



The relationship between carbon dioxide emissions and economic growth



Oxbridge study on CO₂-GDP relationships,
Phase 1 results

Michael Grubb,¹ Benito Müller,² and Lucy Butler¹

¹ Department of Applied Economics, Cambridge University

² Oxford Institute for Energy Studies and University of Oxford



University of
Cambridge

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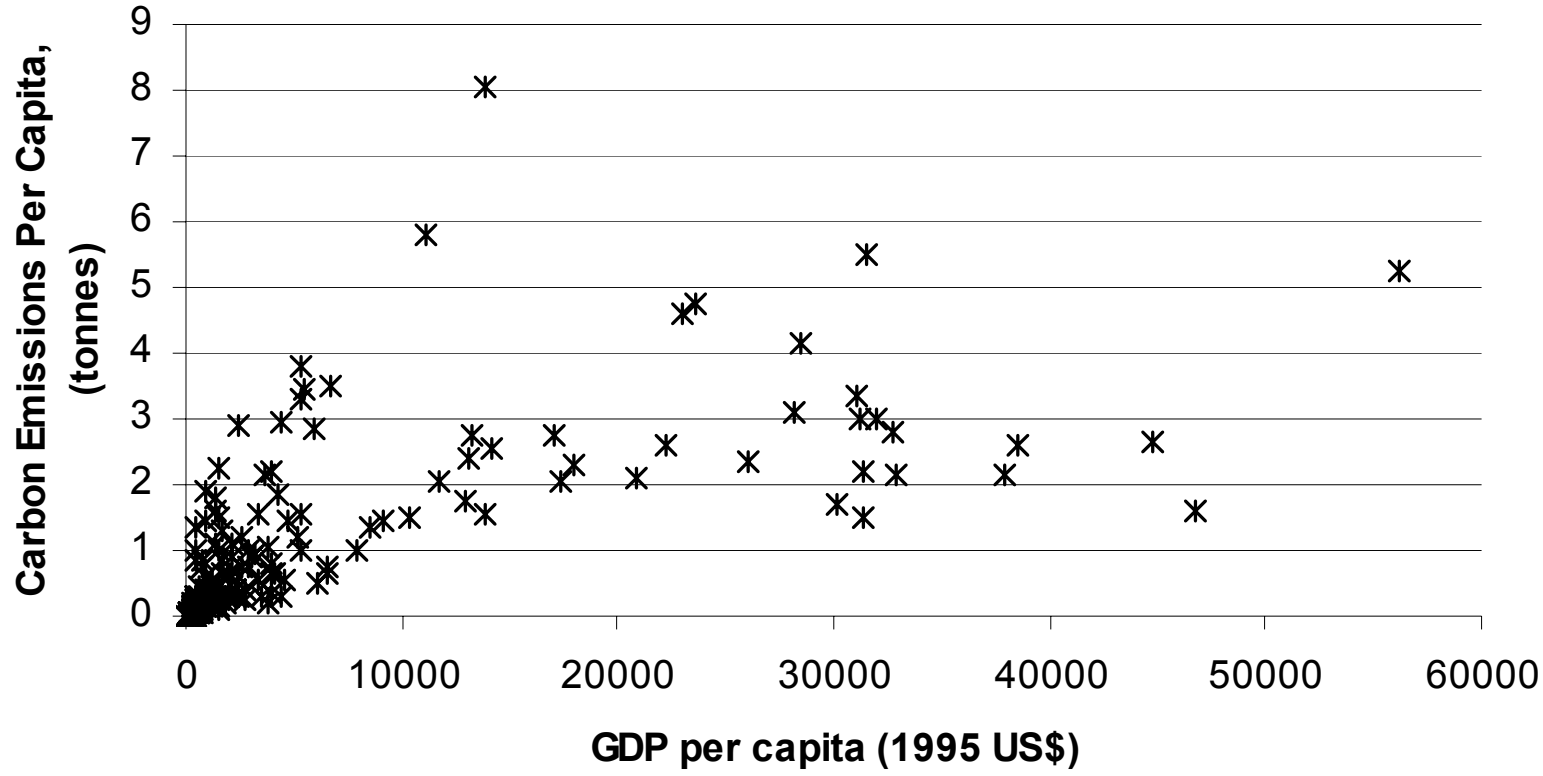
Applied Economics

Overview & datasets

- Aims: to understand past relationships between national CO2 emissions and GDP to help inform current debates about emission projections
- Datasets considered:
 - International Energy Agency
 - Energy Information Administration (US DOE)
 - CDIAC (US Oak Ridge)
 - WRI CAIT
- No major inconsistencies observed, EIA accessible for general trend analysis, CDIAC and CAIT for data since 1950, WRI CAIT most complete for cross-comparisons
- Population is an important factors; all comparisons analysed on per-capita basis

