Valuing Carbon
From theory to practice and back again (twice)

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Two discourses on ‘valuing carbon’

- What should be the ‘cost of carbon’?
  - The theoretical approach
  - Some modeling insights
  - The post-Stern debate
  - Back to the drawing board (with Weitzman and Dasgupta)
- What instrument is best to put a price on carbon?
  - Pigou vs Coase (‘tax versus trade’)
  - The Weitzman refinement
  - The empirical practice
  - Back to the drawing board (with Grubb and Newbery?)
- Where does the White Paper take us?

Valuing Carbon I:
What should be the 'cost of carbon'?

Picking up where I left off (BIEE 2005) on 'Evaluating climate change impacts'

"Survey, stakeholder and revealed impact evidence all disagree with mainstream economic quantifications"

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The nice simple theory of costing carbon

- Estimate the cost of specific impacts of / adaptation to climate change over time eg. on food prices, coastal defences, etc etc
- Aggregate across the world (maybe with some kind of equity weighting)
- Aggregate over the future (with some kind of discounting)
- Get your answer (1992)!
  - Significant (Cline)
  - Trivial but rising over time (Nordhaus)
  - With subsequent variants across and beyond the range (Mendelsohn, Pearce, Eyre, and growing bands of others)

The model used for the Stern Review (PAGE) was capable of producing a wide range *even given constant ethical parameters*

