blocs and countries	2008	2008	GDP per capita (thousand ppp)		
		Population (millions)	GDP (billion \$ ppp)	1988	2008	% increase
Europe	All countries in Europe	525	14,646	19,182	27,907	45.5
America	USA, Central and South America, other Developed (see table 2)	952	21,438	16,531	22,515	36.2
East Asia	Japan, China, East Asia high income and other East Asia (see table 2)	2155	15,984	3,455	7,419	114.8
Other Asia	India, other South Asia, West Asia and CIS	2153	10,218	2,542	4,747	86.7
Africa	All countries in Africa	986	2,543	1,864	2,580	38.4
WORLD	Total	6770	64,829	6,367	9,576	50.4

<sup>2</sup> Note: Ireland has been included with South Europe as a member of the Eurozone.

Table 2 Bloc definitions

Bloc	Countries	2008	2008	GDP per capita (thousand ppp)		
		Population (millions)	GDP (billion \$ ppp)	1988	2008	% increase
North Europe	Norway, Sweden, Finland, Denmark	25	938	25,014	37,930	51.6
UK	United Kingdom	61	2,039	22,248	33,297	49.7
Central Europe	Austria, Belgium-Luxembourg, Switzerland, Germany, France, Netherlands	188	6,232	24,041	33,129	37.8
South Europe	Spain, Greece, Italy, Portugal, Ireland, all other European territories	132	3,668	19,587	27,770	41.7
East Europe	Albania, Bulgaria, Former Czechoslovakia, Hungary, Poland, Romania, Former Yugoslavia	119	1,769	9,499	14,909	57.0
USA	United States	316	13,354	30,498	42,283	38.6
Other Developed	Australia, Canada, New Zealand, Israel	66	2,306	24,186	35,141	45.3
Japan	Japan	127	3,840	24,431	30,168	23.5
East Asia High Income	Republic of Korea, Taiwan, Hong Kong, Singapore	83	2,281	13,344	27,580	106.7
West Asia	UAE, Bahrain, Iraq, Iran, Jordan, Kuwait, Lebanon, Oman, Saudi Arabia, Syria, Turkey, Yemen, other territories	273	3,186	6,017	11,654	93.7
CIS	Former Soviet Union	284	3,256	5,790	11,476	98.2
Central America	Mexico and other America and Caribbean countries	187	1,964	7,500	10,483	39.8
South America	Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Peru, Paraguay, Uruguay, Venezuela	383	3,815	7,111	9,950	39.9
China	Mainland China and Macau	1,338	7,482	1,081	5,592	417.1
North Africa	Morocco, Algeria, Tunisia, Libya, Egypt, Sudan	205	973	2,908	4,739	62.9
Other East Asia	Other Asia and Pacific	607	2,381	2,034	3,926	93.0
India	India	1,181	3,066	1,121	2,595	131.3
Other Africa	All other African countries	780	1,570	1,546	2,012	30.1
Other South Asia	Afghanistan, Bangladesh, Sri Lanka, Nepal, Pakistan, Other South Asia	414	711	1,162	1,716	47.7

Most parts of Europe have been near the top of the world income distribution in recent decades. Eastern European countries, although starting from a much lower level, have nearly doubled per capita income over the past 20 years, with an expectation of continued convergence towards the European average in future. Other high-income countries – the US and Canada, Japan and other high income countries in East Asia – have broadly similar income levels to those in Europe. The total population of high-income countries exceeds 1 billion people and on average these countries have seen per capita income rise by 40% in the past two decades.

The middle-income group, comprising CIS countries, West Asia and Latin America, has around 1.1 billion people with income about 40% of the level in high income blocs.

The remaining population of the world, around 4.5 billion people, have average incomes less than half the level in the middle-income group and between 5% and 15% of the level in high income blocs. Although China, India and other countries in East and South Asia have increased national income per capita quite rapidly, low-income countries in Africa have fallen further behind and in many cases have per capita incomes that are little higher than in 1970.

### **Main topics addressed by the macro-model**

The macro-model focusses first on international finance and trade and the relationship between these phenomena and domestic production, income, and expenditure, banking and government debt. The main extensions beyond these traditional elements of macro-economic models are demographics (population, employment, migration) and energy (sources, uses and carbon emissions).

The model examines a number of medium and long-term issues that are of particular contemporary interest. These include

- global financial imbalances: reflected in current account surpluses or deficits and accumulating external assets or liabilities, of particular concern to debtor regions such as the US, South Europe and many low income countries. Historically such imbalances have often been a cause or symptom of financial crises.
- accumulation of government debt: usually measured by debt to GDP ratios or in the case of low income countries, the ratio of foreign currency debt to annual exports. If the accumulation of debt goes beyond levels acceptable to lenders governments risk downrating, high interest charges and eventual need to cut government services and transfers.
- growth of world trade: most countries rely on growth of exports to maintain the momentum of key industries and services and avoid risks of domestic recession or dependence on external capital inflows and accumulation of debt. Growth of world trade and GDP growth in different regions are closely related with knock-on effects on employment, investment, consumer spending, government revenue and debt and health of the banking sector.
- energy supply and carbon emissions: one consequence of GDP growth has been continued increases in annual world consumption of fossil fuels (coal, oil and gas) whose combustion releases carbon dioxide whose accumulation in the upper

atmosphere contributes to global warming, environmental degradation and risks of extreme weather events. A secondary but significant issue is exhaustion of easily-exploited, low cost reserves of oil and gas, presenting many developing countries with dilemmas about investment to meet rising energy demand.

There follow some issues that are mainly of concern to higher income regions. These include

- ageing and services for the elderly: the increase in life expectancy accompanied by low birth rates in high income regions creates anxiety about the ability of elderly people or their families to meet the cost of services they need to maintain a healthy and rewarding life style. If as seems likely, the rapid increase in the elderly population comes at a time when government budgets are squeezed by pressures to cut debt and reduce tax and social security contributions, elderly people, particularly those in low-income segments of the population, might face a very difficult future. Although the macro-model does not have sufficient data to monitor cost and provision of specific services, some indication of the potential stress is provided by comparing the proportion of elderly people and anticipated availability of resources for government services relative to average income of the population at large.
- employment and migration: availability of jobs is a crucial issue in high income countries where the income and life style of the majority of the people depends on employment. There have always been divergences between population and social dynamics on the labour supply side and availability of jobs in each area. Within countries and groupings of neighbouring countries including particularly the EU, migration has absorbed a substantial part of the mismatch although it presents problems for regions of high emigration and high immigration. Migration also has a global dimension as people tend to move from low and middle income countries to higher income countries. Such movements are of concern to local populations, not only because of labour market impacts, but also because sustained migration may change social and cultural norms and affects property values.

Issues that are of great concern to low and middle-income blocs include

- global concentration of industrial production and exports: although there has been rapid development of new centres of industrial production in many countries in East Asia with continuing investment and growth of exports integrated into global value chains, most low and middle income countries in other parts of the world have had limited success in industrial development and in some cases growth of imports has not been matched by parallel growth of exports, causing countries in question to lag behind unless they are able to increase exports of raw materials, energy or tourist services. Unlike other sectors of production and trade, manufacturing production and exports remains a highly concentrated and unequally distributed activity in which shifts in the location of production may occur quite quickly with major impacts on income of regions that acquire or lose specific specialisations. Even at the level of major countries and country groups, it is possible that success over a period of one or two decades may be followed by failure over succeeding decades. The league table of high performers has changed repeatedly over the past century and is likely to change again in coming decades. This is a particularly important

issue for countries that do not have a long-established and highly-diversified industrial base.

- survival and development in low income countries: despite 60 years of globalisation since the end of the 2nd world war countries in Africa and South Asia with half the world's population have a level of average income per capita that has increased very little with periods of growth alternating with absolute declines. The outcome has been an increasing absolute and proportional gap between these countries and those which are developing rapidly or already have a high level of average income. This means that initial disadvantages in global competition are very hard to overcome as infrastructure, services and government are scarcely adequate for survival let alone sustained development. The main chances for escape from the poverty trap are exploitation of natural resources (exports of energy and primary commodities) and to a lesser extent tourism and development assistance. Continued failure to establish paths for sustainable development and eventual convergence of living standards in low income regions are likely to make for ongoing conflicts at local, regional and global level and make cooperation in resolving global issues such as management of natural resources and emissions impossible. This may aptly be termed the "two worlds" problem as demonstrated by the bimodal distribution of world income with too many countries unable to move into the central space.
- inflation: finally, despite much attention to inflation on the part of economists and policy-makers in high income regions, inflation as a practical issue is mainly a matter of concern to low income countries where resources are more tightly constrained and conflicts over spending power and income may be intense. The dilemma remains that if governments and central banks give overwhelming priority to restriction of credit and spending in order to avoid inflationary pressure, there will be little internal stimulus to development and economic growth depends entirely on the country's ability to develop exports. Global factors such as the price of oil and commodities and cost of external finance (interest rates) have a significant bearing on efforts to restrain inflation while maintaining the pace of economic development.

### The scenarios

In this paper issues like those outlined above are examined in the perspective of different assumptions about governance - in other words, the rules, norms and policies of the players who include governments, international organisations, global and local companies as well as the communities, families and individuals who influence the global outcome by their behaviour patterns and support for different directions of economic and social change.

The baseline which may be loosely termed 'business as usual' provides a context for reviewing what would be implied by continuation of current trends without any major changes in the governance system. In this paper the baseline is used to present the main features of each issue, showing why it may be the subject of ongoing concern and quantifying its potential impact in Europe and other parts of the world over the next two decades.

Remaining chapters examine the potential impact of specific changes in the governance system resulting in changes in government policies and corporate and private sector behaviour. The four governance scenarios are speculative since we

cannot claim to know which changes in governance are most likely to prevail in the next two decades. Each scenario represents a direction or tendency that may have more or less influence and the purpose of each is to suggest the main ways in which changes in a given direction may influence the global economy and mitigate or intensify problems identified in the baseline.

The governance scenarios are categorised as follows:

- **reduced government:** a progressive reduction in government budgets and the role of government, particularly in higher income regions of the world with global business corporations playing an ever-increasing role. This could be regarded as a continuation or extrapolation of changes in governance that have taken place over the past few decades.
- **US-China collaboration:** a larger and more effective role for government locally and globally founded on mutual cooperation between the US and China supported by high income partners in Europe and the Far East. This could be regarded as a necessary development to mitigate tensions as the drive for development and eventual convergence of living standards tilts the global balance. The potential impact on Europe and other regions needs careful investigation.
- **global collaboration:** a wider partnership in which high income countries and China give more consideration to the needs of other middle and low income regions whose cooperation may in the long run be essential to keep the peace and avoid serious damage to the global ecostructure. In this scenario the price of collaboration is a significant investment by higher income countries in restructuring trade, finance and infrastructure to assist lower income countries.
- **regionalisation:** this is another possible direction of change in which countries in each part of the world seek to protect themselves from global instability and achieve a more localised pattern of development that may better accord with inherited social and cultural traditions. The investigation in this paper assumes consolidation of five continental groupings - America (North and South), Europe, East Asia, Other Asia and Africa. Europe currently has the highest per capita income, smallest population and most extensive global linkages. Several questions arise such as whether regionalisation can succeed in its own terms by improving economic performance of participating countries and reducing exposure to global instability, whether it harms other countries and whether it is capable of generating solutions to global problems such as carbon emissions and financial instability.



## Chapter 1 Baseline projection: the main issues

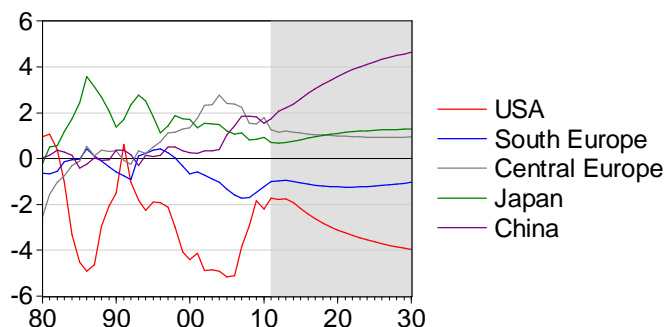
The purpose of this chapter is to review topics listed in the introduction above, giving an idea of what may be expected over the next 20 years, why it matters and which blocs are most affected.

### The global perspective

#### Financial imbalances

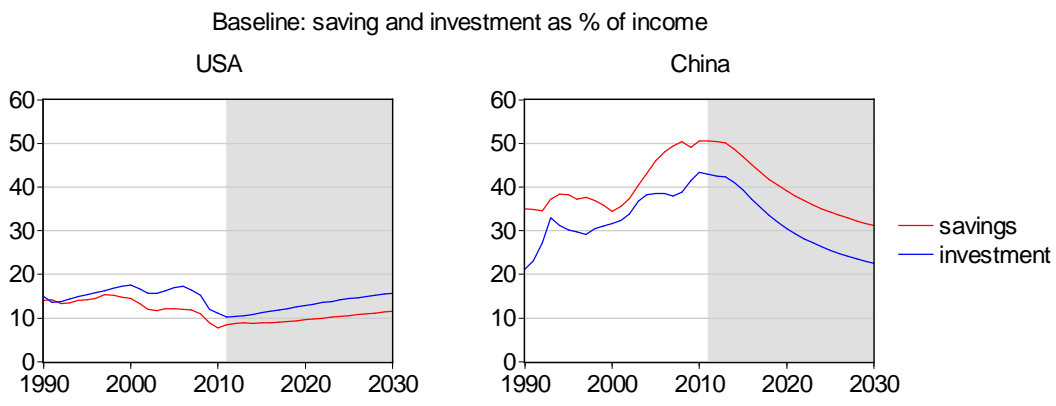
As illustrated in the chart, large financial imbalances emerged in the 1980s and became more prominent in the past decade with the US and more recently S Europe being the main deficit blocs and China taking over from Japan and Central Europe as the main surplus bloc. The baseline projection shows the US deficit gradually increasing again and China's surplus rising to an unprecedented level over the next two decades. Japan's surplus and imbalances within Europe remain around their recent level.<sup>3</sup>

Baseline: current a/c imbalances as % of total world exports

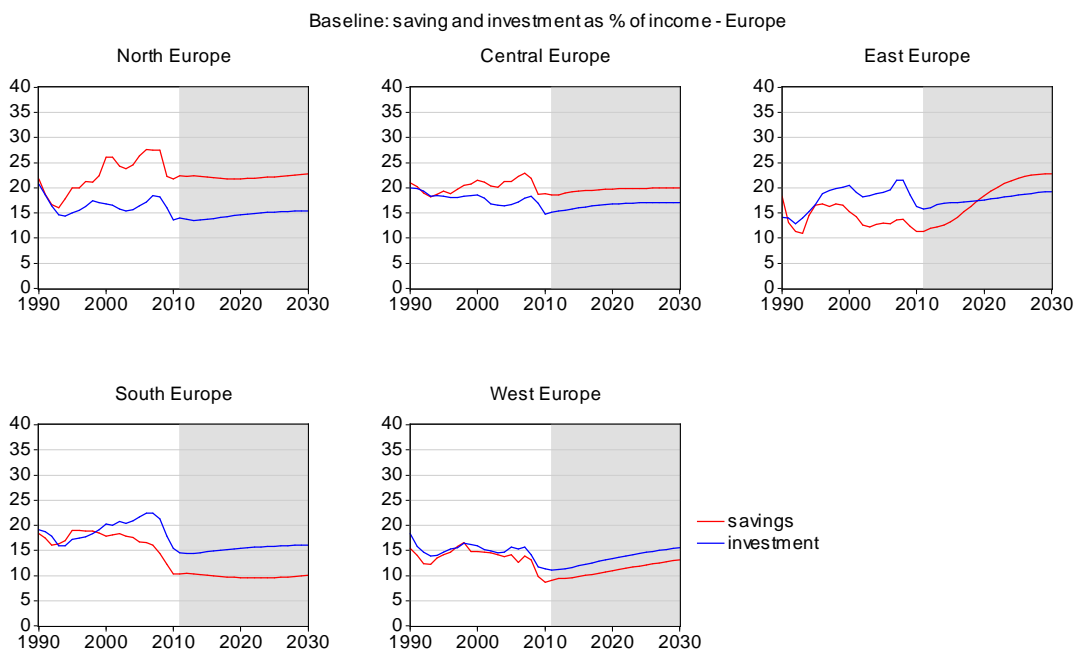


Whether such imbalances will continue or increase in coming years depends largely on two factors: the success of each region in generating adequate growth of GDP and the impact of economic growth on savings and investment within the region. The baseline assumption is that the US will continue to have a low savings rate and a gradual increase in investment while both savings and investment in China fall as the rate of economic growth slows down.

<sup>3</sup> To facilitate comparison between blocs and through time surpluses and deficits of each bloc are shown as a percent of total world exports.



The chart below shows the projected pattern of imbalances within Europe.



The main change is an expected increase in savings in East Europe as rising income per capita improves the fiscal balance and the role of government progressively diminishes. No such development is expected in South Europe as prospects for income growth are much less optimistic.

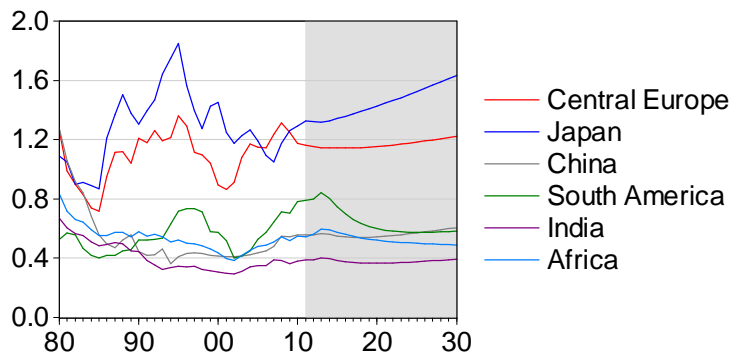
*Does it matter ?*

To the extent that the main imbalances within Europe have arisen within the Eurozone while imbalances between the USA and the Far East involve different currency areas, the problems and avenues for resolution are somewhat different.

So far as the former imbalance is concerned, the main issue is the impact on exchange rates.



Baseline: real exchange rates relative to the USA



On the basis of past behaviour the model suggests it is unlikely that there will be large permanent changes in real exchange rates between the main blocs over the next two decades. The baseline has gradual revaluation (or rising prices) in China relative to the US with more persistent revaluation of the Yen, some reversal of recent revaluation in South America and little change in real exchange rates in Africa and India. This is not to say that a more powerful realignment could not be achieved in a different governance context - e.g. one of close collaboration between the US and China.

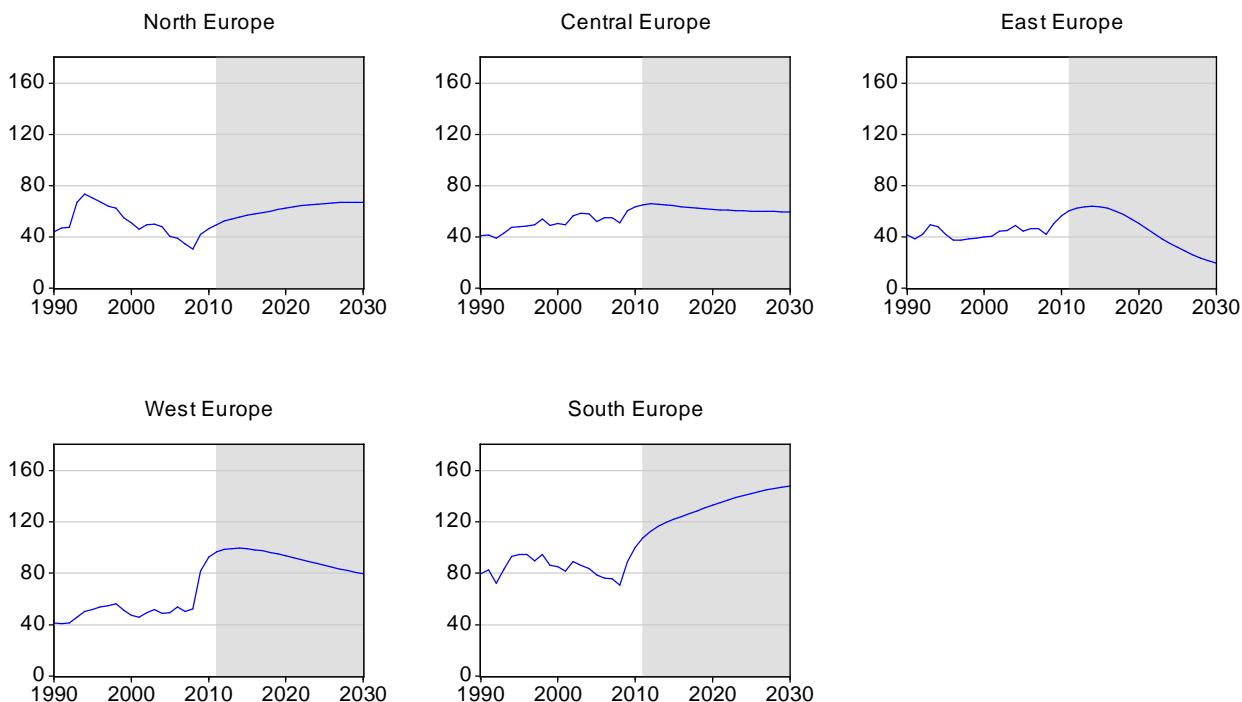
So long as the Eurozone holds, the issue for Europe arising from persistent deficits in South Europe is the way in which the deficits are financed and in particular the viability of government debt, a topic to which we now turn.

Government debt

First examining government debt to annual GDP in different parts of Europe, it is evident that debt to GDP ratios have recently increased dramatically due to the financial meltdown and stimulus packages. Nevertheless, except in South Europe, the baseline implies that debt to GDP ratios will stabilise and eventually fall.

Without a radical reduction in functions of government debt to GDP ratios in South Europe are projected to continue to increase, implicitly or explicitly guaranteed by the EU or Eurozone members. By 2030 the baseline level is 150% of annual GDP.

Baseline: government debts % of GDP, European country groups

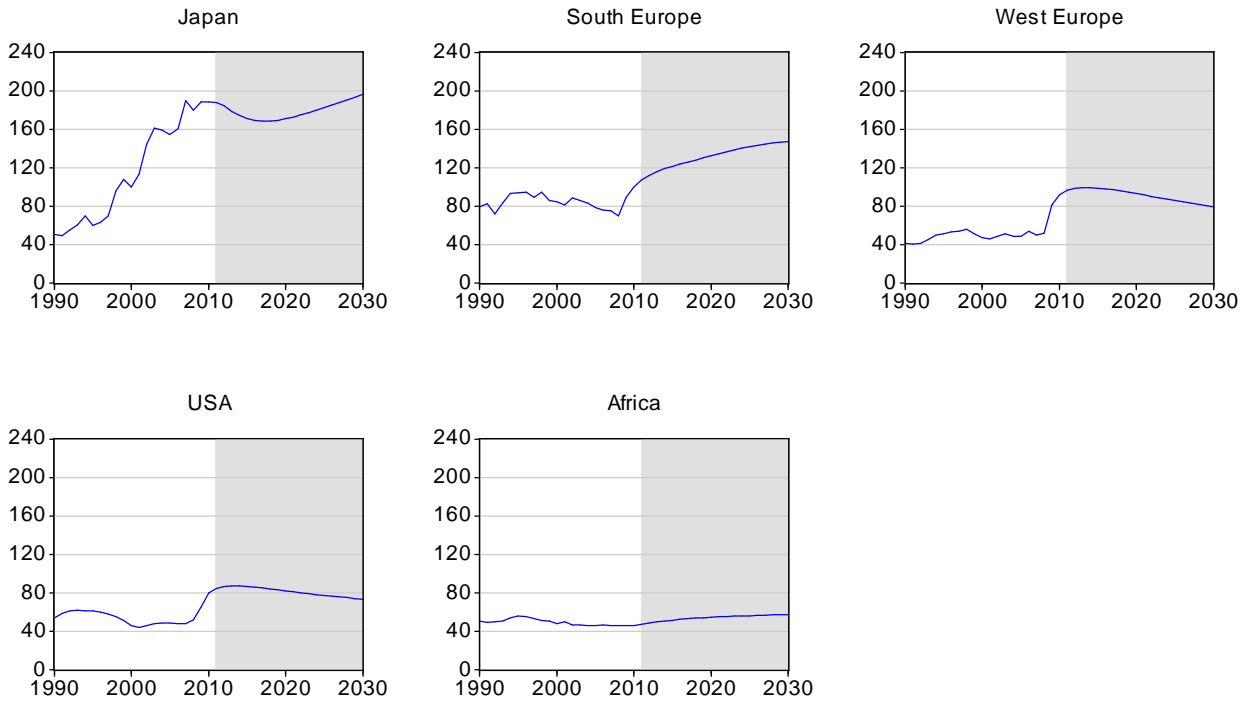


To put this in a wider perspective the next chart compares debt/GDP ratios for South Europe and the UK with those in the US, Japan and Africa. It will be seen that African governments typically have lower debt/GDP ratios than governments in high income regions which in practice means that they have very little debt at all as the level of GDP is itself very low. Without effective external underwriting it may be difficult for African governments to change this situation and secure funding for higher investment in services and infrastructure required for sustained development.

The projected debt/GDP ratio in the USA is not very different from that in the UK. Current levels of government debt cause considerable alarm in both countries for similar reasons.

The debt/GDP ratio in South Europe is of a different magnitude. Although it is lower than the corresponding ratio in Japan this difference does not make government debt in South Europe easier to finance. Japanese government bonds are backed by very large global investments and a falling price level, conditions that do not apply in South Europe.

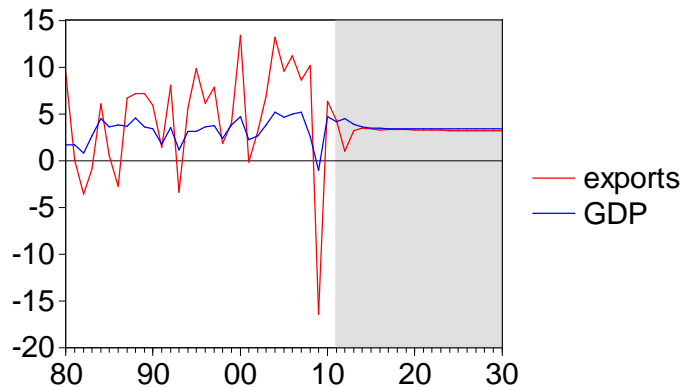
Baseline: government debts as % of GDP, high debtors



Growth of trade and GDP

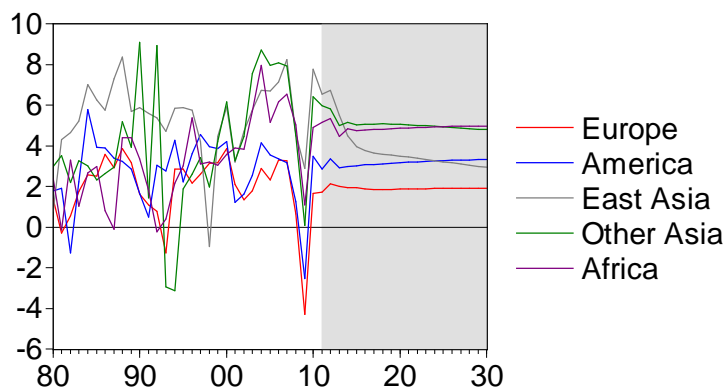
On the assumption that global financial imbalances and high levels of government debt can be financed without major crises, world GDP growth is projected to average 3.5% p.a., similar to the average rate in the past decade and slightly better than in the 1980's and 1990's. However world trade is expected to grow slower than in the past due to a diminishing impetus from opening of new markets and entry of low cost suppliers and a tendency for import prices to rise rather than fall relative to the average price of domestic expenditure.

Baseline: growth of world trade and GDP (% p.a.)



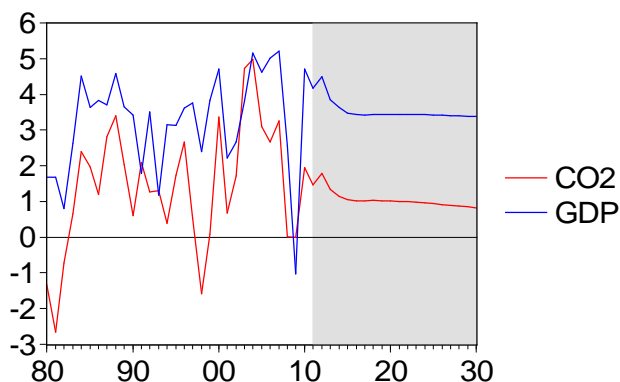
In this context GDP growth in Europe may be modest and growth in East Asia may decelerate substantially. Other regions (Africa, Other Asia and America) that have not performed so well in the past would be less affected and could maintain GDP growth at rates similar to those achieved in the past.

Baseline: GDP growth by world region (% p.a.)

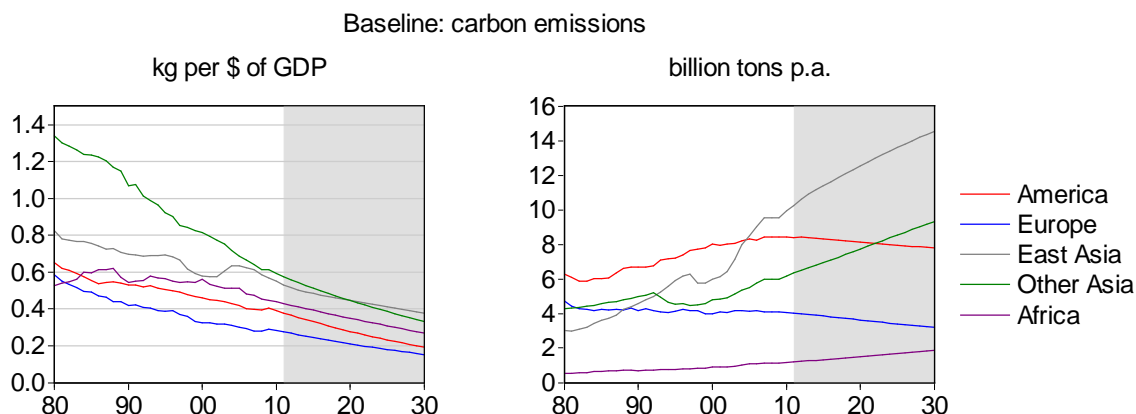


Carbon emissions

Baseline: carbon emissions and world GDP growth (% p.a.)



Despite a relatively low rate of growth of world trade it is hard to imagine a reduction in CO2 emissions under baseline business-as-usual assumptions. With GDP growth averaging 3.5% p.a. carbon emissions are projected to grow by around 1% p.a. Thus 20 years from now annual emissions would have risen by 20% from the current figure of around 30 billion tons p.a. and the goal of reducing accumulation of CO2 in the upper atmosphere would still be remote.



The left-hand chart indicates a long-term and sustained reduction in carbon emissions per dollar of real GDP with Europe in the lead. At the same time income growth in Asia and Africa is pushing up emissions despite efficiency gains. Increases in these regions outweigh reductions in Europe and, prospectively, America. The problem is substantial because carbon emissions per dollar of GDP are still relatively high in Asia and dependence on coal may impede a rapid improvement.

To summarise the baseline overview of global issues, prospects for economic growth are uneven with potential problems for China and to a lesser extent Europe due to reduced growth of world trade. At the same time several global problems remain unresolved: financial imbalances continue as exchange rate movements are unlikely to resolve the underlying causes, CO2 emissions continue to increase and government debt in South Europe may continue increase.

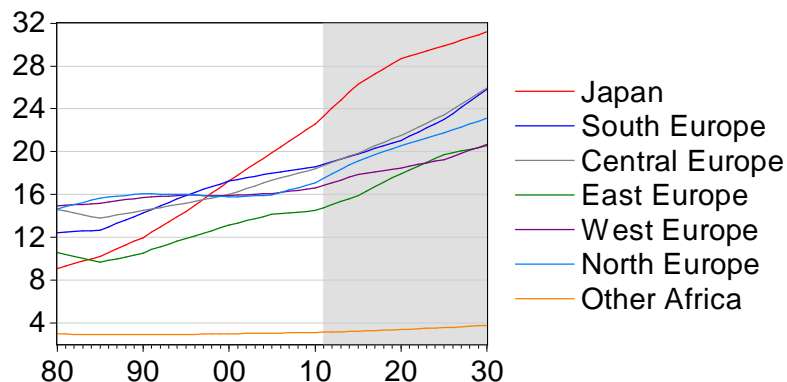
The next section looks more specifically at issues that are primarily of concern to high income regions including Europe.

### Issues for high-income regions

#### Ageing and welfare

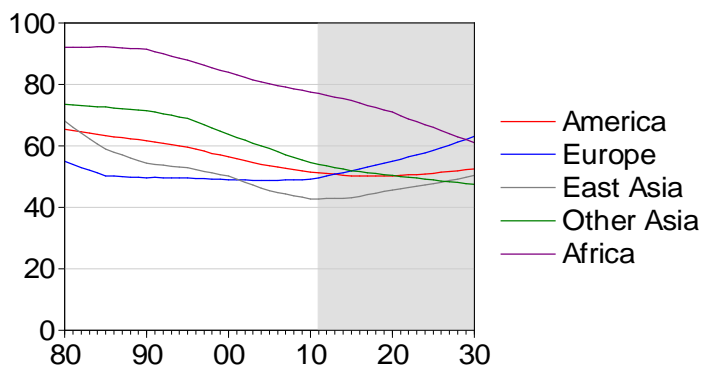
The first chart shows the rapid increase in the elderly population in Japan (reaching 30% of the total in 2030) and projected increase in different parts of Europe (reaching 20-25%) while the corresponding figure for Africa is around 4%. This gives rise to concern about the ability of elderly people to maintain their living standard and obtain support services in retirement. Similar trends are projected for the US.

Baseline: elderly population (% of total)



It is worth noting that the increase in the number of elderly people has been accompanied by a reduction in the number of children. Thus the dependency ratio for children and old people combined (relative to the population of working age) has remained around 50% in Europe over the past 3 decades although it is projected to rise to 60% by 2030. The dependency ratio in Africa has been much higher due to the very large number of children. It exceeded 90% in the 1980s, has been falling gradually since then and is expected to come down to 60% in 2030. Around that time falling dependency ratios in Africa and Other Asia will cross rising dependency ratios in Europe, America and East Asia where birth rates are already quite low and life expectancy is relatively high.

Baseline: dependency ratio  
(children and elderly as % of population of working age)

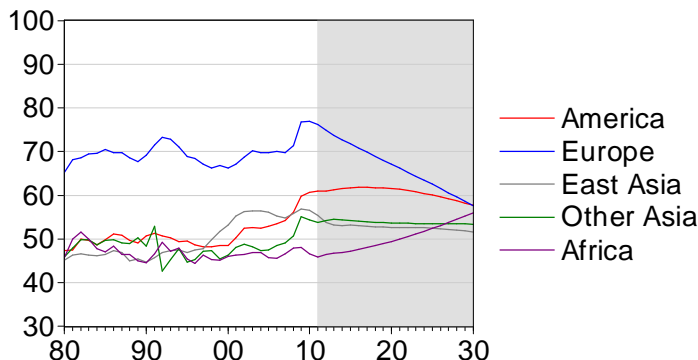


Although children require a lot support, the problem for elderly people may be more acute to the extent that they are less able (in many societies, much less able) to rely on their families. The more fortunate may have acquired sufficient wealth to acquire the support they need on a paying basis. The most exposed are evidently those who have little accumulated wealth and are not supported by families. For these people quality of life and survival in old age will depend greatly on the support they get from government and community organisations.