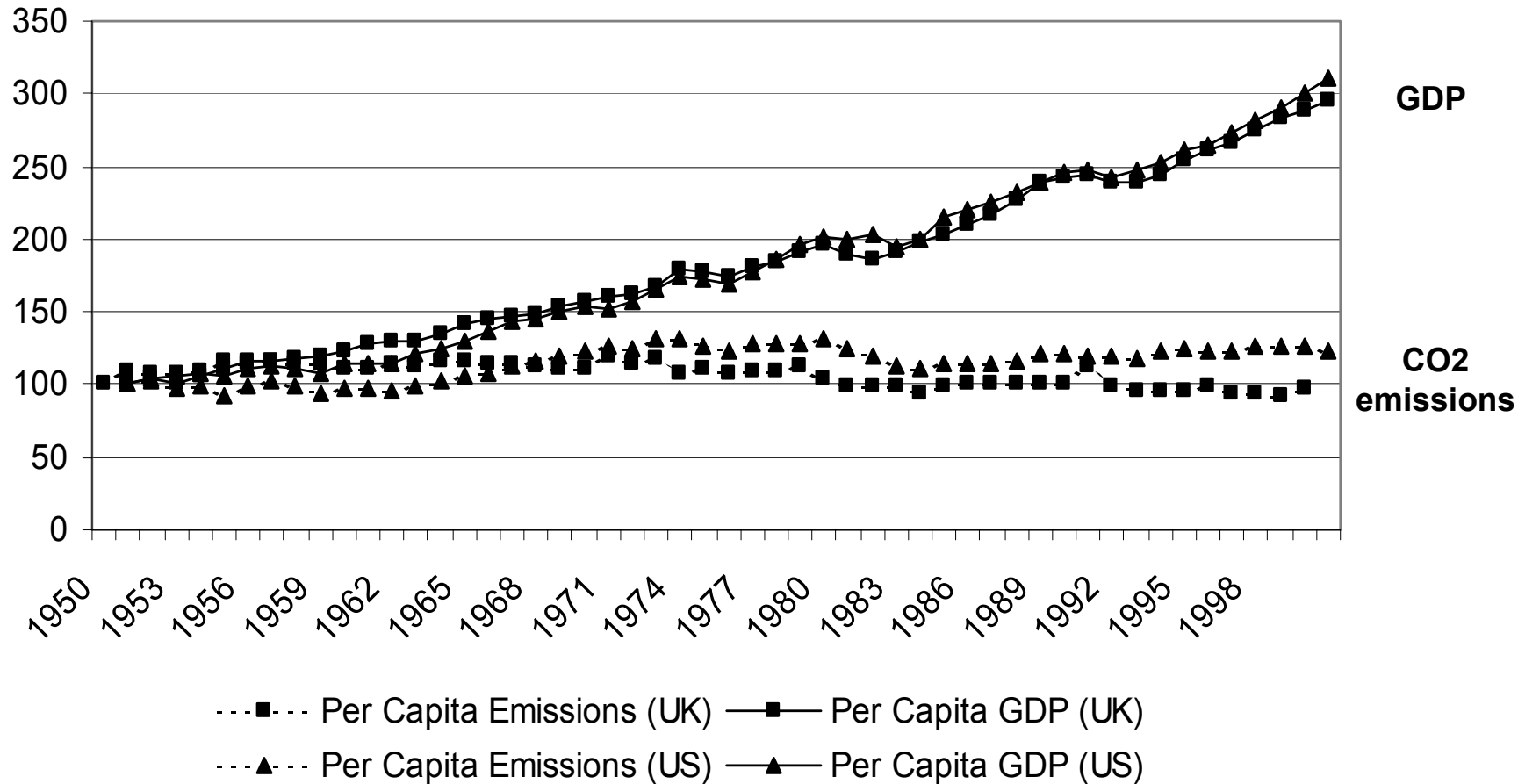
General finding: viewed across all data, basic industrialisation clearly implies higher emissions but link between wealth and CO2 is very weak beyond this

