Globalisation and the Environment

Dr John Llewellyn

Senior Economic Policy Advisor

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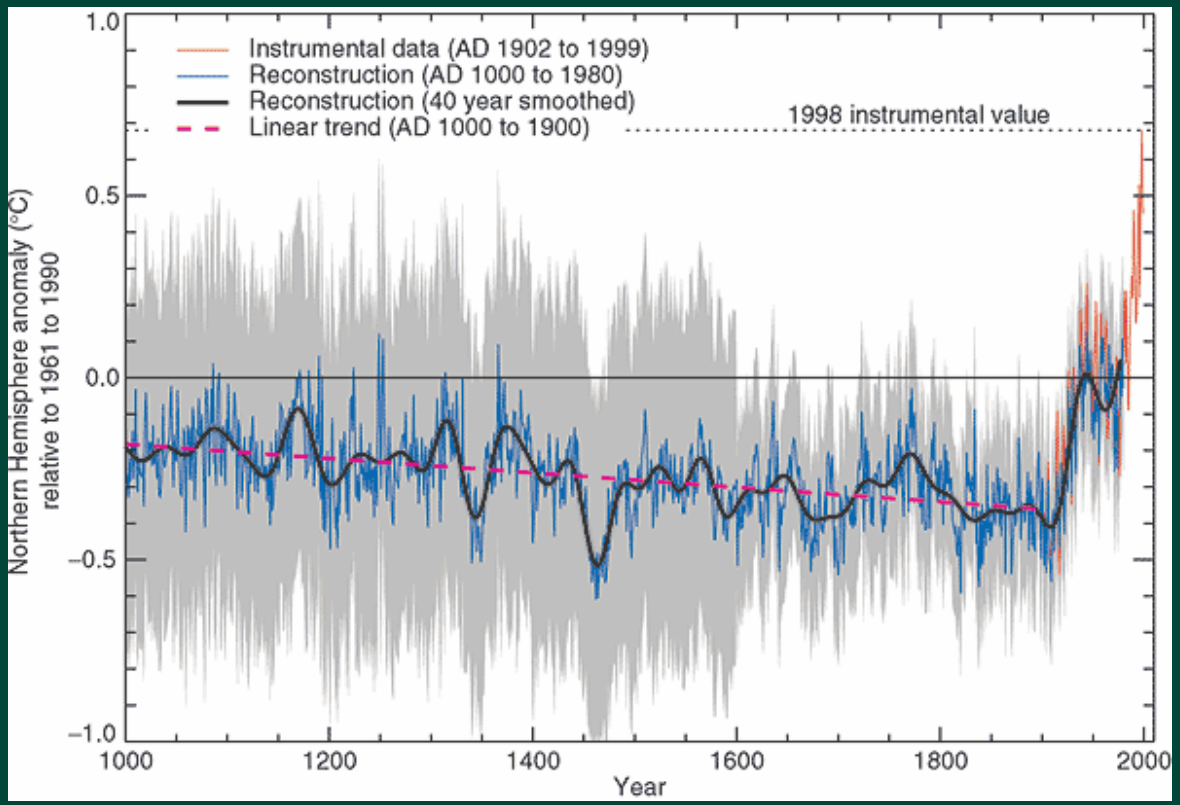
LEHMAN BROTHERS

The warming of planet Earth

There is now fairly broad agreement that man is responsible



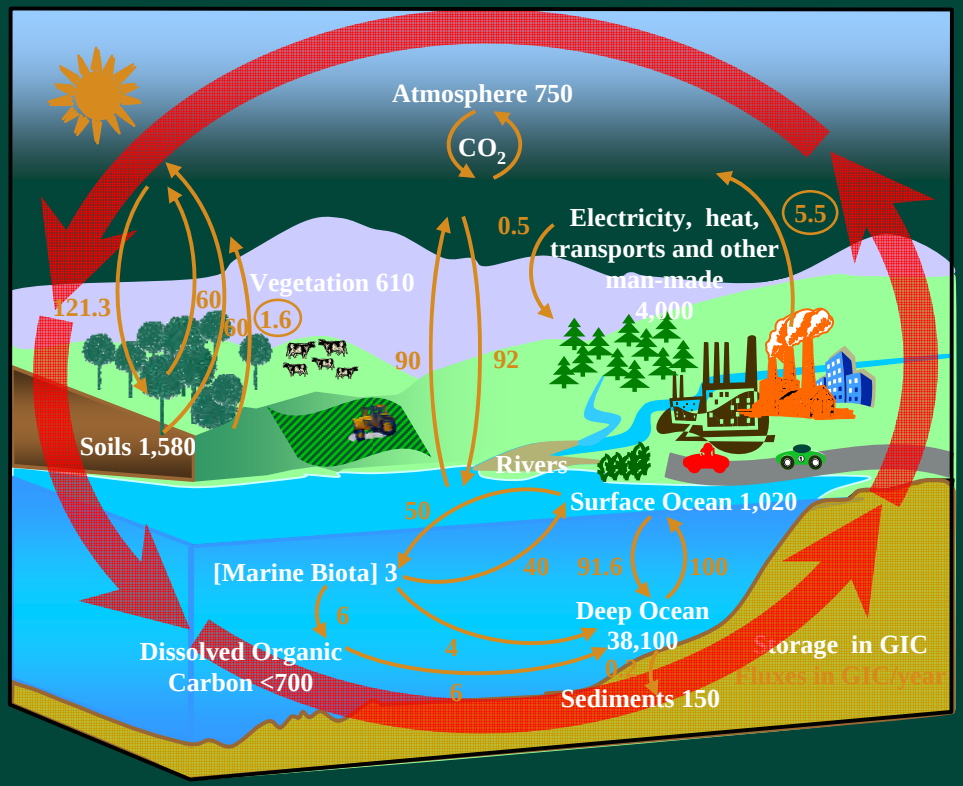
- Most scientific bodies, including the scientific academies of 11 countries, and importantly the US National Academy of Sciences, agree that:
  - Global temperatures have risen markedly in recent decades;
  - This is due in large part to rising atmospheric concentrations of greenhouse gases; and
  - Mankind has largely been responsible for this

Sources: Intergovernmental Panel on Climate Change (2001), 'Climate change 2001: The Scientific Basis'; Mann, M.E. et al. (1998); McIntyre, S. and McKitrick, R. (2003); and the National Academies website.