A rough indication of the problem for government can be given by comparing government expenditure on goods and service to the dependent population (children

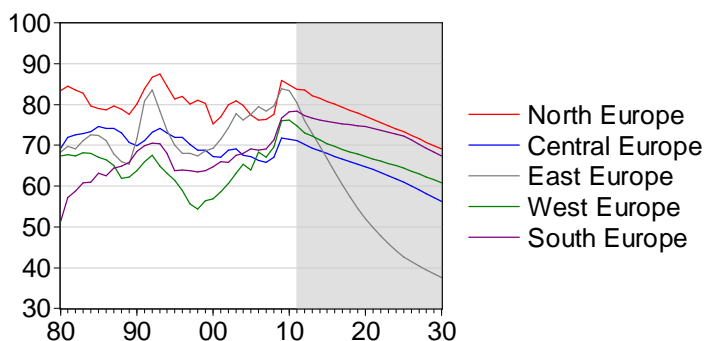
and elderly) and the general level of living standards (indicated by income per capita).

Baseline: government budget per dependent population world regions (% of national income per capita)



The chart shows that government budgets in Europe have been much higher relative to the dependent population than in other continents, averaging around 70% of national income per capita for the whole population, while the figure for other continents has until very recently ranged between 45% and 60%. But despite the good starting position in Europe, the availability of resources for government support is projected to fall steadily to less than 60% by 2030 while the situation improves significantly in Africa as birth rates decline. The final chart provides a breakdown for different parts of Europe. In the case of Eastern Europe a very dramatic decline is projected with government resources relative to living standards in general falling from 80% now to 40% in 2030. The projected decline in other parts of Europe is less dramatic.

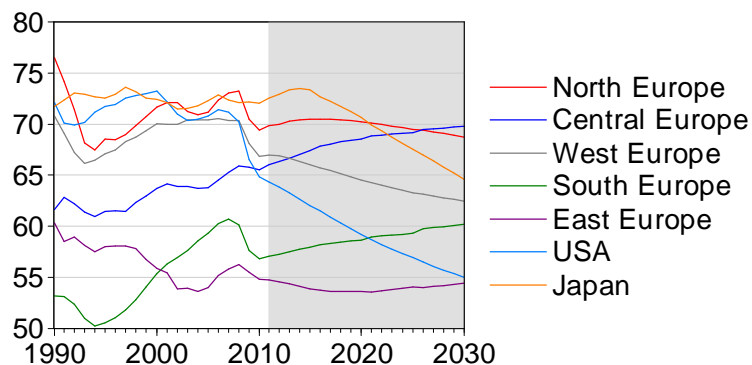
Baseline: government budget per dependent population European countries (% of national income per capita)



### Employment and migration

Another topic of huge concern in Europe, the USA and some other high income regions is employment and migration.

Baseline: loss of jobs in selected countries  
(employment as % of working-age population)

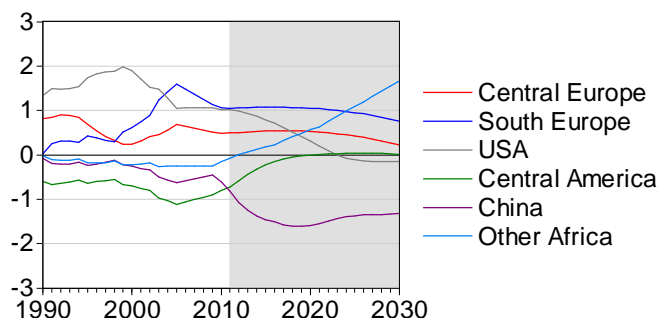


The chart shows past and projected employment rates in Japan, the US and different parts of Europe. It will be seen that current employment rates are very different, at least in part because of different historical traditions affecting participation of women in particular. Employment in the US, UK and North Europe has exceeded 70% over the past two decades and has risen from 60% to 65% in Central Europe and 50% to 60% in South Europe. Only in Eastern Europe has there been a declining trend reducing employment from 60% to 55%.

The baseline projection implies changes in the pattern over the next 20 years. All blocs shown in the chart (apart from Japan) experienced a sudden drop in employment in 2009-10. After that projected trends are different as the US, Japan and to a lesser extent the UK are expected to experience a continuing reduction while employment improves in Central and South Europe and remains stable at the 55% level in East Europe.

Changes in employment rates have important consequences for income distribution and migration.

Baseline: net migration, selected country groups (millions p.a.)



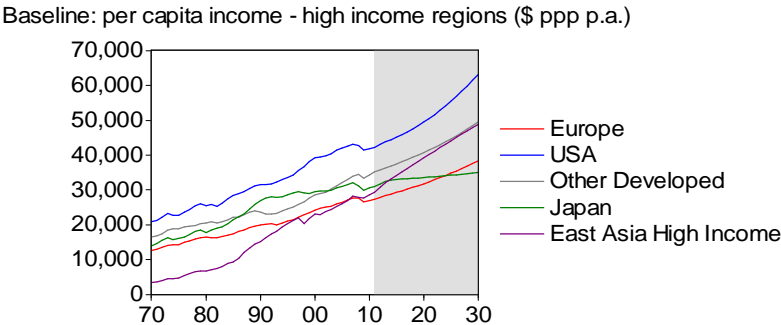
The chart shows annual figures interpolated from 5-year net migration estimates published by the UN Population Division and projected from 2006 onwards using the global macro-model. As the chart shows, the main areas of net emigration in the past (considered in terms of millions of migrants) have been Central America and China and the main areas of net immigration have been the USA, Central Europe and South Europe. This pattern is projected to change as net immigration to the US comes to an end due to the declining employment rate while immigration to Central



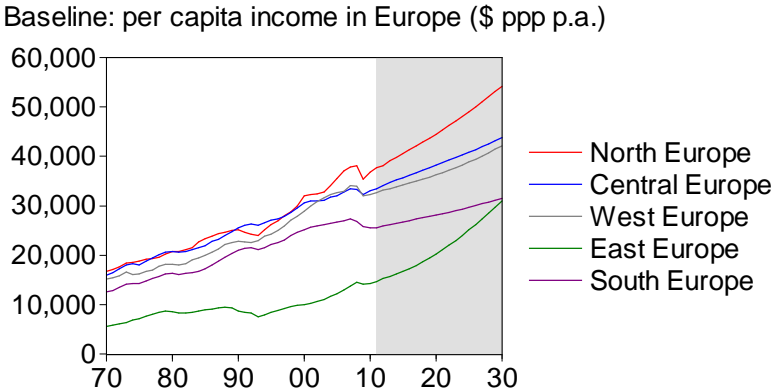
and South Europe continues on broadly the present scale and Other Africa becomes a significant region for net immigration. Correspondingly net emigration from Central America comes to an end while net emigration from China continues.

Per capita income

In per capita terms the US is projected to remain the clear leader with an income level reaching more than 60,000 ppp dollars per person by 2030.<sup>4</sup> Japan and Europe are projected to lag behind with income of 30-35,000 dollars per person. In the middle at a level of around 45,000 dollars the Other Developed bloc (Canada, Australia, New Zealand and Israel) will be joined by the East Asia High Income group (Korea, Taiwan, Hong Kong and Singapore).



North and Central Europe and the UK keep up in relative terms with income in the range 40-50,000 dollars while South Europe falls behind and East Europe catches up reaching an income level of 30,000 dollars by 2030.



**Issues for low and middle income regions**

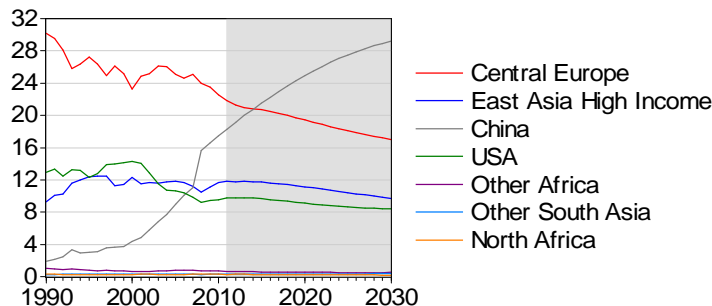
Global concentration of manufactured exports

The degree of concentration of the world market for manufactured exports and the way it has been changing is one of the most dramatic features of the world economy today.

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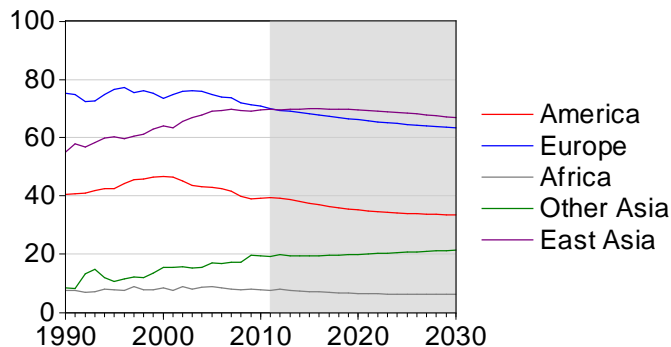
<sup>4</sup> Purchasing power of 2005

Baseline: share of total world exports of manufactures rich and poor (% of world average)

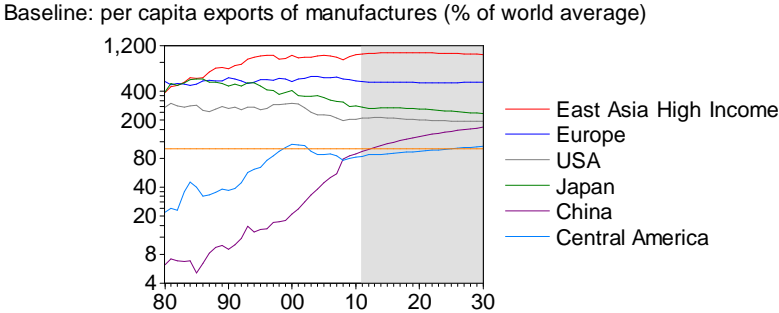


Central Europe's share of world exports has fallen gradually from 30% in 1990 to 22% in 2010 and is projected to decline further to 17% in 2030. China's share has risen from 2% in 1990 to 18% in 2010 and is expected to reach 30% in 2030. The other blocs with a high share of the world total, the US and East Asia High Income, have had around 12% of the market and this is projected to decline slightly. The share of the four blocs taken together has risen from 55% in 1990 to 62% in 2010 and is projected to increase further to 68% in 2030. At the other end of the scale, the share of Africa and South Asia excluding India has fallen from 2.5% in 1980 to 1.4% in 2010 and is projected at 1.1% in 2030 - despite the fact that this group of countries has a population of nearly 1.5 billion (more than 20% of the world total).

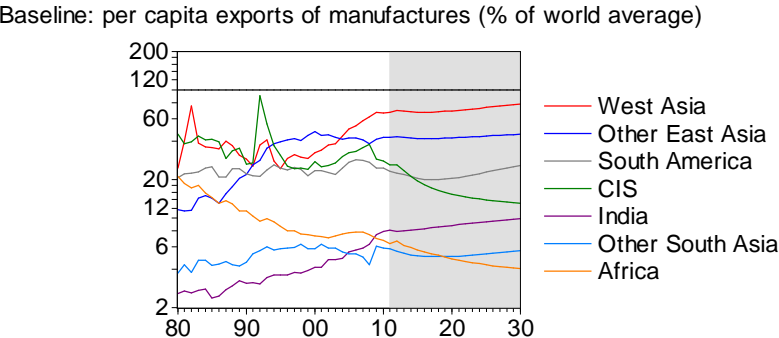
Baseline: share of intra-trade in total imports of manufactures



To some extent the high share of Europe and East Asia in world exports is attributable to intra-regional trade. This accounts for around 70% of total exports of manufactures in these regions as compared with around 40% in the American continent, 20% in the rest of Asia and less than 10% in Africa. It must be assumed that high levels of intra-regional trade are both a cause and a consequence of the strength of the industrial systems in each continent.



The scale of the gaps and the rise of East Asia and to a lesser extent Central America can be seen by looking at per capita exports of manufactures on a log scale, expressed relative to the world average figure. In the past 30 years China has come from a very low level of exports to reach the world average and is projected to achieve around 170% of the world average by 2030. Over the same past period Central America came up from 25% to 100% of the world average and is projected to maintain that position up to 2030. The performance of Europe and the US has been declining slowly but is still projected to exceed that of China in 2030.



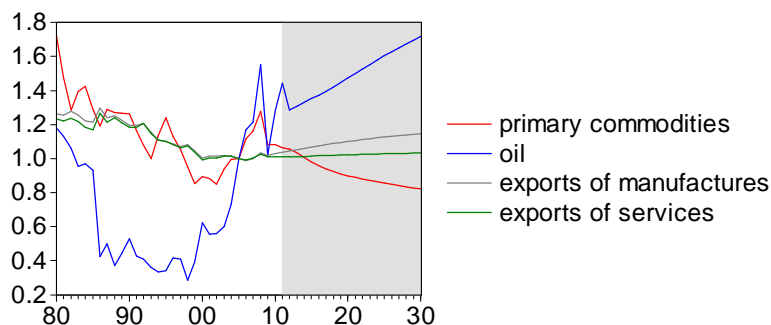
Other parts of the world have had below-average performance in exports of manufactures. Although India's performance has improved from a very low initial level and that of other parts of Asia is projected to remain fairly stable (in the case of West Asia and Other East Asia at a level of 60% and 40% of the world average respectively) the performance of the CIS group shows a trend decline even in per capita terms and that of Africa has fallen from 20% of the world average in 1980 to 7% in 2010 and is projected to decline further to around 4% over the next two decades.

These trends both reflect and contribute to the sense of increasing inequality in economic relationships between different parts of the world and imply ongoing failure to generate convergence on a world scale. It must be questionable whether such trends can continue over the next two decades without provoking major changes to politics, policies and institutions in some or all of the affected regions.

Global commodity markets

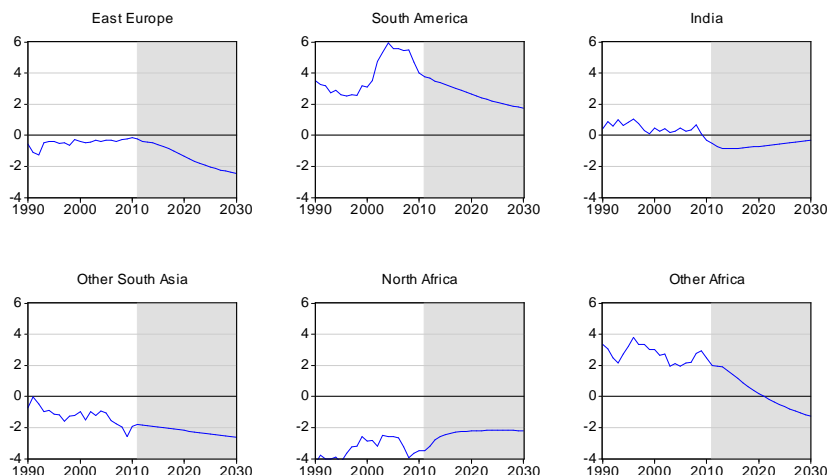
Another contributory factor that must be mentioned briefly is the problem of shifting patterns of production, cyclical price movements and long-term inelasticity of global commodity markets.

Baseline: Relative price indexes (2005 = 1)



The chart showing price indexes for commodities, oil and exports of manufactures and services relative to domestic prices highlights the volatility and downward trend of prices for primary commodities in general and the even greater volatility and upward trend of the price of oil.

Baseline: trade balance on food and raw materials - selected blocs (% of GDP)

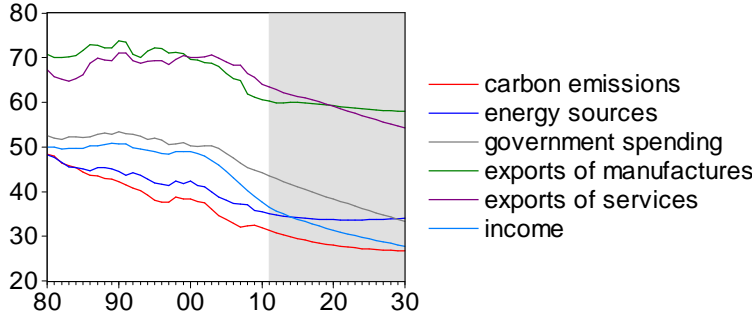


Commodity trade has a significant impact on the economies of low and middle income blocs shown above. South America has achieved net exports rising at one time to 6% of GDP which may ultimately have added as much as 20% to average income. Africa South of the Sahara has had a smaller net export surplus which is projected to decline and turn to deficit by 2030. North Africa and South Asia (excluding India) already have sizeable deficits on commodities overall and East Europe is projected to have a small but increasing deficit in the future.

Per capita income

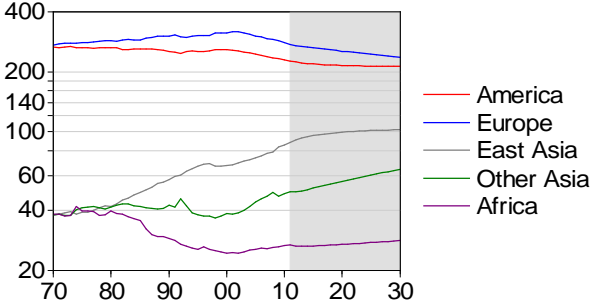
The relative importance of several factors contributing to inequality between the 19 blocs distinguished in this study is indicated by Theil inequality measures scaled such that 100 indicates absolute inequality and 0 indicates equality (defined as an identical per capita outcome in every bloc).

Baseline: Inequality indexes (range 0 to 100)



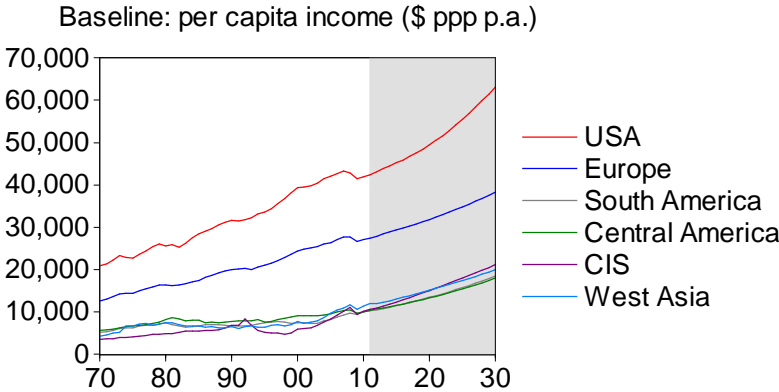
Exports of manufactures and services are the most unequal factors. The projection to 2030 shows an ongoing reduction in inequality of service exports but little or no reduction for manufactures. Government spending has tended to follow income per capita but in the past decade the distribution of income has reduced substantially reflecting rapid growth of income per capita in East Asia while government spending has followed and is projected to follow a more gradual trend towards equalisation. Perhaps surprisingly the distribution of energy production is one of the least unequal factors at bloc level and carbon emissions per capita are the leader in the trend to greater equality.

Baseline: relative per capita income by world region (% of world average)

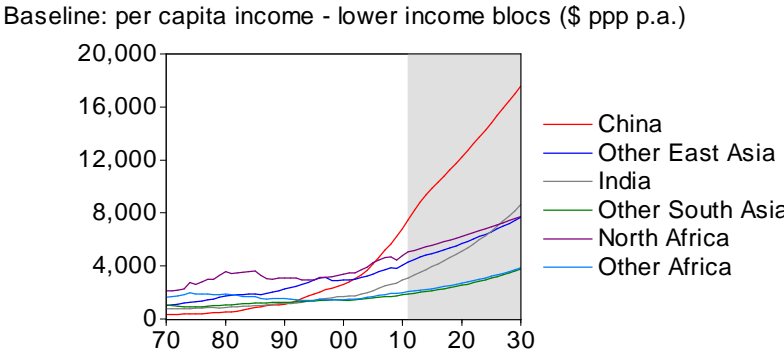


The graph of relative income per capita for world regions shows that Asia generally has improved its position relative to Europe and America. Africa lost ground heavily between 1980 and 2000 and achieved limited recovery in the past decade, being now far behind the other continents.

As shown in the next graph, middle-income blocs comprising Central and South America, North Africa, West Asia and the CIS group form a closely-related band with a gradual increase in per capita income to somewhere near 10,000 ppp dollars per capita in 2010 and in the baseline these blocs are projected to keep their relative positions implying income of around 16,000 ppp dollars by 2030 by which time the level in the US may have reached over 60,000 dollars and the European average 35,000 dollars.



Now considering lower-income blocs, large differences in performance within Asia and Africa are projected to divide countries into three groups. China as the superstar is projected to catch up with the middle-income group discussed above, achieving a level of more than 16,000 ppp dollars per capita by 2030. India, North Africa and Other East Asia tie second at 8,000 dollars per capita. South Asia excluding India and Other Africa come a poor third with an average of 4,000 dollars per capita.<sup>5</sup>



Inflation

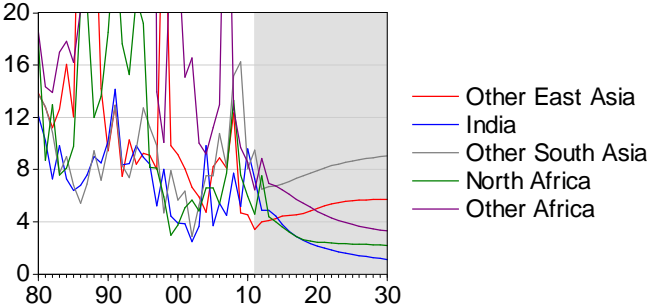
Low and middle income countries have experienced very severe bouts of inflation at different times in the past but the incidence has been very uneven. It must be admitted that it is difficult to come up with a good measure of inflation for a group of countries with different currencies when some have low or moderate inflation and others experience hyperinflation. The weighted average measure used in this paper gives only a very indication of the presence of inflation in one or more countries in a bloc but is not very useful as an indicator of the pain caused on average in the group as a whole. Thus for example hyperinflation in only one out of 50 countries in the Other Africa bloc may be sufficient to push the average rate for the bloc to a high level that is not at all representative of the experience of the majority.

The historical segment of the graph shows this in practice. There have been important outbreaks of inflation in individual countries in each of the four low-income blocs shown in the period between 1980 and 2000. In the case of Other Africa

<sup>5</sup> The purchasing power standard is that of 2005.

hyperinflation continued into subsequent period in countries such as the Democratic Republic of Congo and Zimbabwe. Baseline inflation projections are almost certainly too restrained but can be used to get some idea of changes in average inflation pressure under different scenarios. Since high inflation remains a serious risk for low-income countries with major political repercussions further attention will have to be given to the issue of how inflation risk can best be measured ex post and modelled ex ante. A monetary approach will not help much as it does not tell us much about the macro-economic circumstances that cause governments and central banks to lose control of the monetary system or in popular language 'print money'.

Baseline: domestic price inflation in low income regions (% p.a.)





## Chapter 2 Reduced government

This and the next three chapters examine the logic and potential consequences of changes in the pattern of governance. The presentations concentrate on outcomes for which the governance pattern under consideration may potentially make a significant difference as compared with the 'business as usual' baseline projection.

### Behavioural changes

The scenario reviewed in this chapter contemplates a progressive reduction in government budgets and the role of government, particularly in higher income regions of the world, with global policies increasingly driven by large corporations and financial institutions seeking to develop world markets and maintain conditions necessary to reduce risk exposures for these corporations and institutions.

In general this scenario might be expected to favour investment and trade, at least in regions that provide favourable conditions for global corporates, with constraints on government revenue and reducing levels of government spending and debt. It may also be assumed that labour market imbalances in the US, Europe and China will be at least partially accommodated by wage adjustment or exchange rate shifts and changes in migration flows as government cuts have negative impacts on the job market and governments lack resources and legitimacy for job creation.

The scenario assumes a degree of consensus on the part of global corporates about the need to channel investment in a manner that helps to deal with widely-recognized public issues such as the need to spread industrial production locations more widely especially in India and South America, support for increased production of food and raw materials for domestic use and export in Africa and South America and a substantial increase in energy from non-carbon sources.

Overall the scenario may be described as a progressive response by the global business community to requests by government leaders for business to do more as governments themselves have diminished authority and resources.

Although this scenario is to some extent symptomatic of current institutional trends in many parts of the world, it is not clear that such trends can continue over medium or long-term horizons in which a reduced role for government and increased dependence on global business may have quite severe effects on vulnerable populations in high as well as low income regions of the world.

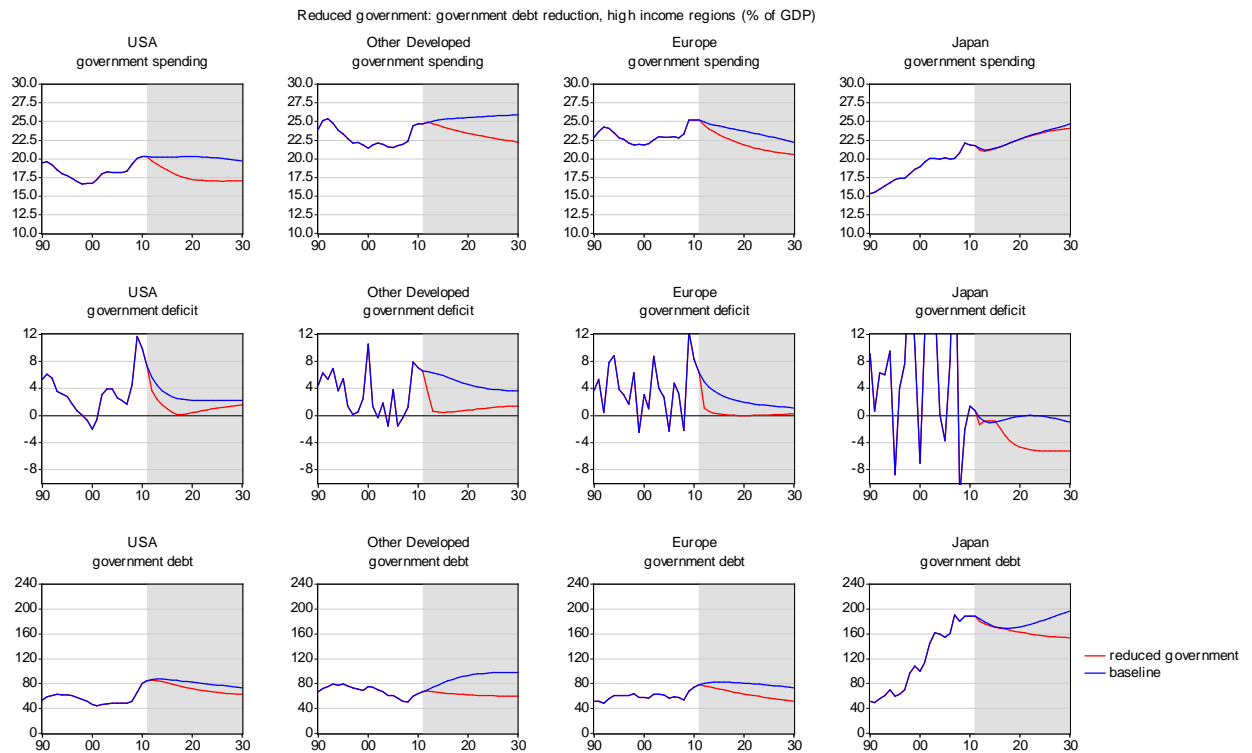
Remaining sections of the chapter review some important potential consequences.

### Balanced budgets and debt reduction

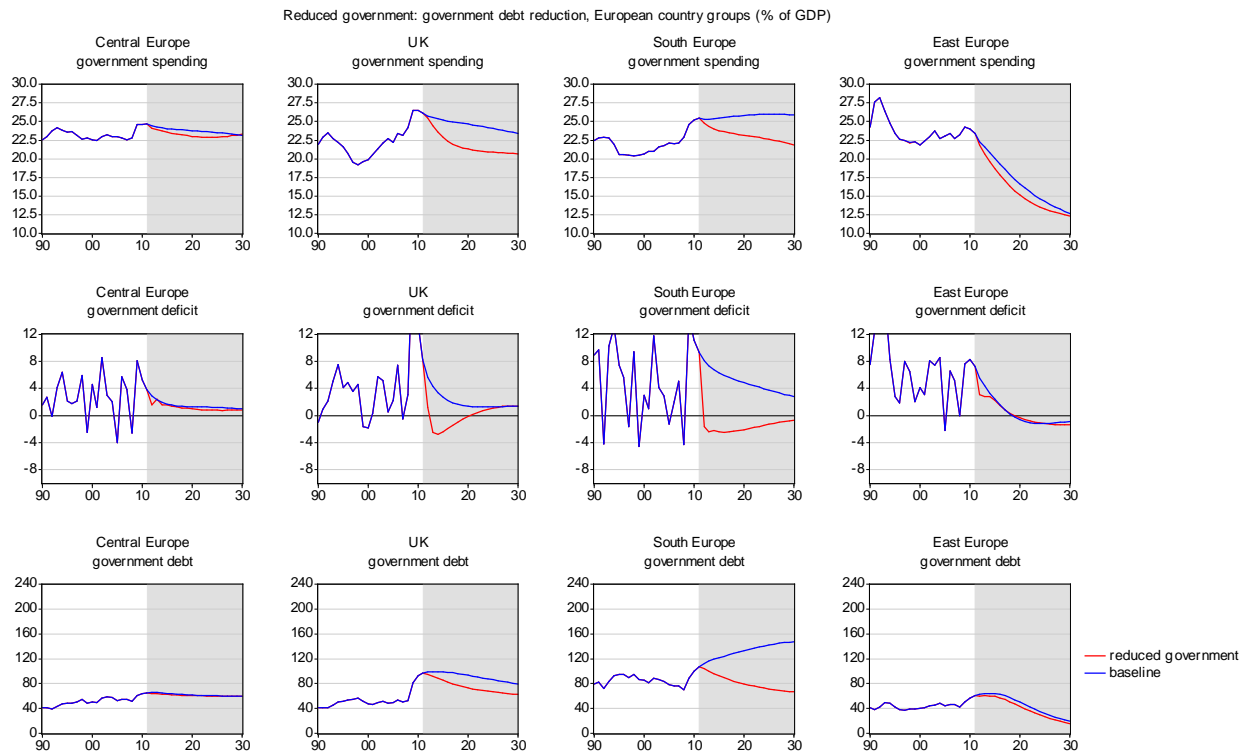
The first issue is whether and how far attempts to reduce the role of government will succeed and in particular whether budget deficits and debt/GDP ratios will revert to more normal levels after they escalated in the recent recession.

The chart illustrates possible paths for reduction of debt/GDP ratios, red lines showing outcomes under the "reduced government" scenario as compared with baseline projections (blue lines). To achieve these debt/GDP reductions government deficits have to be cut rapidly as illustrated. In the case of Japan a budget surplus is required.





Looking at different parts of Europe, the main burden of spending cuts required to achieve a target 60% debt/GDP ratio would fall on the UK and South Europe. Both regions would need to achieve a budget surplus for several years. Central Europe could maintain a 60% debt/GDP ratio with minimal adjustments. In East Europe rapid economic growth would reduce the debt/GDP ratio to around 20% by 2030 with a much lower share of GDP absorbed by government spending than in the rest of Europe.

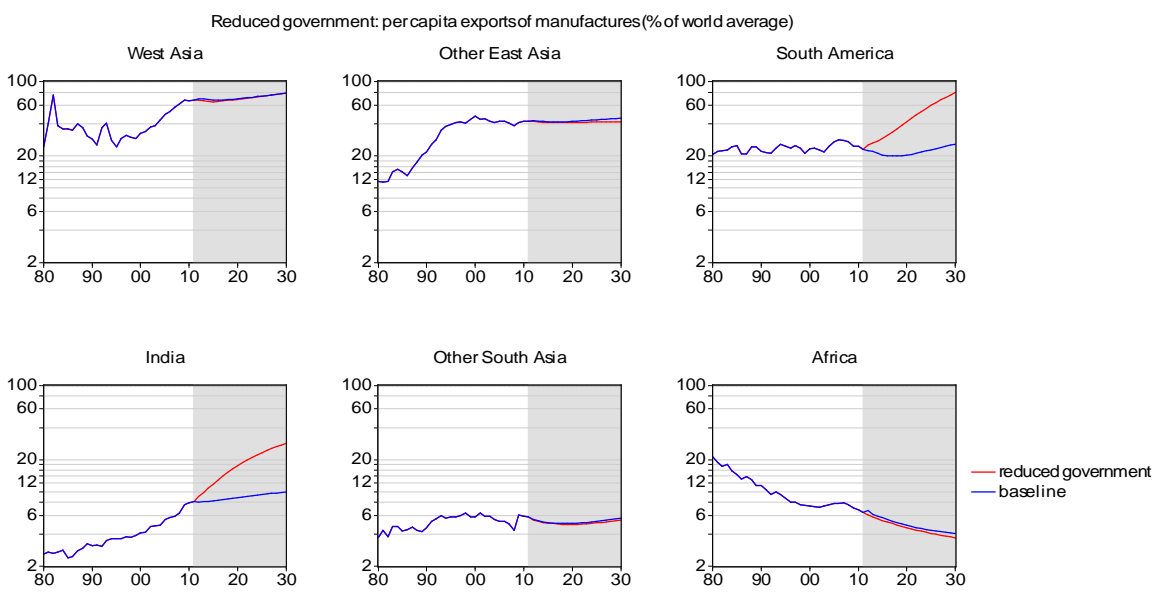


## Location shifts of global industries

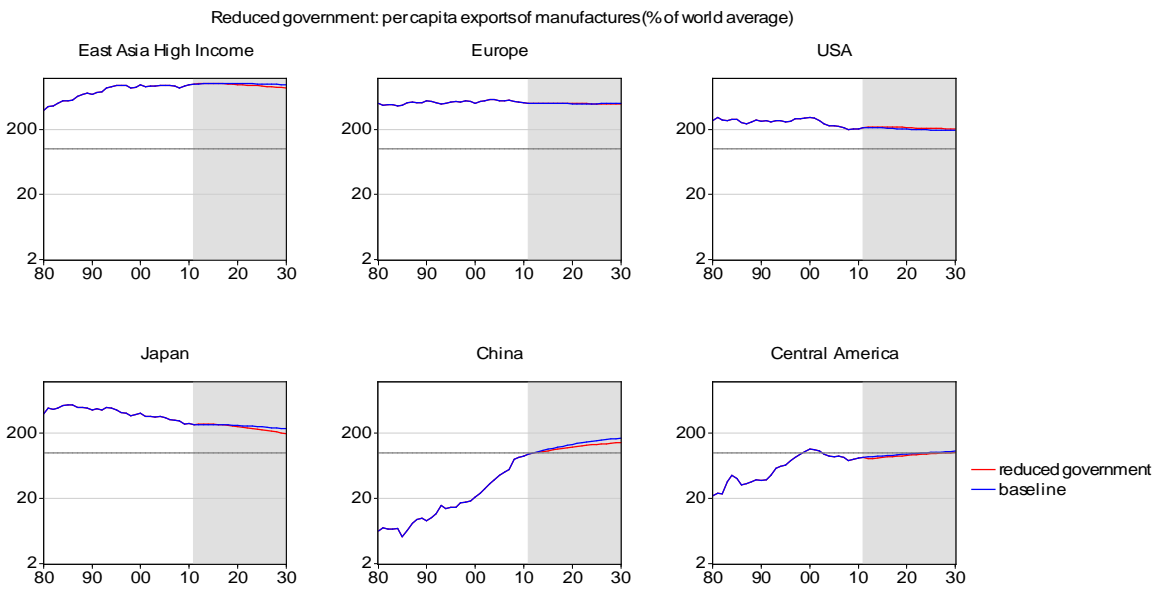
### Manufacturing

As global business dominates international relationships, investment in production of commodities and manufactures may become less concentrated. Governments in most low and middle income countries could be expected to become more aware of the extent to which economic growth and prosperity depends on creation of conditions favourable to foreign direct investment and integration of local business with international networks and this in turn should make it attractive for international business to spread investment in production for world and regional markets more widely.