Per Capita Emissions vs Per Capita GDP, 2000



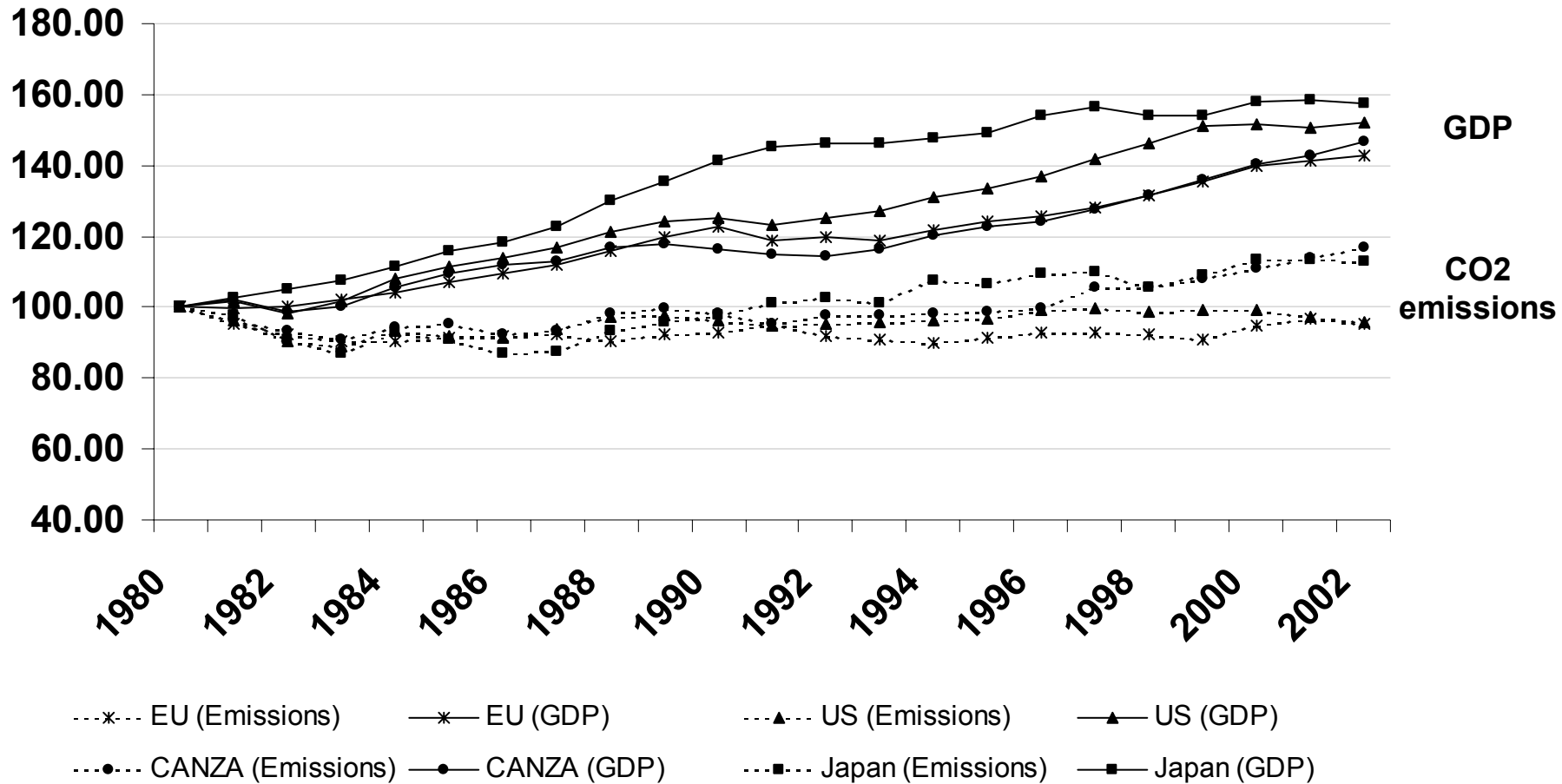
A. Time series patterns in industrialised countries

For major countries which industrialised earliest – UK & US - per-capita emissions have remained close to levels 50 years before whilst per-capita GDP trebled



