Australian National University

Biofuel subsidies and carbon emissions: The case for a ‘green paradox’

Professor Tom Kompas

Crawford School of Public Policy

Quentin Grafton, Tom Kompas and Ngo Van Long, 'Substitution between biofuels and fossil fuels: Is there a green paradox?', *Journal of Environmental Economics and Management*, 2012, 328-341.

Quentin Grafton, Tom Kompas, Ngo Van Long and Hang To, 'US biofuels and the CO_2 emissions: An empirical test for a weak and strong green paradox', under review at *Energy Policy*.

Context

- A clear need to reduce CO_2 emissions and a carbon tax/price --- but there have been constraints on policy instruments.
- Interim and additional measures include the use of biofuels --- food for energy --- and biofuel subsidies.
- But such interim/additional measures bring supply responses by owners/producers of fossil fuels. These can be complicated, including changes in extraction rates, current and future prices, demand/supply elasticities, the costs of extraction, etc.
- Other unwanted effects: (a) increase in the price of food, and (b) production of biofuels may be carbon-intensive.

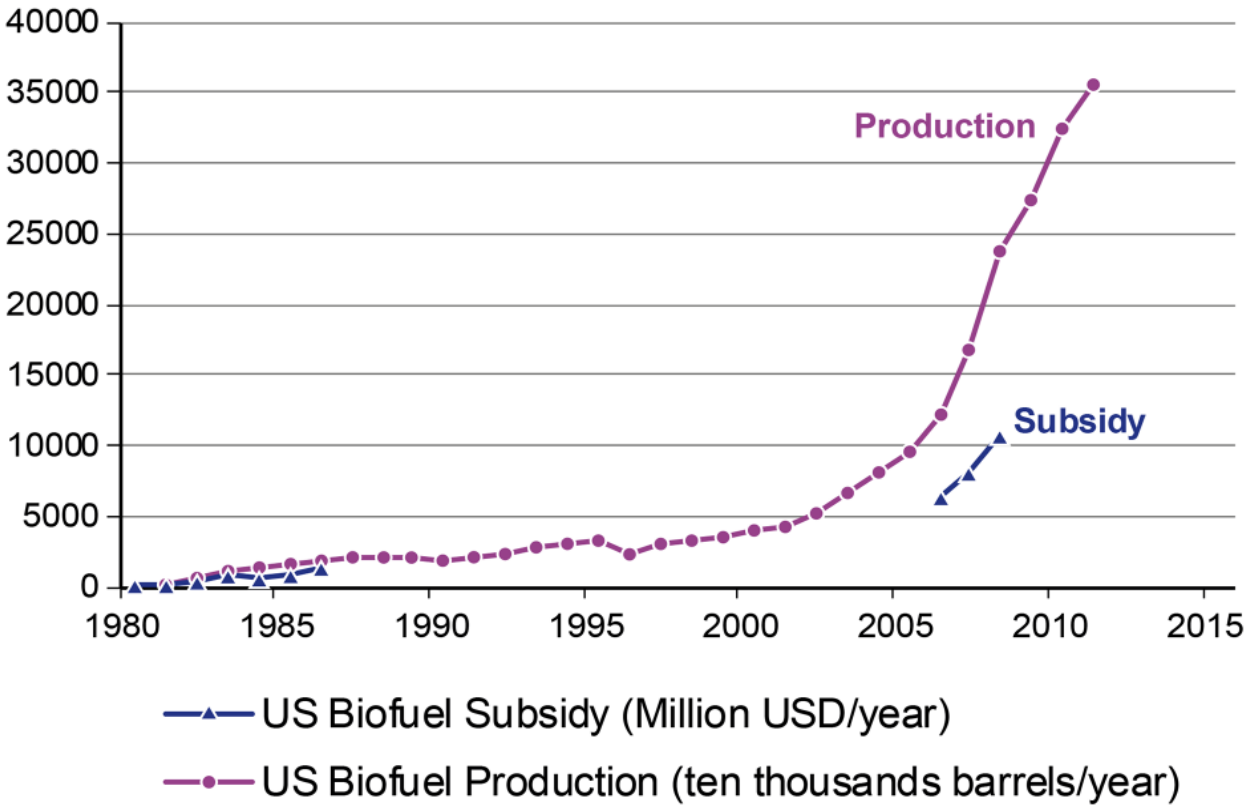
The problem…

- Biofuel production and subsidies to biofuels are seen as a way to reduce greenhouse gas emissions (substituting away from fossil fuels).
- Recent subsidies: EU $3 billion in subsidies in 2008, $10 billion OECD in 2006 and $11 billion in the USA in 2008.
- Biofuel subsidies may lower the future price of fossil fuels, thereby increasing current extraction rates --- the ‘weak green paradox’.
- If this effect is sufficiently large, and depending on how much biofuels lower emissions, biofuel subsidies may actually result in an increase in CO_2 --- the ‘strong green paradox’.
- Simulation results (JEEM paper):
    - Common parameter values: Increased biofuel production implies less fossil fuels demanded, so that with a given price path fossil fuels would not be exhausted by the choke price. Result is earlier extraction and a fall in the price of fossil fuels.
    - Even is there may be no ‘green paradox’ in the long run, short run effects generate a ‘weak green paradox’ over a shorter horizon (e.g., a 30 year period) on an even broader set of parameter values.

USA biofuel subsidies

- Various biofuel subsidies in place since 1978 (e.g., excise taxes, direct subsidies to biofuel producers, R&D funding, tax concessions for biofuel users, etc.).