# WP1 macro-model: governance scenarios to 2030

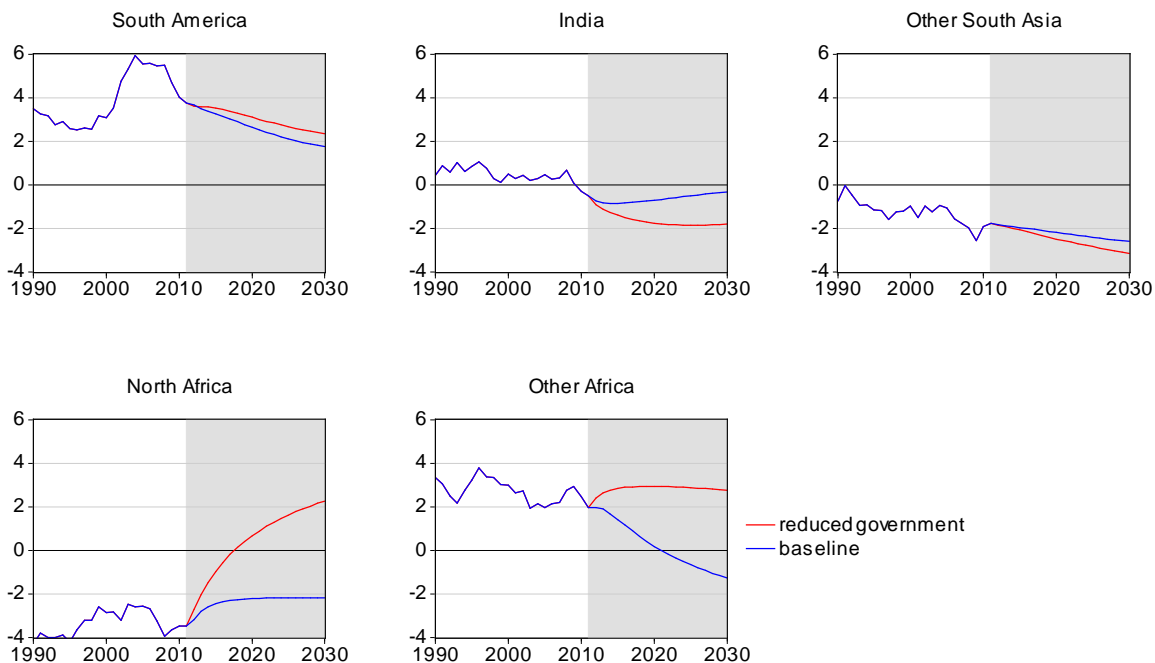


The assumption in this scenario is that South America and India will see rapid growth of industrial production for export and significantly improve their shares of world markets. However the impact on performance of leading export blocs would be marginal.



Primary commodities

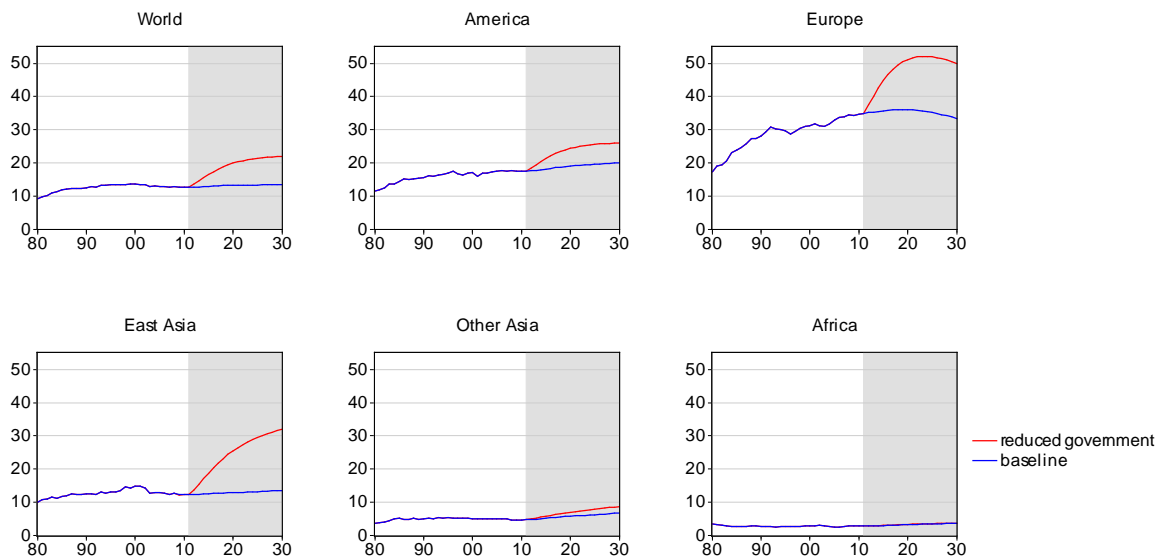
Reduced government: trade balance on food and raw materials - selected blocs (% of GDP)



In the case of primary commodities the main beneficiaries are assumed to be Africa, North and South, and South America.

Investment in non-carbon energy sources

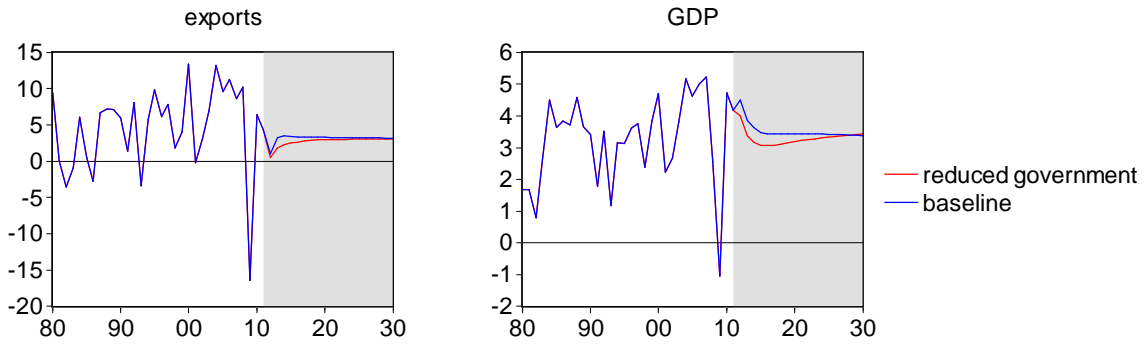
Reduced government: Non-carbon energy production (% of total)



It is assumed that investment in non-carbon energy production would be concentrated in high income regions.

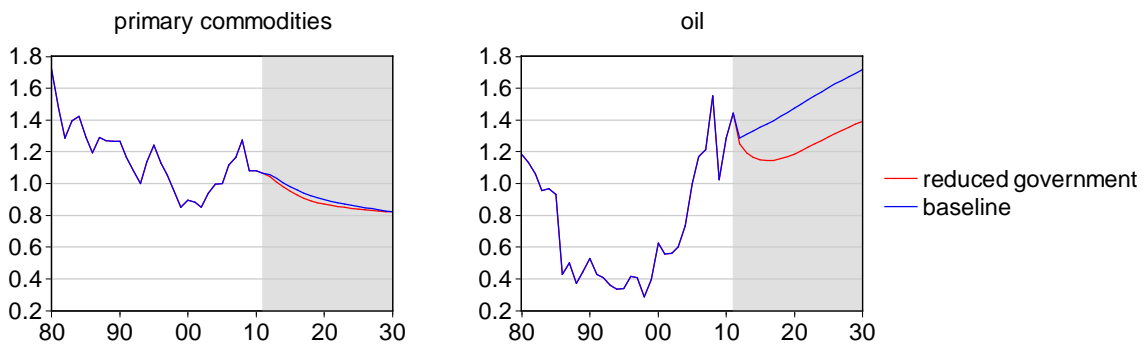
Impact on world trade and global GDP growth

Reduced government: growth of world trade and GDP (% p.a.)



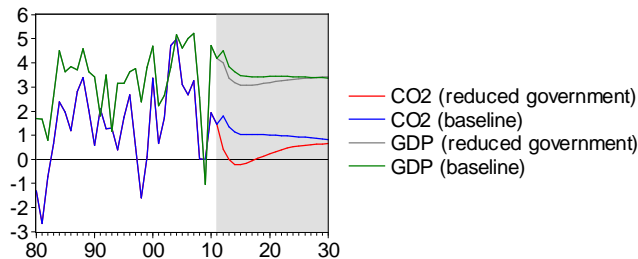
The reduced role of government may imply some loss of exports and GDP in the world as a whole due to more rapid reductions in government spending and debt, not fully compensated by higher private investment or consumer spending.

Reduced government: Relative price indexes (2005 = 1)

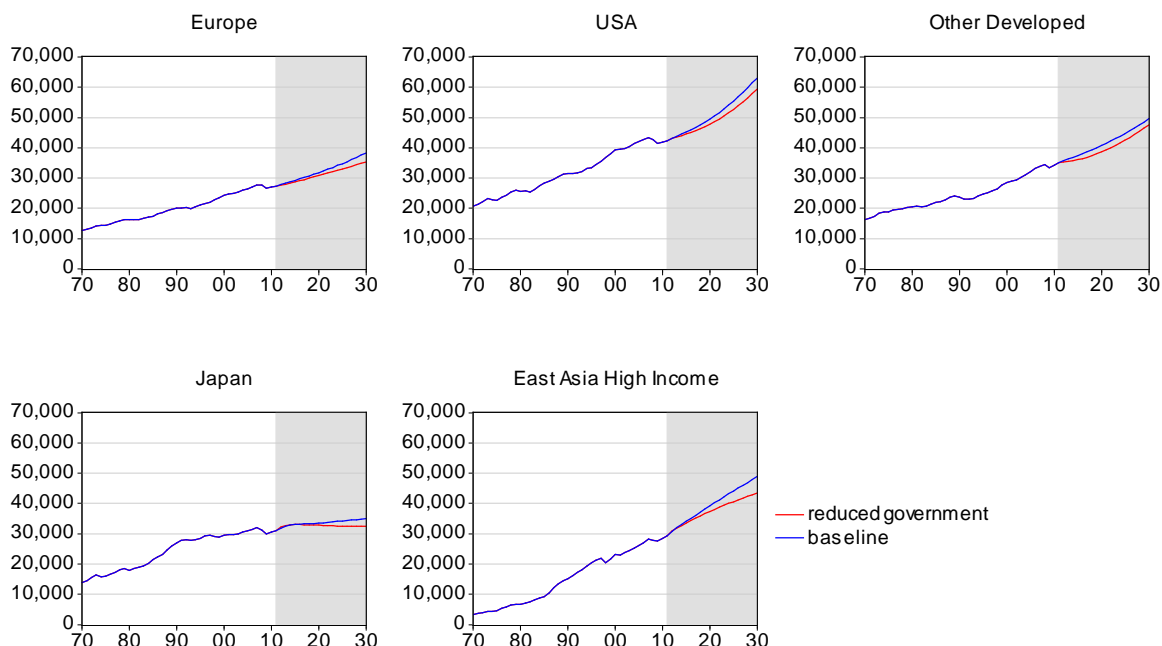


The combination of a slowdown in GDP growth and investment in non-carbon energy sources implies a lower price of oil and reduced growth of global carbon emissions.

Reduced government: carbon emissions and world GDP growth (% p.a.)

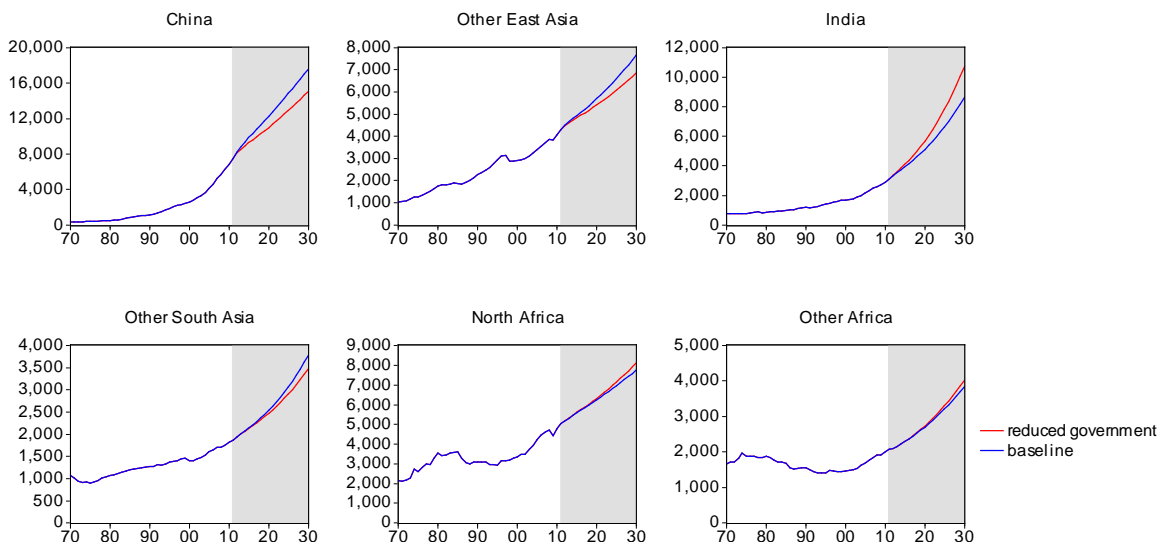


Reduced government: per capita income - high income regions (\$ ppp p.a.)



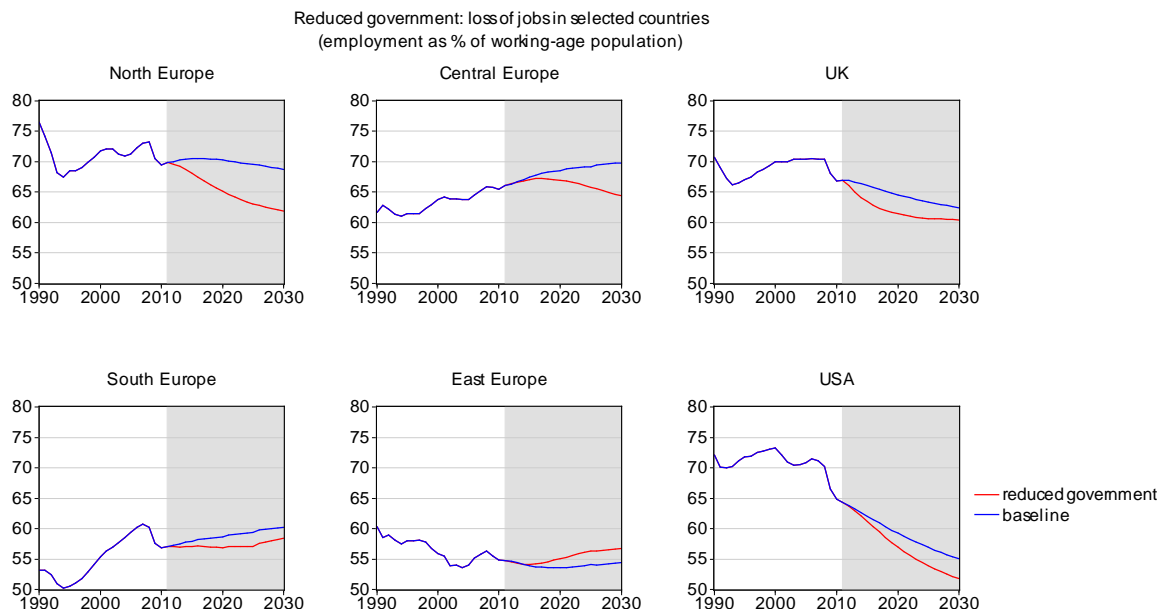
Overall this scenario implies smaller increases in per capita income between now and 2030 in high income regions including Europe and stagnation in Japan. It may also mean slower growth in China and other parts of Asia except India. South America and Africa may marginally benefit.

Reduced government: per capita income - lower income blocs (\$ ppp p.a.)



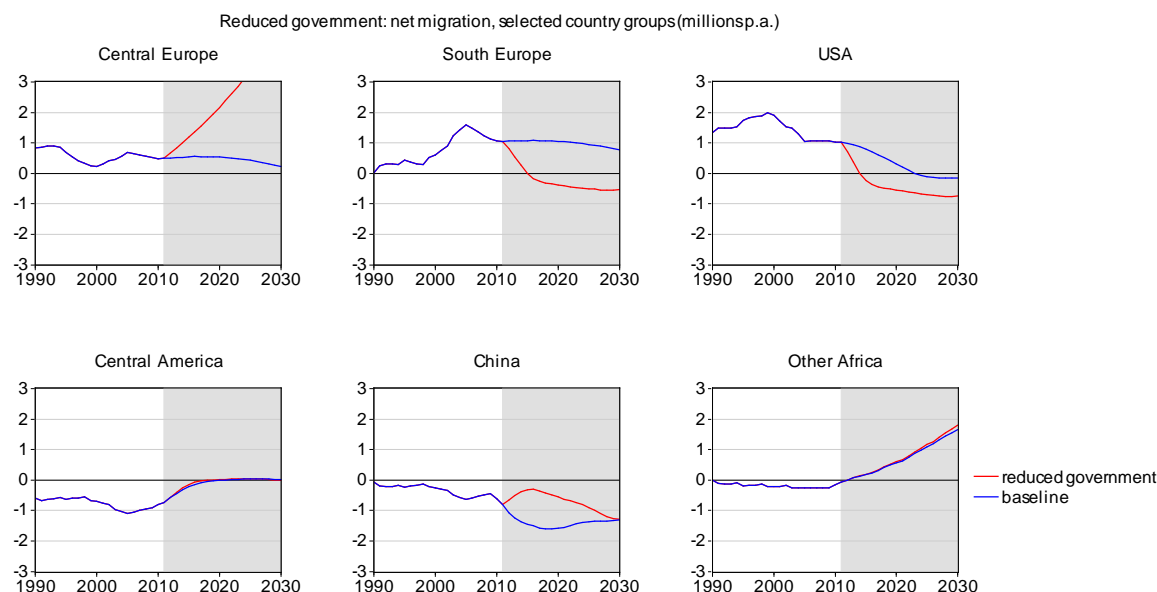
## Employment and migration flows in the US and Europe

### Employment

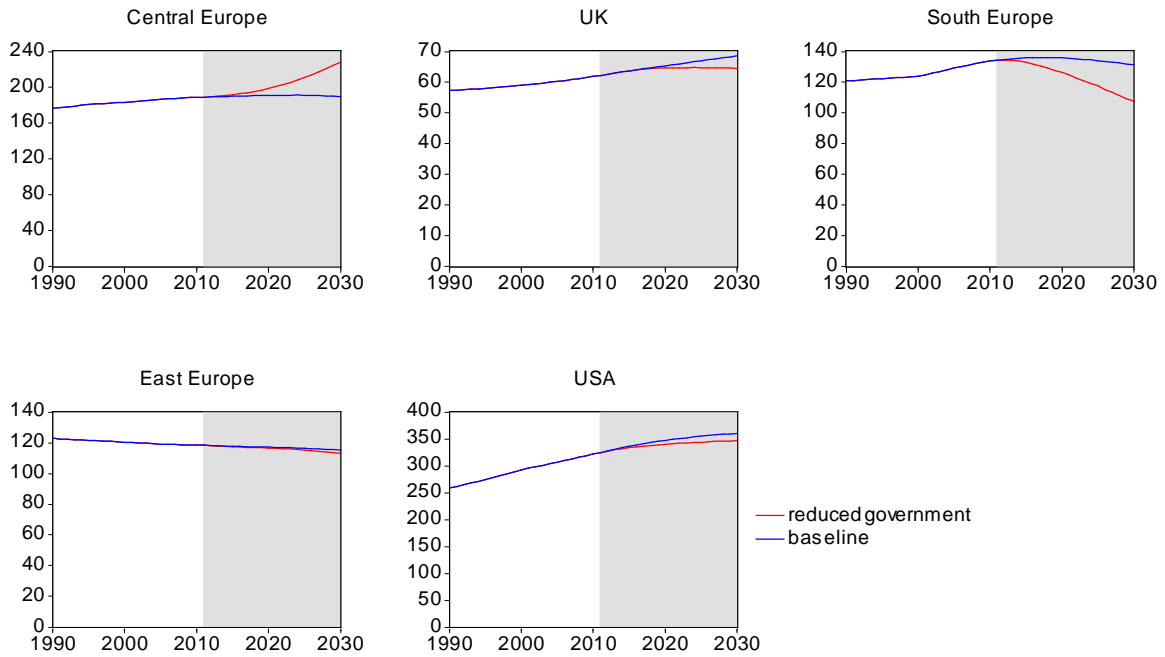


Lower growth and government spending in Europe and the US will tend to reduce employment, aggravating problems that became apparent in the baseline. Long term, job losses and reduced government intervention could substantially change migration patterns with Central Europe receiving large net inflows and South Europe and the US experiencing net outflows due to poor employment prospects.

### Migration



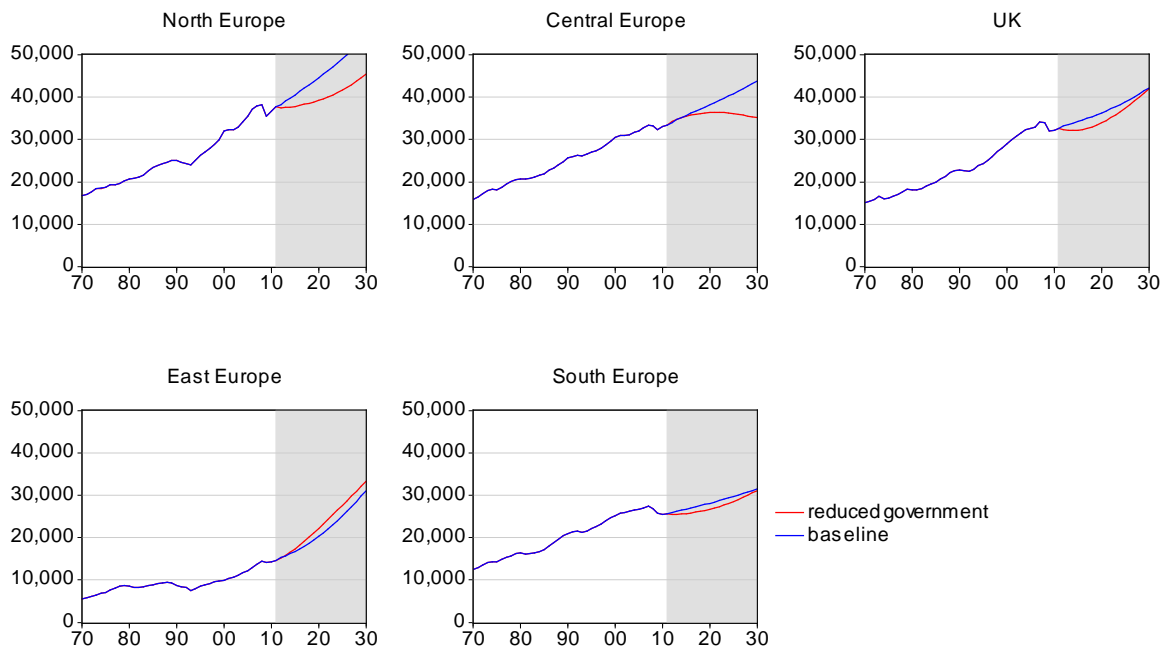
Reduced government: population, selected countrygroups (millions)



After 20 years, the population of Central Europe would increase significantly and that of South Europe decline.

Per capita income trends in Europe

Reduced government: per capita income in Europe (\$ ppp p.a.)

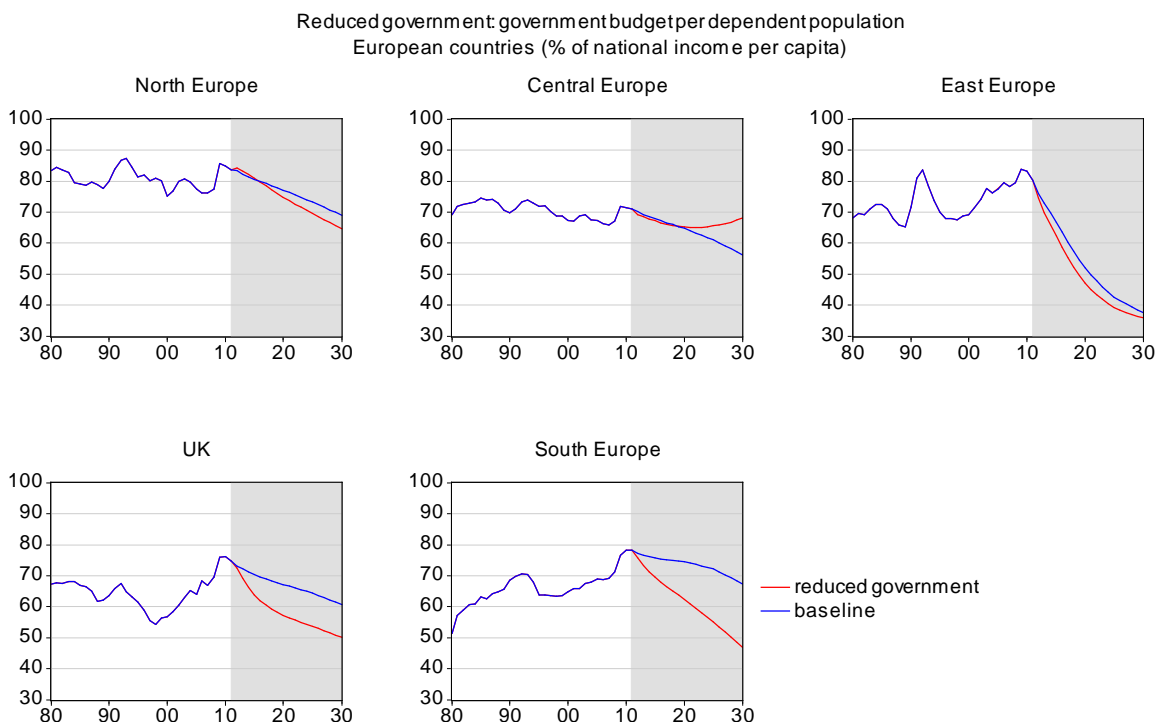




Immigrant labour in Central Europe may reduce labour productivity and GDP per capita while emigration from South Europe averts a fall in already relatively-low income levels.

Support for ageing populations

A further issue that may become an increasing concern is reduced availability of government services for the ageing population.



### Chapter 3 Collaboration between the US and China

The second scenario considers a larger and more effective role for government reinforced by mutual cooperation between the US, China with Europe and most other high and middle income blocs following their leadership. The aims of collaboration between the US and China would include stabilisation of financial markets, exchange rate management, reduction or resolution of politically sensitive issues such as job losses and high levels of government debt in the US and Europe on the one hand and the need to improve living standards in China without generating inflation and excessive pollution on the other.

**Policies**

This scenario implies a stronger role of government in management of the world economy and significant changes of policy (as compared with the present or the baseline projection) are assumed in the following areas:

- exchange rate management intended to revalue the yuan and Euro in real terms relative to the US dollar

- increases in domestic consumer expenditure and imports of manufactures and services in China, Japan and other high income East Asian countries intended to reduce global financial imbalances (current account surpluses and deficits)
- job creation and labour market policies in the US and Europe intended to maintain employment at acceptable levels
- labour market policies in China intended to avoid labour shortages and over-working
- heavy investment in development of non-carbon energy sources in the US, Europe, China and India
- management of the world oil market with some restraints on production in order to maintain a high real price of oil and provide global incentives for energy saving and clean energy use.

The questions to be investigated are how far the above policies could succeed in achieving their aims, the consequences of such changes for global development and growth of world trade and well-being in different blocs.

Although the scenario implies important reductions in social and economic risks in high income regions of the world and sustained growth of world income and trade, it is also likely to be conservative and benefits in low and middle income parts of the world may be uneven.

The main benefits to China of close collaboration with the US are on the one hand external security as the US and Europe are better able to manage internal problems such as employment, migration and ageing, and on the other hand internal stability through promotion of domestic demand and labour market policies that encourage a progressive increase in productivity.

Energy policies led by the US and China may reduce growth of carbon emissions but are unlikely to achieve ongoing reductions at the global level.

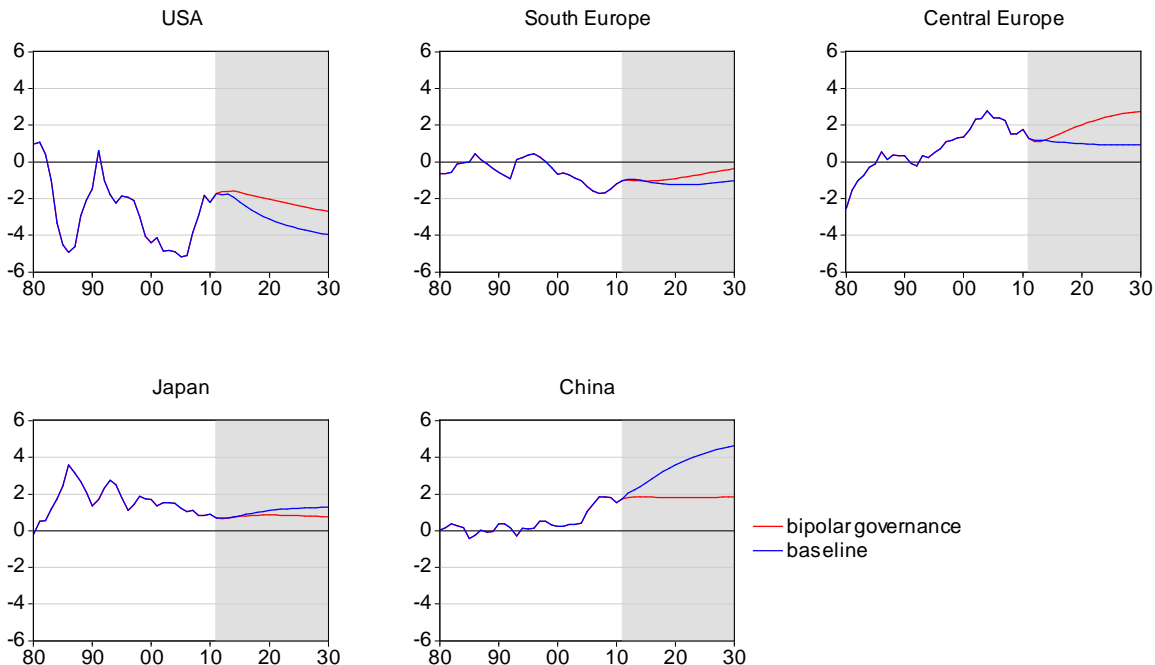
Thus bipolar leadership may ultimately be found lacking when measured against demands for environmental sustainability, improving living standards and social justice on the part of the large majority of the world's population outside the US, Europe and East Asia. The consequences of failure to generate sustainable growth and long-run convergence are hard to assess but continuing failure will surely generate pressures for political change across low and middle income regions of the world.

### **Benefits to the US and Europe**

If domestic market stimulus in the Far East is combined with measures to promote imports of manufactures and services it should be possible to limit current account surpluses and give some support for deficit reduction in the US although a larger part of the benefit could be taken up by Europe, making the prospect of US-China partnership particularly attractive to Europeans.

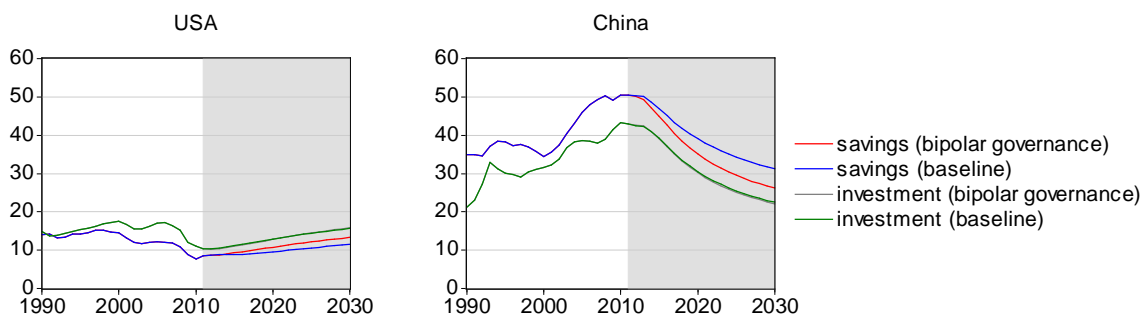
Global financial imbalances

Bipolar governance: current a/c imbalances as % of total world exports



The extent to which current account imbalances respond depends mainly on domestic savings as illustrated in the graph below.

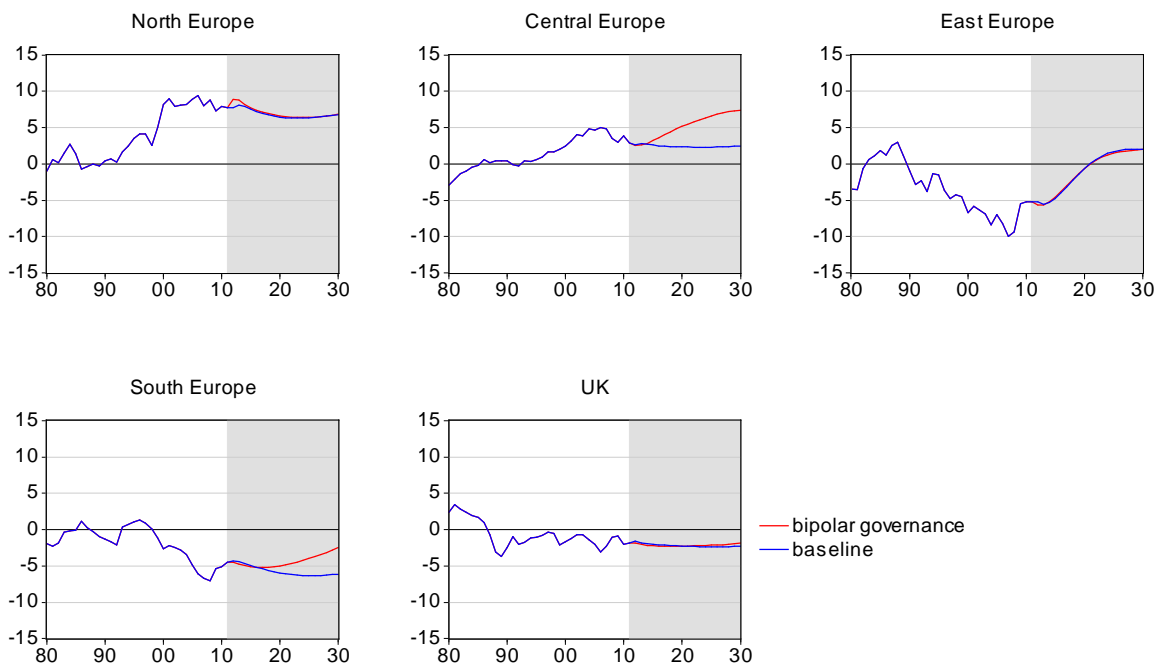
Bipolar governance: saving and investment as % of income



Imbalances and government debt in Europe

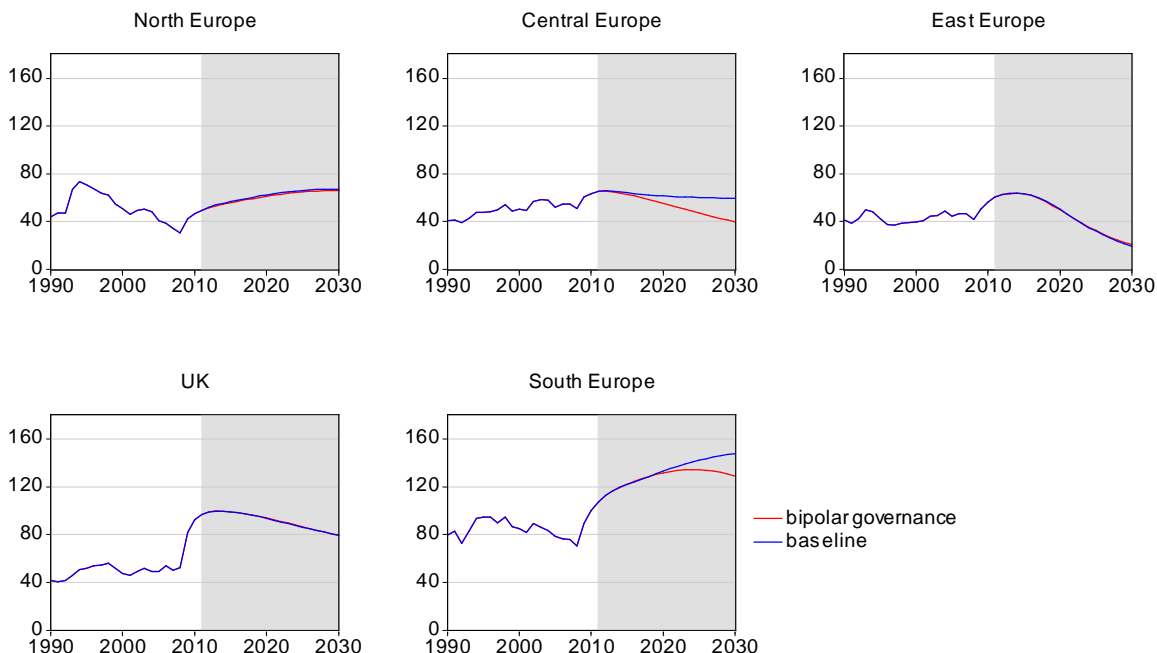
Within Europe the main response comes in the Eurozone, especially Central Europe. There is less benefit to non Eurozone members as their exchange rates may adjust to offset potential trade gains.