Data Source: US Energy Information Administration

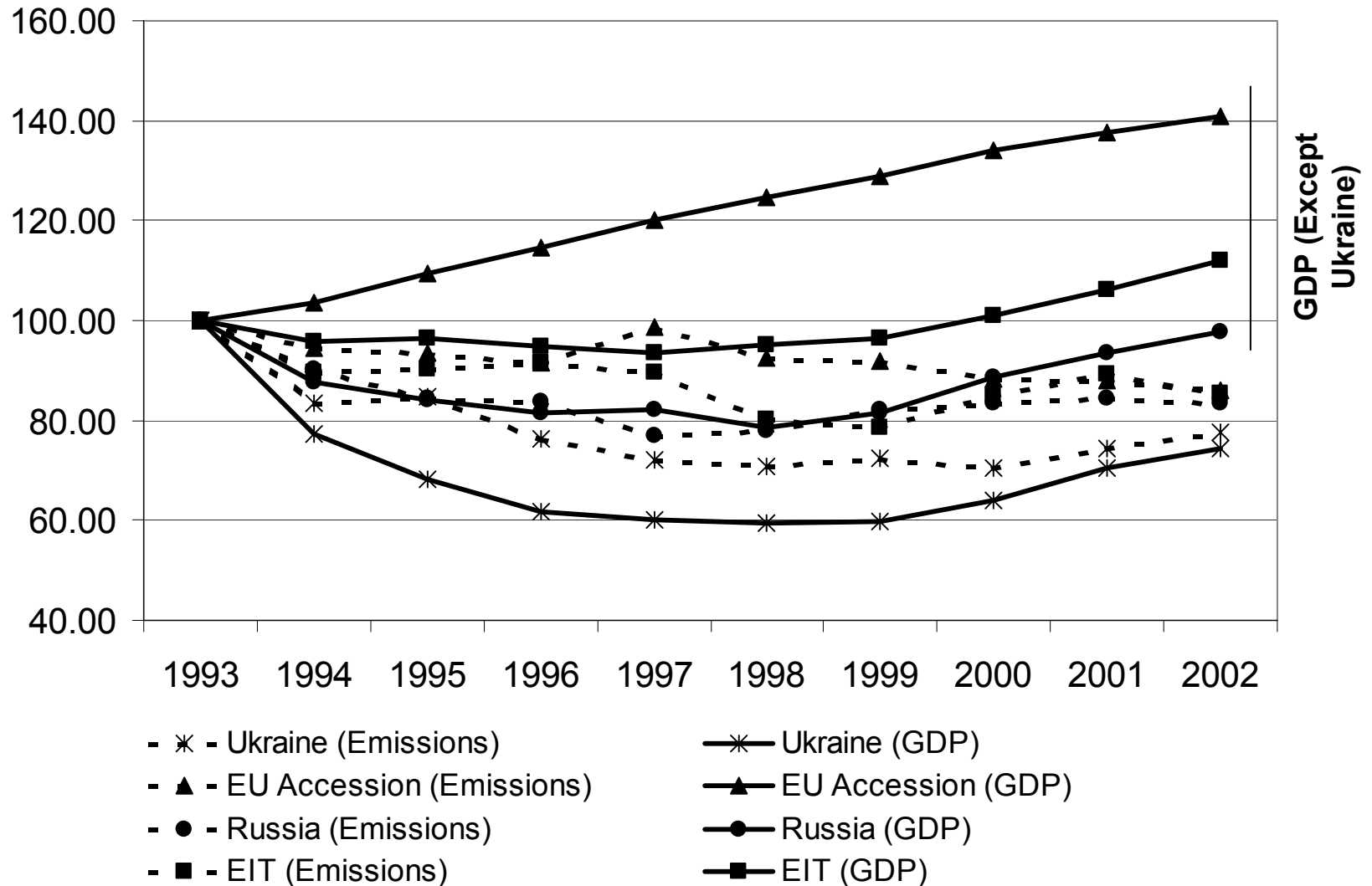
In last two decades, wider groups of developed economies show divergence between GDP and emissions with no clear linkage with GDP variations



CANZA = Canada, New Zealand, Australia

Data Source: US Energy Information Administration

In the 'post transition' period, transition economies (EITs) have grown with little or no emissions growth