Nature, carbon cycle, and man-made emissions

Greenhouse gases are warming the planet

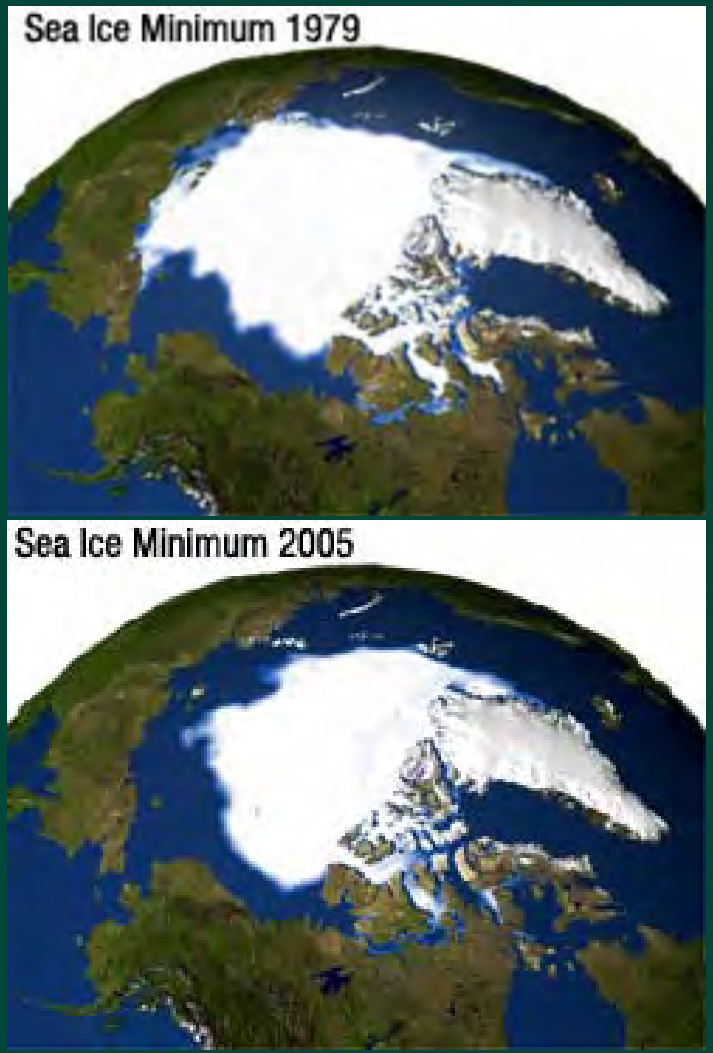
Values in giga tonnes



- Natural carbon transfers net approximately to zero
- Atmospheric CO_2 concentration has increased from 280ppmv in 1880 to more than 380ppmv today
- Isotopic fingerprinting identifies burnt coal, oil, and gas as the principal source
- Man-made emissions are estimated at around 7.1 giga tonnes per year
- About half of these remain in the atmosphere for one hundred years
- Each doubling of atmospheric CO_2 concentration raises Earth's mean temperature by 3ºC

Source: NASA Earth Observatory website, <http://earthobservatory.nasa.gov/Library/CarbonCycle/>.