Bipolar governance: current a/c imbalances as % of GDP - Europe



The benefit to South Europe may help to reduce increases in government debt.

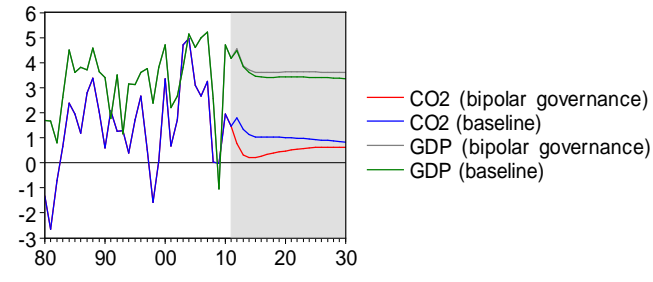
Bipolar governance: government debt as % of GDP, European country groups



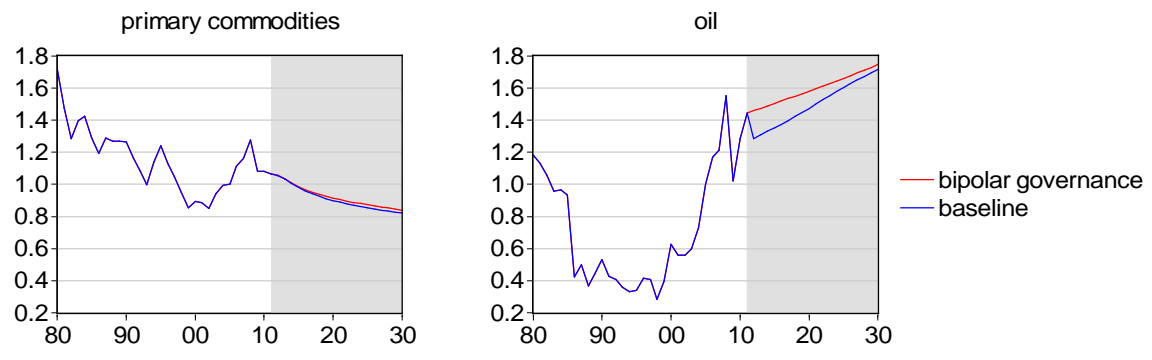
Global GDP growth and emissions

For the world as a whole China-US partnership may marginally increase GDP growth while collaboration on clean energy reduces the growth of carbon emissions.

Bipolar governance: carbon emissions and world GDP growth (% p.a.)

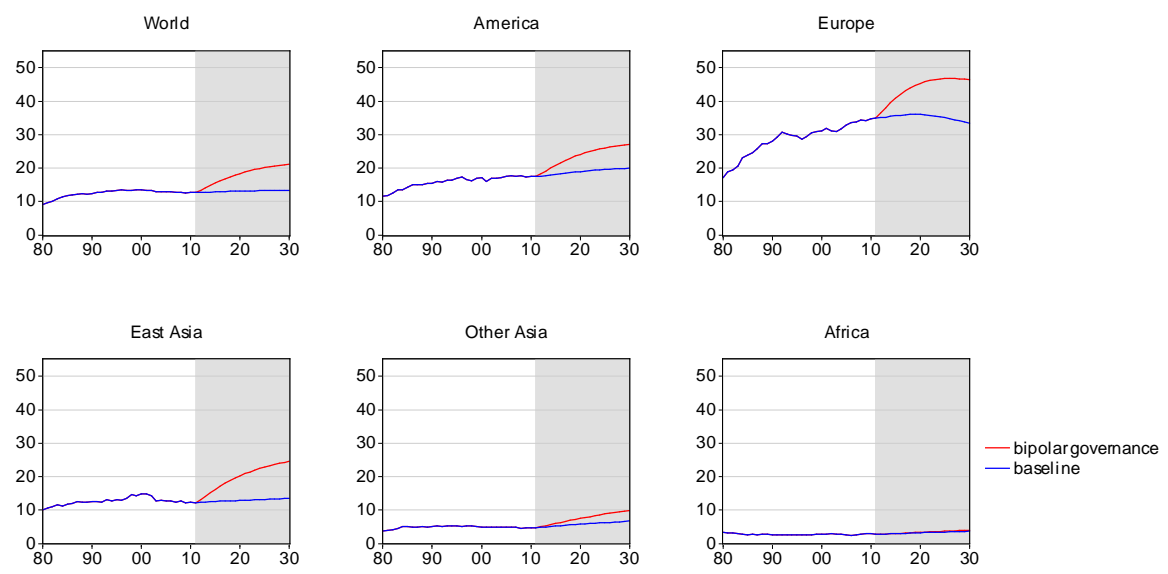


Bipolar governance: Relative price indexes (2005 = 1)



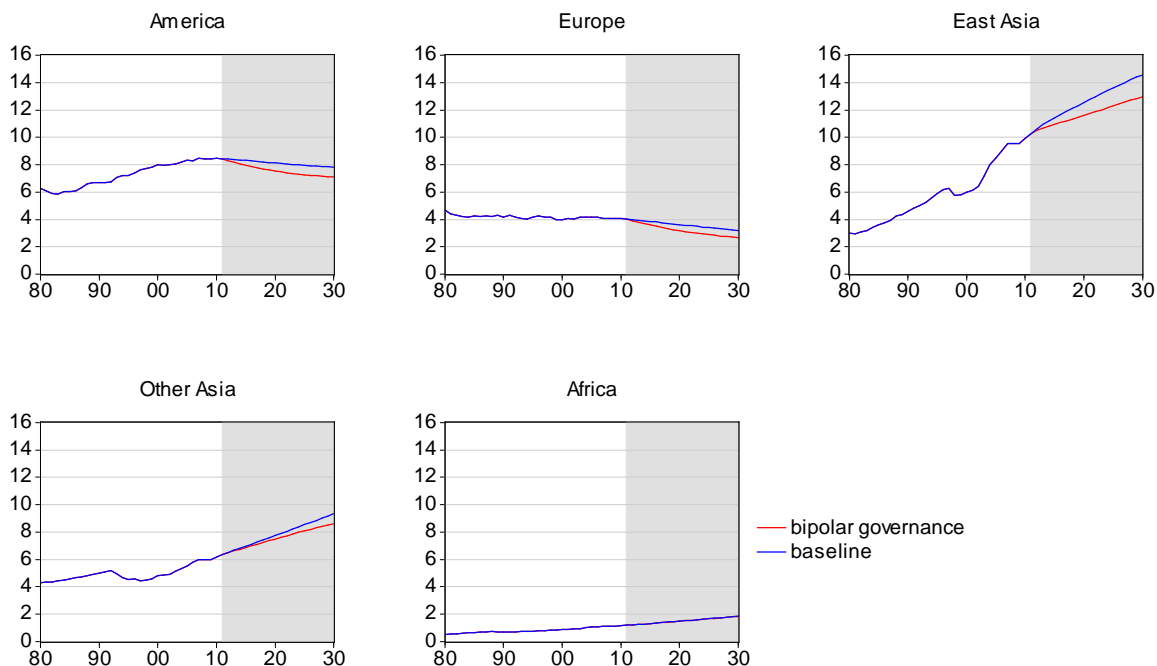
It is assumed the price of oil will be regulated by cooperation of the main producers, supported by the US and China, to maintain a clear incentive for energy saving and diversification.

Bipolar governance: Non-carbon energy production (% of total)



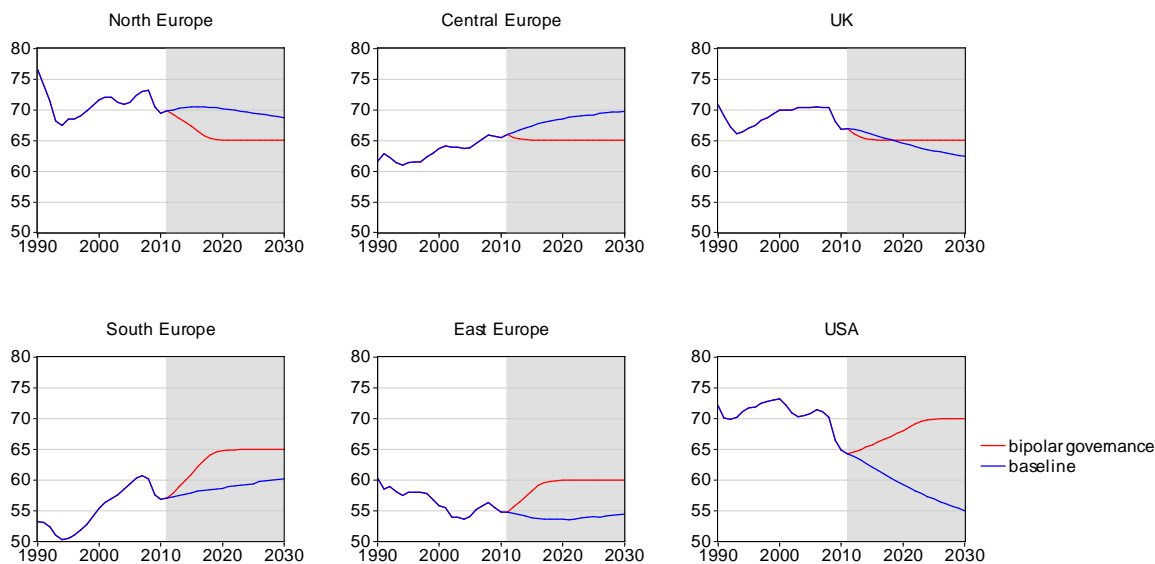
Substantial increases in non-carbon energy production help to reduce emissions in the US and Europe and limit growth of emissions in Asia where GDP is growing rapidly. But the world total may still increase because the US-China axis cannot mobilise sufficient global commitment.

Bipolar governance: carbon emissions (billion tons p.a.)



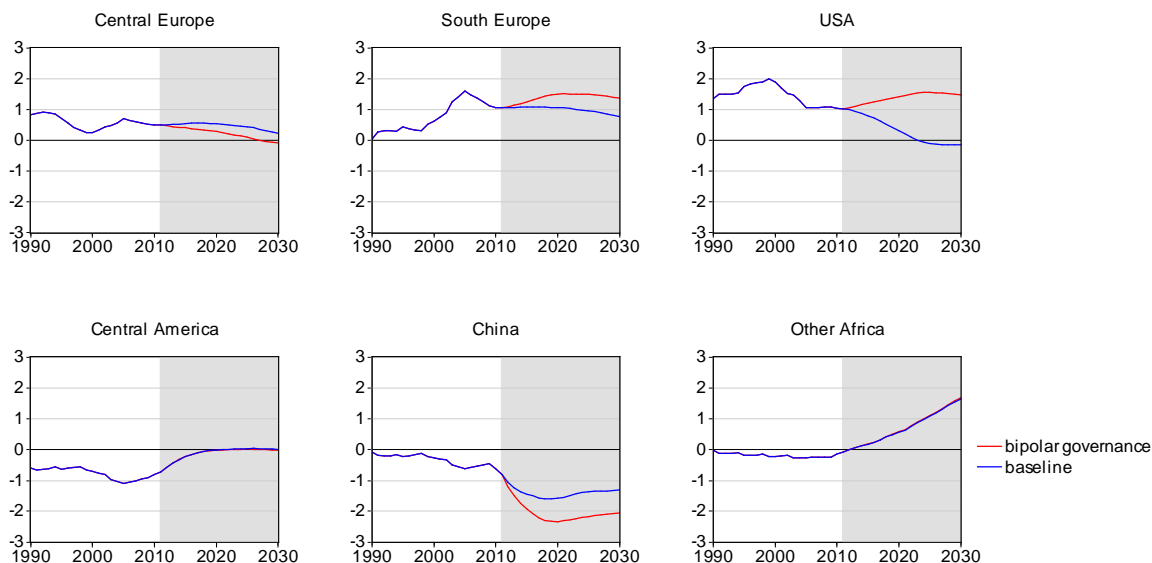
### Employment and migration

Bipolar governance: loss of jobs in selected countries (employment as % of working-age population)



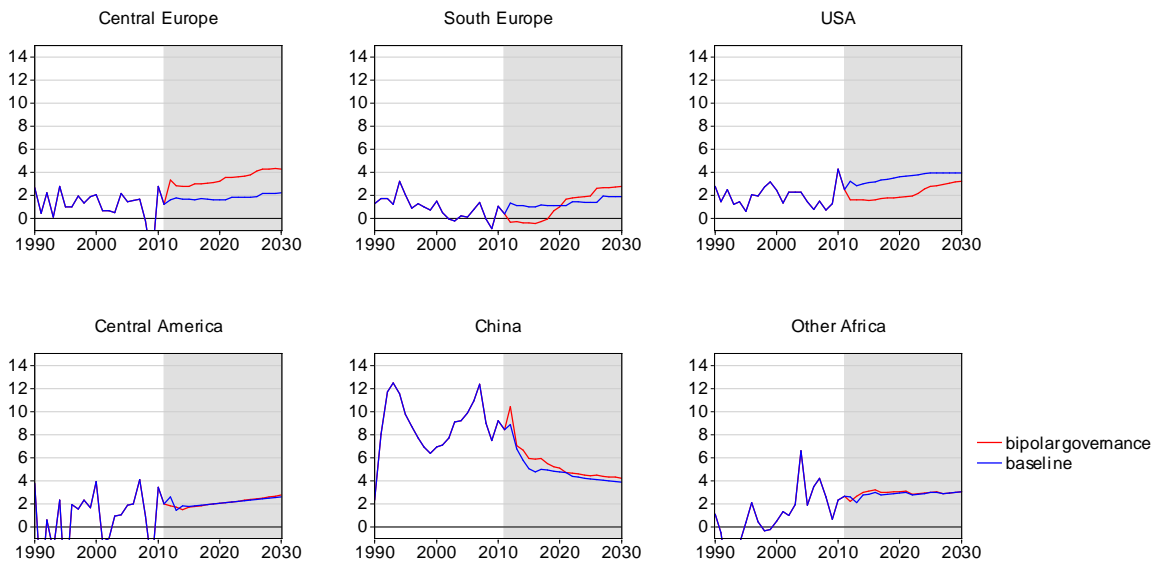
Within the framework of US-China collaboration, labour market policies could mitigate loss of jobs in Europe and the US and preserve current patterns of migration.

Bipolar governance: net migration, selected country groups (millions p.a.)



This may imply divergent trends in output per person as Central Europe achieves fast GDP growth without heavy immigration while productivity growth in South Europe and the US is reduced by continued growth of labour supply.

Bipolar governance: GDP per person employed, selected country groups (% p.a.)



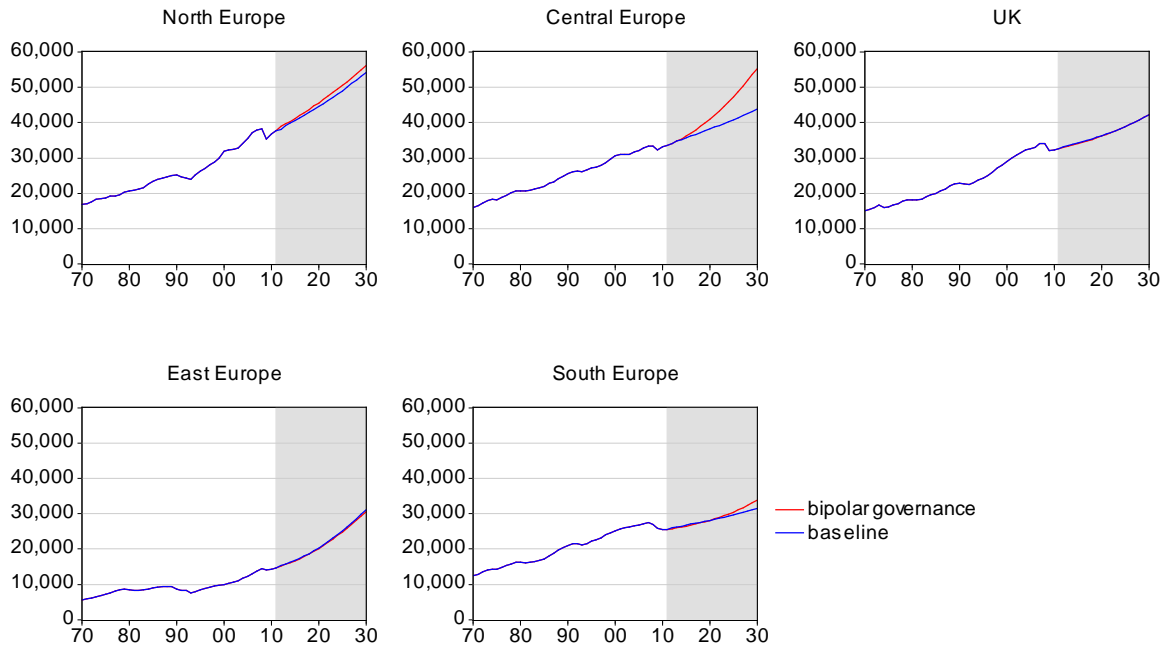
### Income per capita and development of different regions

#### High income countries

GDP per capita in Europe increases rapidly in Central and East Europe and more gradually in the US and South Europe.

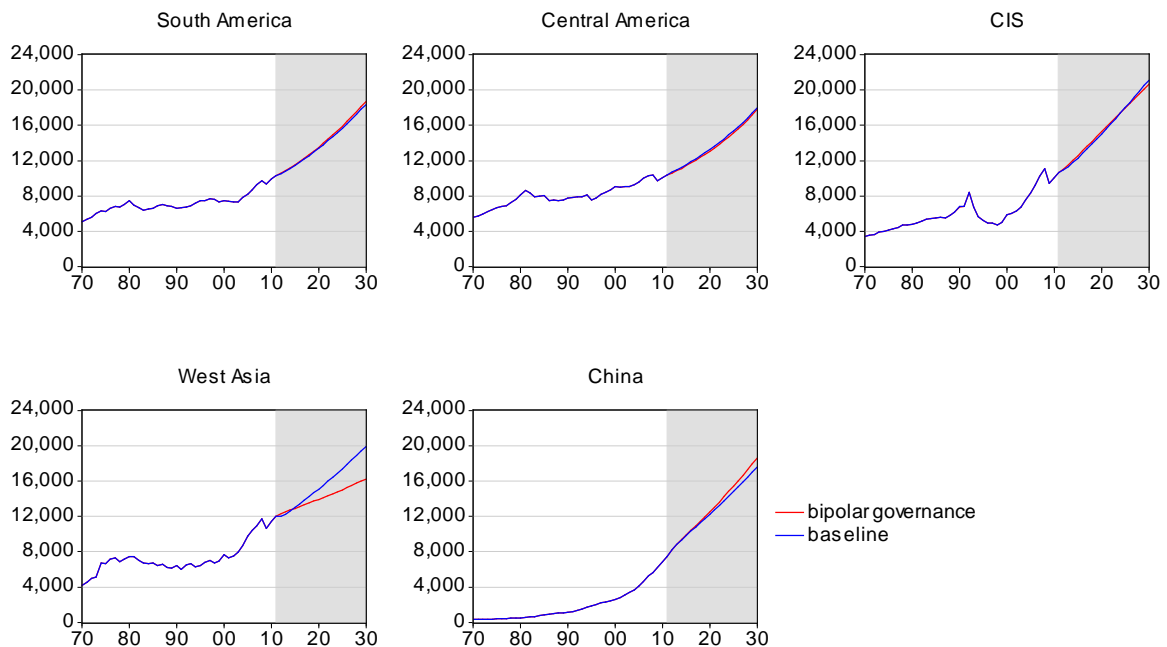
# WP1 macro-model: governance scenarios to 2030

Bipolar governance: per capita income in Europe (\$ ppp p.a.)



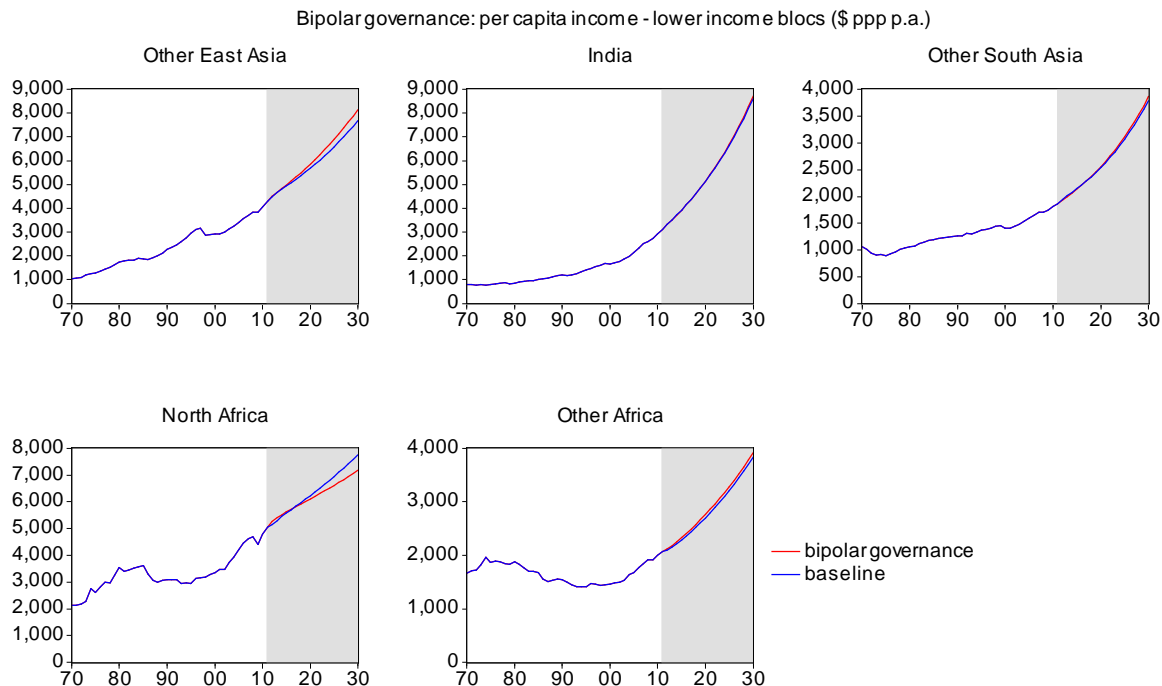
## Low and middle-income blocs

Bipolar governance: per capita income - middle-income blocs (\$ ppp p.a.)



Other middle income countries in Central and South America and the CIS may be able to maintain good income growth rates as in the baseline projection while West Asia may have a lower growth rate as oil reserves are conserved to maintain a high price and encourage energy saving and substitute fuels.





There is also no reason why low income regions should lose out although energy policies may not be favourable for parts of Africa.

## Chapter 4 Global collaboration

The third scenario provides a more optimistic vision of global cooperation resulting in concerted efforts to deal with pressing issues already mentioned. Governments and business in all regions of the world are assumed to cooperate in energy saving, development of new energy sources and reduction of emissions. At the same time development of low income regions of the world is substantially accelerated by a range of measures giving them specific benefits underwritten by higher-income regions with regard to market access, resources for economic development, including infrastructure, health and education and financial support in case of currency instability. Rapid development of low and middle income countries has spillover benefits for high income regions.

This scenario suggests the possibility in principle for the world community to achieve long-term growth and gradual convergence of living standards with less damage to the global environment and without sacrificing income, employment and social benefits in high income areas.

### Policies

Several policy changes assumed in the US-China scenario are retained and extended in this scenario. These include labour market policies in the US, Europe and China, stimulus to domestic demand and imports in East Asian countries to limit current account surpluses, investment in non-carbon energy sources and management of the world oil market.

An additional feature in Europe is coordinated fiscal management and finance of government debt aimed at steady GDP growth and convergence of income levels in

different parts of Europe rather than debt/GDP limitation in each country. A positive fiscal policy helps to ensure growth of domestic demand, production and imports, sustaining the European economy and making it possible to accord financial and commercial privileges to lower-income parts of the world.

Policies to facilitate development of low-income blocs underwritten by the US, Europe, China and other high-income countries in East Asia include

- financial assistance to maintain minimum real exchange rates and exchange reserves
- investment incentives and trade preferences for production and export of primary commodities and manufactures
- investment in non-carbon energy production
- support for fiscal policies that maintain net government revenue at a moderate share of GDP and generate maintain a strong momentum of domestic demand growth.

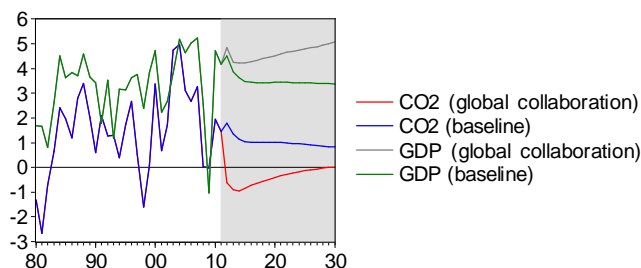
Policy changes aimed at reducing pollution and carbon emissions are extended to include:

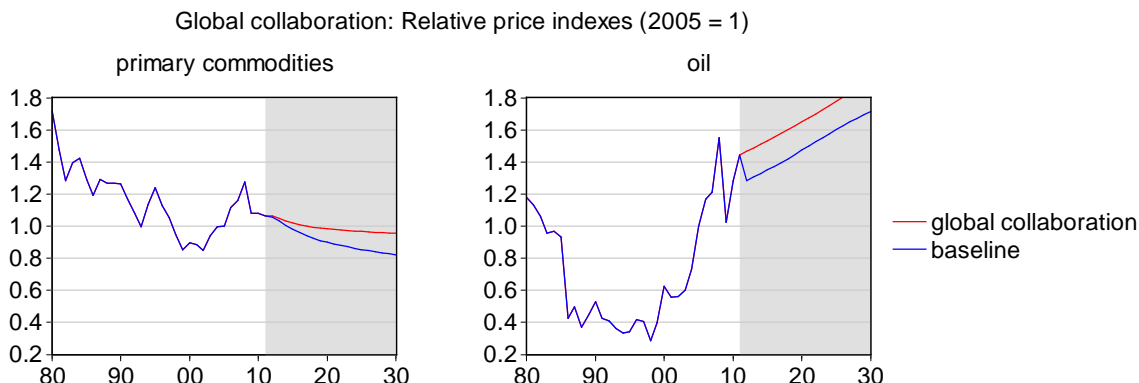
- encouragement of energy saving
- other structural changes to reduce CO2 emissions.

### Outcomes

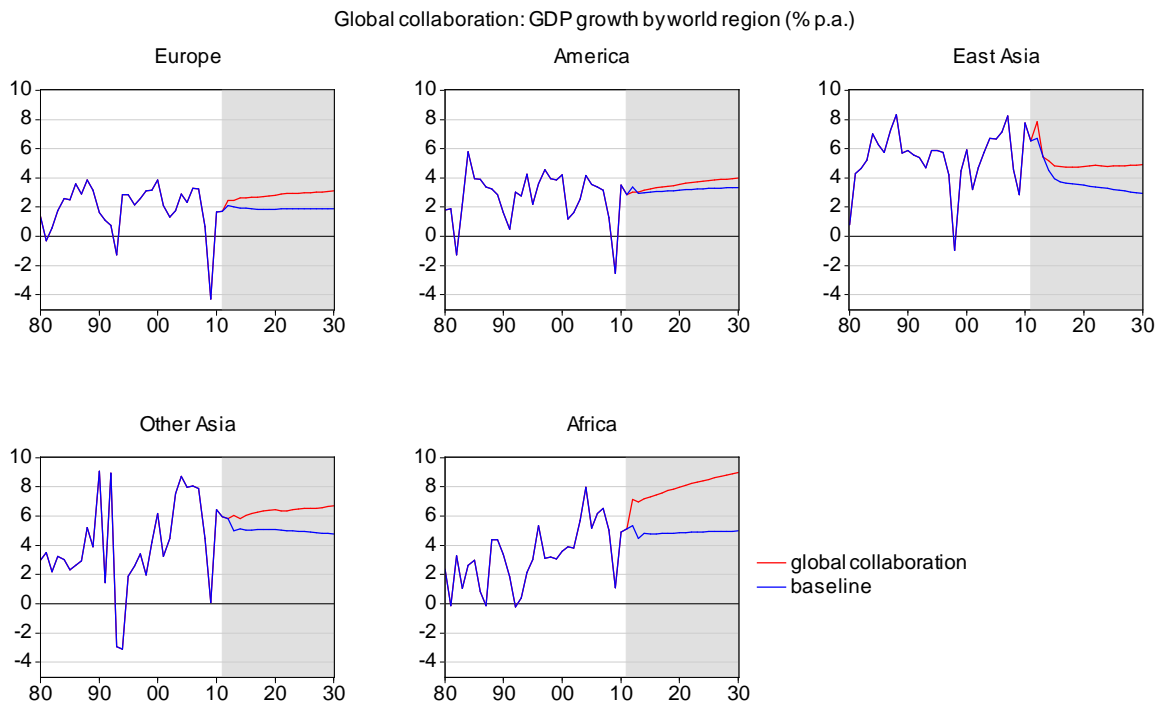
To achieve rapid development of low and middle income regions without sacrificing income and employment in high income regions, world GDP needs to grow at around 5% p.a. This presents a huge challenge to energy policy if carbon emissions are to be reduced at the same time. Hitherto the average improvement in what may be called carbon efficiency, in other words CO2 emissions per \$ of GDP, has been between 1.5% and 2% per year. To reduce emissions significantly in a context of global development will require increases in carbon efficiency at the rate of 6-7% per year.

Global collaboration: carbon emissions and world GDP growth (% p.a.)





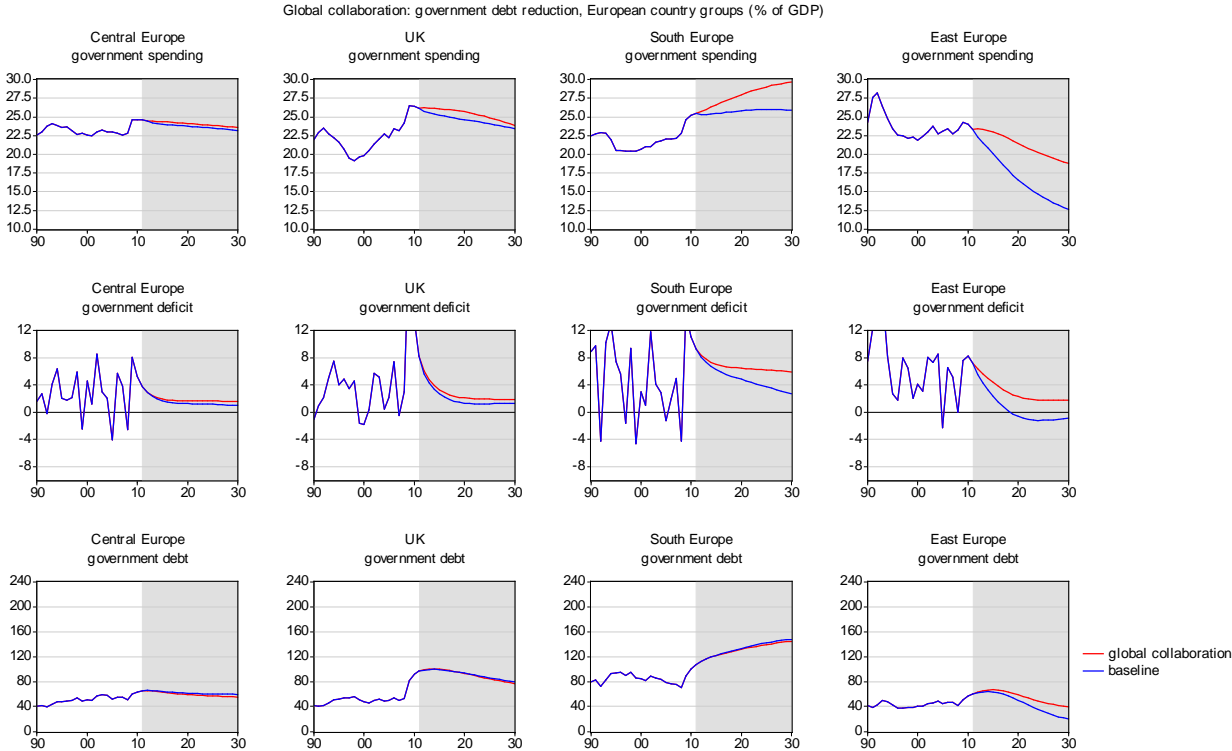
Another issue is prices of commodities and oil. Although a high global growth rate will boost demand for raw materials substantially, long-run supply elasticities may be sufficient to maintain roughly constant terms of trade for commodities in general as opposed to the more normal long-run decline. The price of oil on the other hand depends on policies of countries with large reserves of oil and gas as well as demand trends. This scenario assumes the main supplier will keep oil prices rising gradually while production of carbon fuels increases slowly (less than 1% p.a.).



To achieve gradual convergence of income and living standards in different parts of the world the overall pattern of GDP growth has to favour low income regions, in particular Africa and Other Asia, with East Asia in a middle position followed by America and finally Europe.