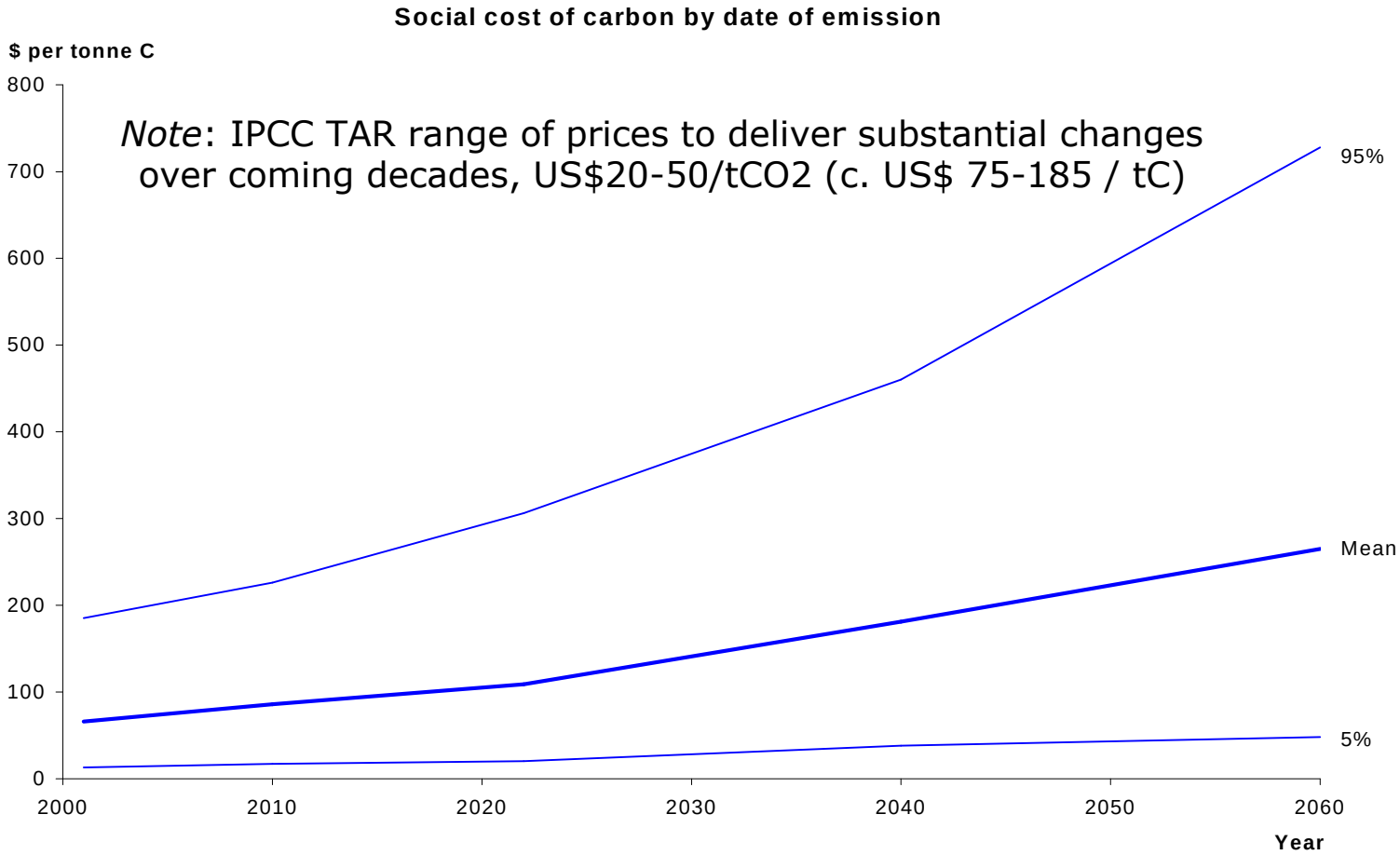
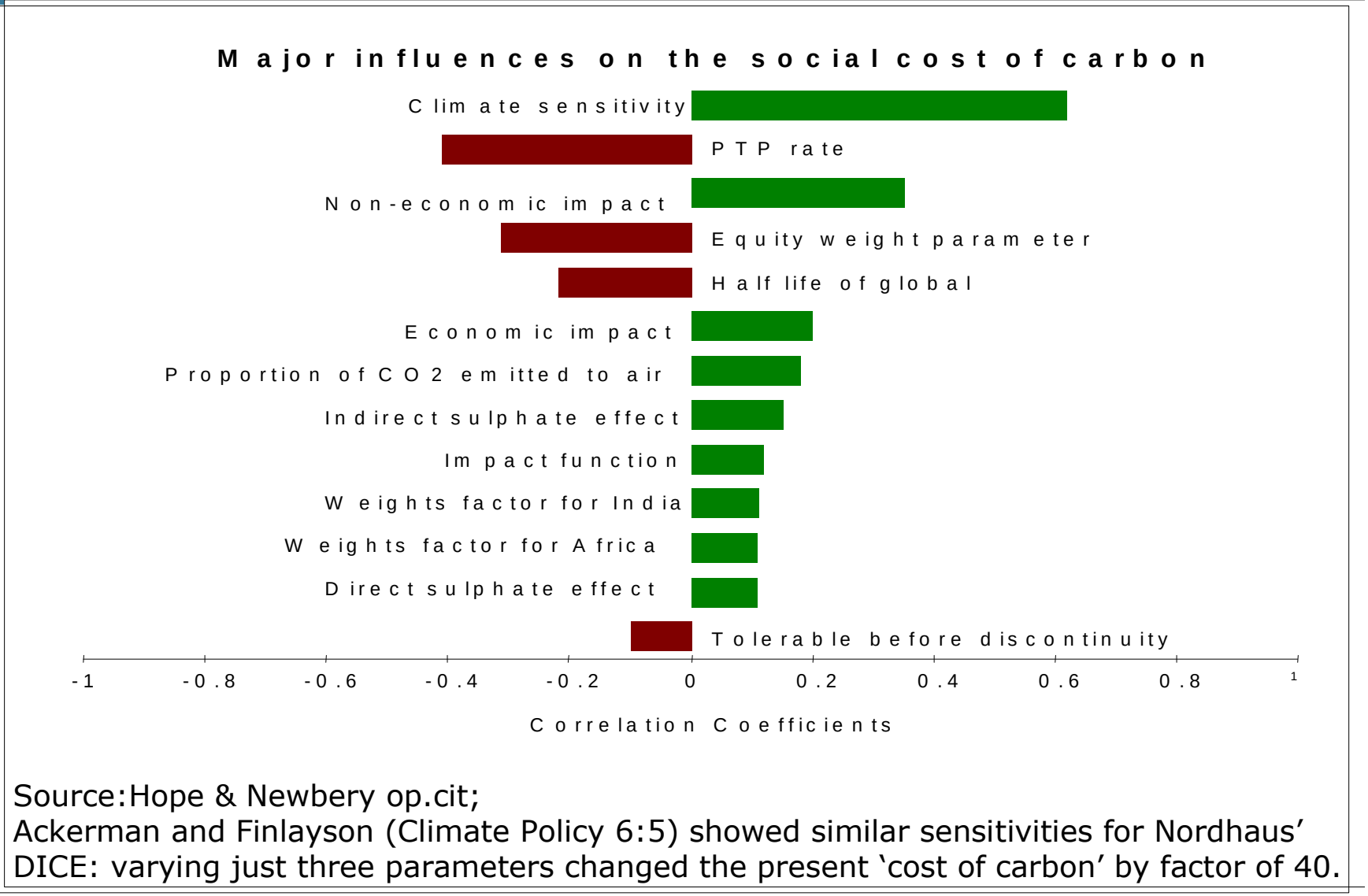