Recent evidence on the speed of global warming



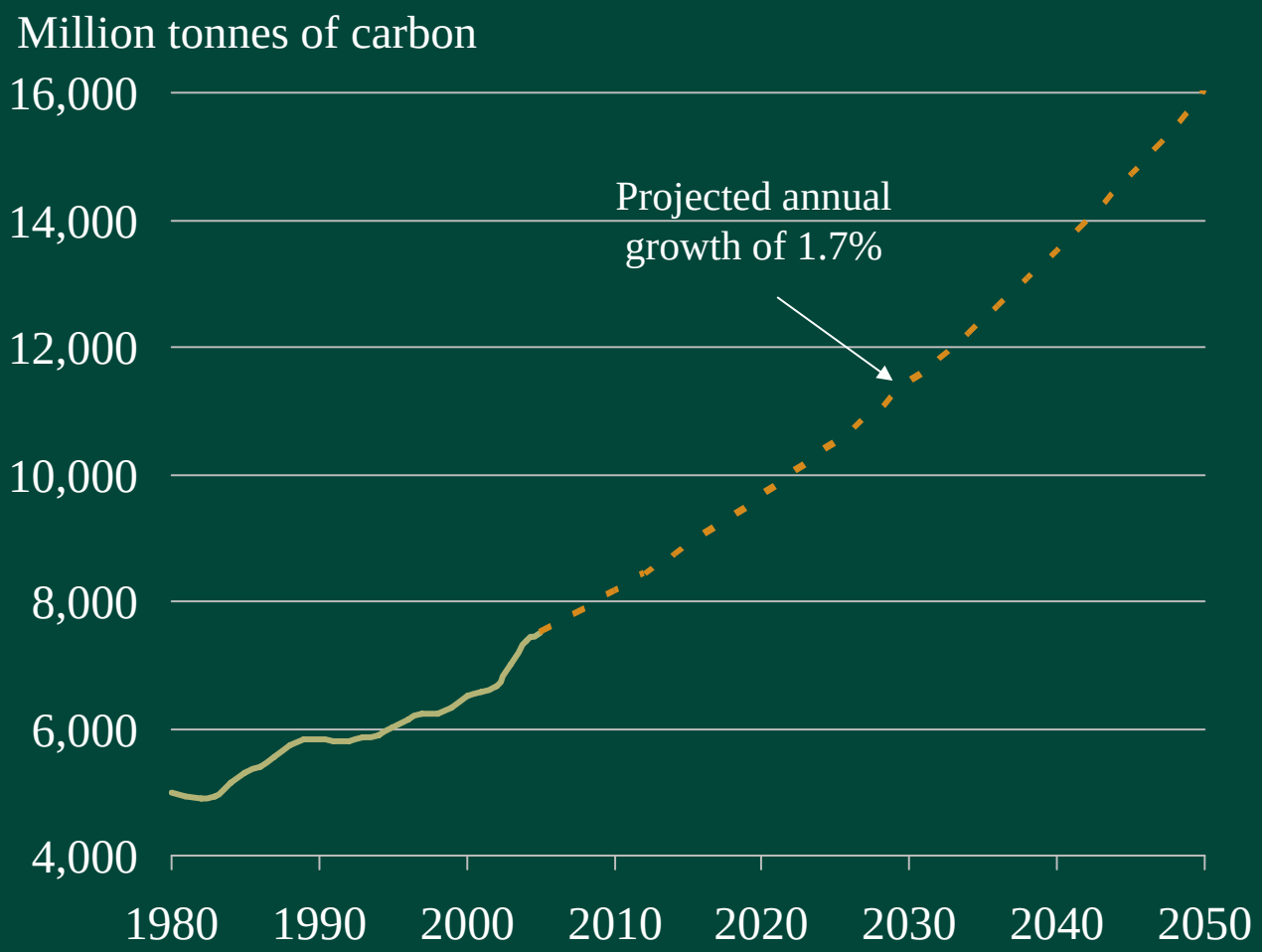
Arctic ice is retreating

- The most recent evidence is that positive feedbacks are causing Earth to warm faster than expected
- Melting of the ice is accelerating: in 1996, 92bn cubic metres of Greenland ice melted away. In 2005, the figure was 220bn cubic metres
- This record-high melt was superseded in summer 2007
- Arctic perennial ice shrank by 14% between 2004 and 2005, 18 times the rate of previous years. The decrease totalled 720,000 square kilometres, the equivalent of the size of Texas
- Some researchers foresee the possibility of ice-free arctic summers by 2040

Sources: NASA website, <http://www.nasa.gov/centers/goddard/news/topstory/2005/arcticice_decline.html>; Holland, M.M. (2006), 'Future Abrupt Reduction in the Summer Arctic Sea Ice'.

World carbon emissions from burning fuels

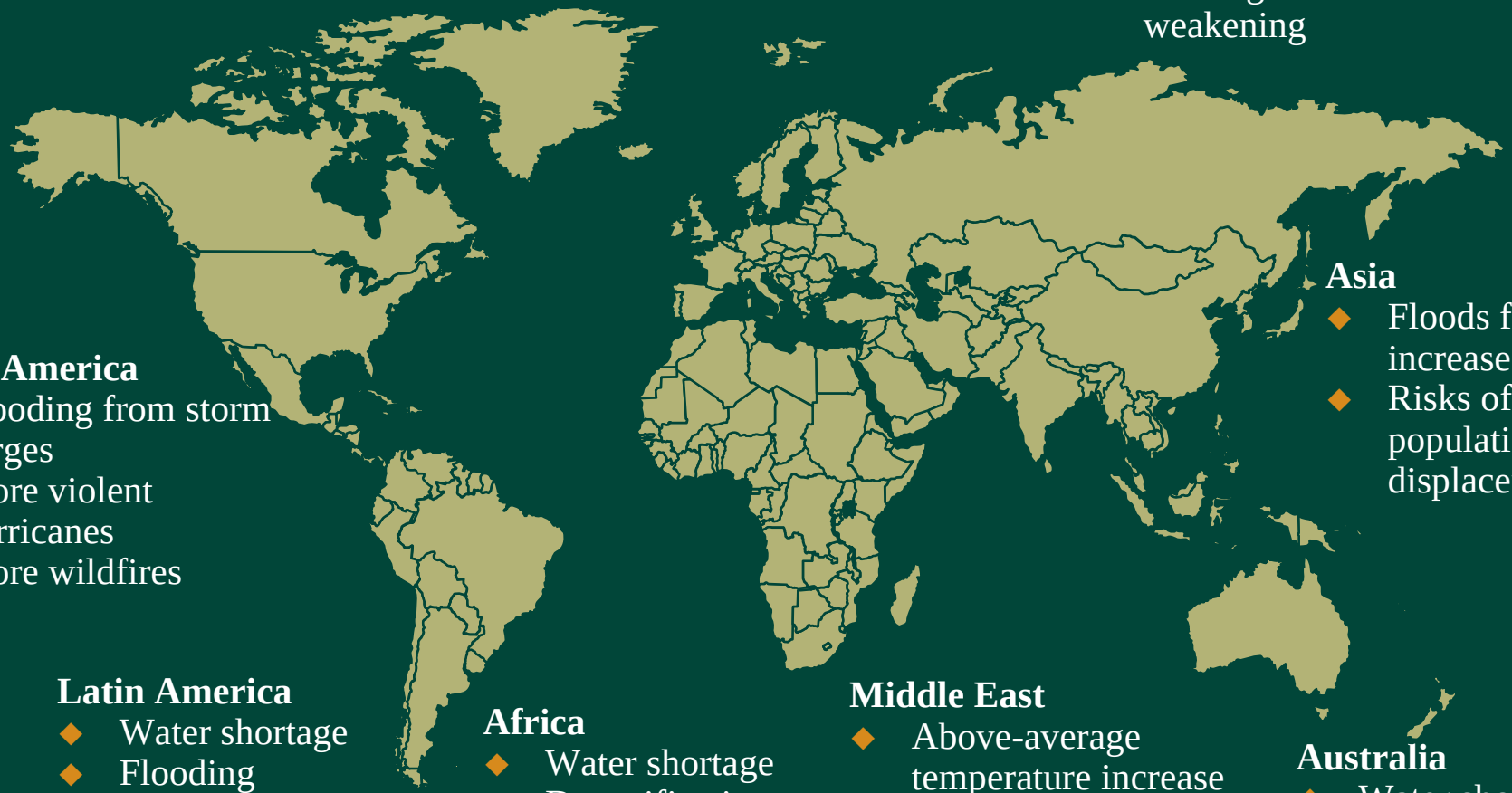
The IEA projects 1.7% annual growth of emissions



- Because of thermal inertia, even were CO_2 emissions to cease today, Earth's temperature would rise further – by around 1ºC over the coming 50 to 100 years
- However, "business as usual" emissions stand to grow at an annual rate of 1.7%
- In turn, IPCC scenarios suggest a 1.1ºC to 6.4ºC increase in mean temperature by 2100

Source: Energy Information Administration; International Energy Agency (2006), 'World Energy Outlook for 2006'; IPCC; and Lehman Brothers.

