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Reducing rebound without sacrificing macroeconomic benefits of increased energy efficiency in public transport provision Karen Turner

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Project title: 'Energy Saving Innovations and Economy-Wide Rebound Effects'





Engineering and Physical Sciences Research Council

Overview

- What is rebound and why does it matter?
- Policy perspective: potential multiple benefits of energy efficiency
- Analysis: decoupling economic expansionary and economy-wide rebound effects of increased energy efficiency in public transport
- Directions for future research

What is rebound?



- Determined by ratio of actual energy savings to potential energy savings following an energy efficiency improvement
- PES generally stated in terms of potential engineering or technical savings
- Increase efficiency by 10%, require 10% less physical energy input to produce same level of production output or consumption utility
- AES depends on focus direct rebound just energy use of more efficient user; economy-wide rebound is all energy use across economy

Why does rebound matter?

- The rebound process is driven by economic responses
- What is the objective function of energy efficiency initiatives/policy?
- To increase welfare?
- To reduce energy use?
- To reduce associated carbon emissions?

Policy perspective

- Primary aim of energy efficiency policy is to reduce energy use and emissions
- But policymakers tend to operate in context of multiple objectives
- Likely to welcome economic benefits that drive rebound
- But need to know what energy savings will be delivered
- And where in the economy energy use and emissions may rise or fall



IEA (2014), Capturing the Multiple Benefits of Energy Efficiency, OECD/IEA, Paris.



Modelling economy-wide rebound using CGE techniques

- Multi-sector economy wide computable general equilibrium models the most commonly adopted method for considering economy-wide rebound
 - *Ex ante ex post* (historical) analyses often conducted using econometric methods
- Key benefit of CGE focus on causal process, importance of interactions between sectors and markets
- Assess in context of wide range of economic and energy use impacts
- Distributional impacts where identifying different household income groups
- Useful for 'multiple benefits' context that may concern policy
- Here UK CGE model with focus on how households choose between public and private transport options
- Key interactions: more efficient public transport, supply and use of refined fuels in both public and private transport

Question: can we decouple economy-wide rebound and economic expansion?

- Economy-wide rebound driven by same processes as economic expansion
- Does this make rebound a necessary 'evil'?
- Can we reduce rebound without sacrificing macroeconomic benefits of increased energy efficiency?
- Focus of energy efficiency often simply on the most energy intensive activities
- What if we increase energy efficiency in something that is a competitor for a relatively energy-intensive activity?

Public vs. private transport?

- 10% increase in energy efficiency in 'Road and Rail Transport' (UK IO sector – freight and public transport)
- Macro level benefits
- Increased competitiveness public transport relative to private transport in household consumption choice
- Impact on transport activity and economy-wide rebound depends on one key parameter

Macro-level impacts of a 10% increase in energy efficiency in UK 'Road and Rail ' industry (% change from base)

	Short run	Long run
GDP	0.004	0.011
Consumer Price Index	0.005	-0.007
Unemployment Rate	-0.102	-0.146
Total Employment	0.007	0.009
Real Gross Wage	0.010	0.015
Investment	0.033	0.014
Household Income	0.013	0.015
Gov deficit	-0.067	-0.085
Export REU	-0.012	0.006
Export ROW	-0.014	0.006
Energy use in households	0.015	0.008
Energy use in Industry	-0.119	-0.121
Total energy use in UK	-0.082	-0.085
Energy Productivity (GDP/energy use)	0.080	0.090
Share of household income spent on energy	0.002	-0.007
Economy-wide rebound	9.502	6.063

Public vs. private transport?

- (Price) elasticity of substitution between public and private transport in household consumption decision
- When set very low, due to increased income, households increase use of both public and private transport
- As increase, demand for cars and refined fuels falls from outset



Impact on economy-wide rebound of varying subsitutability public and private transport – we can decouple!



Future research? A multi-disciplinary, multi-dimensional policy challenge

- Pathway to the low carbon economy: changing the *composition of activity* with directed energy (and other) efficiency improvements acting as driver/enabler
- TECHNOLOGY (DEVELOPMENT AND AVAILABILITY) making public transport more energy efficient and widely available
- BUSINESS/MARKETS ensuring efficiency improvements translate through prices to increased competitiveness
- USER BEHAVIOUR getting people to respond to changes in relative prices
- **Or** using energy cost savings to otherwise improve quality and attractiveness of public transport options?
- Will same lessons apply to other cases in 'dematerialisation' agenda, e.g. electrification of heat and transport, shift from coal/oil to gas, or gas to hydrogen, and so on
 - Rebound in energy becomes less important than carbon intensity?



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Thank you for listening

Questions?

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EPSRC project web-site: <u>http://cied.ac.uk/research/impacts/energysavinginnovations</u>

Personal web-site (papers): <u>http://www.strath.ac.uk/staff/turnerkarenprof/</u>