Figure 3 Social cost of carbon over time for δ (PRTP) = 1.5%, and ν (inequality aversion) = 1

Source: Hope and Newbery, 'Calculating the Social Cost of Carbon', Ch.2 in Grubb, Pollitt and Jamasb, 'A low carbon electricity system for the UK', CUP forthcoming

… yet ethical parameters (pure time preference and inequality aversion) were two of the top four sources of variation in PAGE



Source:Hope & Newbery op.cit;
Ackerman and Finlayson (Climate Policy 6:5) showed similar sensitivities for Nordhaus' DICE: varying just three parameters changed the present 'cost of carbon' by factor of 40.

The post-Stern debate on valuing carbon has prompted two main lines of criticism/enquiry
(1) 'space-time consistency'

- Weitzman's original review of Stern argued for '2,2,2' estimates of discounting, inequality aversion and growth rate parameters
- Dasgupta (forthcoming, Review of Environmental Economics & Policy) summarises more concerted attack on *consistency*:
  - Accepts Stern case for low PRTP, and rejects Nordhaus' claim to empirical basis for discount rate, ***but***
  - Concept of inequality aversion applies symmetrically across time as well as space and concludes Stern is inconsistent in his treatment
  - Also rejects the Schelling argument about space-time inconsistency of strong climate policy (ie. "caring more about future poor than present poor"), for reasons of 'incentives, governance and responsibility'
  - Resolves the internal tension by noting that higher inequality aversions (for which there is empirical evidence) can restore significant discount rate but *also makes the valuation (even) more sensitive to uncertainties*
  - Concludes that sufficiently high uncertainty can result in 'no optimum policy existing … consumption discount rates cannot be defined and social cost-benefit analysis of projects becomes meaningless'

Across the pond, the other line of debate on valuing carbon has also led to Big Conundrum
(2) Weitzmans 'Dismal Theorem'

- Uncertainty is key
- Traditional economic treatments, where they have considered uncertainty at all, have *assumed 'thin-tailed' distributions* (eg. Normal) for mathematical convenience
- *But* a rigorous statistical analysis clarifies that we are dealing with 'probability distributions of probability distributions' , arising from the (inevitably) finite data available on extremes
- => Actual impact is a '*thick tailed'* distribution, in which the *welfare damage* of extreme impacts rises faster than their *probability* declines
- Weitzman (2007, unpublished): the 'Dismal Theorem'
  - 'No finite sample can assess probability of magnitudes of the most extreme disasters lurking in the distant tails of distributions – expected (impacts) will be driven to an arbitrarily large extent by this unavoidable limitation.. …
  - 'climate change generally and climate sensitivity specifically are prototype examples of this general principle, because we are trying to extrapolate inductive knowledge far outside the range of our limited experience'
  - 'the debate about discounting may be secondary to a debate about the open-ended catastrophic reach of climate disasters'
- In common parlance: Stern is right for the wrong reasons: rigorous economic treatment shows that scientific precaution should dominate

White Paper Conclusion 1:

- Basing UK policy on a legally-defined long-term mid-Century quantified target is entirely consistent with what we can say about the economics of the problem ..

  (though so would be quite a lot of other choices..)

Valuing Carbon II:
What instrument is best to put a price on carbon?