B. Scatter analysis of CO₂ – GDP relationships in industrialised countries

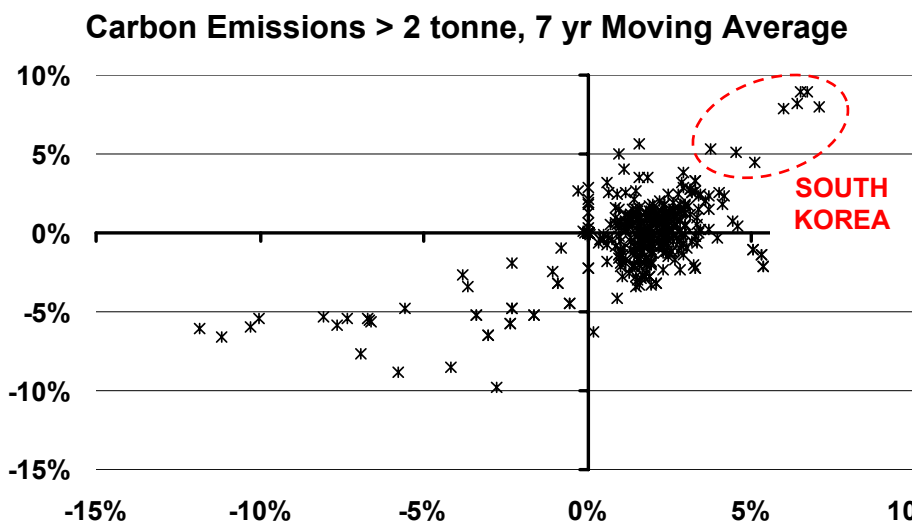
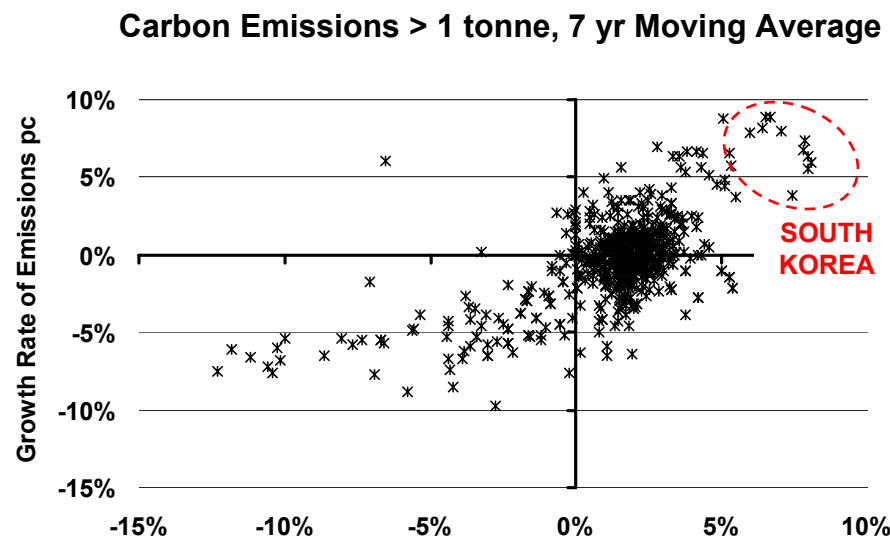
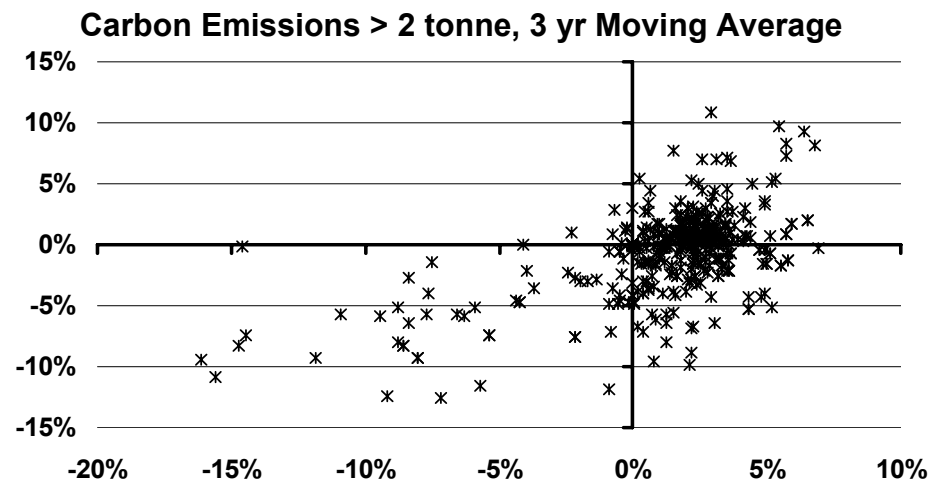
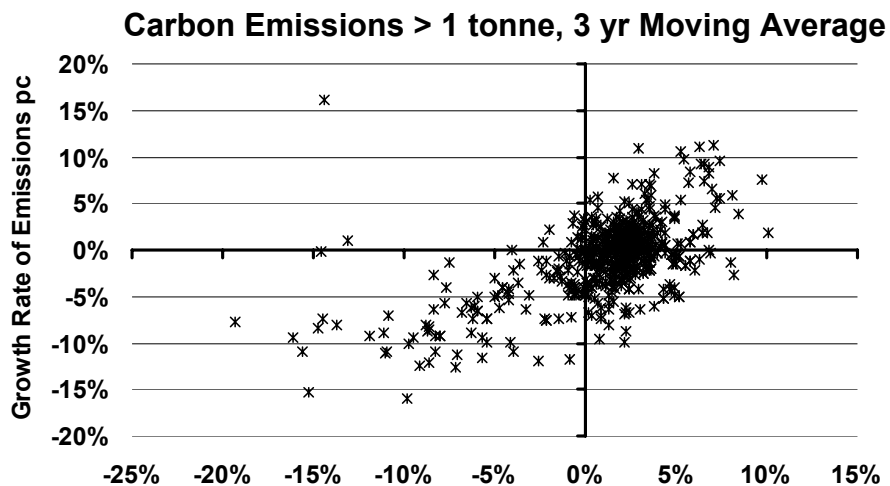
For scatter analysis, care needs to be taken to avoid spurious results

- Oxbridge dataset for scatter analysis of industrialised countries:
 - Source data from WRI CAIT includes all present OECD and EIT countries
 - Data problems for some EITs prior to 1992
 - Countries with population < 5m excluded to avoid small county project and border effects (eg. Luxembourg steel plant); Latvia, Lithuania and Estonia aggregated to Baltic data
 - Data examined subject to per-capita emission thresholds of (a) 1tC/yr and (b) 2tC/yr to explore sensitivity to degrees of prior industrialisation
 - Data smoothed over (a) 3 years and (b) 7 years to examine variational effects