Climatology: Global and regional scenarios



Northern polar circle
- Thawing permafrost: good for agriculture, but damaging for infrastructure
- Arctic may open for transport

Europe
- River flooding
- Disappearance of glaciers
- Cooling due to Gulf Stream weakening

Asia
- Floods frequency increase
- Risks of big population displacements

North America
- Flooding from storm surges
- More violent hurricanes
- More wildfires

Latin America
- Water shortage
- Flooding
- Spread of diseases

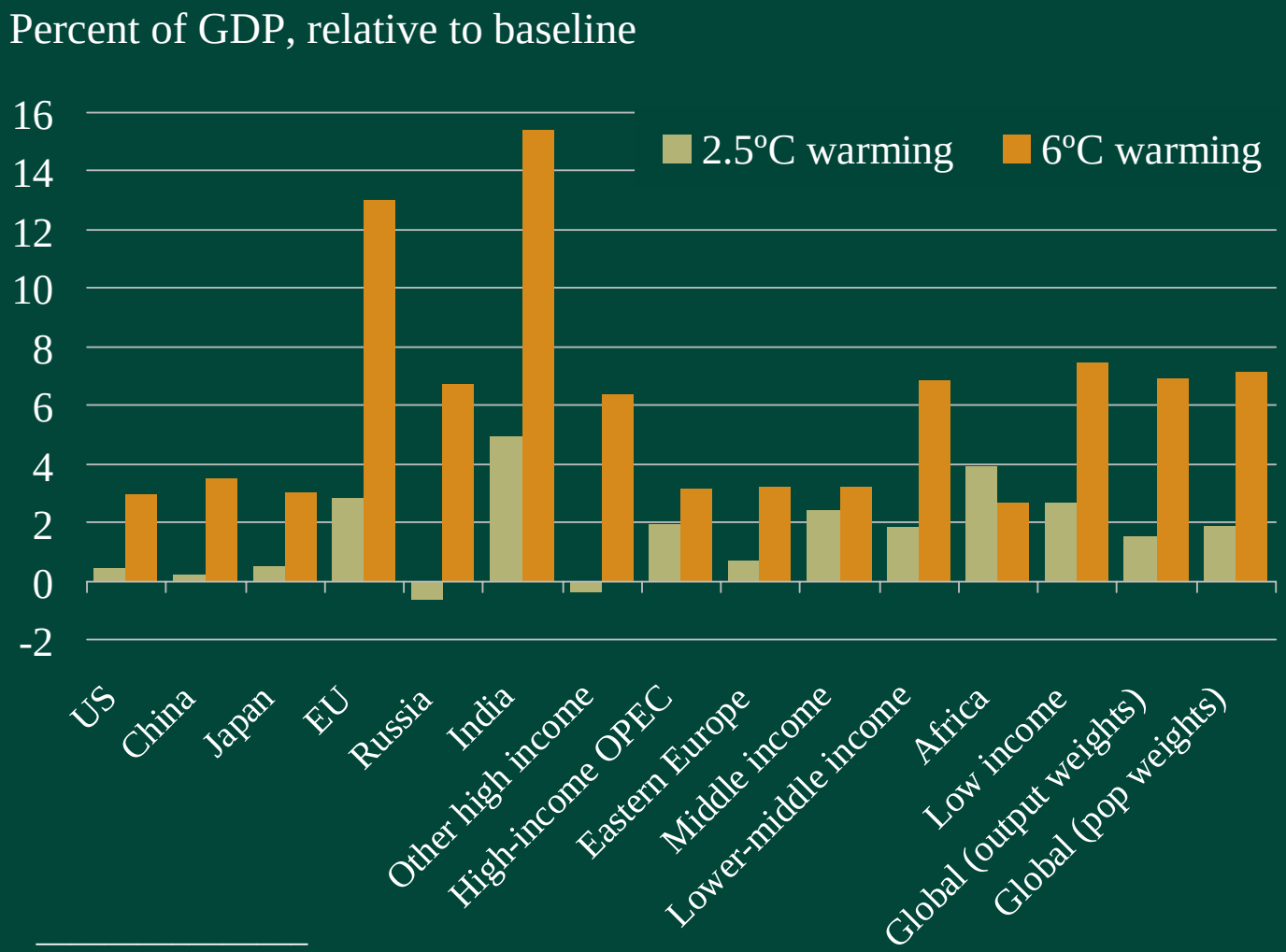
Africa
- Water shortage
- Desertification
- Spread of diseases

Middle East
- Above-average temperature increase
- North: more drought
- South: more rain

Australia
- Water shortage
- Coral reefs and alpine systems endangered

Climate change costs by region

Effects of global warming differ across regions



- Conservative estimates put the global cost at 2 to 3% of GDP annually by say 2100
- Some countries stand to benefit (Russia); while others may be seriously damaged (India)
- Economic cost rises disproportionately with temperature
- Moreover, there is a risk of catastrophic damage to the biosphere

Source: Nordhaus, W.D. and Boyer, J. (1999), 'Roll the DICE again: The Economics of Global Warming', Yale University.

Scientists, technologists, and economists

So far, the dialogue has been rather limited

- **Scientists**, insisting that greenhouse gas concentrations must not go above 550ppmv, and thereafter must be reduced, calculate that greenhouse gas emissions must be reduced by 30% to 70% relative to "business as usual" by 2050
- **Technologists** say that many useful technologies exist already, but that some needed new ones – most notably carbon capture and sequestration – are yet to be developed. Typically, they lament that their technologies are not taken up: but they tend to ignore cost
- **Economists** speak little of technology, and insist on the role of the price mechanism in ensuring that emission reduction is achieved in the most economical, i.e. lowest cost way. They would attribute a key role to either a tax on carbon or auctioning permits to emit ("cap and trade")

➢ **The three groups** have not yet proved very adept at discussing with one another: they remain largely on their respective islands