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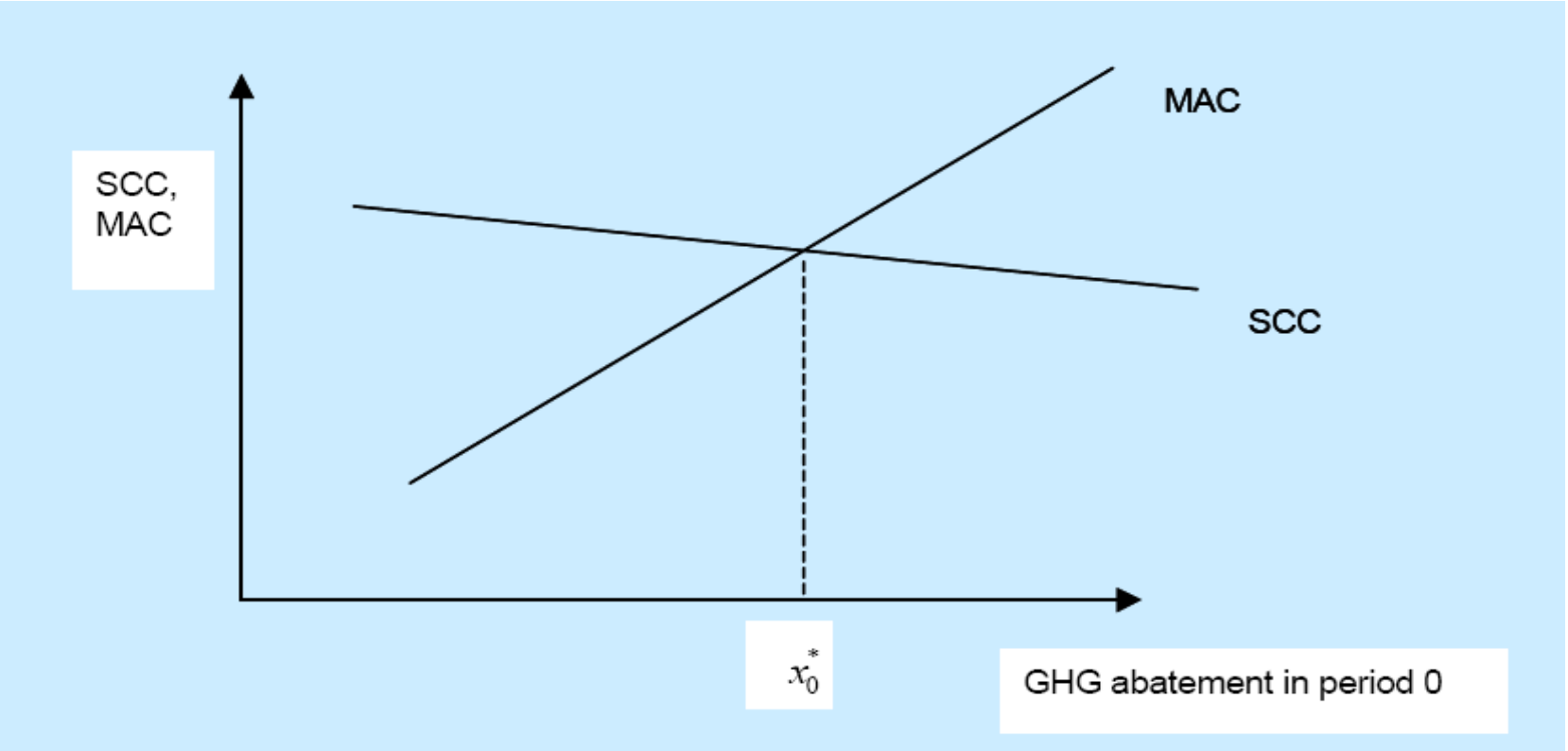
Two instruments ..

- Pigou (1929): theory of externalities corrected by imposing a 'Pigouvian tax'
- Coase (1937?): theory of equilibrium established by creating property rights that limit the impacts and form a market price reflecting the constraint ('cap-and-trade')
- Until 1970s (and often way beyond) economics textbooks treated the two as essentially equivalent
  - An oddity to governments and industries, who have non-trivial interest in
    - "who gets the money"!
    - the institutional basis of decision-making
  - But the subsequent theory of instrument choice was inspired instead by Weitzman ..