Europe: government finance, income, employment and migration

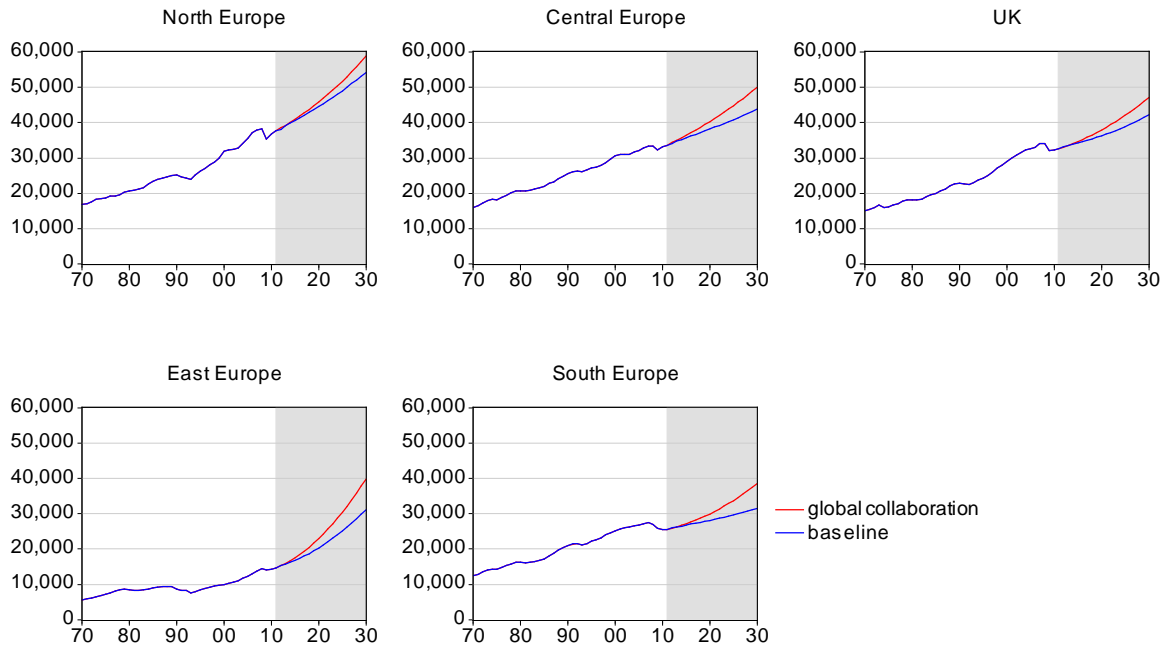
Domestic demand stimulus including steady growth of government spending in Europe is one element of the strategy necessary to maintain global growth at a high rate. Higher spending in South and East Europe implies ongoing deficits and in the case of South Europe a slow increase in the ratio of debt to GDP. Provided this is collectively financed or guaranteed, this will not present a problem for financial markets as the overall level of government debt in the Eurozone and Europe as a whole will not be excessive.



Sustained fiscal expansion in Europe will generate benefits in terms of income and employment as illustrated by the following graphs.

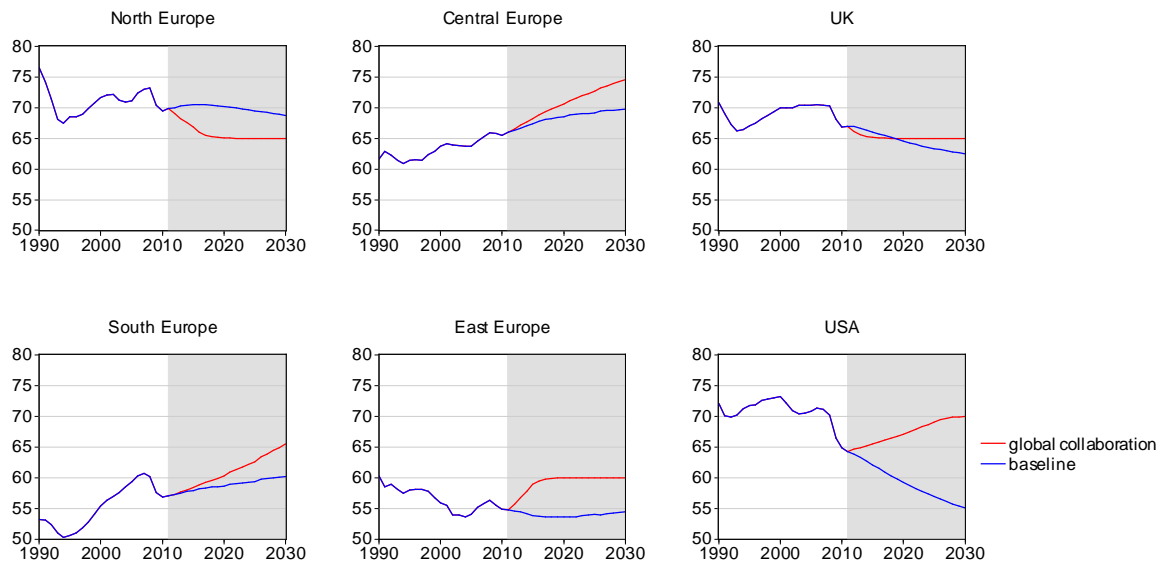
# WP1 macro-model: governance scenarios to 2030

Global collaboration: per capita income in Europe (\$ ppp p.a.)



**This policy mix is highly favourable for convergence and will facilitate maintenance of employment in all parts of Europe. Similar considerations apply in the US.**

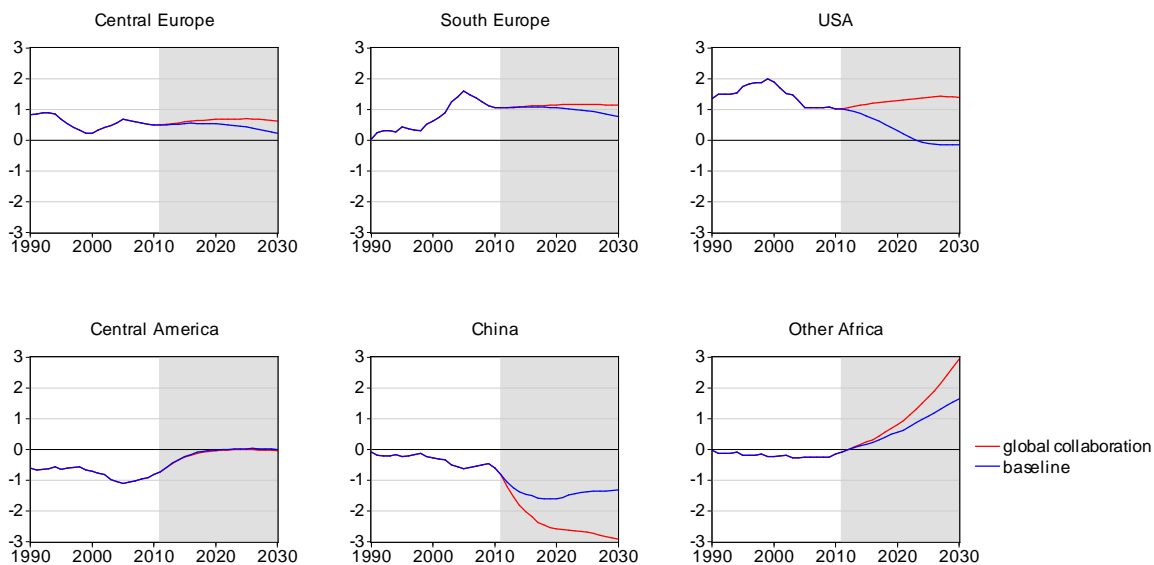
Global collaboration: loss of jobs in selected countries (employment as % of working-age population)



**The consequence for migration may be continued net immigration to Central and South Europe and the USA although rapid development of low and middle income countries may mean an end to net emigration from Central America and a reversal of emigration from Africa.**

# WP1 macro-model: governance scenarios to 2030

Global collaboration: net migration, selected country groups(millionsp.a.)



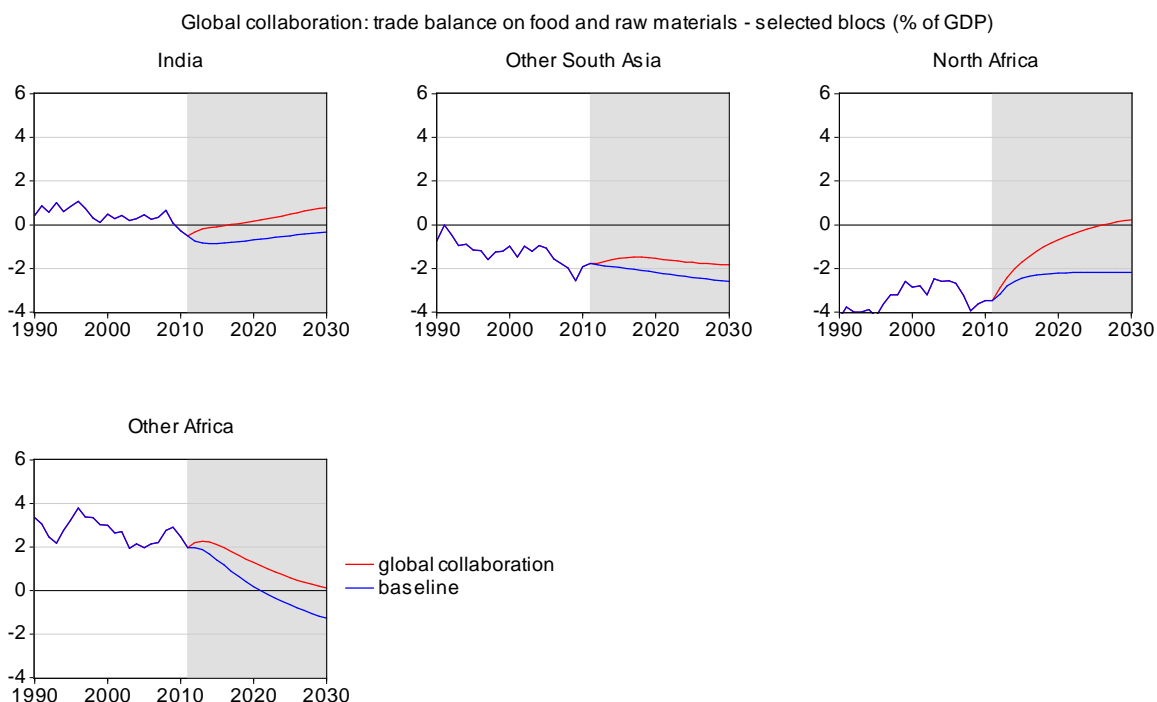
### Development of low and middle income countries

As indicated in previous chapters, the localisation of industrial production for domestic use and export to world markets is the most critical factor driving the distribution of income between different parts of the world.

A system of investment incentives and asymmetrical trade preferences is required to boost production and exports from regions that have relatively weak performance in industrial trade including, principally, Africa and South Asia (excluding India), and additionally, perhaps on a lower scale, South America, the CIS bloc, West Asia, India and Other East Asia.

#### Localisation of industries

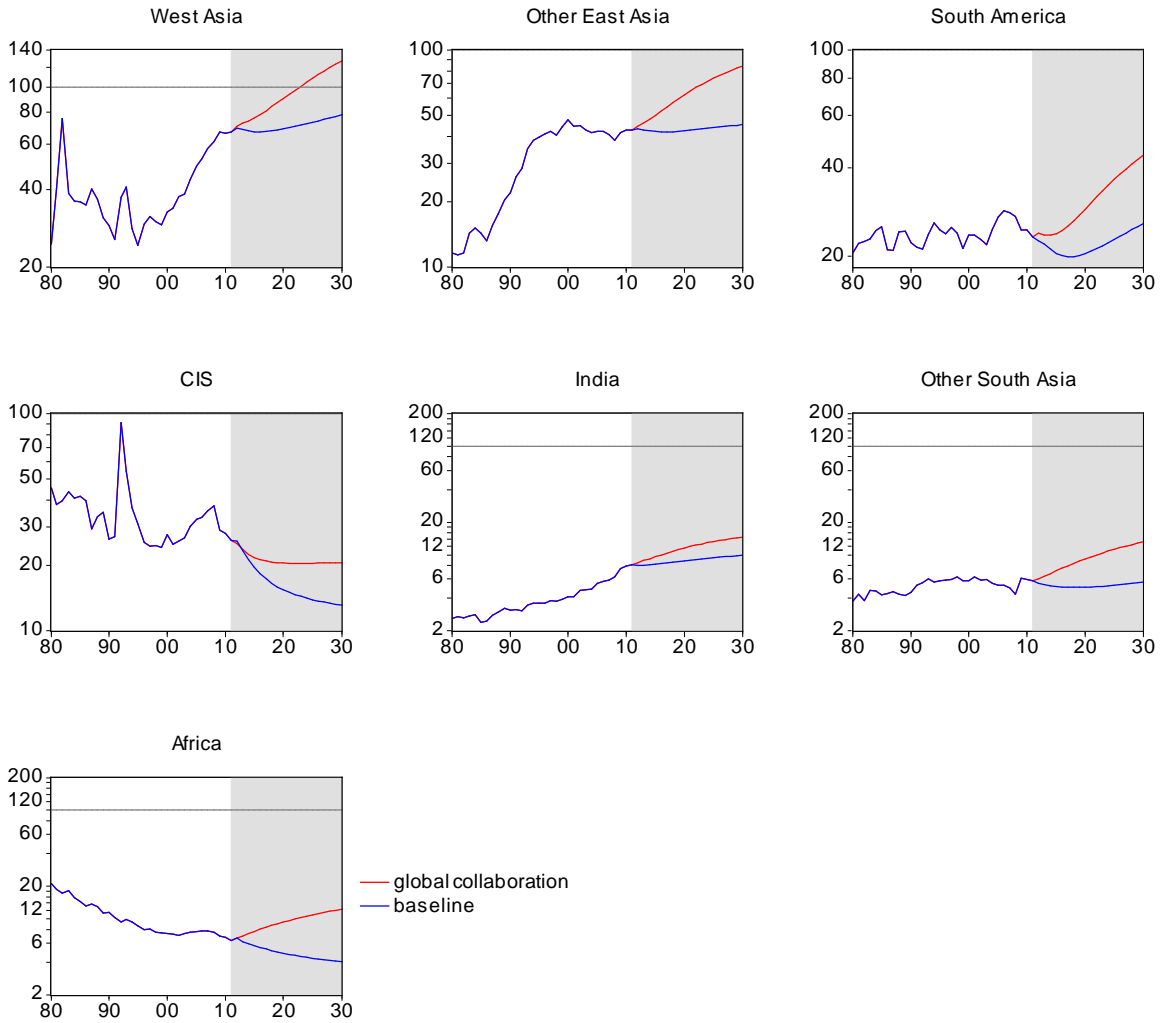
The position of low income countries can be boosted by incentives and preferences for production and export of food or other primary commodities.



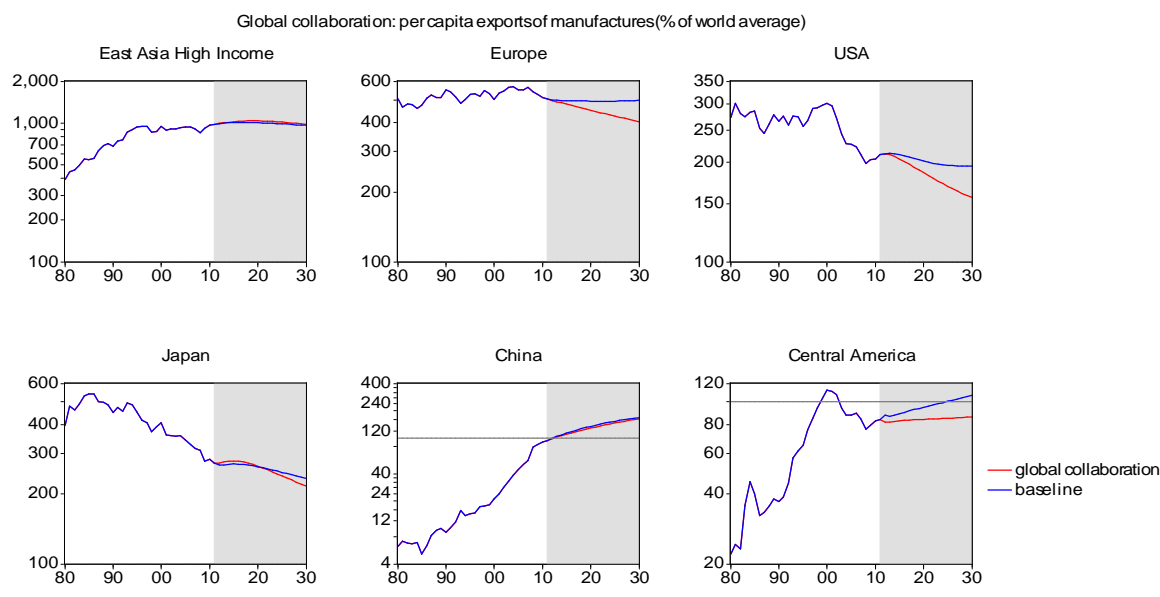
A wider group of countries could benefit very substantially from incentives and preferences for industrial production and export. As indicated in charts on the next two pages, the relative position of Europe and the US as leading industrial exporters would be eroded. But as the world market expands this should not result in loss of income or jobs.

# WP1 macro-model: governance scenarios to 2030

Global collaboration: per capita exports of manufactures (% of world average)

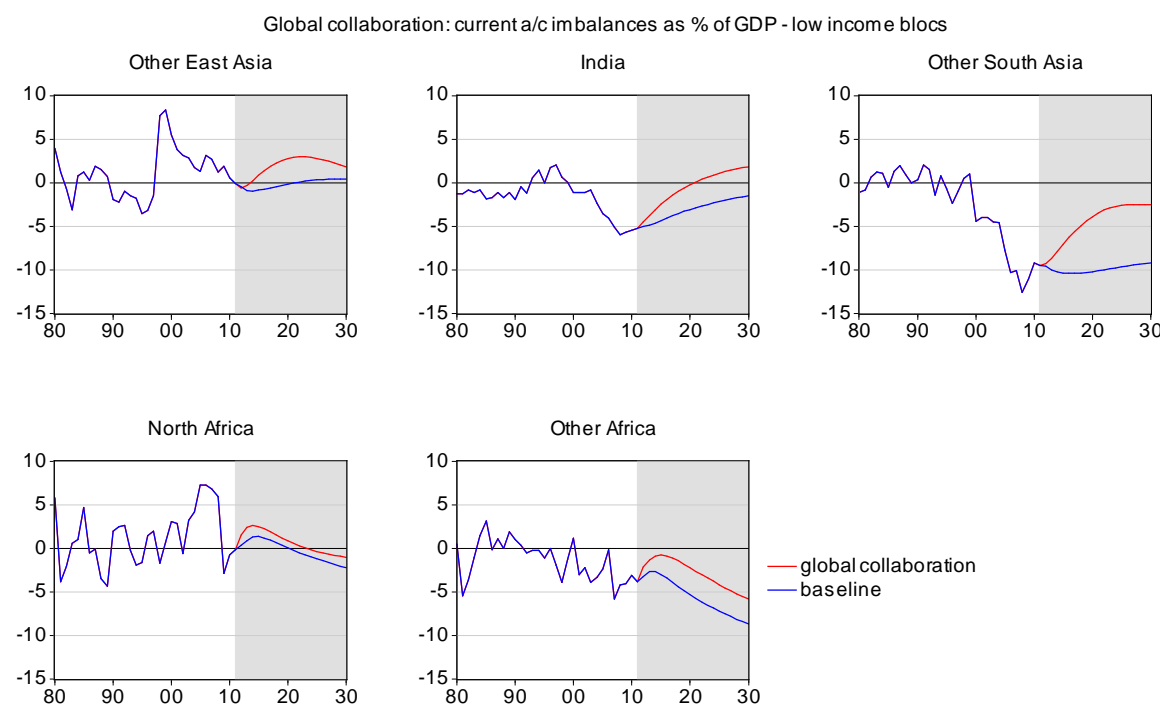






### Savings, investment and fiscal policy in low income countries

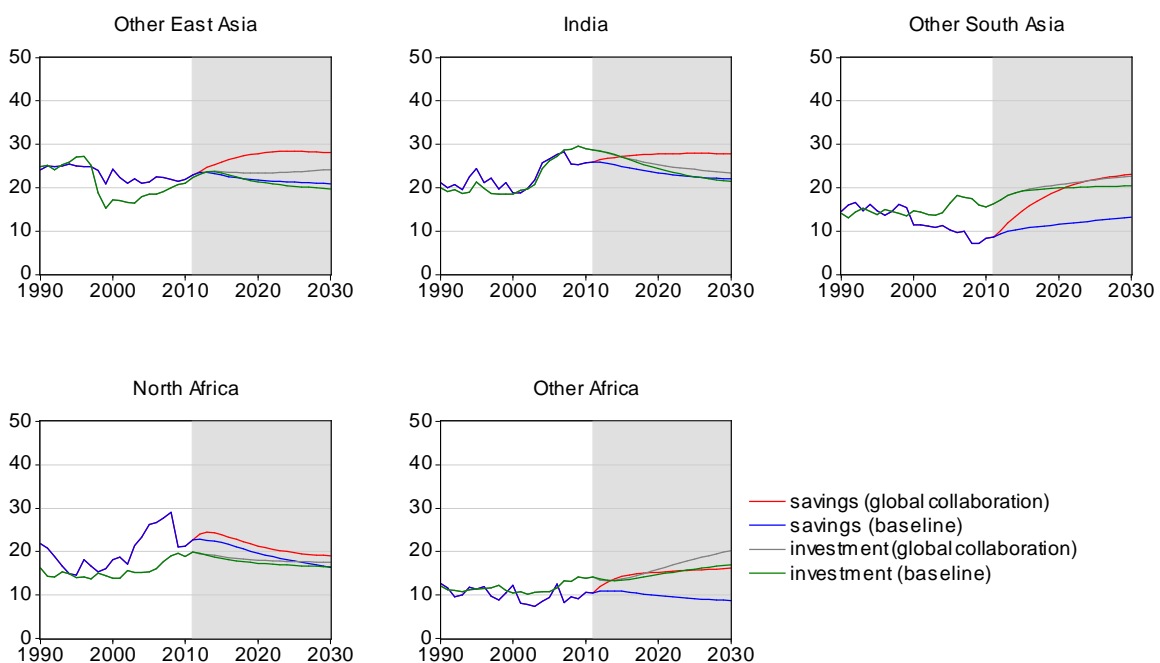
The boost to exports and income in low income countries generates higher savings and investment. Overall current account positions are projected to be stronger and by implication, dependence on external finance is reduced, as domestic savings increase more rapidly than investment.



# WP1 macro-model: governance scenarios to 2030

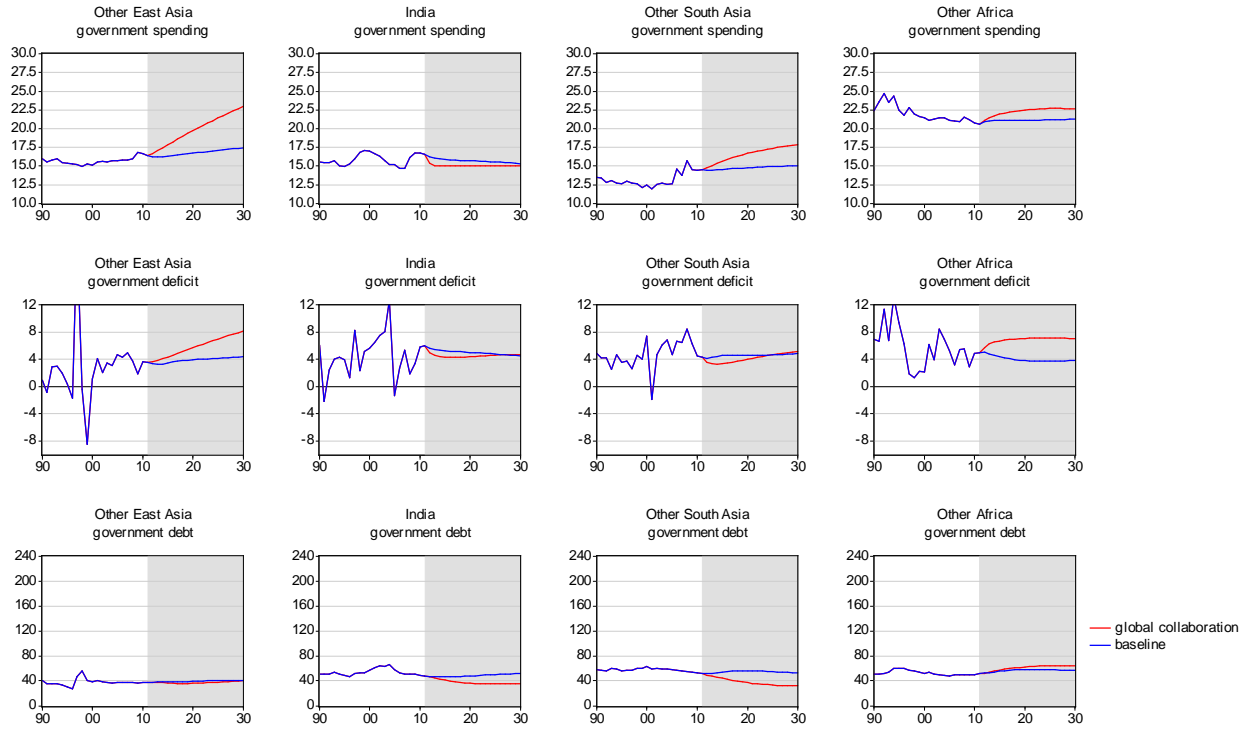


Global collaboration: saving and investment as % of income - low income blocs



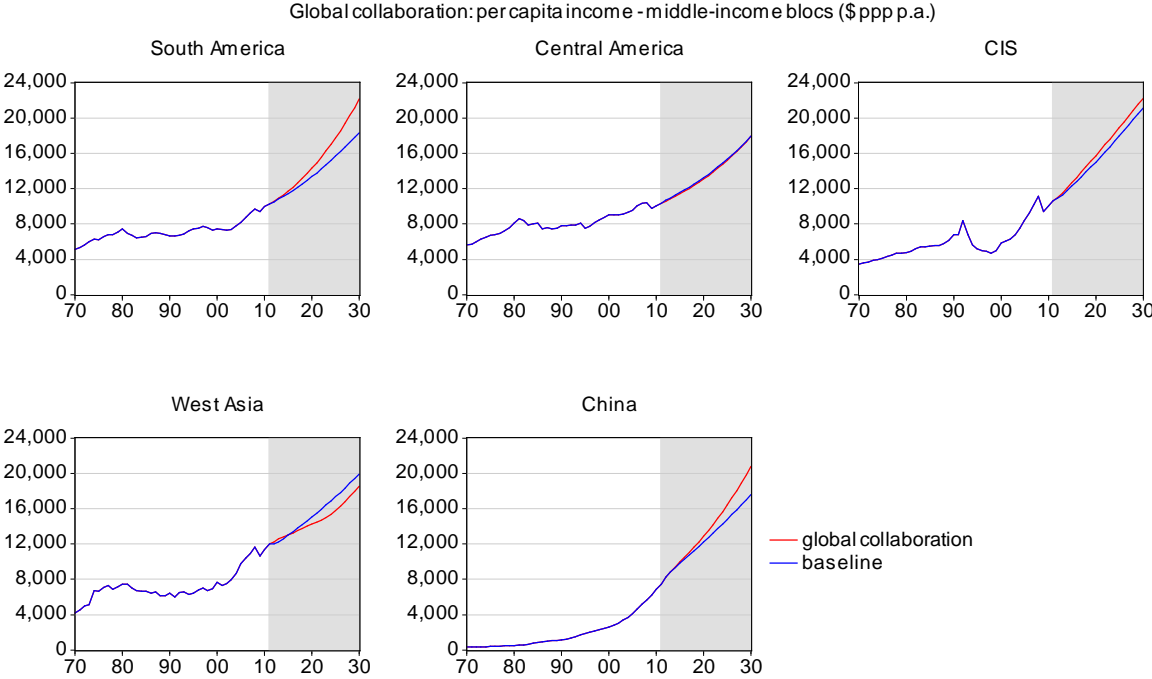
The consequences for fiscal policy include higher spending and deficits but static or falling debt/GDP ratios as GDP rises fast enough to run ahead of government debt.

Global collaboration: government debt, low income regions (% of GDP)



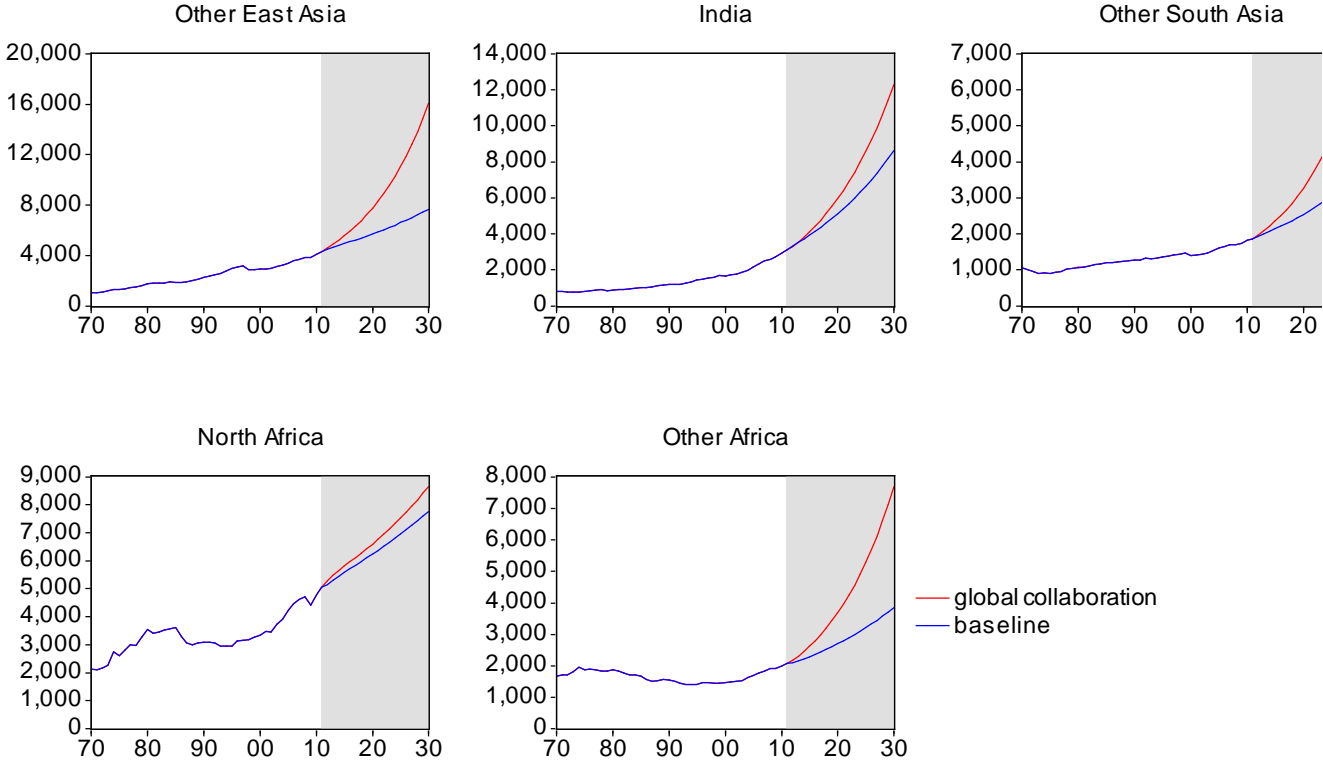
Global income distribution

Among middle-income blocs the main beneficiaries of global collaboration are South America, the CIS and China. Once again oil conservation policies will not favour GDP growth in West Asia in the short term.



Benefits for low income regions could be very large if investment incentives and trade preferences are applied vigorously.

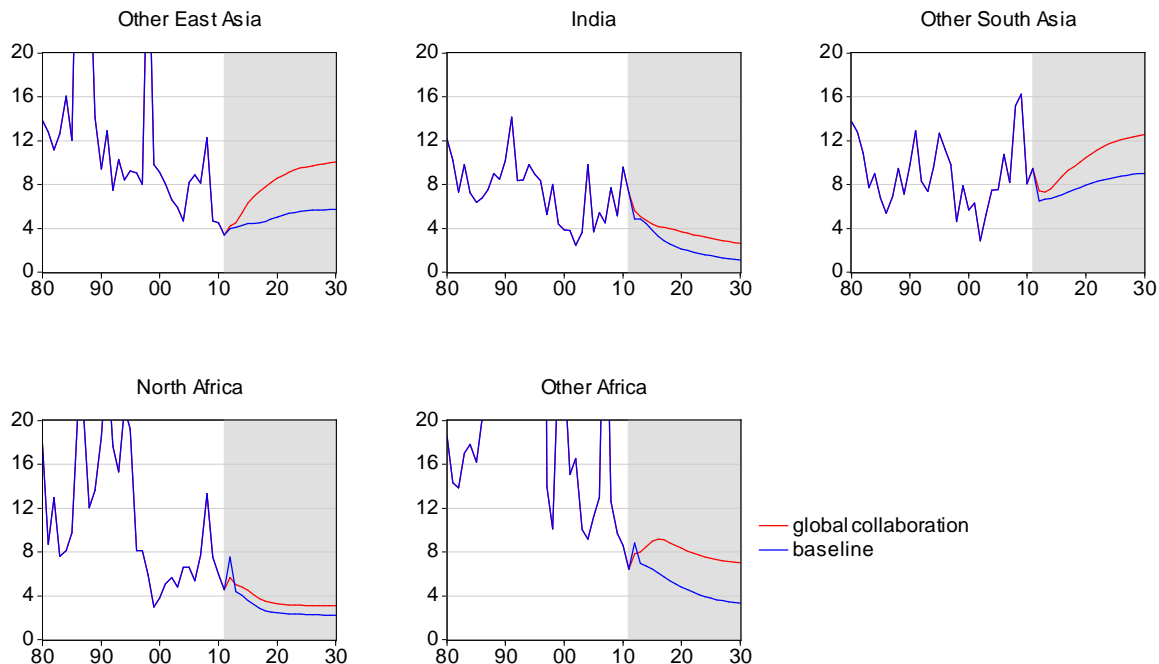
Global collaboration: per capita income - lower income blocs (\$ ppp p.a.)



Inflation

Inflation risks in a context of accelerated economic growth are quite significant in low-income regions that may not have elastic domestic supplies of sensitive products or well-established import chains that can anticipate rapid growth of demand and respond fast in case of shortages. Part of the answer may lie in maintenance of a sufficient level of exchange reserves to assure liquidity of external payments and global cooperation in support of stable real exchange rates. Nevertheless some increase in rates of inflation in low income countries seems very likely in a context of rapid and sustained GDP growth.

Global collaboration: domestic price inflation in low income regions (% p.a.)



## Chapter 5 Regionalisation

The final scenario introduces what might be considered a second best governance assumption, namely fragmentation of the global system in continental groupings each of which seeks to develop its own internal pattern of investment and specialisation.

### The regions

To simplify the presentation a fairly simple pattern of regionalisation based on continents is assumed rather than a patchwork which is no doubt more likely in reality. America is treated as a single region, combining four blocs (US, Central America, South America and Other Developed).<sup>6</sup> Africa combines two blocs (North Africa and Other Africa). East Asia combines Japan, China, East Asia High Income and Other East Asia. Other Asia includes India, Other South Asia, the CIS and West Asia. Europe is treated as a separate region and as in previous chapters no distinction is made between EU members and non members.