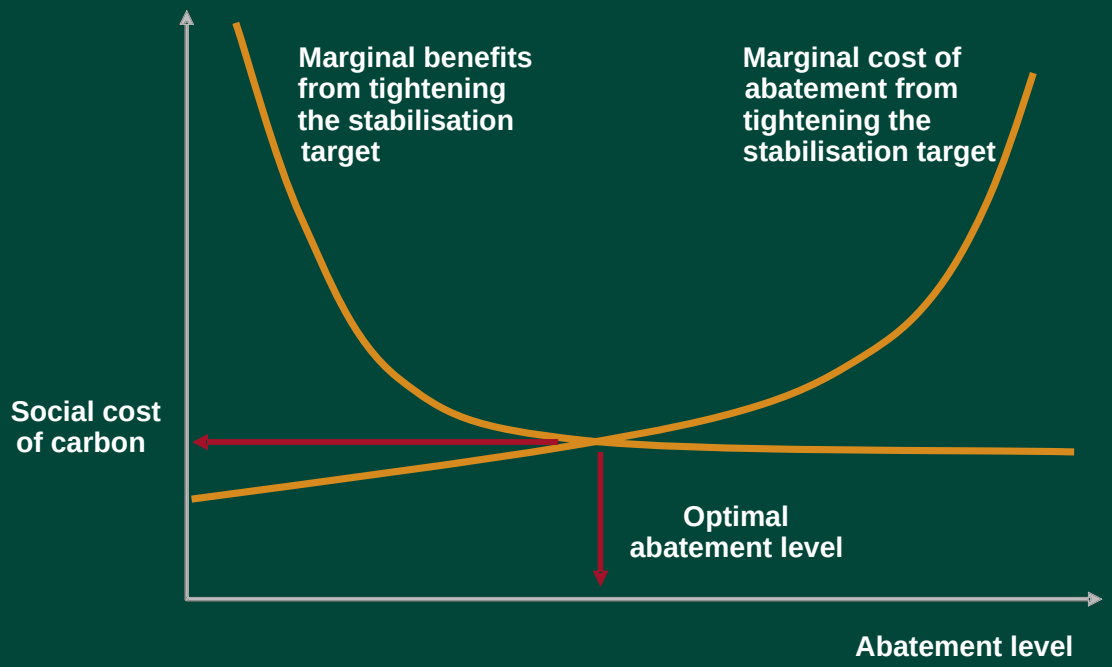
Climate change policies and the price of carbon

Every emissions-reducing policy carries a price of carbon

- Tax-based policies and emissions trading schemes both carry an explicit price of carbon
- Other policies, such as regulations, standards, technology pushes, carry an implicit price of carbon: e.g:
  - Hydroelectricity and on-shore wind turbines: negative price
  - Energy-efficient light bulbs: $10 per tonne of carbon
  - European car regulation: reduction of autos' emissions from 160g CO_2/km to 120g CO_2/km may value one tonne of carbon between $700 and $2,300
  - Solar PVs: $6,300 per tonne of carbon
- Similarly, new technology development carries a price tag, with an implicit price of carbon
- So what price, and hence what policies, would be rational?

The ‘social’ cost of carbon

Policy should aim for a carbon price as close as possible to the ‘social’ cost of carbon

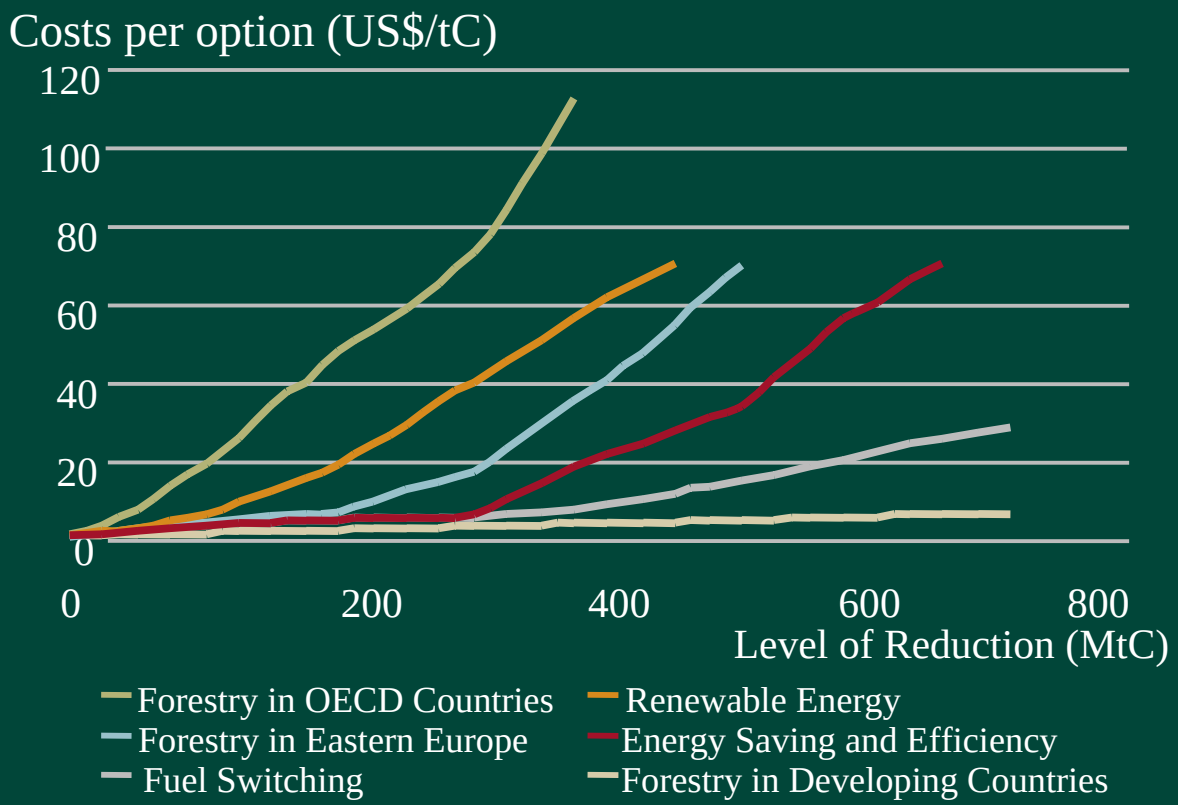


- A “top-down” economists’ approach would reduce emissions just to the point where the (marginal) cost of so doing just equals the (marginal) value of the damage thereby avoided

Source: Lehman Brothers.