The classic Weitzman (1972) argument suggests superiority of carbon taxes over quantity constraints …



Classic Weitzman:

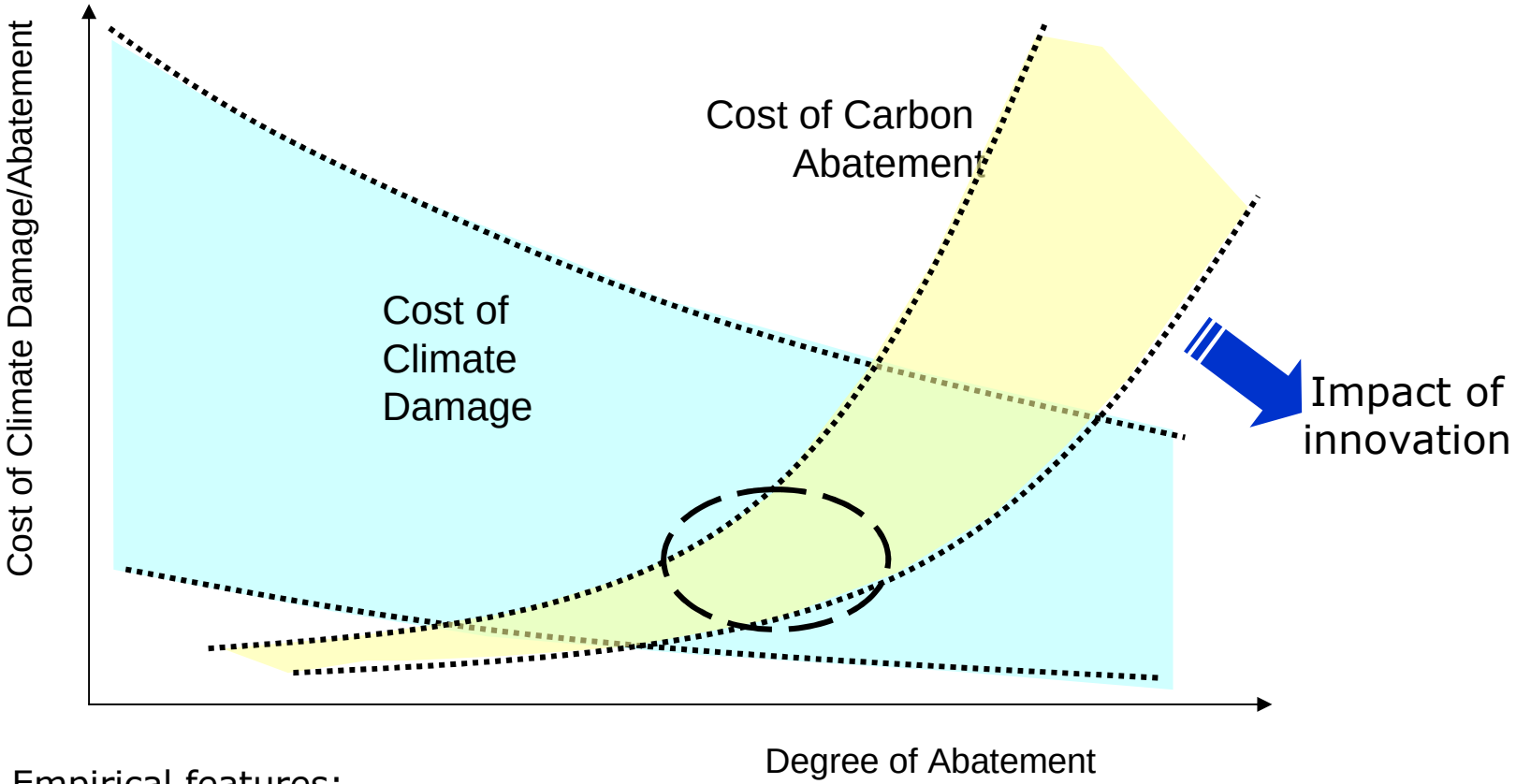
Taxes superior to permits if Marg.Ben. of abatement flatter than M.Cost

If CO2 damage from emissions today effectively same as tomorrow

=> marginal benefit of near-term abatement is almost flat

=> marginal cost of near-term abatement is steep

But Weitzmann-led conclusion neglects issues of *relative magnitude of uncertainties*, *curvature* in the MC function, and *persistence*