Other blocs have very large land areas and populations compared with Europe. Africa and America have almost twice the population of Europe while East Asia and Other Asia have four times the population. Europe has higher GDP per capita than America as a whole, nearly four times that of East Asia, six times that of Other Asia and eleven times that of Africa.

<sup>6</sup> Formally this puts Australia, New Zealand and Israel into the America group.

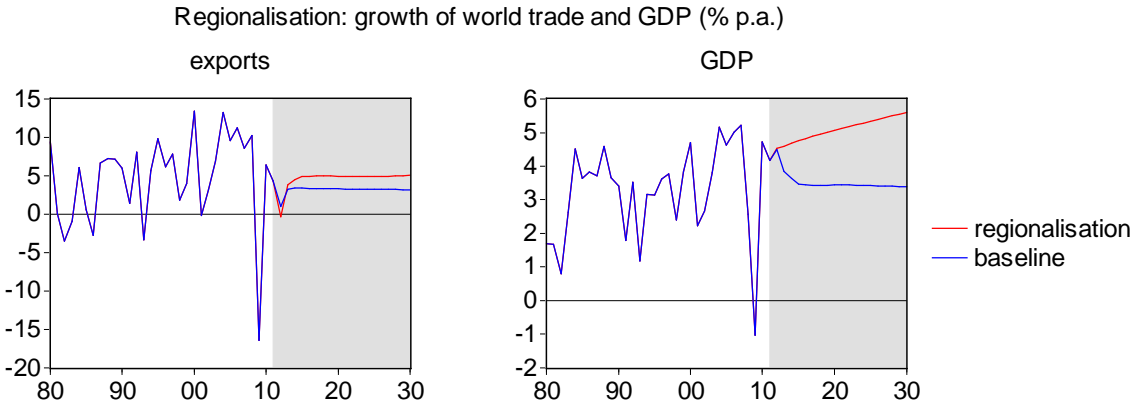
**Typical policies**

The main instruments of integration are assumed to be trade preferences for manufactures, investment incentives to promote infrastructure, industrial development and new energy supplies, and coordination of exchange rate policies to maintain a stable pattern of real exchange rates at levels that promote convergence within each grouping. Investment is seen as an important driver of growth in the blocs or sub-regions that make up the grouping.

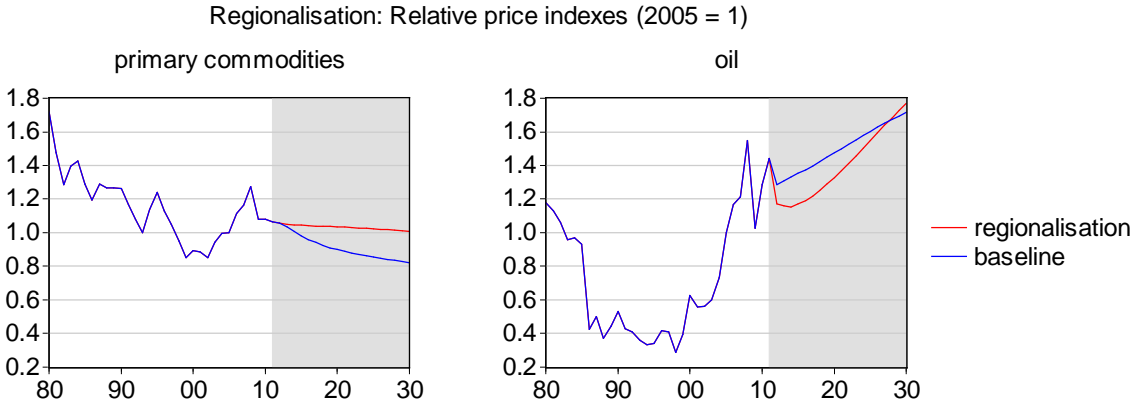
The situation of Europe, relying heavily on trade with other parts of the world and having already integrated the internal market, is marginally different to that of the large continental groupings. The scenario assumes there will be no new system of trade preferences in Europe, in particular no new discrimination against imports from other continents. It is also assumed that South Europe will remain in the Eurozone (fixed nominal exchange rate) while North, East and West Europe maintain stable real exchange rates vis-a-vis the Eurozone core (Central Europe).

**Outcomes**

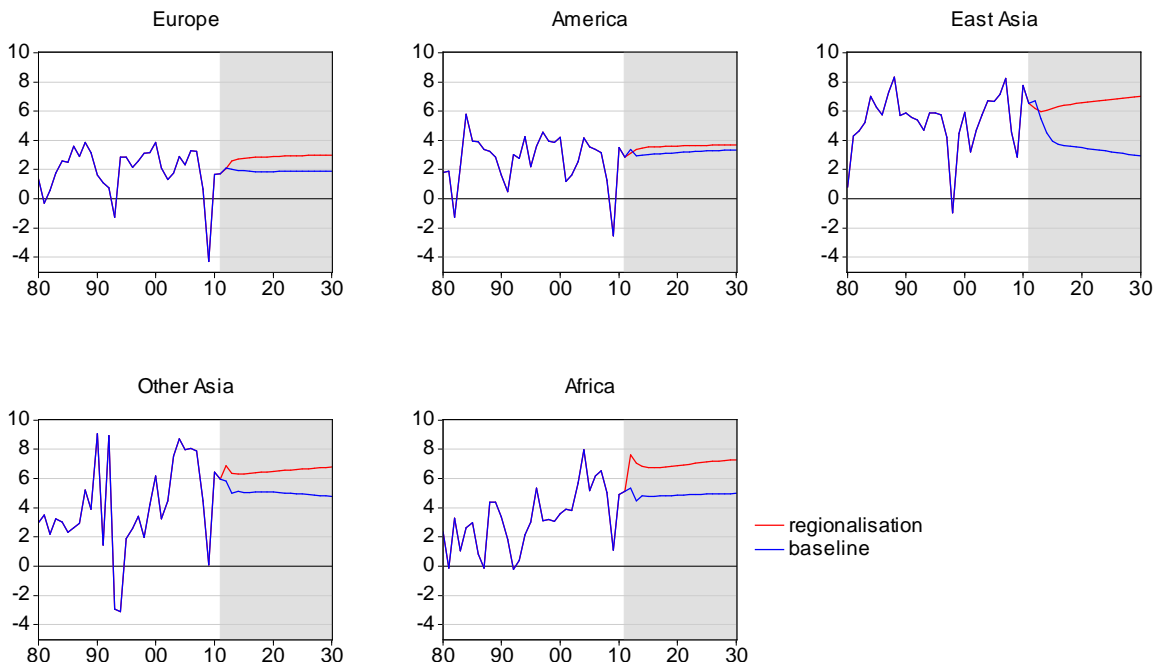
World GDP growth, trade and commodity prices



This scenario is favourable to GDP growth in the world as a whole and growth of exports within each continent implying a favourable trend of commodity prices and longer-term growth of the real price of oil.

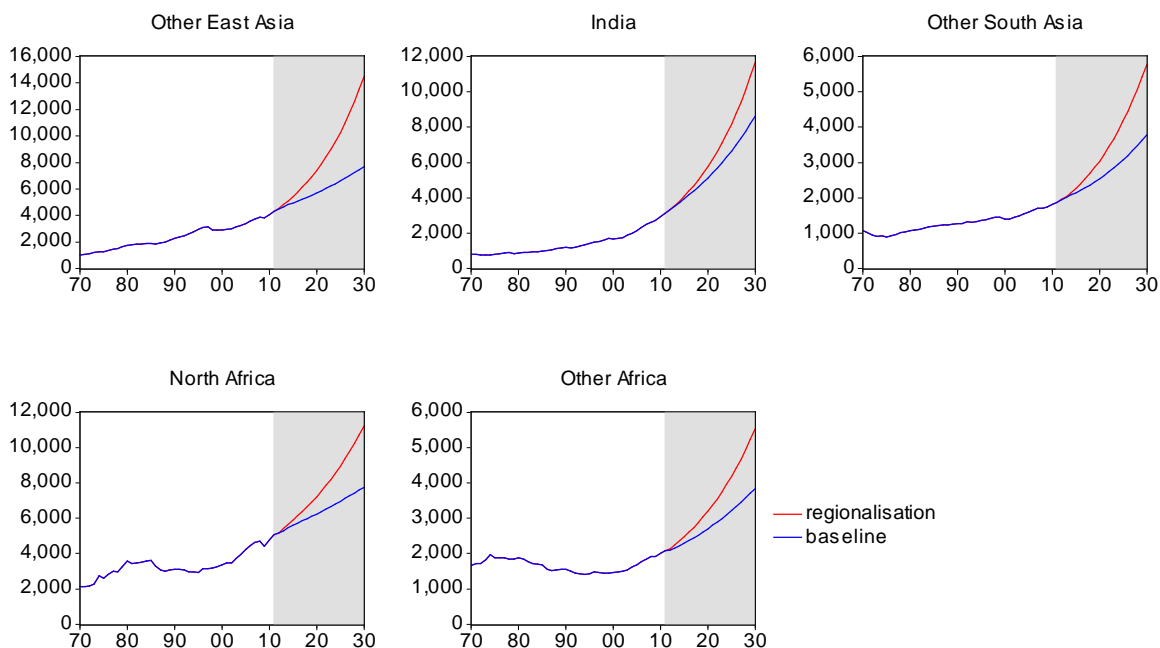


Regionalisation: GDP growth by world region (% p.a.)

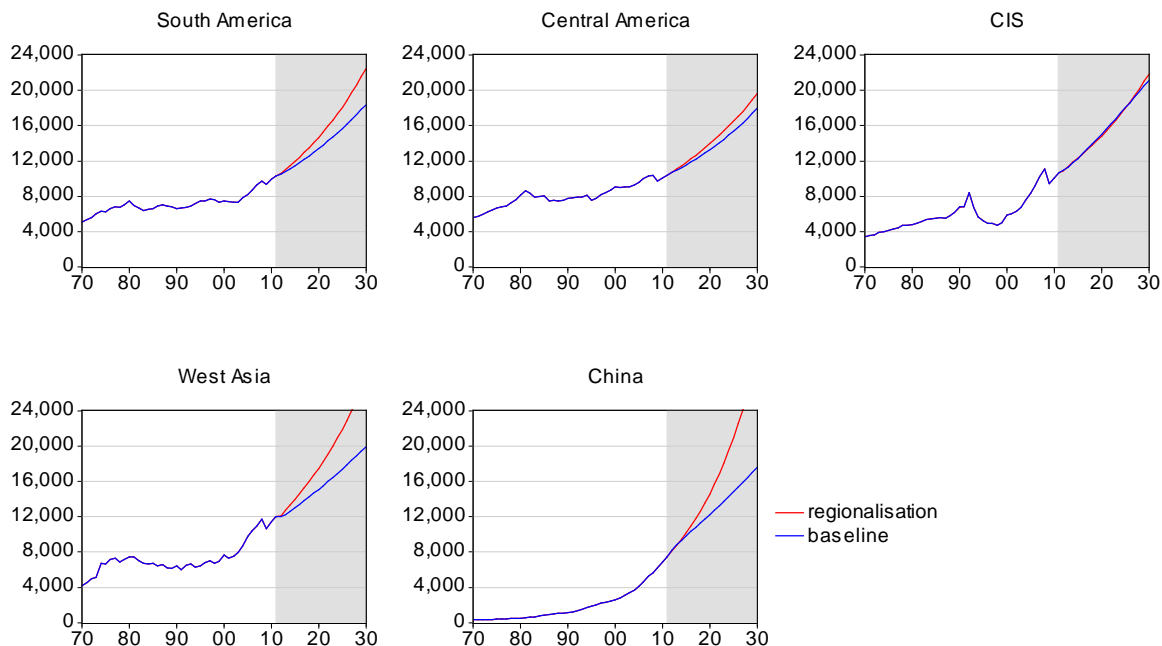


The largest beneficiaries are Africa and Asia (similar to the outcome in the global collaboration scenario) achieving 6-7% average annual growth of GDP. The regionalisation model is quite favourable to lower-income blocs as there is an incentive to promote convergence within each world region.

Regionalisation: per capita income - lower income blocs (\$ ppp p.a.)

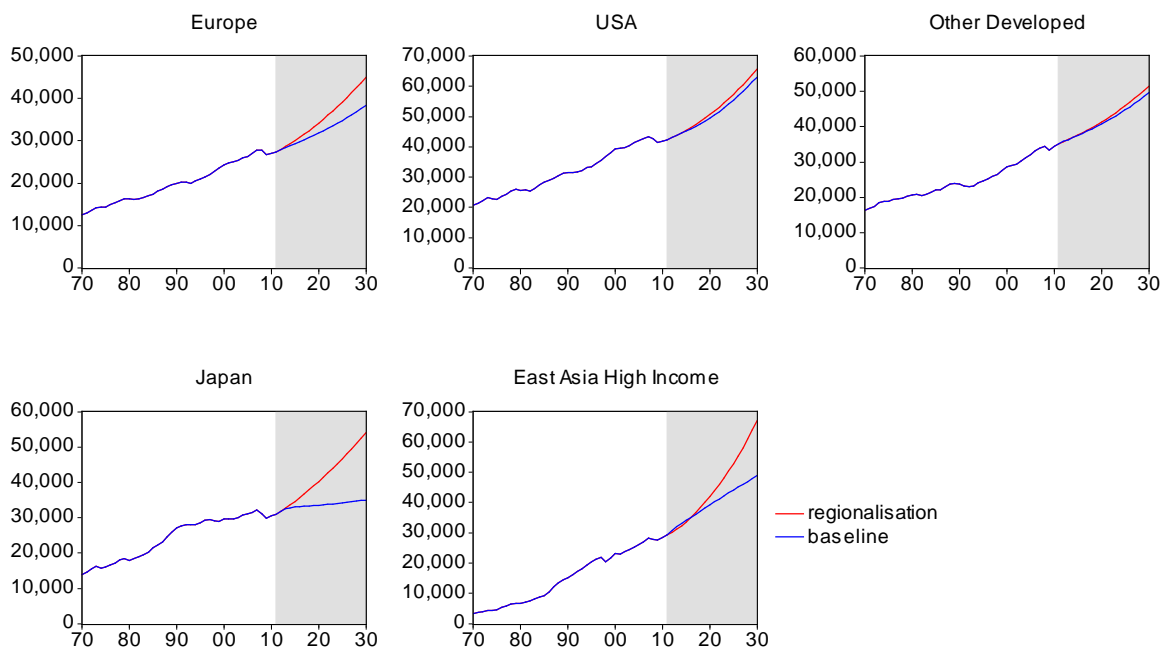


Regionalisation: per capita income - middle-income blocs (\$ ppp p.a.)



The scenario generates very rapid growth in China and West Asia. Several other middle and high income blocs including Europe also benefit significantly.

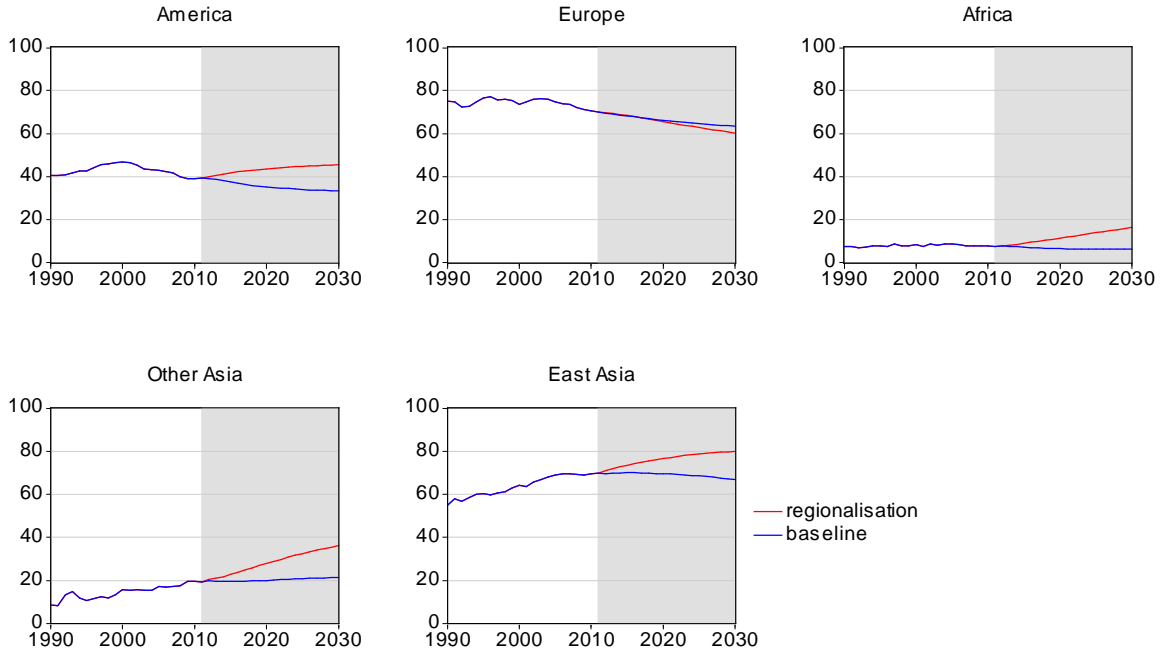
Regionalisation: per capita income - high income regions (\$ ppp p.a.)





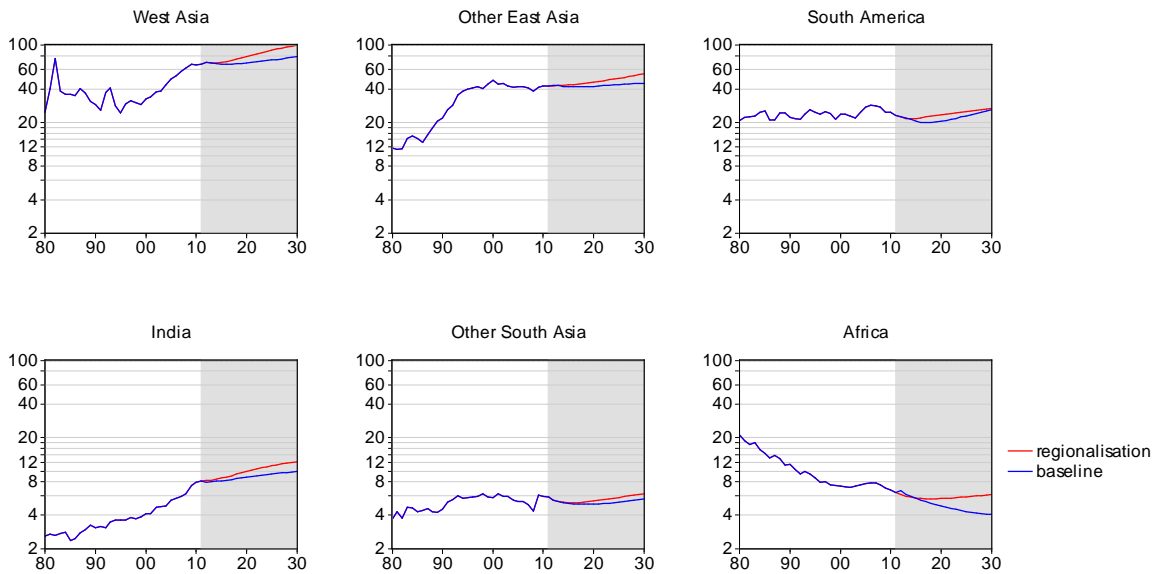
Trade in manufactures

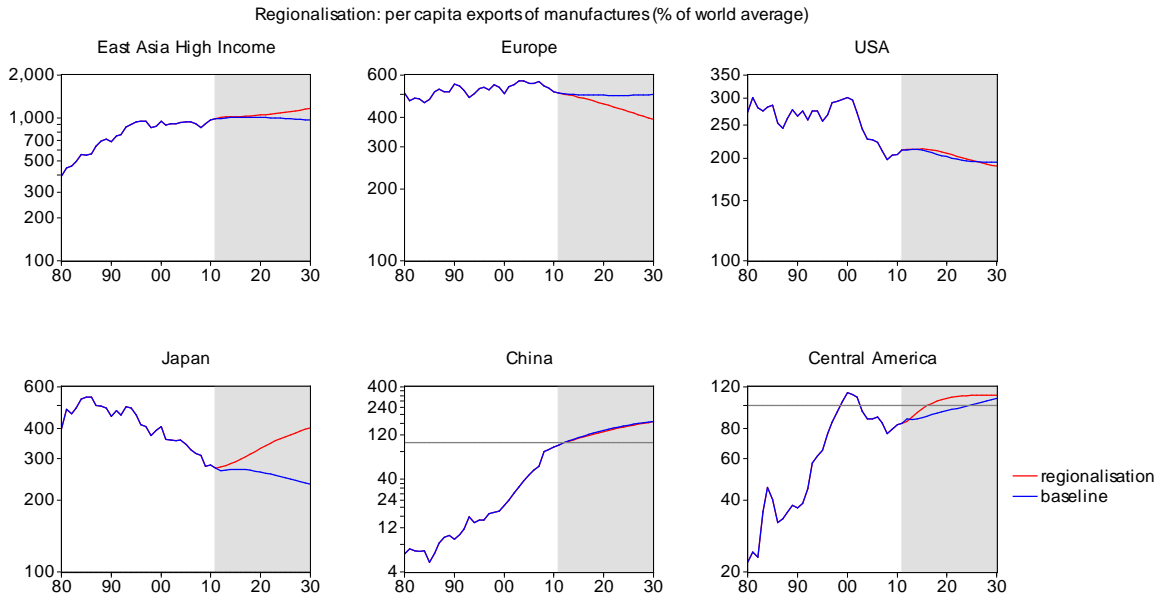
Regionalisation: share of intra-trade in total imports of manufactures



Growth of exports of manufactures is driven mainly by internal trade within each continental grouping - except in the case of Europe that we assume will maintain open trading relationships with the other groups. Export performance of some middle and low income blocs would improve (especially Africa).

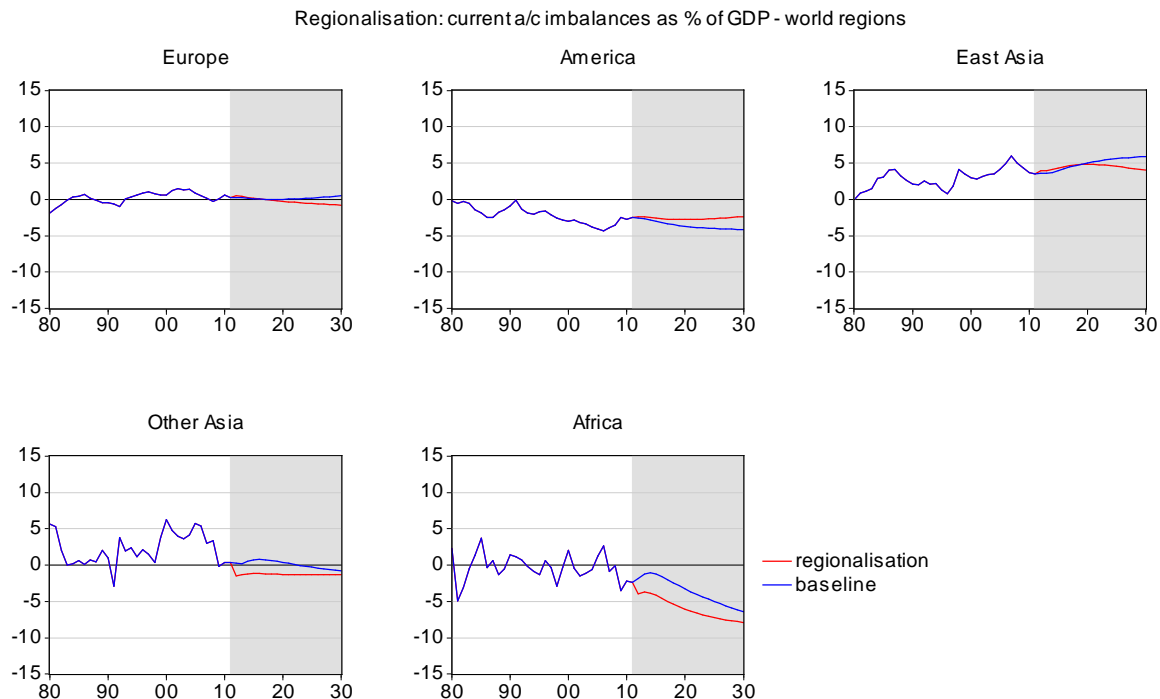
Regionalisation: per capita exports of manufactures (% of world average)





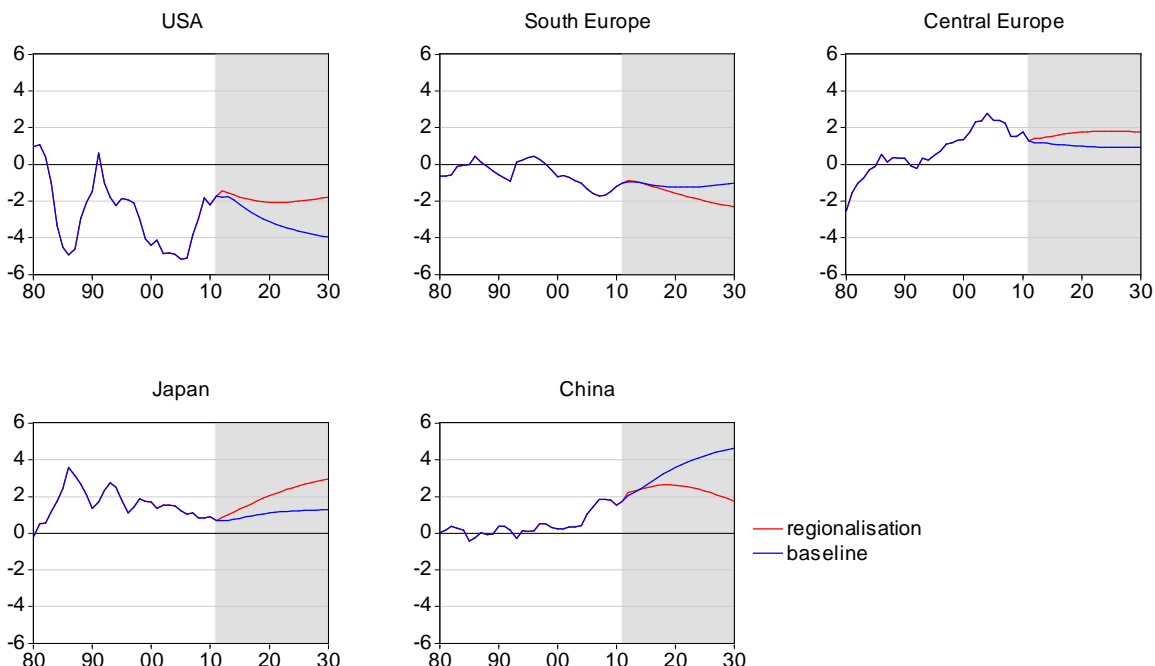
Europe's relative strength in exports of manufactures would be eroded while that of Japan and East Asia High Income would strengthen.

Global financial imbalances



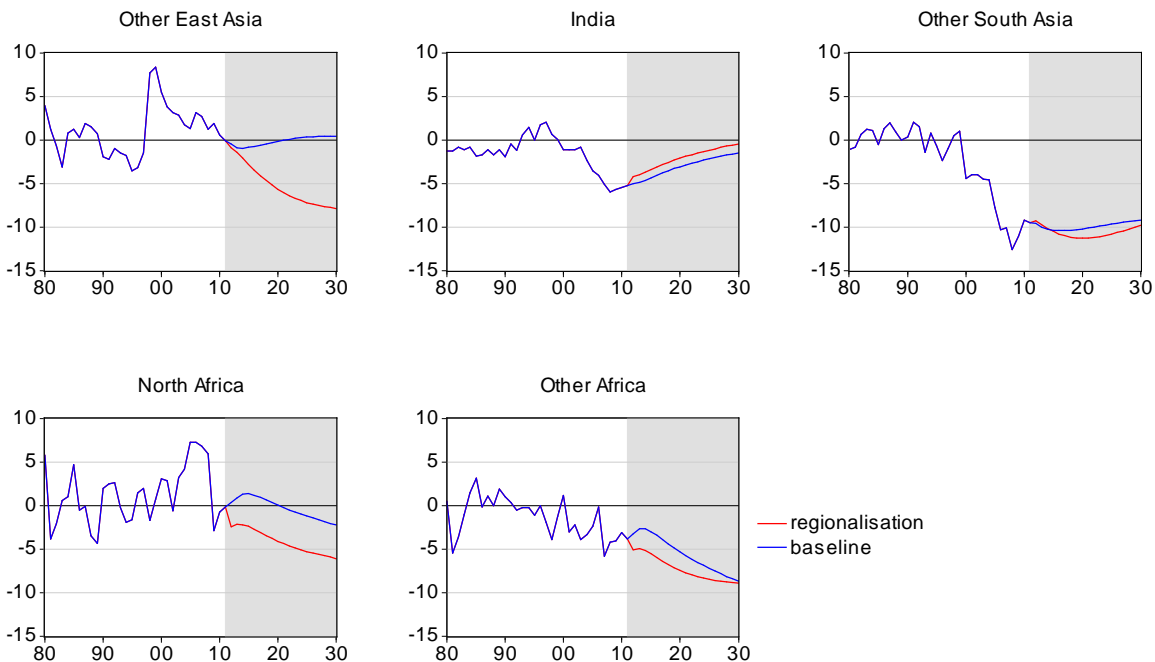
At the level of world regions, East Asia remains the main surplus area while Africa and to a lesser extent America have significant deficits. Europe and Other Asia are roughly in balance.

Regionalisation: current a/c imbalances as % of total world exports

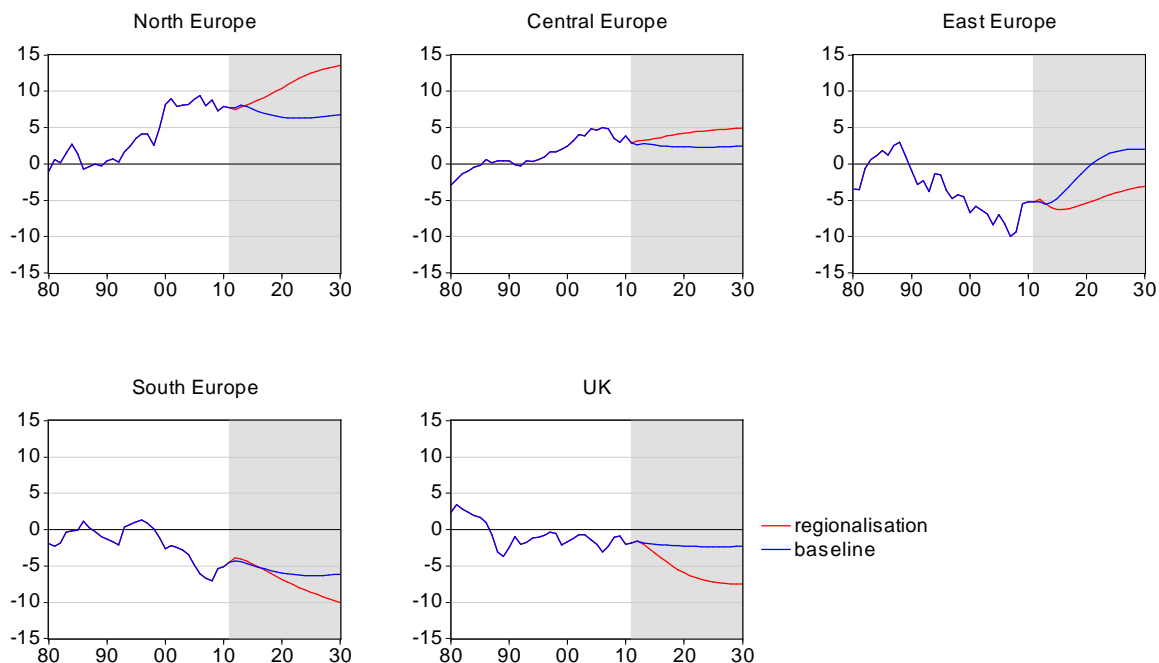


Financial imbalances within each region may increase due to the strong emphasis on investment intended to promote convergence and strengthen the region's position in global trade.

Regionalisation: current a/c imbalances as % of GDP - low income blocs

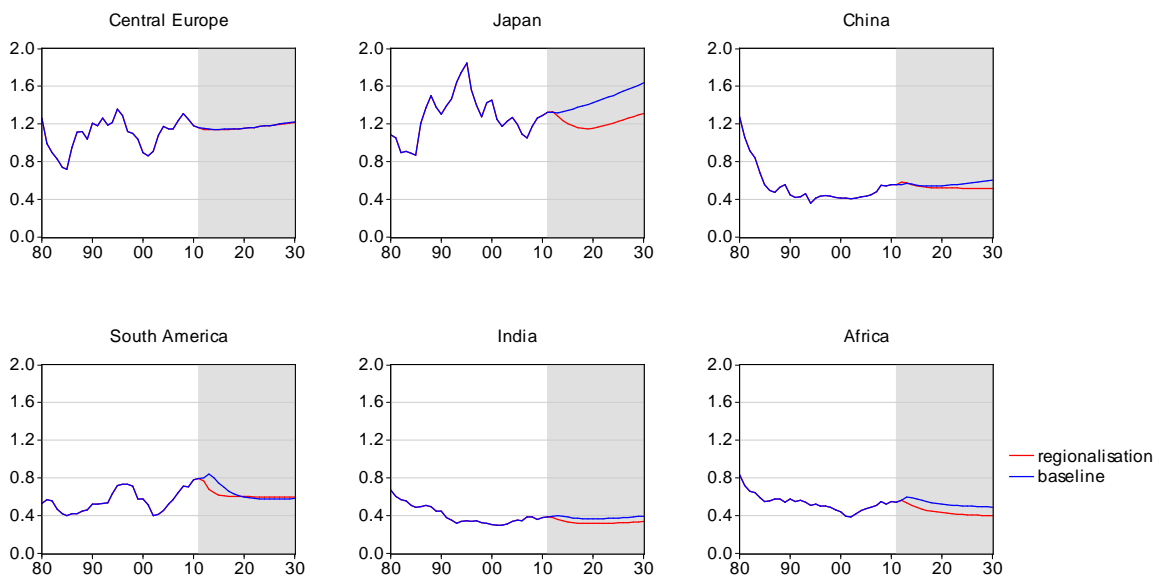


Regionalisation: current a/c imbalances as % of GDP - Europe



This applies also to Europe where there would be large internal investment flows from North and Central Europe to the UK, East Europe and South Europe.