Costs of abatement

Two principal features of abatement costs

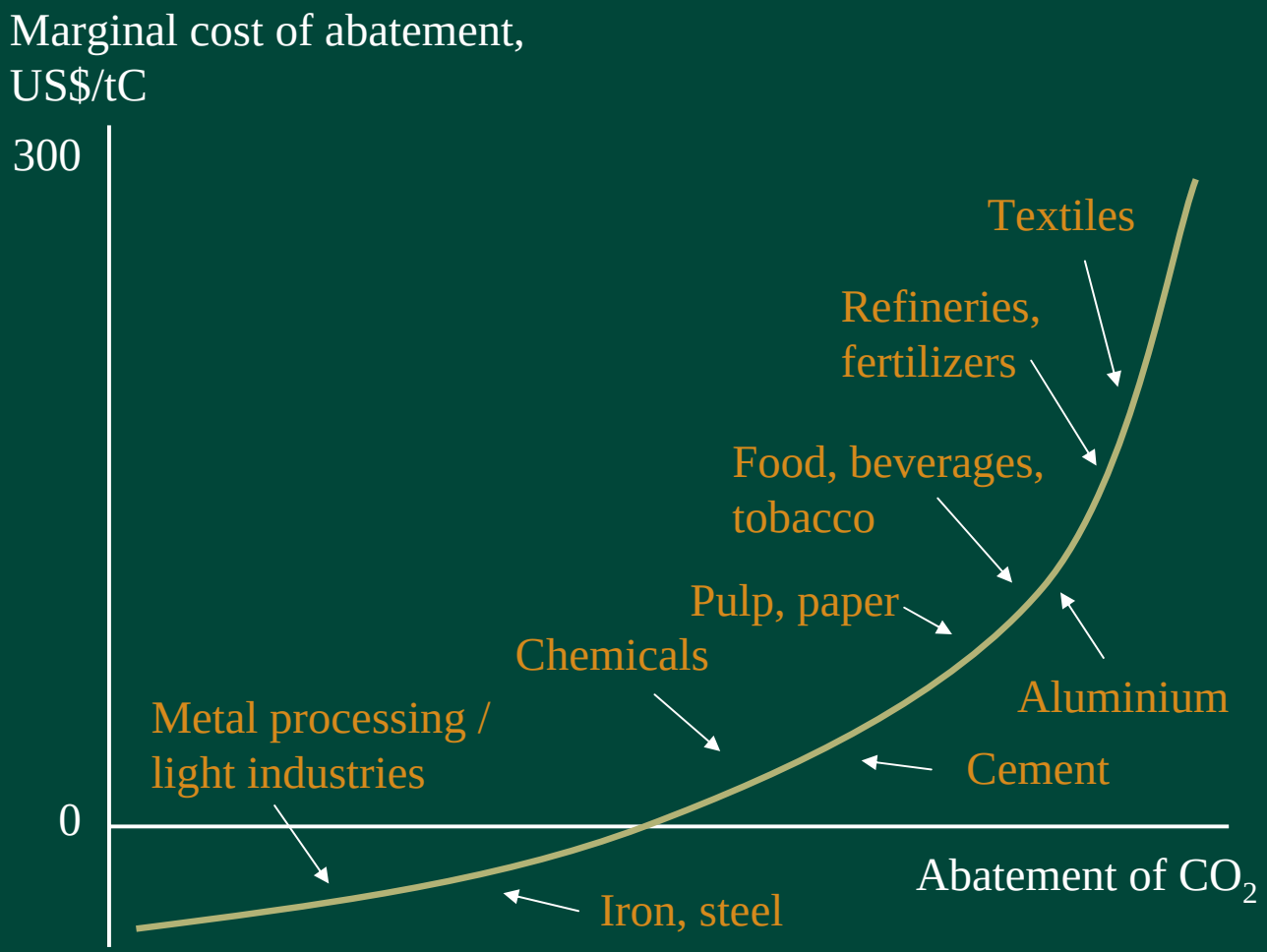


- The "bottom-up" approach looks at the costs of reducing emissions by different methods. It recognises that:
  - Abatement cost rises, more than proportionately, with the scale of abatement
  - Abatement cost differs considerably by activity

Source: Intergovernmental Panel on Climate Change (IPCC) 2001, 'Climate Change 2001: Mitigation', ch.4.

Cost of improving energy efficiency

Similarly, abatement cost differs importantly across sectors



- Greenhouse gas emissions may be reduced through improving energy efficiency with old and new technologies
- Cost of investing in capital and equipment differs considerably by sector
- For some sectors the abatement cost may even be negative: e.g. for metal processing and light industries

Source: Intergovernmental Panel on Climate Change (2001), "Climate Change 2001: Mitigation", ch.4.

So: how much should society be prepared to pay?

"Bottom-up" and "top-down" analyses both suggest lower costs than the value of the damage avoided

- Expenditure of around 1% of global GDP annually would, even on conservative estimates, save economic damage of around 3% of global GDP annually
- This represents a good payoff
- Moreover, to the extent that it would reduce the risk of catastrophic damage, it represents an even better payoff

A global policy for a global problem

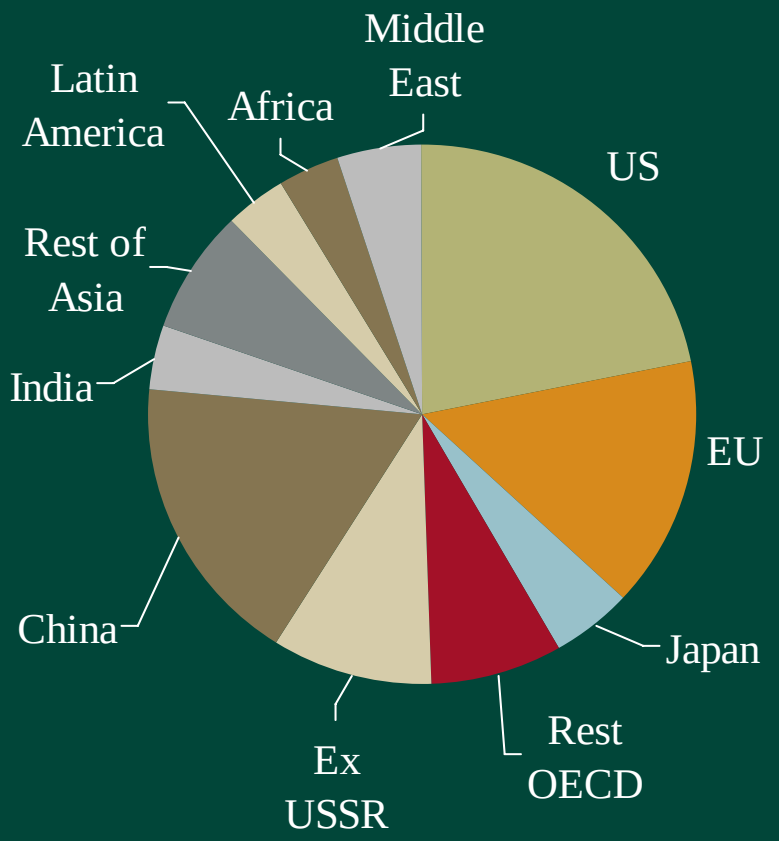
The equity question stands to shape the international outcome