  - Production/consumption incentives (5 acts of Congress)
  - Grants, credits, tax concessions on capital investment (8 EPA acts)
  - Government funded research (7 EPA acts/5 FCE acts)
  - Subsides to biofuel-consuming capital (3 EPA acts)
  - Subsides to infrastructure related to biofuel distribution (2 EPA acts)
  - Renewable fuels mandate --- min ethanol in fuels 7.5 billion gallons in 2012/target of 36 billion gallons of renewable fuels in 2012.

US Biofuel Subsidy and Production



Empirical results (‘weak paradox’)

- We test for a ‘green paradox’ using data from 1981-2011 that includes production of crude oil, production of biofuels, oil prices, coal prices, and gas and electricity prices --- using biofuel production as a proxy for subsidies.
- Estimated elasticity of USA oil production to USA biofuel production is 0.04, oil production increases by 0.04 percent for every 1 percent increase in biofuel production --- evidence for a ‘weak green paradox’, and the possible effect of subsidies on oil production.

Table 1: Estimate Model of US Oil Production

Variable	US Oil production	
	Coefficient	*p* Value
Ln(oil production(-1))	0.54	0.010
Ln(oil price(-1))	0.07	0.008
Ln(biofuels production(-1))	0.04	0.050
Ln(coal price)	-0.12	0.080
Time trend	-0.02	0.011
Year 2010 Dummy	0.10	0.013
Year 2011 Dummy	0.11	0.009
Intercept	6.89	0.023
R_squared	0.9907	
F_statistic	336 ($p = 0.000$)	
LM test for AR(4)	F=1.67 ($p = 0.200$)	
Ljung–Box test for AR(12)	Q=10.04 ($p = 0.613$)	

Empirical results (‘strong paradox’)

- How much goes a biofuel for fossil fuel substitution reduce carbon emissions?
  - Excluding land-use change, FAO (2008) estimates a 20-60 percent reduction (first-generation biofuels), with projections to 80 percent for second generation biofuels.
  - With land-use change, reductions are much less: corn ethanol 13% reduction; 12% for ethanol and 41% for biodiesel. With land converted to biofuel production, net emissions may even be positive (FAO 2008).
- We calibrate CO_2 emissions reduction by parameter X and evaluate using a 1 percent rise in biofuels production.

Table 2: US Biofuels Production and Effect on CO_2 Emissions, 2011 data

1% increase in biofuels production	Increase in oil production due to 1% increase in biofuels production	Change in CO_2 emission due to 1% increase in Biofuels poduction				
(thousand barrels)	*(thousand barrels)*	X = 0.1	X=0.2	X=0.26	X = 0.3	X = 0.4
3248	827	502	177	0	-147	-472