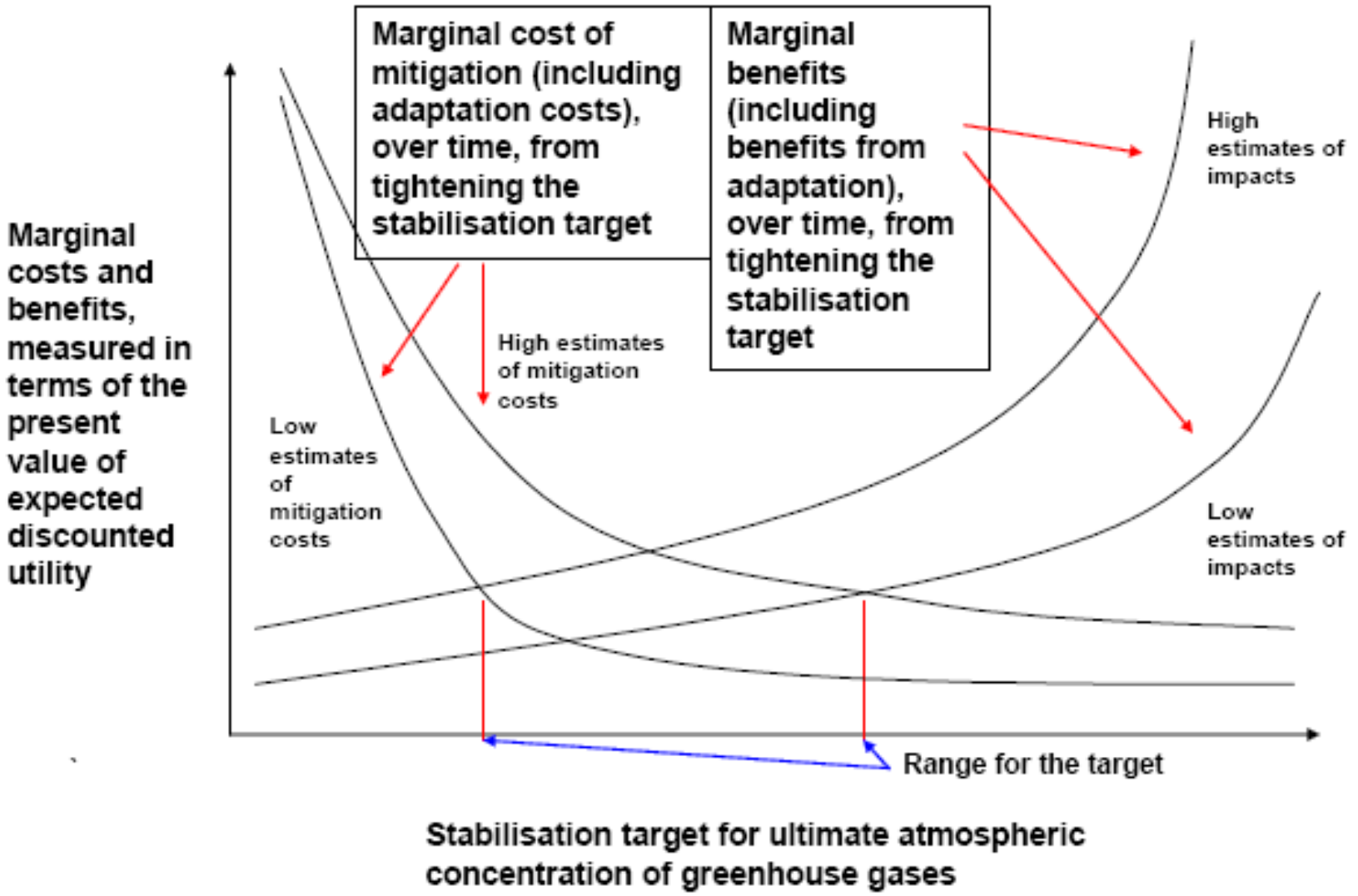


Empirical features:

- Damages uncertainty actually *much bigger* than illustrated here, & far bigger than MC range
- Mitigation costs are *highly* convex
- Mitigation today may have big influence on mitigation tomorrow (stock lifetimes, etc)

Source: From Grubb and Newbery, Ch.11 in Grubb, Jamasb and Pollitt (eds), A low carbon electricity sector for the UK: technology, economics and policy, CUP Forthcoming

- Issues of curvature reflected in Stern view of the long-term challenge, but *persistence links the short-term to long term*