Scatter analysis of data shows wide dispersion that declines for longer averages and higher emissions

- only South Korea showed strong GDP-CO2 link at high growth rates

Per Capita GDP Growth vs Per Capita Emissions Growth



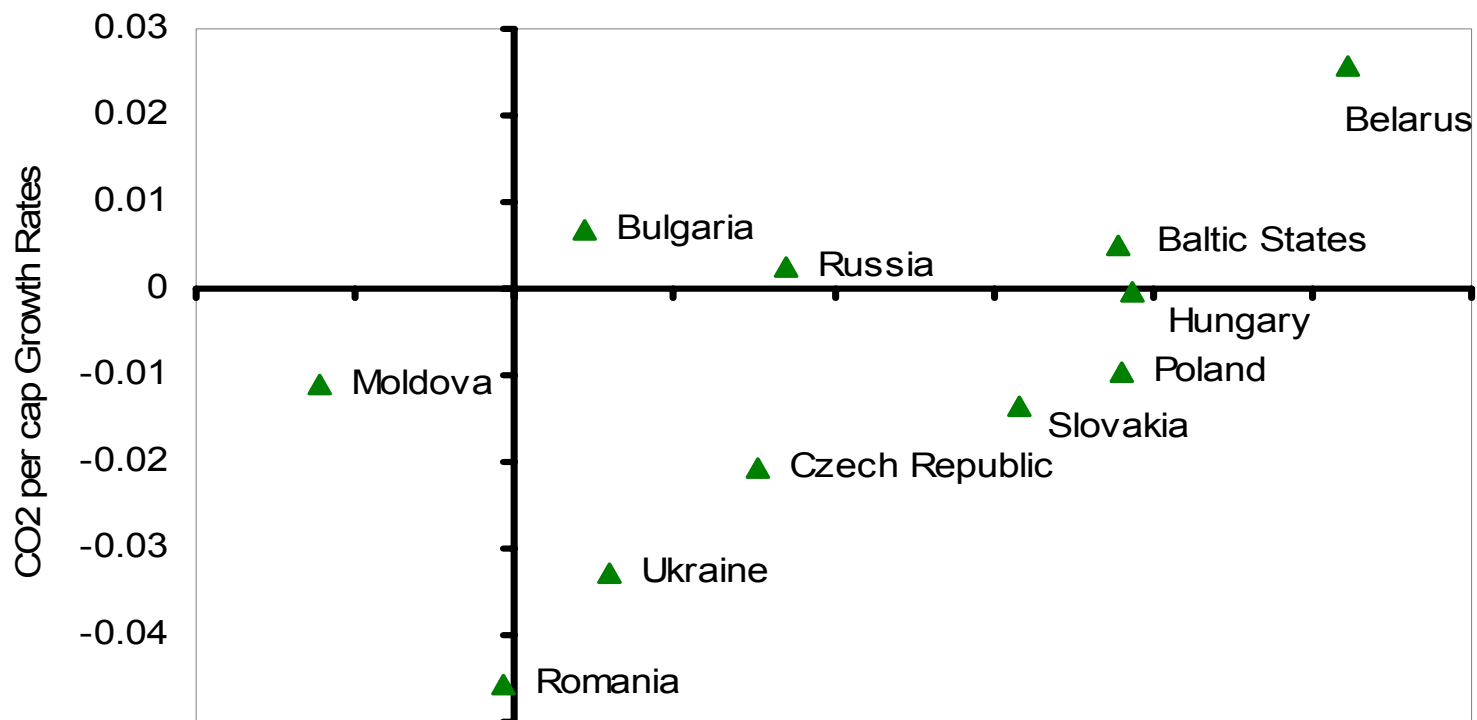
Specific growth rate findings from scatter analysis of OECD & EIT countries

- There is wide dispersion of results, with per-capita emissions growth in the dataset mostly in the range +/- 10% (3-year trend) and +/-5% (7-year trend) about an average of almost stable per capita emissions
- There are short bursts of emissions growth exceeding 10%/yr, but
- the only cases with emissions growth sustained above 5%/yr for 7 years or more are:
 - The 'tiger economies' in the earlier stages of their basic industrialisation whilst emissions still less than 2tC/yr
 - South Korea in the ten years after the oil price crash
- Excepting South Korea, sustained (7-year avg) GDP growth rates above 4% are associated with emission trends within range +/- 3%/yr.