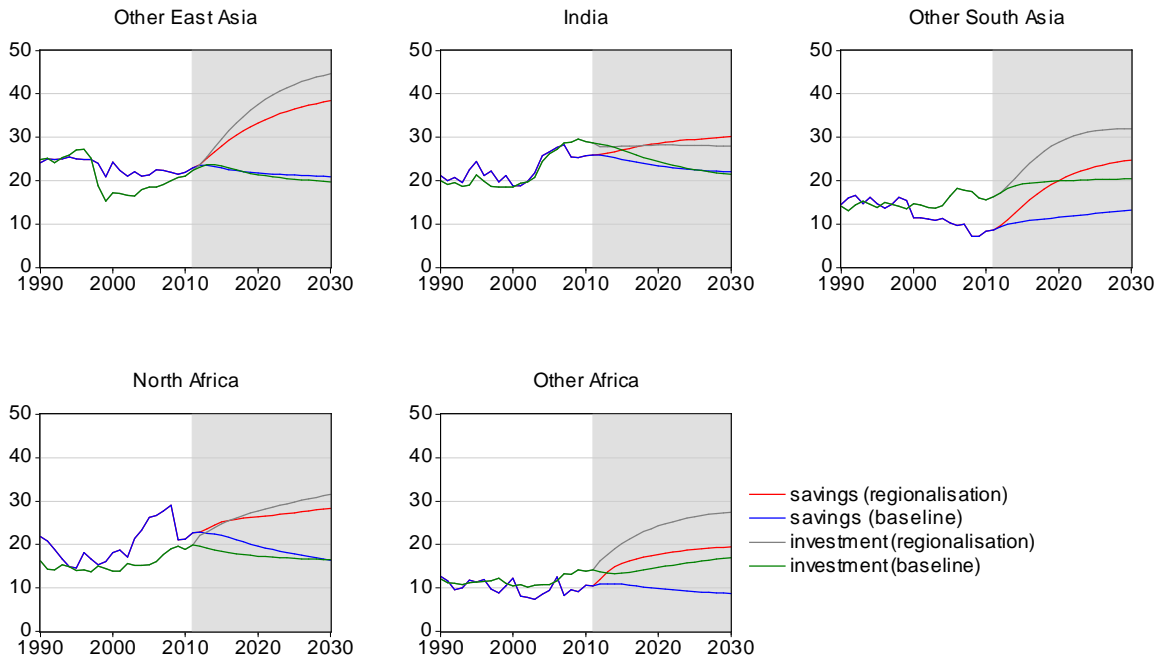
Regionalisation: real exchange rates relative to the USA



This scenario does not imply important changes in real exchange rates except for Japan which has a better chance of avoiding continuing upward pressure when there is a strong regional focus to investment and regulation of East Asian financial markets.

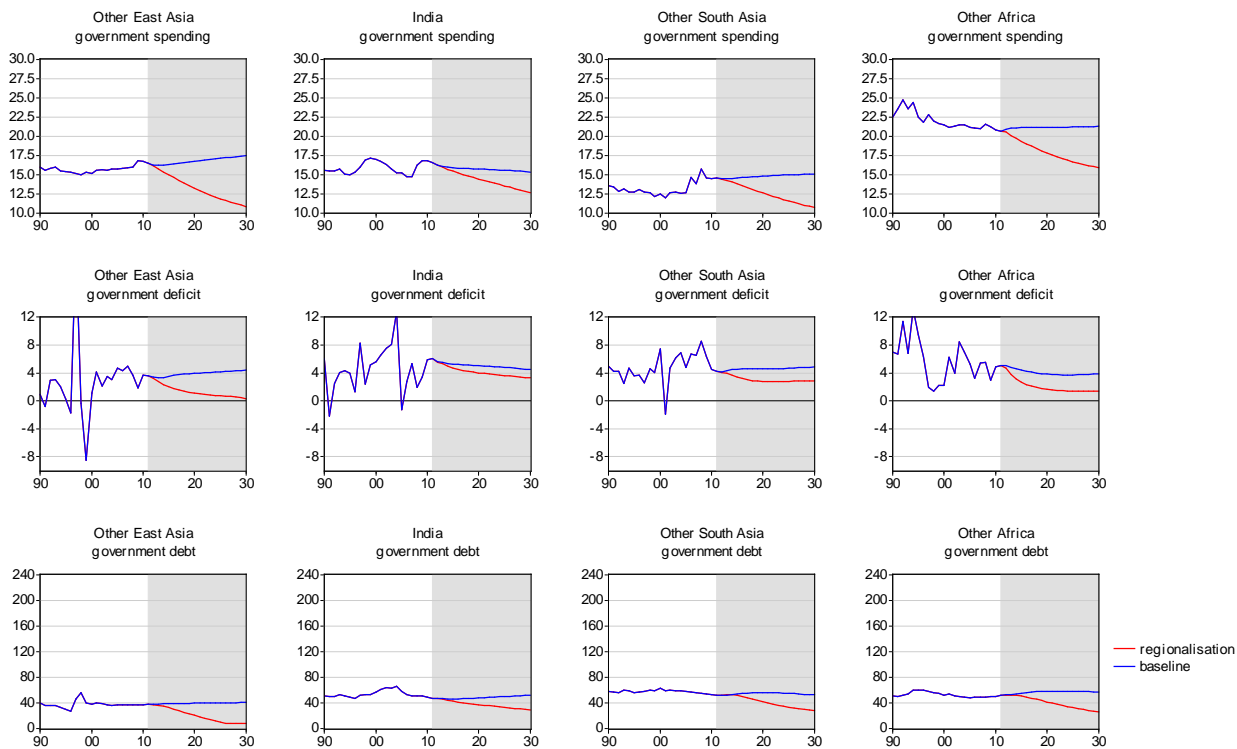
Financial impact on low income blocs

Regionalisation: saving and investments as % of income - low income blocs



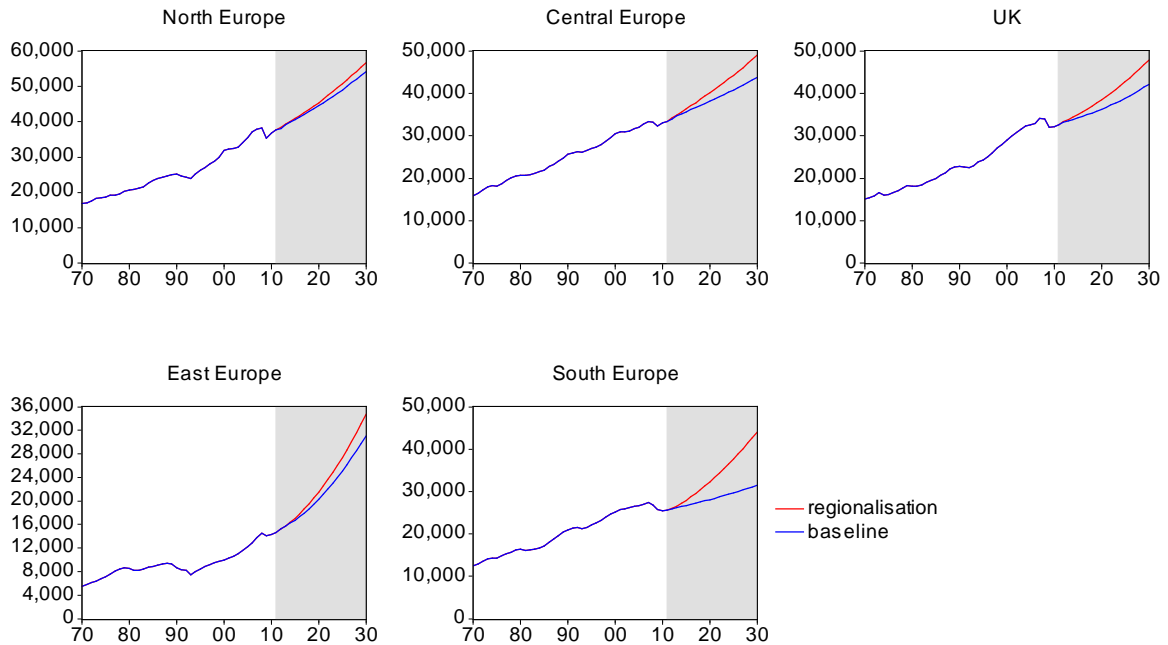
Large increases in investment in low income blocs generate higher savings and with fast growth the weight of government spending and debt reduces relative to GDP.

Regionalisation: government debt, low income regions (% of GDP)



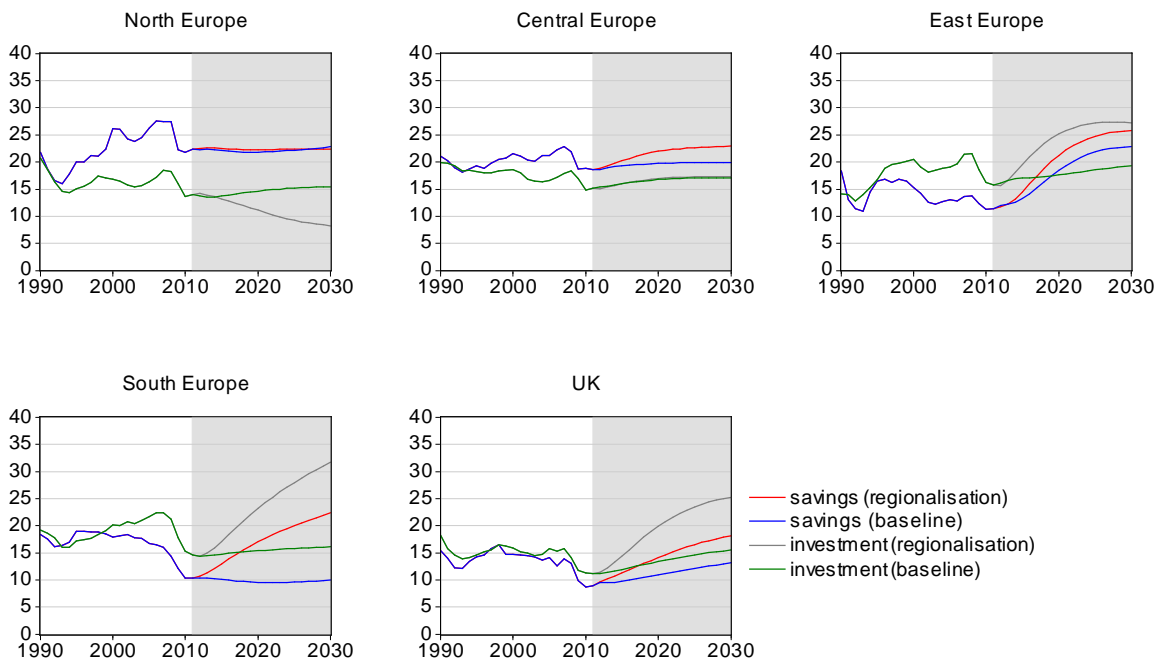
Income, savings/investment and government finance in Europe

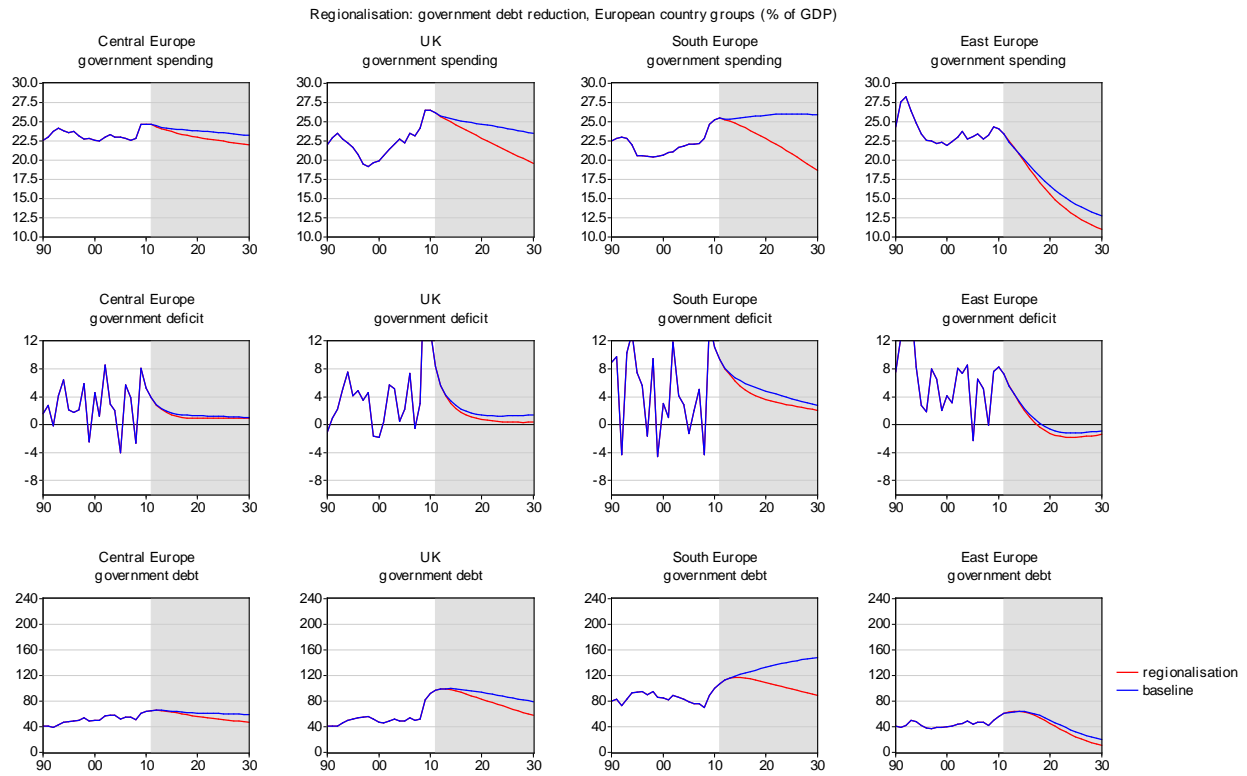
Regionalisation: per capita income in Europe (\$ ppp p.a.)



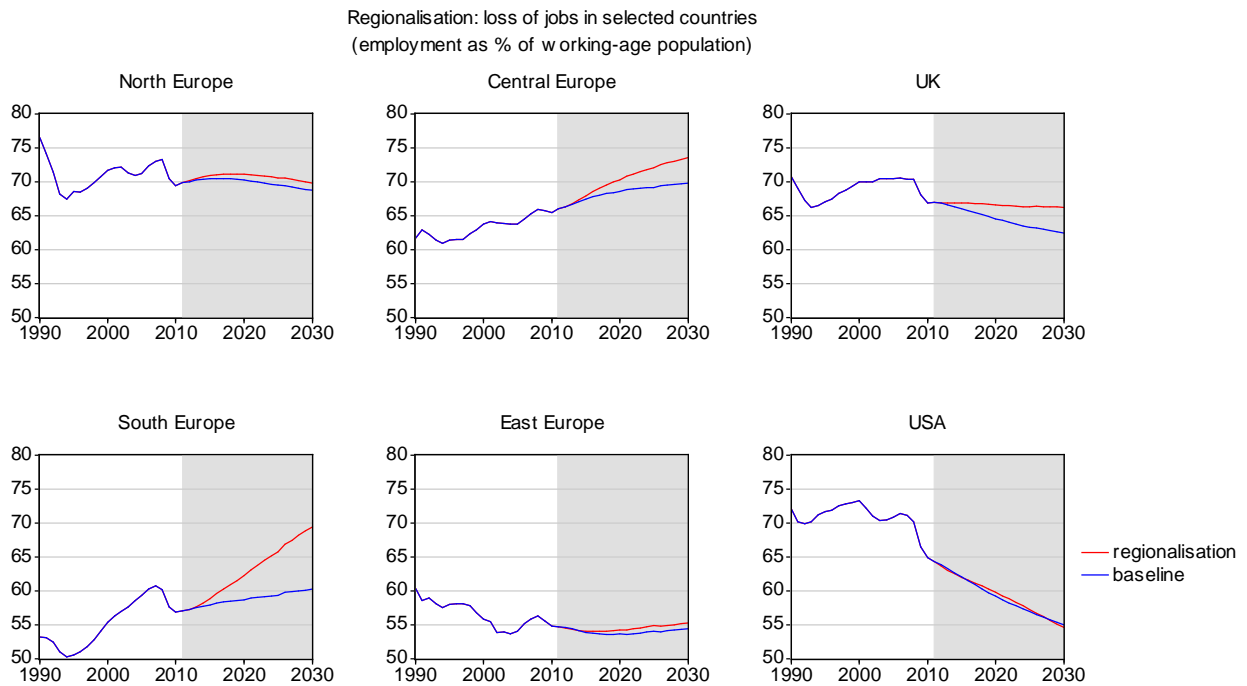
The investment pattern in Europe is assumed to support convergence objectives with a large improvement in GDP and per capita income in South Europe.

Regionalisation: saving and investment as % of income - Europe

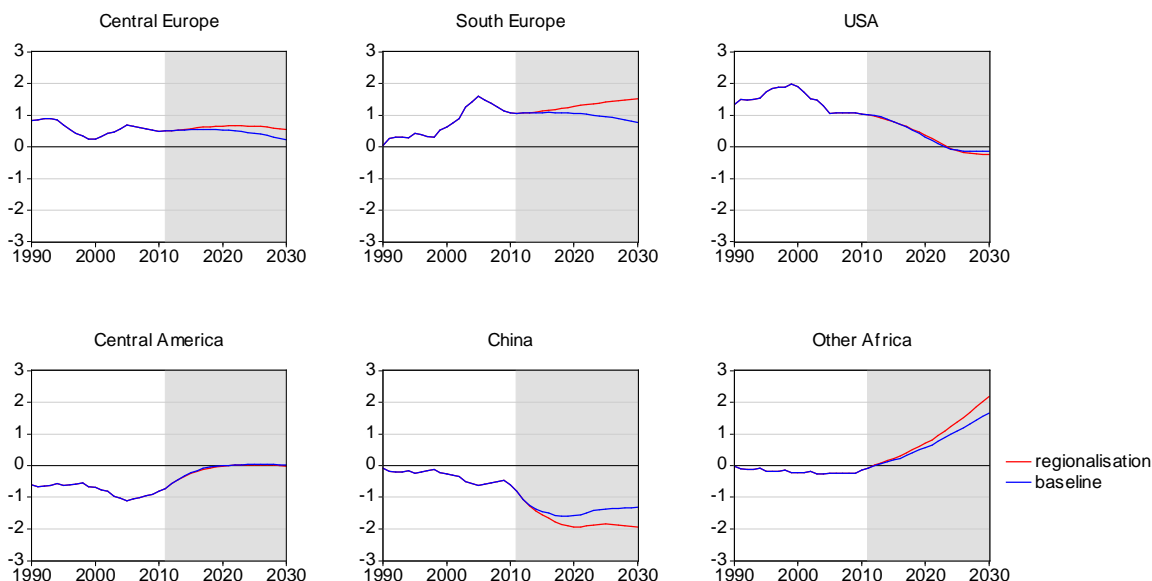




The improved pattern of growth helps to reduce the weight of government spending and debt and raise employment rates.



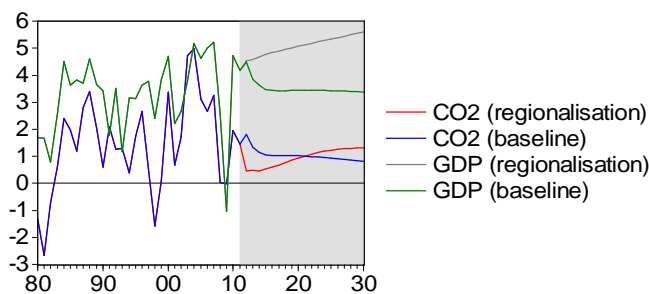
Regionalisation: net migration, selected country groups (millions p.a.)



With higher employment in Central and South Europe net immigration may continue. This is different from the situation for the US and Other Developed countries where regionalisation is less likely to improve growth and employment prospects.

Energy policy and carbon emissions

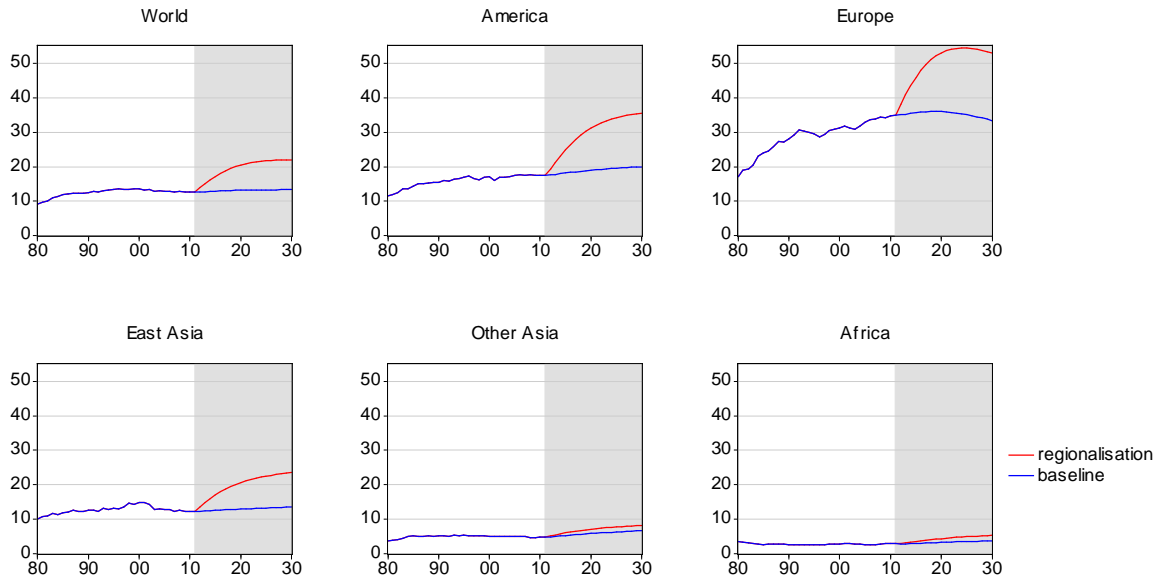
Regionalisation: carbon emissions and world GDP growth (% p.a.)



The high rate of growth of world GDP in this scenario implies increases in global carbon emissions averaging 1% p.a. despite investment in non-carbon energy supply.

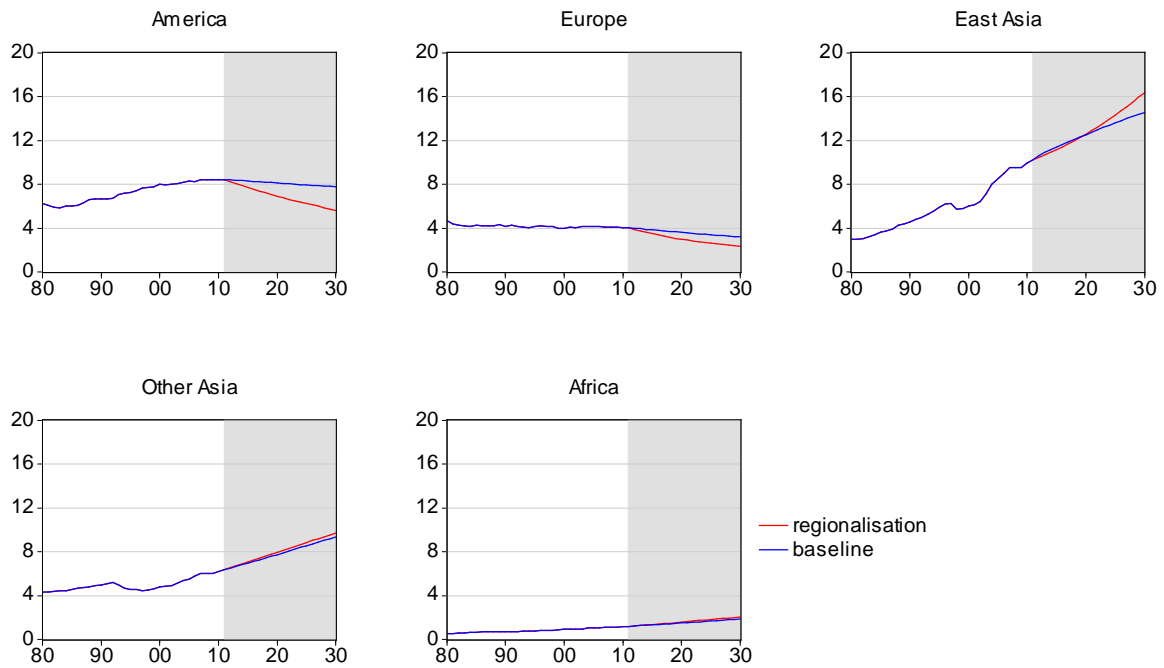


Regionalisation: non-carbon energy production (% of total)



The growth of emissions in Asia will substantially exceed reductions in America and Europe.

Regionalisation: carbon emissions (billion tons p.a.)



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## APPENDIX A The Macro Model

The role of the macro-model in the AUGUR project is to provide historical time series and projections within a defined, formal framework that provides an account of inter-relationships between the different domains including trade, finance, demography, energy, income and well-being, allowing different assumptions to be made about future policies and behaviour, coordinated or otherwise, in each part of the world.

### The databank

The model's databank relies mainly on UN sources that are designed to provide global coverage. Although there are problems of availability, reliability and accounting consistency, experience to date indicates that such data give a reasonably consistent picture of economic developments confirmed by regularity of cross-section and time-series relationships (Cripps and Khurasee, 2006). An iterative adjustment method developed by R. Byron (1978) is used to resolve inconsistencies and enforce accounting identities at the level of individual countries and the world as a whole.

Observations that depart significantly from the historical pattern can usually be explained by wars, political upheavals or other major disruptions or data errors that are more-or-less self-evident when traced back to original sources. At the same time there is a wide variation in reliability of data and all observations in the databank are tagged to indicate whether they have been estimated or substantially adjusted and to record the original source from which they derive (Cripps and Khurasee, 2010a).

The most important reservations about data for the world economy over the past 40 years concern discontinuities resulting from the breakup of the former USSR, gaps in data for many territories in the 1970s and 1980s and the absence of regional data for India and China that each account for nearly 20% of the world's population.

### Measurement conventions

The model employs an accounting framework in which variables are presented in real terms to maintain comparability through time and across countries.

Two purchasing power concepts are used:

- i) domestic purchasing power, or valuation of money flows in terms of goods and services entering domestic final expenditure in each bloc (consumers expenditure, government expenditure on goods and services, gross spending on fixed capital and inventories).
- ii) global purchasing power, or valuation of money flows in terms of goods and services entering final expenditure in the world as a whole.<sup>7</sup>

Real values in domestic or global purchasing power units are calculated by dividing current dollar figures by the relevant deflator. There is a different domestic deflator for each bloc reflecting differences in the price of goods and services purchased in each country and in each year.

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<sup>7</sup> This includes traded goods and services together with goods and services that are domestically produced and consumed in each country.



**Table 2 Year 2005 purchasing power parity adjustments**

<i>Bloc</i>	<i>Ratio</i>	<i>Bloc</i>	<i>Ratio</i>
North Europe	1.308	West Asia	0.559
Central Europe	1.134	South America	0.518
UK	1.180	Central America	0.612
South Europe	1.019	China	0.429
East Europe	0.567	Other East Asia	0.400
USA	0.985	India	0.345
Japan	1.175	Other South Asia	0.331
Other Developed	1.025	North Africa	0.440
East Asia High Income	0.705	Other Africa	0.490
CIS	0.429		

The real exchange rate for each bloc is defined as the ratio of international to domestic purchasing power of money converted at market exchange rates. This changes through time as a result of exchange rate movements and differences between domestic price inflation and global price inflation<sup>8</sup>. The real exchange rate is generally higher in high-income blocs where many locally-produced products and services are expensive and lower in low-income blocs where locally-produced products and services may be relatively cheap. This situation is sometimes regarded as a sign of overvaluation (high income regions) or undervaluation (low income regions) but it occurs more or less inevitably when imports are liberalised and prices of traded goods and services become less unequal than they may have been when trade was highly restricted.

Average prices of exported manufactures and services in the world as a whole tend to follow costs in a reasonably stable manner while prices of oil and commodities are subject to large relative price fluctuations and exhibit distinct long-run trends. The resulting movements in relative prices can have marked effects on income and trade balances of countries with substantial net exports or imports of commodities and energy.

The model captures terms of trade effects by the use of volume and (real) value measures for exports and imports in each broad category of trade, tracing the impact of relative price changes on income and price inflation in each bloc.

Definitions of real values and volumes have been chosen to maintain adding-up properties for series in each bloc and the world as a whole. The main disadvantage is that deflators representing weighted averages of prices in different countries or blocs do not necessarily give an unbiased impression of the impact of price shifts. Thus, for example, when expenditure weights change rapidly in favour of emerging low-income economies it is possible for the real exchange rate to decline in all blocs as the average price of world expenditure is pulled down. Equivalently, it is possible for the world price deflator fall even if prices in each bloc are static or increasing. This may happen if the share of low-cost blocs in total expenditure increases.

Further caveats have to be mentioned with regard to construction of series for price inflation, nominal exchange rate changes and interest rates in blocs comprising countries with different currencies. Weighted averages used in the model do not give

<sup>8</sup> Measured in a common currency such as US dollar.

a very meaningful picture for a group of countries if one or more of the members has a very high inflation rate and dramatic exchange rate movements.

### Assets and wealth

Financial flows such as savings and investment, government deficits and the external current account and capital transactions are reflected in accumulating asset positions that eventually feed back into spending and savings behaviour. Since time series of asset values and wealth are in many cases lacking estimates for each bloc have to be constructed using a variety of information sources together with some heroic assumptions about valuation changes and write-offs.

In the global macro-model the banking sector is defined to include the central bank. Assets of the banking sector include exchange reserves and domestic lending. Government investment in banks (deposits and capital) is identified explicitly. The residual item, termed "deposits" in the model, includes banks' net external liabilities and capital.

Government debt is affected by asset transactions with state enterprises, banks, households and non-residents (e.g. lending to foreign governments or international institutions). As published data in this area are very weak the macro-model estimates government asset transactions and debt write-offs as a residual.

Tangible assets are estimated by cumulating net investment. Wealth estimates are little more than guesses for most countries as the calculation requires assumptions about changes in the value of real estate, intangible assets and goodwill for which there is no comprehensive international data source.

### Methodology and structure of the model

The structure of the macro-model and its practical methods of operation reflect its purpose and timescales as well as data availability (see Morgan and Morrison, 1999 and van den Bogaard, 1999). It is designed to provide a tool for investigation and learning about behaviour of the world economy and interrelationships between events in different regions through exploration of historical data, construction and modification of key variables and equations and study of alternative assumptions about future policies and behaviours. To the extent that the model is broadly realistic, such activities give model users some understanding of magnitudes and rates of change of different phenomena and the potential outcome of different policies.

The model is regular in the sense that it uses the same basic structure of variables and equations for each bloc. Outcomes in each bloc reflect differences in initial conditions and intercepts as well as behavioural variations incorporated in functional relationships by the use of indicator variables such as the level of income per capita.

Accounting identities constrain the possible movement of series in each bloc and for the world as a whole in many important respects. Remaining degrees of freedom in the model are modelled by behavioural equations that provide approximate representations of the wide variety of short and long-term real-world interactions that determine observed movements of macro variables. In general the model uses auto-regressive equations with a structural component representing behaviour that is regarded as typical or common across countries and through time, together with constants and residuals that represent bloc-specific trends, shocks and variant behaviour.

The main purpose of structural elements in the model is to represent interactions in the same bloc (local effects) and across blocs (spillovers).

Global consistency of bloc-level behaviour is achieved by imposing proportionate adjustments on predicted values for each bloc. This 'scaled adjustment' method provides an unbiased method for correcting inconsistencies and provides a widely-used representation of competition in which shares of given totals (markets) are determined by relative advantage - for example, in the Armington model of international trade which is used to predict bilateral flows of exports of manufactures.

### **Global linkages**

As shown in the diagram below, the model includes four types of linkage between economies of individual countries or blocs.

#### *World markets for primary commodities and energy*

Resource endowments and long-term changes in the exploitation and use of resources imply that individual blocs tend to experience a surplus or shortfall in supply relative to domestic demand stimulating exports in the case of a surplus area or imports in the case of a deficit area. Fluctuations in the actual or expected balance between supply and demand often provoke major swings in world prices. Although it may be assumed that in the long run such price movements are eventually capable of restoring approximate balance as patterns of production and use adjust, there is little certainty about the level at which prices will stabilise. Price volatility of primary products is modelled by a demand equation and exports are assumed to be limited by availability of import markets. The world price of oil on the other hand is solved endogenously in each year so as to bring supply and demand for exports of primary energy into equilibrium.

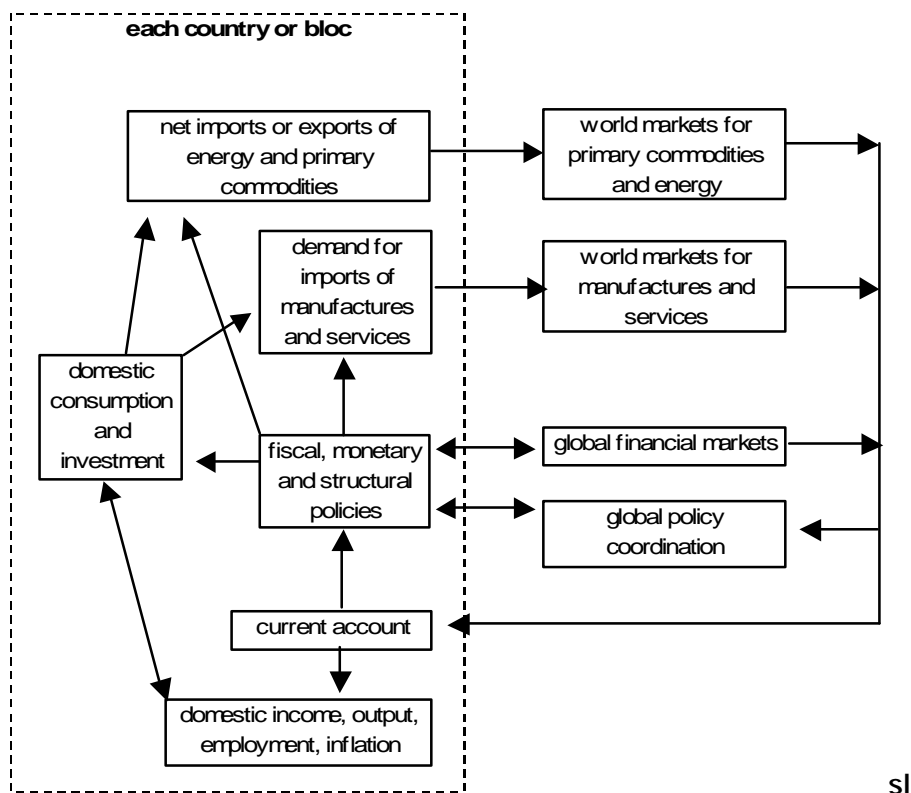


Figure 1 Global linkages

*World markets for manufactures and services*

World markets for manufactures and services are assumed to be demand-driven with supply-determined prices. Changes in bilateral market shares for manufactured exports represent the outcome of competition between international firms and their strategies for locating or sourcing supply. Market shares are responsive to movement of relative costs of production in different blocs.

*Global financial markets*

Exchange rates in blocs with open financial systems are determined in global markets where prices respond to current and anticipated demands for each currency. In other blocs exchange rates are fixed more or less directly by the monetary authority. But despite institutional differences, longer-term considerations about the viability of exchange rates are likely to be similar in both cases. A particularly important consideration is the real or inflation-adjusted level of the exchange rate since this has a direct impact on profitability of exports and imports and therefore on trade performance and costs in each bloc.

In blocs with open financial systems the influence of global financial markets extends to interest rates, bond yields and stock prices. The monetary authority has some degree of independent influence but may not be able to move inflation-adjusted rates and returns very far from levels considered reasonable by market participants. As in the case of exchange rates, the monetary authority may be in a stronger



position to fix interest rates in a less open system but is ultimately faced with similar issues to those that have to be considered by market participants in more open systems.

One important aspect of global markets is the phenomenon of 'contagion' affecting stock price indexes, bond yields and interest rates in different blocs simultaneously. When confidence factors are correlated across blocs, there is evidently a larger risk that changes in confidence will impact world trade and income on a significant scale.