- As governments meet collectively, equity considerations are coming towards the centre of the negotiations
- Developing countries argue that the developed countries got rich by emitting carbon, and that it would be unjust to prevent them from doing likewise
- The developed countries argue that the developing countries will have to be part of the solution, because by 2030 they will be responsible for half of all global emissions
- Resolution of this impasse will require that agreement be reached on an equitable way of sharing the ‘climate change bill’, past and future

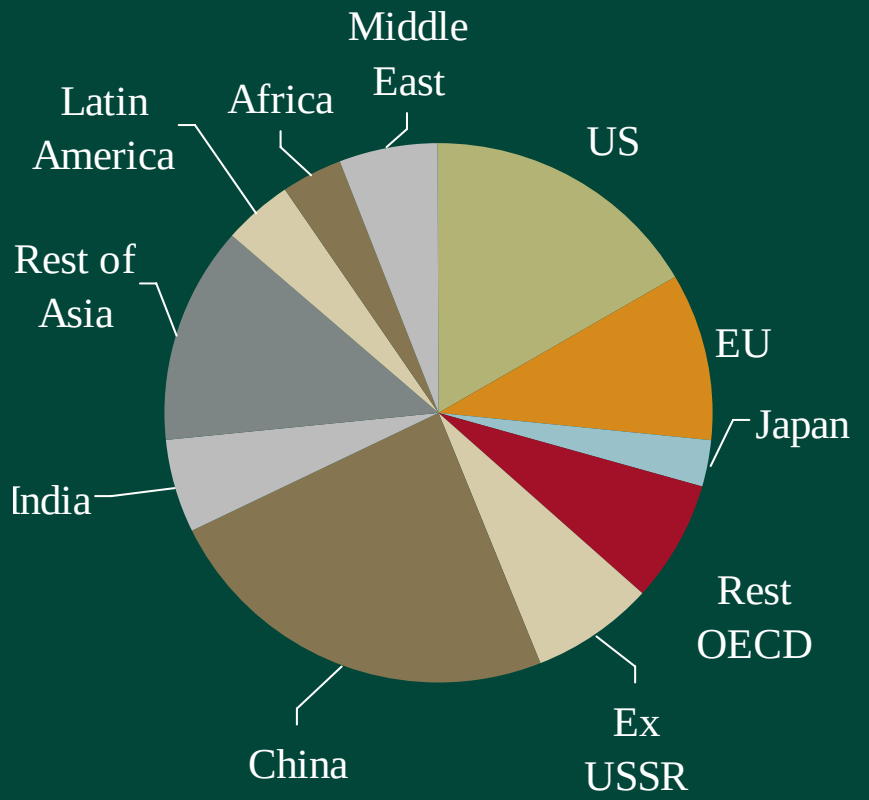
Carbon emissions today and in 2030

Asian emissions will account for more than half of total emissions in 2030

Global emissions by region, 2004



Global emissions by region, 2030



Source: Energy Information Administration (EIA), International Energy Agency (IEA).

Resolving how to pay the "climate change bill"

The economic theory of compensation offers a solution

- Economists agree that, looking forward, all polluters – developed and developing alike – should pay for the damage they cause
- However, they also agree that past polluters should pay for the damage they have caused
- To the extent that past pollution has led to the current value of the social cost of carbon being around $50/tonne, this implies that the industrial countries "owe" the non-industrial world around $4.6 trillion, or around 12% of OECD countries' GDP
- This is a large figure. However, if regarded as an "endowment", paying (say) 5% p.a. in perpetuity, this would amount to an annual payment of 0.5% of GDP per year
- This is the same order of magnitude as the UN aid "target" of 0.7% of GDP

What next?

- We see a **75% probability** that some sort of international agreement will be implemented, with carbon trading at the centre
- **Europe:** the EU ETS will be extended, and regulations tightened
- **United States:** a federal carbon cap-and-trade scheme is likely to be implemented
- **Japan:** a technological push in the first instance, and price-based policies to be implemented thereafter
- **China:** regulatory measures will be invoked first, but price-based policies will have to be implemented afterwards
- **India:** may lag China in implementing climate change policies

Impacts of carbon trading schemes on businesses

Some sectors are directly affected by carbon trading schemes

- In Europe, the EU ETS already covers around **50% of total emissions**
- Sectors covered include: **utilities, chemicals, building materials**
- Other sectors may be soon included: e.g. **aviation**
- Other countries may join an international trading scheme: **the US and China**
- **Companies covered by the scheme are obliged:**
  - Either to purchase permits to emit
  - Or to invest in low-carbon-emitting technologies
- **In response to the EU ETS, utilities, for example, have:**
  - Heavily invested in Clean Development Mechanism (CDM) projects
  - Made investments to decrease carbon emissions: clean coal technology, nuclear, renewables

Impacts of regulation on businesses

Some sectors are directly affected by regulation, for example:

- **The auto sector:**
  - In Europe: the Commission plans to introduce legislation to decrease car emissions to a mandatory target of 120g CO_2/km (average today = 160)
  - In the US: the Corporate Average Fuel Economy (CAFE) standard sets a target of 27.5 miles per gallon (equivalent to 210g CO_2/km)
  - Manufacturers are taking action: direct-injection petrol engines and hybrid electric vehicles in Europe, diesel in the US
- **The real estate sector:**
  - Exposed to local, national, and international regulations: mandatory emission reductions, energy sourcing, labelling
  - Key challenge: to meet requirements for new and existing buildings => risk of obsolescence
  - Buildings' value could be affected by environmental labels