*** The Danish moving average to 1996 (only) exceeded 5%/yr due to combination of oil price collapse with extended low rainfall reducing imports of Scandinavian hydro power.**

In the transition economies, resumed economic growth in many of the fastest-growing economies has been accompanied by continued emission reductions

**GDP vs CO2 Annual Growth Rates
(Per Capita, 1995-2001)**



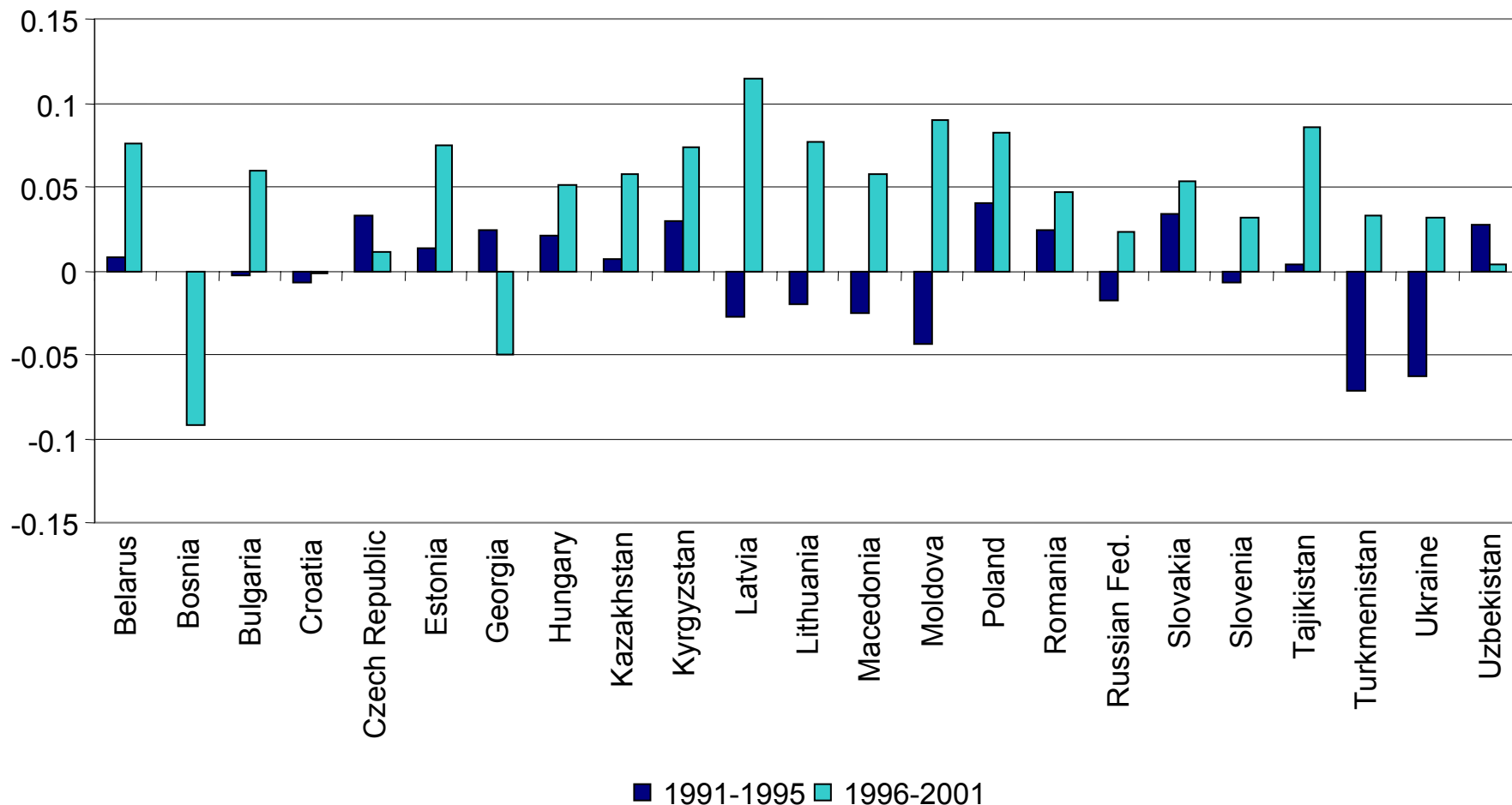
Note:

Data Source: US Energy Information Administration

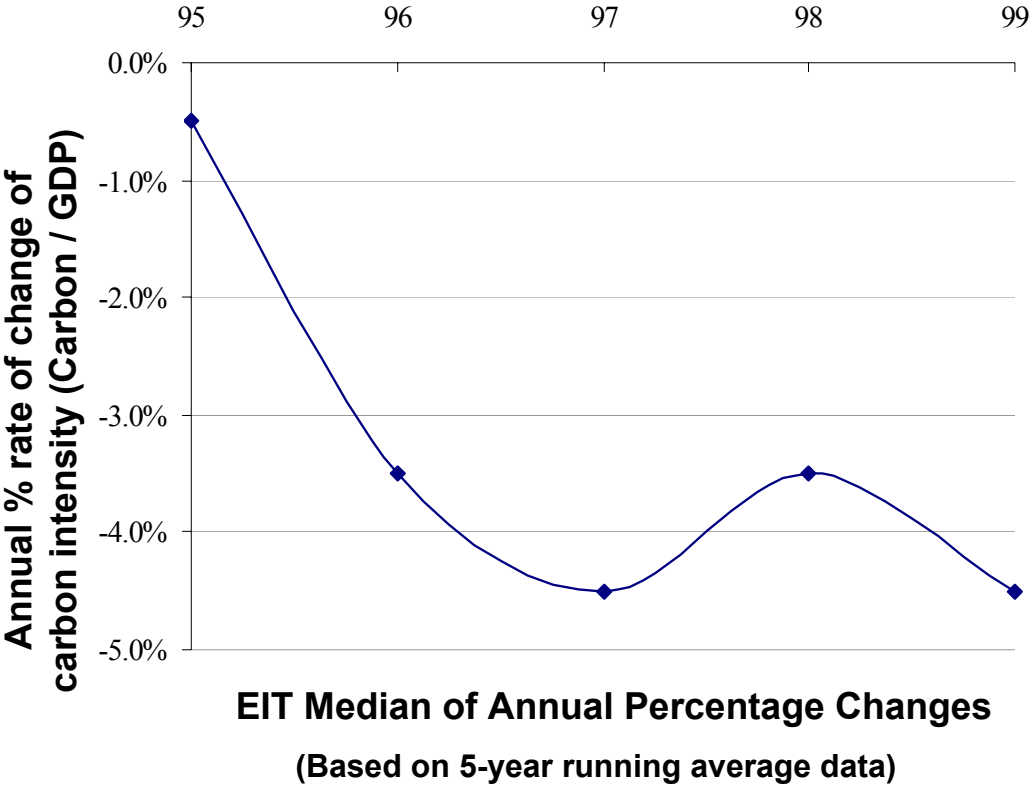
C. A closer look at carbon intensity trends in countries with economies in transition

Emission intensities trends in EITs were very varied during recession periods (first half 1990s) but since 1996 most have averaged 3-10% annual improvement

Annual rate of decline in Carbon Intensity (%/yr)



The median rate of intensity reduction across all the EITs was by late 1990s more than 4%/yr



Principal conclusions

Conclusions regarding GDP-CO2 relationships: General and OECD

- Data are highly variable over time and between countries; any generalisations need to be treated with great care
- Beyond basic industrialisation, any relationship between GDP and CO2 appears to be very weak
- The available historical data for OECD indicate:
 - Major 'early industrialisers' (US, UK) show evidence of saturation in per-capita emissions, but at very different levels
 - Excluding small country effects, no country other than South Korea after oil price collapse has sustained per capita emission growth rates (7 year average) above 5%/yr
 - With this exception, since 1980 any link between emissions and GDP appears very weak and this has not changed in the period of energy price stability (1990+): there is no clear link between more rapid economic growth and more rapid CO2 growth

Conclusions regarding GDP-CO2 relationships: EITs

- For Economies in Transition, comprehensive analysis is constrained by inadequate data prior to 1992, but:
 - The collapse of emissions associated with the initial transition has not reversed during the period of subsequent economic growth
 - Countries that have implemented reforms have since mid 1990s experienced resurgent economic growth without emissions growth
 - For these countries, annual carbon intensity improvements since mid 1990s have been in range 3 – 10%/yr with the median across all EITs exceeding 4%/yr

Postscript: our findings in relation to the Institute of Economic Analysis paper on 'Economic Consequences of Possible Ratification'

- The Institute paper presents extensive and interesting analysis of international data, but appears quite selective in its use and questionable in the analogies drawn
- Our findings on the tendency of many advanced economies towards approximate per-capita emissions stabilisation is in sharp contrast
- Our findings regarding intensity trends appear very different. Major reasons include:
 - Institute analysis of intensity vs. economic growth (Fig. 31 and associated paragraphs) is driven largely by the *negative* data (economic collapse of EITs) and the results of early industrialising and OPEC oil exporters;
 - OECD and EIT data (as in our analysis) address the experience of diversified and growing economies with an established industrial base
 - The Institute's use of 2%/yr carbon intensity improvement is hard to reconcile with evidence from other transition economies
- The biggest issues are:
 - all the evidence suggests that emissions are to an important degree a function of policy and choice that determines the energy efficiency of economies
 - no industrialised country other than South Korea after the oil price collapse (which started from a far lower emissions and intensity base) has sustained the rate of emissions growth projected in the Institute's analysis over a comparable period
 - Is the Russian economic structure analogous to OPEC or to other EITs, and do its aspirations lie to a diversified OECD-like market economy, or a primary resource economy with subsidised energy prices?