The determinants of theoretical optimum policy are much more subtle than classical Weitzman

- Has Weitzman (2007) wrecked the basis of Weitzman (1972)?
- Choice between price and quantity instruments in near term may be secondary compared to value of ensuring application of either roughly in the region defined by inflexion in the MC curve *and ensuring adequate investment in* ***low carbon*** **infrastructure** and in ***innovation*** for the longer term
- Need for national decision on goals and responsibilities in the global context:
  - Many other factors including portion of global SCC appropriate to apply to national mitigation, reflecting values including national role in the global context
  - Mitigation costs and points of inflexion at national level
  - Long term and option implications of infrastructure and innovation incentives
- Dynamic efficiency (eg. banking in trading scheme) is also valuable
- These decisions may well be more important than the choice of tax or trade *per se*
- *Again, existing theories not adequate to the challenge of climate change*

A rational carbon pricing policy has to be *international*, and yet this brings two additional considerations to the force:

- Additionality
- Political economy

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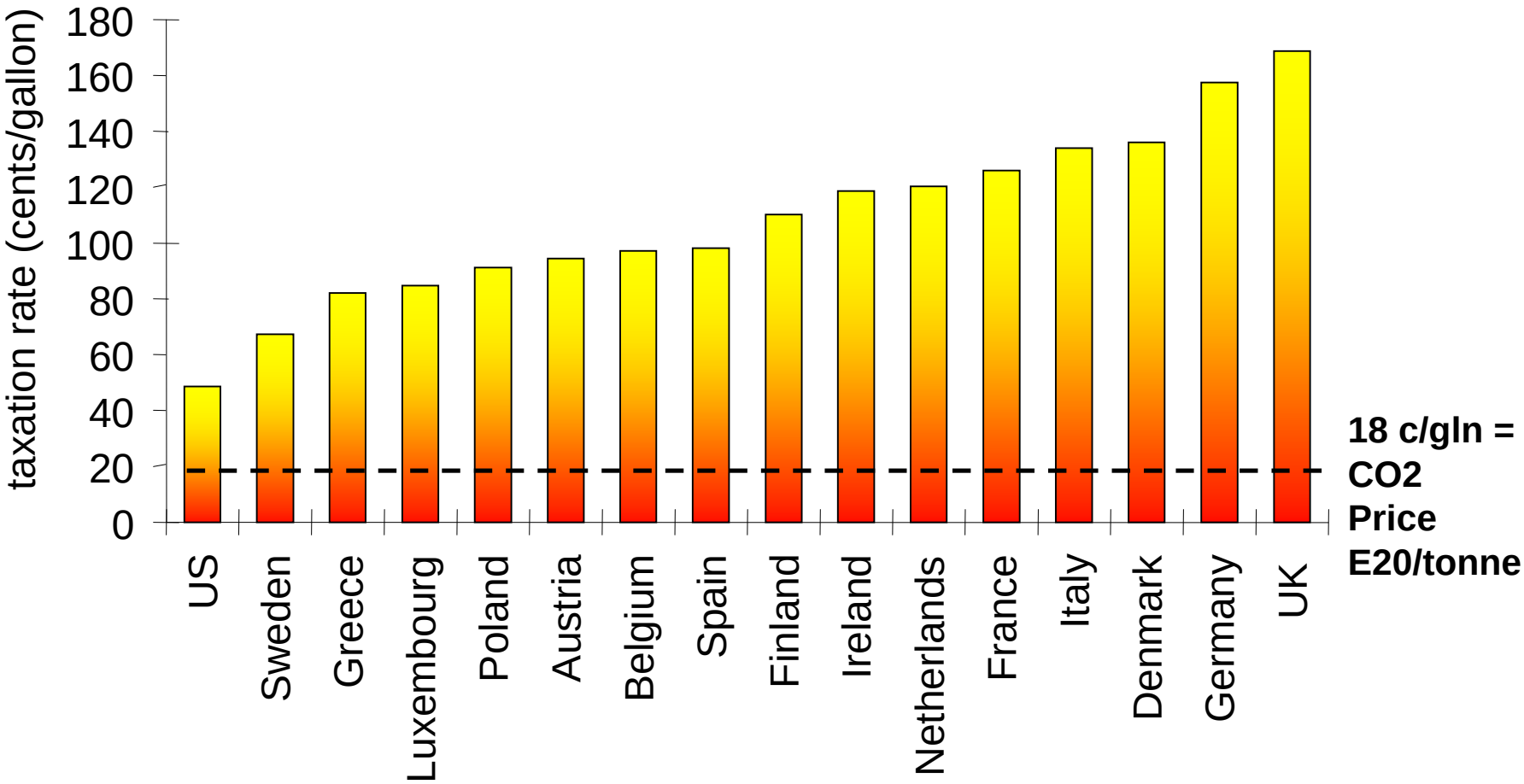
Additionality of tax instruments is extremely hard to establish: consider gasoline taxation…