### *International policy coordination*

Many areas of public policy including, in particular, economic and financial policy are the subject of review and negotiation in a variety of global and regional forums. In addition policy-makers react to changes in the international environment with some degree of regularity. Thus there may be implicit as well as explicit coordination of policy responses, reflected in rules or norms for the conduct of policy or agreements on common action to deal with immediate problems. The model does not embody fixed assumptions about forms of policy coordination that have been or may in future be followed at the global level. Assumptions about policy coordination in any scenario are built onto the model by defining linked response functions where several blocs cooperate to achieve a common objective or parallel response functions where several blocs introduce similar innovations in the expectation that the combined outcome will be mutually beneficial.

### **The model for each bloc**

Given the global context, bloc-level variables interact to determine the level of output, income, inflation etc. in each bloc.

### *Real demand, fiscal policy and the balance of payments*

i) real demand is largely determined by the income of each bloc that in turn reflects domestic expenditure and critical supply factors (notably sources of primary energy) as well as external demand and prices. The level of interest rates, monetary policy interventions and financial market confidence may impact real demand but the longer-term effects of these influences are weak as compared with the effects of fiscal policy and external trade.

ii) inflation has little impact on real demand and income except in relatively extreme circumstances. In normal conditions (i.e. except in case of bottlenecks arising from critical shortage of essential inputs<sup>9</sup>) aggregate production tracks real demand with flexibility provided by inventories, imports and domestic margins of production capacity.

iii) fiscal policy impacts public and private spending and therefore aggregate demand, operating as a stabiliser by default. The share of disposable income taken by government does not change rapidly and tends to be somewhat higher in countries with relatively high per capita income. Government expenditure on goods and services is not closely constrained by income and the level of government debt relative to GDP varies widely.

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<sup>9</sup> In such cases, high rates of inflation or hyper-inflation may occur unless demand is stringently and effectively controlled by rationing.



iv) fluctuations in export earnings and the cost of imports, in particular oil and raw materials, have a direct impact on the balance of payments current account and national income. In the longer run as public and private expenditure adjust to changes in income, the current account impact diminishes and the income effect increases. Thus over a period of years it becomes evident that the distribution of income between blocs and countries is closely governed by their relative advantage or disadvantage in international trade.

### *Monetary policy, inflation and exchange rates*

- i) inflationary pressure is related to capacity utilisation and terms of trade shifts.
- ii) interest rates are typically adjusted in relation to inflation such that the real interest rate is positive but not very high.
- iii) exchange rate movements have a significant impact on costs that in turn impact price-fixing and market shares of different suppliers of traded goods and services. Real exchange rate movements may change the dynamics of exports and imports, feeding into the balance of payments current account and growth of real income and demand.
- iv) monetary authorities in many countries have accumulated large exchange reserves. This behaviour can be explained in part by market intervention intended to limit upward appreciation of the exchange rate in order to maintain a competitive edge in trade and in part by the desire to maintain market confidence and minimise the risk of a future currency crisis. There is little evidence that accumulation of large exchange reserves has much impact on the real exchange rate in the long run.
- v) the determination of exchange rates in open exchange regimes is essentially a market process. The level of nominal and real exchange rates prevailing at any time reflects anticipations by a wide range of market participants who generate massive turnover of exchange transactions in the global market. Although exchange rates are certainly influenced by central bank intervention and by policy statements and commitments made by governments in each country, there is no simple way to model such interactions.

### *Matrix of stocks and flows*

Financial stocks and flows for an individual bloc are summarised in the following accounting matrix. Opening stocks of assets at the top of the table are modified by flows related to income, expenditure, asset transactions, holding gains and write-offs to determine closing stocks at the bottom of the table.

External transactions and assets or liabilities suffixed with \$ are converted to domestic purchasing power by dividing by the real exchange rate,  $rx$ .

**Stocks and flows for an individual bloc**

<i>Liabilities</i>	<i>Expenditures and transfers</i>				<i>Assets held by</i>				<i>Total</i>
	<i>of Supply</i>	<i>Private</i>	<i>Govt</i>	<i>Foreign</i>	<i>Private</i>	<i>Govt</i>	<i>Banks</i>	<i>Foreign</i>	
<u>Opening positions</u>									
<i>Capital</i>					KP <sub>-1</sub>				
<i>Private</i>						AGO <sub>-1</sub>	LN <sub>-1</sub>	LX <sub>-1</sub> /rx <sub>-1</sub>	LP <sub>-1</sub>
<i>Govt</i>					LGO <sub>-1</sub>		LGF <sub>-1</sub>		LG <sub>-1</sub>
<i>Banks</i>					DP <sub>-1</sub>	AGF <sub>-1</sub>			AF <sub>-1</sub>
<i>Foreign</i>					AXO <sub>-1</sub> / rx <sub>-1</sub>		R <sub>-1</sub> /rx <sub>-1</sub>		AX <sub>-1</sub> /rx <sub>-1</sub>
<i>Total</i>					AP <sub>-1</sub>	AG <sub>-1</sub>	AF <sub>-1</sub>		
<u>Final demand</u>									
	C+IP+IV	G	X\$/rx						F
<u>Income</u>									
<i>Private</i>	V.tt		BIT\$/rx						Y
<i>Govt</i>		YG							YG
<i>Foreign</i>	M\$/rx								M\$/rx
<u>Flow of funds</u>									
<i>Private</i>		NLP			IP + IV	IAGO	ILN	ILX\$/rx	IAP
<i>Govt</i>			NLG		ILGO		ILGF		IAG
<i>Banks</i>					IDP	IAGF			IAF
<i>Foreign</i>			-CA\$/rx		IAXO\$/rx		IR\$/rx		ILX\$/rx
<i>Total</i>	F	Y	YG	M\$/rx	IAP	IAG	IAF	ILX\$/rx	
<u>Revaluations and write-offs</u>									
<i>Capital</i>					KP <sub>-1</sub> *(rpkp-1)-WKP				
<i>Private</i>							LN <sub>-1</sub> *(rpfa-1)-WLN	(LX <sub>-1</sub> / rx <sub>-1</sub> ) * (rplx <sub>-1</sub> -1)	HAP
<i>Govt</i>					LGO <sub>-1</sub> *(rpfa-1)		LGF <sub>-1</sub> *(rpfa-1)		HLG
<i>Banks</i>					DP <sub>-1</sub> *(rpfa-1) -WLN	HAGF			HAF
<i>Foreign</i>					(AXO <sub>-1</sub> / rx <sub>-1</sub> ) *(rpaxo <sub>-1</sub> -1)		(R <sub>-1</sub> / rx <sub>-1</sub> ) *(rpr <sub>-1</sub> -1)		AX <sub>-1</sub> /rx <sub>-1</sub>
<i>Total</i>					HAP	HAGF	HAF	HAX	
<u>Closing positions</u>									
<i>Capital</i>					KP				
<i>Private</i>							LN	LX\$/rx	AP
<i>Govt</i>					LGO		LGF		LG
<i>Banks</i>					DP	AGF			AF
<i>Foreign</i>					AXO\$/rx		R\$/rx		AX\$/rx
<i>Total</i>					AP	AGF	AF	LX\$/rx	

### Alignment with current-year estimates

Before simulations of future developments are generated the model is aligned with available data and estimates for the current year. This alignment is performed by a program which sets residual terms in specified behavioural equations to align variables such as growth of constant and current price GDP, the current account, inflation and nominal exchange rate changes with values reported or estimated in the most recent World Economic Outlook (IMF 2010).<sup>10</sup>

The baseline projection incorporates user-defined add factors that represent short or long-term breaks with past behaviour including most importantly anticipated changes in energy supply or other supply factors that are not captured by the model. Variant baselines may be generated used to examine the consequences of alternative assumptions about trends, shocks or confidence cycles.

### Governance scenarios and policy adjustments

Each governance scenario is defined by specifying behavioural adjustments applying to some or all blocs that cause the model simulation to depart from the baseline.

Variables determined by behavioural equations can be categorised in terms of their actual or potential sensitivity to policy and other types of behavioural modification that may be implied by a governance scenario. Variables typically classified as policy instruments include

- monetary policy
  - interest rates
  - accumulation of exchange reserves
  - the exchange rate
  - non-bank holdings of government debt
  - government investment in the banking system
- fiscal policy
  - government expenditure on goods and services
  - government revenue (less grants, subsidies and interest payments)
  - government investment in other sectors

Many other variables are subject to a degree of policy influence that depends on the regulatory regime and expectations or norms.

- domestic expenditure
  - consumers expenditure

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<sup>10</sup> Plausibility of the alignment procedure for each bloc is checked by generating a p-value (probability) for the size of residual adjustments based on their historical volatility.

- fixed investment
- inventory changes
- energy supply and use
  - primary energy production and use
- external trade and payments
  - exports and imports of primary commodities, energy, manufactures and services
  - receipts and payments of income and transfers
  - capital flows
- inflation
  - domestic costs and prices
  - world market prices of primary commodities and oil.

### How the influence of policy is represented in the model

Several methods are provided for specification of alternative policy assumptions or other behavioural modifications in a scenario.

#### *Exogenous shocks and changes in trend*

The simplest form of innovation is the imposition of shocks or changes in trend affecting specified variables - for example, a temporary or sustained reduction in government spending or an increase in interest rates or for that matter private investment spending. Such impulses are specified as intercept adjustments. The final effect depends not only on the size of the intercept shift but also on feedbacks via other variables that influence the variable in question.

#### *Adjustment rules*

More complex behaviour may be specified by adjustment rules. In this case the behaviour of a given variable is modified systematically in order to achieve a target outcome for another variable or composite such as a ratio, ceiling or floor. The dynamics of the modified behaviour may be specified as a fixed rule (adjustment to discrepancy between the most recent value and a desired value) or as a more flexible process in which the variable is modified to achieve a given target in the same year.

Several variables may be linked to a given objective, forming a policy package operated in a single bloc or several blocs simultaneously.<sup>11</sup>

Fixed adjustment rules may or may not be effective in achieving the specified target. If the adjustment process does not affect the outcome in the manner expected, the gap between target and actual values may increase over time, provoking increasingly large adjustments to the policy variable, and in extreme cases this may

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<sup>11</sup> A multi-bloc arrangement assumes the existence of a coordination mechanism to define the common objective and the relative strength of adjustments to be made in different blocs.

cause the model to break down before the scenario horizon is reached unless some constraint is imposed on the size of interventions.

It is usually implausible that the value of an instrument can depart very far from the value that would be implied by 'normal' behaviour observed in the past. Therefore when policy variables are manipulated it often makes sense to impose bounds on the size of intercept shifts that may be imposed. The approach followed in the macro model is to restrict the size of intercept shifts to values within confidence bounds at a given probability level (e.g. 95% or 99%) judged in relation to past volatility of residual terms for the bloc and variable in question.

The macro-model provides an option to restrict add factors for policy instruments to values within a given range of probability, e.g 5% to 95%, or 1% to 99%. Bounds are calculated with reference to the historical distribution of residuals for the policy instrument in the relevant bloc.

## APPENDIX B Technical development of the macro-model

This appendix briefly outlines work in progress to further develop the macro-model as a tool for examination of global and regional trends relevant to the AUGUR project.

### Blocs and groups

The macro-model now supports a 2-level disaggregation of the world economy. The basic structure used for simulations is defined as the more detailed bloc level representing individual countries and country groups. Results for higher-level other groupings are derived by aggregation. This makes it possible to review outcomes for Europe and other world regions underpinned by a more detailed analysis at bloc (sub-regional) level.

### Data updates

The database and model have been updated in March 2011 to include historical data up to 2009. Baseline estimates for 2010-12 are currently aligned with the October 2010 WEO. These will shortly be updated to use the WEO of April 2011.

### Migration, employment, demography

The macro-model has been extended to provide demographic breakdowns by age group and simulate employment and net migration. These extensions are under review in the light of work by other AUGUR contributors (SOAS and CEPN) who have recommended further disaggregation by sex and broad economic sector.

### Savings behaviour

Other AUGUR contributors (CEPN) have suggested adjustment of the model's savings functions to take account of ageing or other demographic changes. Hypotheses will be tested and incorporated if appropriate in the next round of adjustment of the model.

### Productivity trends

The current employment equation in the model makes productivity (GDP per person employed) a function of the growth path of GDP and labour supply (population of working age). The productivity trend is implicit making it difficult to incorporate explicit assumptions about the independent influence of factors such as investment, technology and structural change. Further investigation will be made to check the feasibility of including additional structural variables or disaggregating the employment equation.

### Well-being indicators

A number of well-being indicators have been introduced into the databank and historical section of the macro-model and research by other AUGUR groups (notably ISMERI) has clarified historical relationships between several important indicators and macro-economic variables such as per capita. In the next round of adjustments the model will be extended to include equations that can be used to simulate baseline and scenario outcomes for well-being indicators.

### Carbon emissions and energy supply

The model has been extended with assistance from CIRED to provide estimates of carbon emissions based on a decomposition of energy supply and use between carbon sources (oil, gas and coal) and non-carbon sources (primary electricity). Further consideration may be given to disaggregation between carbon sources with very different emission characteristics and non-carbon sources with very different limits and risks (e.g. nuclear, solar, hydro) and to dynamic paths (time-scales) of possible substitution. The aim will be to synthesise information provided by IMACLIM and feed main results into the macro scenarios.

### Other indicators

Although indicators relevant to some other areas of the macro-model including agricultural production and industrial and service trade have been introduced into the databank, we do not thus far have any specific proposals for incorporating them as variables in the macro-model, either because the data are too fragmentary or because they may be hard to endogenise or require too much additional structure to implement at the aggregate level.

### Variant scenarios

The methodology adopted by CIRED for simulation of the IMACLIM energy model permits systematic examination of a large number of alternative outcomes, thereby enriching the analysis by providing an overview of the range of uncertainty in some critical dimensions.

By contrast simulations of the macro model reported in this paper are excessively smooth and deterministic. Two approaches that suggest themselves in this context are simulation with predefined patterns of exogenous shocks (stress tests) and stochastic simulation of selected behavioural elements.

Stress tests to clarify the impact of periodic financial or 'real' shocks will be introduced in the next round of analysis. Stochastic simulation is a more difficult challenge in a large non-linear macro-model and preliminary tests suggest that substantial further modification of the model's structure may be necessary to make it sufficiently robust to support stochastic simulation over a significant range of key behaviours.



## APPENDIX C Technical assumptions for the baseline and each scenario

### 1. Baseline

Aligned with WEO (October 2010) up to 2012. Model projections with residuals decaying to zero from 2013 onwards.

#### Baseline overrides

<i>Purpose</i>	<i>Description</i>	<i>Code</i>
Eurozone	South and Central Europe have same nominal exchange rate movements	call Target("rxu_EUS", "rxna_EUS-rxna_EUC", "0", 100,100)
Prevent negative inflation if growth slows down	Additional inflation impulse in China and CIS	pvi_CN_a = 0.05 pvi_CI_a = 0.10
China's balance on primary commodities	Prevent return to large surplus if growth slows down	BAOU_CN_a = -0.002

Note: the above are retained in all scenarios unless noted otherwise.

### 2. Reduced government scenario

Baseline residuals and overrides plus scenario overrides from 2012 onwards.

#### Scenario overrides

Note: all overrides are subject to a 95% confidence limit on the size of adjustments relative to historical residuals for the same variable and bloc.

<i>Purpose</i>	<i>Description</i>	<i>Code</i>
Labour market flexibility in US and Other Developed	Adjustment of relative costs and net migration to maintain employment rate	call Try("rxu_US", "NE_US/NWP_US", ".70", -.05, 20) call Link("NIMU_US", "rxu_US", 2) call Try("rxu_OD", "NE_OD/NWP_OD", ".70", -.1, 20) call Link("NIMU_OD", "rxu_OD", 2)
Labour market flexibility in North, West and East Europe	Adjustment of relative costs and net migration to maintain employment rate	call Try("rxu_EUN", "NE_EUN/NWP_EUN", ".65", -.1, 20) call Link("NIMU_EUN", "rxu_EUN", 2) call Try("rxu_EUW", "NE_EUW/NWP_EUW", ".65", -.1, 20) call Link("NIMU_EUW", "rxu_EUW", 2) call Try("rxu_EUE", "NE_EUE/NWP_EUE", ".60", -.1, 20) call Link("NIMU_EUE", "rxu_EUE", 2)
Labour market flexibility in Eurozone	Net migration to maintain employment rate	call Try("NIMU_EUS", "NE_EUS/NWP_EUS", ".65", -.3, 20) call Try("NIMU_EUC", "NE_EUC/NWP_EUC", ".65", -.3, 20)
Labour market flexibility in China	Adjustment of relative costs and net migration to avoid very high employment rate	call Try("rxu_CN", "NE_CN/NWP_CN", ".75", -.1, 20) call Link("NIMU_CN", "rxu_CN", 2)
Reduced government revenue in US, Europe and Other Developed	Targets for net revenue as % of GDP	call Target("YG_US", "YG_US/VV_US", ".15", 1, 30) call Target("YG_OD", "YG_OD/VV_OD", ".20", 1, 30) call Target("YG_EUN", "YG_EUN/VV_EUN", ".25", 1, 30)



Purpose	Description	Code
		call Target("YG_EUC","YG_EUC/VV_EUC", ".20", 1, 30) call Target("YG_EUE","YG_EUE/VV_EUE", ".20", 1, 30) call Target("YG_EUS","YG_EUS/VV_EUS", ".20", 1, 30) call Target("YG_EUW","YG_EUW/VV_EUW", ".20", 1, 30)
Asset sales and reduced government spending to reduce debt/GDP ratio in US, Europe and Other Developed	Ceilings for government debt as % of GDP	call Ceiling("G_US","100*LG_US/VV_US(-1)", "60",100,10) call Link("IAGO_US","G_US", 1) call Ceiling("G_OD","100*LG_OD/VV_OD(-1)", "60",100,10) call Link("IAGO_OD","G_OD", 1) call Ceiling("G_EUN","100*LG_EUN/VV_EUN(-1)", "60",100,10) call Link("IAGO_EUN","G_EUN", 1) call Ceiling("G_EUC","100*LG_EUC/VV_EUC(-1)", "60", 100,10) call Link("IAGO_EUC","G_EUC", 1) call Ceiling("G_EUE","100*LG_EUE/VV_EUE(-1)", "60",100,10) call Link("IAGO_EUE","G_EUE", 1) call Ceiling("G_EUS","100*LG_EUS/VV_EUS(-1)", "60",100,10) call Link("IAGO_EUS","G_EUS", 1) call Ceiling("G_EUW","100*LG_EUW/VV_EUW(-1)", "60",100,10) call Link("IAGO_EUW","G_EUW", 1)
Asset sales and reduced government spending in Japan	Ceiling for government debt at % of GDP	call Ceiling("G_JA","100*LG_JA/VV_JA(-1)", "150",100,10) call Link("IAGO_JA","G_JA", 1)
Trend to locate industrial production in India and South America	Increased share of world export markets for manufactures taken by India and South America	sxmu_AMS_ins = 0.1 sxmu_IN_ins = 0.1
Trend to extract more primary commodity exports from Africa and South America	Increased net exports of primary commodities from Africa and South America	BAOU_AFS_ins = 0.003 BAOU_AFN_ins = BAOU_AFS_ins BAOU_AMS_ins = 0.5*BAOU_AFS_ins
Trend to invest more in non-carbon energy supply in the US, parts of Europe, China and India (less government restriction)	Increased non-carbon energy production in the relevant areas	EPN_US_ins = 0.10 EPN_EUC_ins = 0.15 EPN_EUW_ins = 0.15 EPN_CN_ins = 0.20 EPN_IN_ins = 0.10



### 3. US-China cooperation

#### Scenario overrides

Note: all overrides are subject to a 95% confidence limit on the size of adjustments relative to historical residuals for the same variable and bloc.

<i>Purpose</i>	<i>Description</i>	<i>Code</i>
Gradual realignment of relative costs	Coordinated long-term real exchange rate alignment between the US, China and Europe	call Target("rxu_US", "@pc(rx_US)", "-1", 90 ,100) call Target("rxu_EUC", "@pc(rx_EUC)", "0", 90 ,100) call Target("rxu_CN", "@pc(rx_CN)", "1", 90 ,100)
Job creation in the US, Europe and Other Developed	Labour market policies tending to reduce GDP per person employed	call Target("NE_US", "NE_US/NWP_US", ".70", 0.1, 50) call Target("NE_OD", "NE_OD/NWP_OD", ".70", 0.1, 50) call Target("NE_EUN", "NE_EUN/NWP_EUN", ".70", 0.1, 50) call Target("NE_EUC", "NE_EUC/NWP_EUC", ".65", 0.1, 50) call Target("NE_EUS", "NE_EUS/NWP_EUS", ".65", 0.1, 50) call Target("NE_EUW", "NE_EUW/NWP_EUW", ".65", 0.1, 50) call Target("NE_EUE", "NE_EUE/NWP_EUE", ".60", 0.1, 50)
Increased labour productivity in China	Labour market policies tending to increase GDP per person employed	call Target("NE_CN", "NE_CN/NWP_CN", ".75", 0.1, 50)
Labour market flexibility in China	Adjustment of relative costs and net migration to avoid very high employment rate	call Try("rxu_CN", "NE_CN/NWP_CN", ".75", -.1, 20) call Link("NIMU_CN", "rxu_CN", 2)
Increased GDP growth and reduced c/a surpluses in East Asia	Current account ceiling equal to 3 % of GDP in China, Japan and Other East Asia High Income, achieved through real exchange rate adjustment, reduced savings and increased imports of manufactures and services	call Ceiling("SP_JA", "100*CA\$_JA/Y\$_JA", "3", 100,10) call Link("rxu_JA", "SP_JA", -1) call Link("MM\$_JA", "SP_JA", -1) call Link("BS\$_JA", "SP_JA", 1) call Ceiling("SP_EAH", "100*CA\$_EAH/Y\$_EAH", "3", 100,10) call Link("rxu_EAH", "SP_EAH", -0.5) call Link("MM\$_EAH", "SP_EAH", -0.5) call Link("BS\$_EAH", "SP_EAH", 0.5) call Ceiling("SP_CN", "100*CA\$_CN/Y\$_CN", "3", 100,10) call Link("MM\$_CN", "SP_CN", -0.5) call Link("BS\$_CN", "SP_CN", 0.5)
Regulation of the real price of oil to encourage long-term energy saving and substitution of alternative fuels	Control of oil and gas supply in all main producing areas including the US, China, West Asia, the CIS group, North Africa, etc. to maintain a steady increase in the real price of oil at 1% p.a.	call Target("EPC_WA", "@pc(pe_w)", "1", -500, 100) call Link("EPC_CI", "EPC_WA", 0.5) call Link("EPC_AFN", "EPC_WA", 0.5) call Link("EPC_ACX", "EPC_WA", 0.5) call Link("EPC_AMS", "EPC_WA", 0.25) call Link("EPC_OD", "EPC_WA", 0.25) call Link("EPC_US", "EPC_WA", 0.25) call Link("EPC_CN", "EPC_WA", 0.25) call Link("EPC_EAO", "EPC_WA", 0.15)
Trend to invest more in non-carbon energy supply in the US, parts of Europe, China and India (with government support)	Increased non-carbon energy production in the relevant areas	EPN_US_ins = 0.10 EPN_EUC_ins = 0.10 EPN_EUW_ins = 0.10 EPN_CN_ins = 0.15 EPN_IN_ins = 0.10

## 4. Global cooperation

### Scenario overrides

Note: all overrides are subject to a 95% confidence limit on the size of adjustments relative to historical residuals for the same variable and bloc.

Purpose	Description	Code
Sustained growth of demand in Europe	Stable expansion of government spending in each part of Europe at rates appropriate to long-term GDP growth targets	call Target("G_EUE", "@pc(G_EUE)", "4", 100, 100) call Target("G_EUN", "@pc(G_EUN)", "2", 100, 100) call Target("G_EUC", "@pc(G_EUC)", "2", 100, 100) call Target("G_EUS", "@pc(G_EUS)", "3", 100, 100) call Target("G_EUW", "@pc(G_EUW)", "2", 100, 100)
Job creation in the US, Europe and Other Developed	Labour market policies tending to reduce GDP per person employed	call Target("NE_US", "NE_US/NWP_US", ".70", 0.1, 50) call Target("NE_OD", "NE_OD/NWP_OD", ".70", 0.1, 50) call Target("NE_EUN", "NE_EUN/NWP_EUN", ".70", 0.1, 50) call Target("NE_EUW", "NE_EUW/NWP_EUW", ".65", 0.1, 50) call Target("NE_EUE", "NE_EUE/NWP_EUE", ".60", 0.1, 50)
Increased labour productivity in China	Labour market policies tending to increase GDP per person employed	call Target("NE_CN", "NE_CN/NWP_CN", ".75", 0.1, 50)
Labour market flexibility in China	Adjustment of relative costs and net migration to avoid very high employment rate	call Try("rxu_CN", "NE_CN/NWP_CN", ".75", -.1, 20) call Link("NIMU_CN", "rxu_CN", 2)
Increased GDP growth and reduced c/a surpluses in East Asia	Current account ceiling equal to 3 % of GDP in China, Japan and Other East Asia High Income, achieved through real exchange rate adjustment, reduced savings and increased imports of manufactures and services	call Ceiling("SP_JA", "100*CA\$_JA/Y\$_JA", "3", 100, 10) call Link("rxu_JA", "SP_JA", -1) call Link("MM\$_JA", "SP_JA", -1) call Link("BS\$_JA", "SP_JA", 1) call Ceiling("SP_EAH", "100*CA\$_EAH/Y\$_EAH", "3", 100, 10) call Link("rxu_EAH", "SP_EAH", -0.5) call Link("MM\$_EAH", "SP_EAH", -0.5) call Link("BS\$_EAH", "SP_EAH", 0.5) call Ceiling("SP_CN", "100*CA\$_CN/Y\$_CN", "3", 100, 10) call Link("MM\$_CN", "SP_CN", -0.5) call Link("BS\$_CN", "SP_CN", 0.5) call Ceiling("SP_IN", "100*CA\$_IN/Y\$_IN", "3", 100, 10) call Link("MM\$_IN", "SP_IN", -0.5) call Link("BS\$_IN", "SP_IN", 0.5)
Stronger reserves and stable real exchange rates in low income regions	Financial support from global financial institutions and central banks in high income regions	call Floor("R\$_AFS", "R\$_AFS/(RX_AFS*VV_AFS)", "0.2", 0.1, 30) call Floor("R\$_ASO", "R\$_ASO/(RX_ASO*VV_ASO)", "0.2", 0.1, 30) call Floor("R\$_EAO", "R\$_EAO/(RX_EAO*VV_EAO)", "0.2", 0.1, 30) call Floor("rxu_AFS", "rx_AFS", "0.4", 1, 100) call Floor("rxu_ASO", "rx_ASO", "0.4", 1, 100) call Floor("rxu_EAO", "rx_EAO", "0.4", 1, 100)

<i>Purpose</i>	<i>Description</i>	<i>Code</i>
Government revenue and spending in low income regions	Target growth rates for government spending and target levels of revenue relative to GDP	call Target("YG_AFS", "YG_AFS/VV_AFS", ".15", 1, 30) call Target("YG_ASO", "YG_ASO/VV_ASO", ".15", 1, 30) call Target("YG_EAO", "YG_EAO/VV_EAO", ".15", 1, 30) call Target("G_AFS", "@pc(G_AFS)", "10", 100, 100) call Target("G_ASO", "@pc(G_ASO)", "10", 100, 100) call Target("G_EAO", "@pc(G_EAO)", "10", 100, 100)
Target minimum government spending in India	Target for government spending as % GDP	call Target("G_IN", "G_IN/VV_IN", "0.15", 0.15, 100)
Location of industrial production in low and middle income regions	Increased share of world export markets for manufactures taken by relevant blocs	sxmu_AFS_ins = 0.1 sxmu_AFN_ins = sxmu_AFS_ins sxmu_ASO_ins = sxmu_AFS_ins sxmu_IN_ins = 0.5*sxmu_AFS_ins sxmu_WA_ins = 0.5*sxmu_AFS_ins sxmu_EAO_ins = 0.5*sxmu_AFS_ins sxmu_AMS_ins = 0.5*sxmu_AFS_ins sxmu_CI_ins = 0.5*sxmu_AFS_ins
Increased primary commodity production in Africa, India and Other South Asia	Increased net exports or reduced net imports	BA0U_AFS_ins = 0.003 BA0U_ASO_ins = 0.5*BA0U_AFS_ins BA0U_IN_ins = 0.5*BA0U_AFS_ins BA0U_EAO_ins = 0.5*BA0U_AFS_ins BA0U_AFN_ins = 0.5*BA0U_AFS_ins
Regulation of the real price of oil to encourage long-term energy saving and substitution of alternative fuels	Control of oil and gas supply in all main producing areas including the US, China, West Asia, the CIS group, North Africa, etc. to maintain a steady increase in the real price of oil at 1.5% p.a.	call Target("EPC_WA", "@pc(pe_w)", "1.5", -500, 100) call Link("EPC_CI", "EPC_WA", 0.5) call Link("EPC_AFN", "EPC_WA", 0.5) call Link("EPC_ACX", "EPC_WA", 0.5) call Link("EPC_AMS", "EPC_WA", 0.25) call Link("EPC_OD", "EPC_WA", 0.25) call Link("EPC_US", "EPC_WA", 0.25) call Link("EPC_CN", "EPC_WA", 0.25) call Link("EPC_EAO", "EPC_WA", 0.15)
Investment in non-carbon energy supply in high, middle and low income regions	Increased non-carbon energy production in the relevant areas	EPN_US_ins = 0.10 EPN_EUC_ins = 0.10 EPN_EUW_ins = 0.10 EPN_CN_ins = 0.15 EPN_IN_ins = 0.15 EPN_ACX_ins = 0.15 EPN_AMS_ins = 0.15 EPN_EAO_ins = 0.15 EPN_ASO_ins = 0.15 EPN_AFS_ins = 0.15
Reduced energy dependence	Intensified energy saving in all blocs	ED_xxx_ins = -0.01 (all blocs)
Reduced CO2 emissions	Reduced emissions per ton of carbon-based energy	CO2_xxx_ins = -0.000005 (all blocs)

## 5. Regionalisation

Baseline residuals and overrides plus scenario overrides from 2012 onwards.

### Scenario overrides

Note: all overrides are subject to a 95% confidence limit on the size of adjustments relative to historical residuals for the same variable and bloc.

<i>Purpose</i>	<i>Description</i>	<i>Code</i>
<b>EUROPEAN POLICY</b>		
Sustained growth of demand and balanced development	Stable real exchange rate for non-Eurozone members and investment incentives in each part of Europe to promote convergence of living standards	call Target("rxu_EUN", "rx_EUN/rx_EUC", "1.1", 1 ,20) call Target("rxu_EUW", "rx_EUW/rx_EUC", "1", 1 ,20) call Target("rxu_EUE", "rx_EUE/rx_EUC", ".8", 1 ,20) call Target("IP_EUN", "@pc(H_EUN)", "2", 25, 50) call Target("IP_EUC", "@pc(H_EUC)", "2", 25, 50) call Target("IP_EUE", "@pc(H_EUE)", "4.5", 25, 50) call Target("IP_EUS", "@pc(H_EUS)", "3.5", 25, 50) call Target("IP_EUW", "@pc(H_EUW)", "3", 25, 50)
Reduced emissions	Investment in non-carbon energy in all regions	EPN_EUC_ins = 0.1 EPN_EUN_ins = EPN_EUC_ins EPN_EUE_ins = EPN_EUC_ins EPN_EUS_ins = EPN_EUC_ins EPN_EUW_ins = EPN_EUC_ins
<b>AMERICAN GROUP</b>		
Sustained growth of demand and balanced development	Stable real exchange rates and investment incentives to promote convergence of living standards	call Target("rxu_OD", "rx_OD/rx_US", "1.2", 1 ,50) call Target("rxu_ACX", "rx_ACX/rx_US", ".6", 1 ,50) call Target("rxu_AMS", "rx_AMS/rx_US", ".6", 1 ,50) call Target("IP_US", "@pc(H_US)", "3", 25, 50) call Target("IP_OD", "@pc(H_OD)", "3", 25, 50) call Target("IP_ACX", "@pc(H_ACX)", "4.5", 25, 50) call Target("IP_AMS", "@pc(H_AMS)", "5", 25, 50)
Secure internal market for manufactures	Increased share of intra-trade	sxmu_ss_pp_ins = 0.05 for each supplier ss and partner pp within the continental group
Reduced emissions	Investment in non-carbon energy in all regions	EPN_US_ins = 0.1 EPN_OD_ins = EPN_US_ins EPN_ACX_ins = EPN_US_ins EPN_AMS_ins = EPN_US_ins
<b>AFRICAN GROUP</b>		
Sustained growth of demand and balanced development	Stable real exchange rates and investment incentives to promote convergence of living standards	call Target("rxu_AFS", "rx_AFS/rx_AFN", ".5", 1 ,50) call Target("IP_AFS", "@pc(H_AFS)", "8", 25, 50) call Target("IP_AFN", "@pc(H_AFN)", "6", 25, 50)
Secure internal market for manufactures	Increased share of intra-trade	sxmu_ss_pp_ins = 0.07 for each supplier ss and partner pp within the continental group
Reduced emissions	Investment in non-carbon energy in all regions	EPN_AFN_ins = 0.05 EPN_AFS_ins = EPN_AFN_ins

# WP1 macro-model: governance scenarios to 2030

<i>Purpose</i>	<i>Description</i>	<i>Code</i>
<b>EAST ASIA GROUP</b>		
Sustained growth of demand and balanced development	Stable real exchange rates and investment incentives to promote convergence of living standards	call Target("rxu_EAO", "rx_EAO/rx_CN", "1", 1 ,50) call Target("rxu_EAH", "rx_EAH/rx_CN", "1.6", 1 ,50) call Target("rxu_JA", "rx_JA/rx_CN", "2.2", 1 ,50) call Target("IP_CN", "@pc(H_CN)", "8", 25, 50) call Target("IP_EAO", "@pc(H_EAO)", "8", 25, 50) call Target("IP_EAH", "@pc(H_EAH)", "4", 25, 50) call Target("IP_JA", "@pc(H_JA)", "2", 25, 50)
Secure internal market for manufactures	Increased share of intra-trade	sxmu_ss_pp_ins = 0.05 for each supplier ss and partner pp within the continental group
Reduced emissions	Investment in non-carbon energy in all regions	EPN_CN_ins = 0.1 EPN_EAH_ins = EPN_CN_ins EPN_EAO_ins = EPN_CN_ins EPN_JA_ins = EPN_CN_ins
<b>OTHER ASIA</b>		
Sustained growth of demand and balanced development	Stable real exchange rates and investment incentives to promote convergence of living standards	call Target("rxu_CI", "rx_CI/rx_WA", "1", 1 ,50) call Target("rxu_ASO", "rx_CI/rx_WA", ".6", 1 ,50) call Target("rxu_IN", "rx_CI/rx_WA", ".6", 1 ,50) call Target("IP_WA", "@pc(H_WA)", "6", 25, 50) call Target("IP_CI", "@pc(H_CI)", "4", 25, 50) call Target("IP_ASO", "@pc(H_ASO)", "8", 25, 50) call Target("IP_IN", "@pc(H_IN)", "8", 25, 50)
Secure internal market for manufactures	Increased share of intra-trade	sxmu_ss_pp_ins = 0.05 for each supplier ss and partner pp within the continental group
Reduced emissions	Investment in non-carbon energy in all regions	EPN_WA_ins = 0.05 EPN_CI_ins = EPN_WA_ins EPN_ASO_ins = EPN_WA_ins EPN_IN_ins = EPN_WA_ins