Indirect impacts of policies on businesses

- **Increase in energy prices:**
  - Any policy that reduces carbon emissions increases the price of carbon, and thereby the price of fuel
  - All businesses that are heavy electricity consumers are affected: e.g. aluminium producers, cement producers, chemicals
- **Increase in food prices:**
  - Caused by governmental push given to ethanol production
  - This has led food retailers to increase their prices to consumers
- **Shift in consumers' demand:**
  - Climate change policies lead to shift in consumers' demand towards less carbon-intensive products
  - Opportunity for sectors such as renewables and new technologies

Implications for firms' value

- **Obviously, firms that emit relatively more carbon will be relatively more affected by policy**
- **Less obviously, however, firms' environmental impacts differ considerably, not only *between* sectors, but also *within* sectors**
- **For example, across a sample of 33 US electricity companies:**
  - Rate of return on capital ranged from 8.6% to 1.0%
  - But, if companies had had to pay $14/t of CO2 emitted, these figures would have been 6.7% to -14.2%
  - The two series were almost perfectly non-correlated
- **Similarly, within a sample of European airlines: one company emits 64% more emissions relative to turnover than the average, while another emits 20% less**

Implications for companies

Even within sectors there will be winners and losers

- Firms that prosper are those with the best management practices
- Firms that will prosper in a climate-changed landscape will be those that are early to recognise the importance and inexorability of climate change; foresee at least some of the implications for their industry; and take appropriate steps, including;
  - Inculcating a constructive culture of adaptation to a changing economic landscape
  - Encouraging employees to embrace change, and equipping them to do so
  - Undertaking the requisite research and development
  - Translating this R&D into appropriate investment in physical and human capital

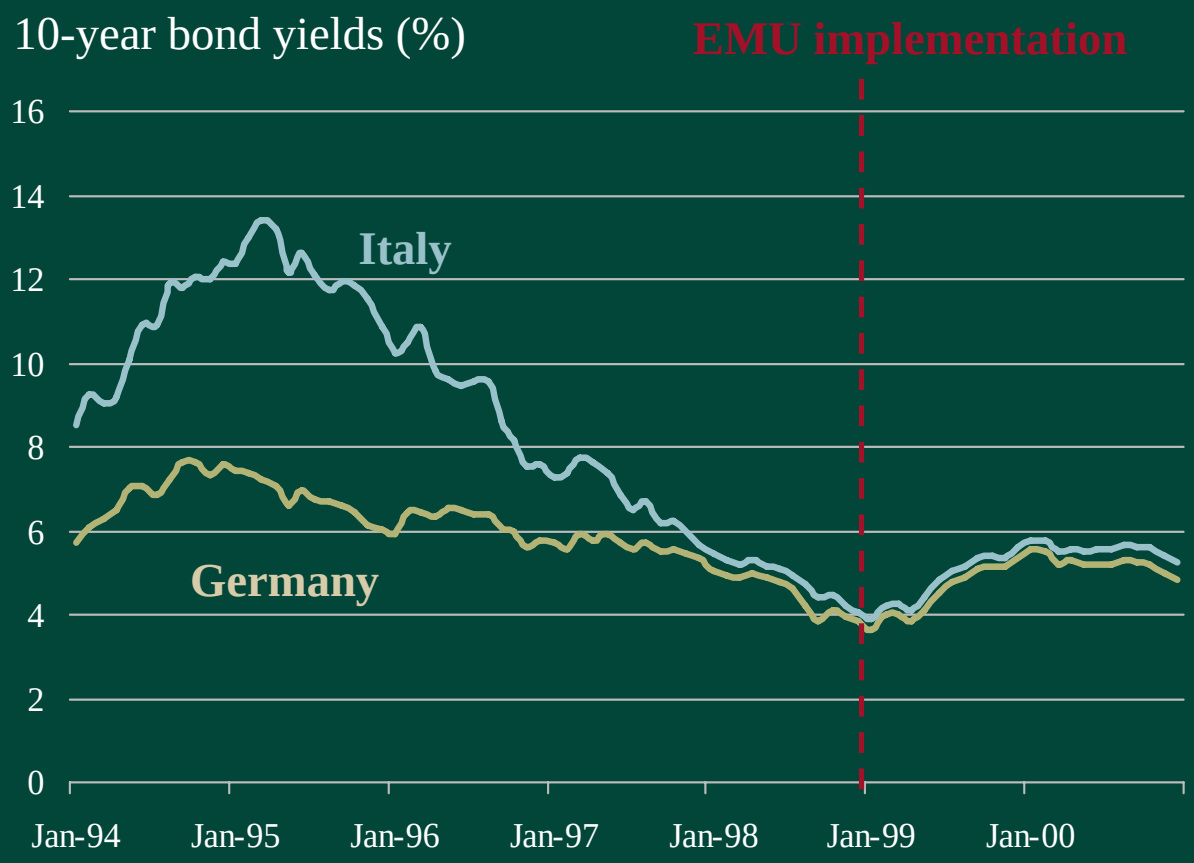
Sources: Bloom, N. and Van Reenen, J. (2006), 'Measuring and Explaining Management Practices Across Firms and Countries', Centre for Economic Performance, London School of Economics.

Implications for investors

- **The potential for asset price adjustment is considerable …**
  - Relative share prices will tend to move ***across*** sectors, in accordance with (relative) carbon intensities
  - Relative share prices will tend to move ***within*** sectors, in accordance with (relative) carbon intensities
- **… with major implications for investors**
  - Carbon light funds will, over a run of years, tend modestly but continually to outperform otherwise similar carbon-heavy fund
  - Investor interest will grow in funds that track recognised indexes but comprise companies with a lighter carbon footprint

The EMU parallel

The wide spectrum of opinion is reminiscent of the situation in the 1990s with the EMU



- Public opinion about climate change is diverse, as opinion was before the implementation of the European Monetary Union
- It took three years for opinion to converge and hence for asset prices to adjust
- In the case of climate change, as investors become more certain, asset prices will probably move similarly slowly