Source: EU Commission 2002, Germany 2003; American Petroleum Institute 2004, Energy Information Administration, 2004

Political economy problems of taxation are multiplied many times at the international level ..

- Remember the EU Carbon Tax?
- Taxation is amongst the most jealously guarded areas of national sovereignty
- Where carbon taxes have been implemented, even in relatively small homogenous regions such as carbon taxes introduced across **Scandinavia** from 1990-1992:
  - 'The taxes differ considerably regarding rates, tax base and exemptions .... nominal rates are currently the highest for Danish Households. Sweden and Norway have the highest rates for industry, however, Norway applies the high rate to offshore oil and gas .. all four countries have [differing] special arrangements for energy-intensive companies ...`

- Mikael Skou Anderson (2004), 'Vikings and Virtues: a decade of CO2 taxation', Climate Policy Vol.4(1):13-24

Political economy and the capacity to evolve are paramount

- Single CO2 price across the EU is a monumental achievement, when contrasted with
  - 50 years of struggle to build a Single Energy Market (with still very mixed results)
  - The dismal failure of the EC Carbon Tax and the highly distorted nature of most national taxes
- **Industry attitudes change** once the instrument is adopted: lobbying then focuses upon 'getting the best'
- **Greater auctioning** over time can address many of the imperfections – and a 'reserve price' would introduce more tax-like properties
- **=> Capacity to evolve is essential!**
  - EU ETS Phase I proved market design and allocation problems, gave actors expertise
  - Phase II has tackled allocation, will reveal the problems of perverse incentives, allows most participating sectors to profit and build up reserves to help fund low carbon adjustment, and will give auctioning experience
  - Directive may need adjustment for Phase III to address issues around perverse incentives, allow for much greater auctioning, and potentially address competitiveness and price stability issues
- The likely course of evolution is towards a **hybrid scheme** with elements of price corridor or price stability

White Paper Conclusion 2:

- Basing UK carbon price instrument on the EU ETS policy makes sense, IF …

… IF The limitations of the EU ETS are acknowledged and can be addressed over time

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EU ETS: High level evaluation

- **The EU ETS works primarily for operational abatement, with overwhelming evidence of savings so far "a few percent" of total covered emissions:**
  - early action / updating incentives may drive up price more than reduce abatement
  - leakage has been a negligible fraction (probably <5% of savings)
- **… and Not for supporting low carbon investment**
  - New Entrant Rules are a major distortion that largely negate the EU ETS' incentives for low carbon investment
  - Price Volatility and uncertainty post 2012 are major impediments to factoring in CO2 price in investment decisions
  - Leakage may be a bigger issue for new investment (notably in cement and steel) than for operational decisions

Neither the White Paper nor the UK Climate Change Bill really solve the problem of 'low carbon investment security'

- **White Paper** appeals to 'strengthen the EU ETS'
  - The core instrument for implementing UK energy & low carbon policy is an instrument that the UK does not control
  - The EU ETS is *explicitly* uncertain due to its dependence upon sequential caps in context of both EU and complex, evolving global negotiation processes
- The **Climate Change Bill** seeks to create a serious institutional structure to set national goals at least 15 years ahead
  - But national quantity goals are not easily 'bankable' by industry
  - Is 15 years far enough ahead, any risk of 'falling between two stools'?
  - How does unilateral setting of national goals square with the international dimensions - both future EU ETS allocations, and global negotiation incentives?
- Climate change creates truly **fundamental instrumental dilemmas** – for how to 'get investors and consumers to value carbon appropriately', and our theories are *not* adequate for the needs of policy