Indirect Land Use Change: Assessing and Dealing with this Real Effect is Important in Biofuel and Climate Policy

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Technological advances and the environmental and economic need for low-carbon alternatives to petroleum for transportation have placed ethanol and other biofuels at the center of a critical debate about the meaning of sustainable fuels.

To compare the energy and environmental effects of fossil energy to biofuels, life-cycle analysis of the greenhouse gas impacts of production and use emerged as a necessary first measure of two sustainability dimensions, climate impact and energy balance (cf. Farrell, *et al,* 2006). The first wave of analysis, however, did not include the emissions from indirect land use changes (ILUC) induced by the increased production of biofuels (Searchinger, *et al.* 2008).

ILUC results when any economic use bids land away from the production of food, feed, or fiber (FFF), and international commodity markets re-equilibrate by partially restoring the levels of production that would have occurred in the absence of the new, extra demand for biofeedstock (in the present case) and thus demanding new agricultural land. The market response also includes two further effects in addition to the extensification one described above, each of which the current literature, and basic economic theory, indicate to be non-zero (Searchinger, *et al.*, 2008; Dumortier *et al.,* 2009; Hertel*, et al.,* 2010; Tyner *et al.,* 2010; Al-Riffai *et al.,* 2010; USEPA 2010). These additional effects are:

- Reduced consumption of food, feed and fiber (FFF)
- Higher yields of crops achieved in the short term by increasing inputs like fertilizer and in the long term by development of new agronomic practices and varieties

Conversion of pasture and forest land is demonstrated to occur when economic actors, including consumers and producers, attempt to replace the crops displaced by biofuel feedstock, resulting in the burning and decay of carbon held above and below ground in forests and pastures. This discharge of greenhouse gases (GHG) is analogous to a capital investment (of global warming) in capacity to produce biofeedstocks, and it is a **climate-consequential result of a biofuel program attributable causally to the biofuels it promotes**.

With these results in mind, we were particularly concerned to see a recent policy brief arguing against "…the current practice of considering ILUEs [indirect land use effects, or ILUC] of biofuels in the current California and Federal regulations of biofuel [because] the indirect land uses are uncertain, vary over time, and their current estimates diverge significantly." (Zilberman, *et al*., 2010)

The Zilberman *et al.* report urges policy makers to 'reopen' the debate about policy recognition of ILUC emissions, with the recommendation that ILUC impacts should "not be counted" when comparing transportation fuels like biofuels and petroleum.

There are several problems with this perspective. **First, uncertainty alone is not a valid reason to ignore an important effect which, by all indications, is positive and non-zero**. This is akin to recommending against hurricane precautions in the Gulf of Mexico because we don't know where the next hurricane will strike or how strong it will be.

The importance of this debate lies not only in the very large values that have been estimated for ILUC impacts but also precisely in their uncertainty. This uncertainty is not uniformly distributed across any possible value of ILUC related GHG discharges for biofuels. **There is an extremely low likelihood that the values are tiny, but significant likelihood that it is much *larger* than current estimates** (Plevin *et al* 2010).

In evaluating the sagacity of recommending that ILUC not be considered in the analysis of fuels, we find several points that strongly argue against the approach recommended by Zilberman, *et al.* (2010). We detail these arguments in the following paragraphs.

The ILUC discharge of any given fuel is not known with certainty.

"Not known with certainty," we emphasize, is not at all the same thing as evaluating a quantity to be " probably zero", but 'ignoring' ILUC is precisely the latter. In fact, no study known to us has estimated ILUC for any biofuel as zero, and to believe that a significant diversion of cropland from FFF to energy will not have all three of the effects listed above requires that we not believe what may be the most fundamental economic predictive principle, namely the law of supply and demand. To bet climate and energy market outcomes on such a deliberate ignorance of the way human affairs are known to be ordered, and in the absence of any theory or story to put in its place, seems to us remarkably unwise.

In any case, a claim that ILUC (or any other phenomenon is not certain enough to use in policymaking requires that we know both the units of measure of certainty and the critical value thereof –how uncertain is 'too uncertain'?–and here we have neither; at the same time lots of consequential policy in other contexts is knowingly and rightly made with even greater uncertainty about its effects.

If the jurisdictions in which ILUC discharge occurs had efficient and effective carbon discharge policies, biofuel cultivation would not cause ILUC

This is certainly true: with appropriate regulatory systems in all the places land is converted from wild and pasture to crops, the ILUC effects of biofuel promotion would be pecuniary externalities and not a matter of policy concern in either cultivation or importing regions. **But land use emissions are not regulated everywhere, and the California LCFS and the RFS2 are concerned with all emissions attributable to the biofuel no matter where they occur**. Saying that US corn ethanol should be treated as though it doesn't cause ILUC because places like Indonesia and Brazil don't have perfect control of their forests is like saying a lock on the door wouldn't prevent theft because burglary is caused by people with imperfect moral and impulse control. Further, research is already underway to examine precisely these inter-regional impacts (Searchinger, *et al*., 2010).

Even if current biofuels are more GHG intensive than fossil fuels (or about the same) their use should be encouraged in order to stimulate a future advanced lower-carbon biofuel regime.

This argument warrants investigation, but unfortunately has not been examined in detail to date. The infrastructure costs of an advanced biofuel system are relatively modest and (with the exception of a flex-fuel vehicle fleet that could be encouraged with relatively small–< $100/vehicle–costs but so far has not been widely deployed) can be put in place quickly, unlike nuclear plants or hydroelectric generation. If and when it is shown that misrepresenting the real GW intensity of current biofuels will produce present discounted benefits in the future by this mechanism, with reasonable assumptions about the time to market of advanced biofuels, we would be happy to concede this point (though it would surprise us if emitting extra GHG now is the most efficient way to emit less later). **By contrast, lower ILUC is one of the principal differentiators between advanced biofuels (which have low ILUC because they have high per-hectare energy yields) and first generation biofuels. Suppressing the real ILUC component of GWI of these fuels will actually delay the move to advanced biofuels because one of their most important competitive advantages would be nullified.**

Other fuels have ILUC effects, and ILUC is not the only indirect effect of biofuels

Along with the recognition that biofuels are not the only causes of ILUC GHG discharges (others include parks, suburban housing, urban sprawl, and rural roads) these are correct and may be important. Though it is never possible to investigate every possible effect of an action to see if it's much larger or more likely than it appears, we favor estimating at least indirect ILUC GHG effects of any fuels covered by the LCFS and EISA. To date, estimates of this for any fuels other than biofuels have been very small, especially for fossil fuels obtained from desert or water bodies (as would be the ILUC for algae biofuel grown in similar locations that are not food-capable). Global petroleum use will likely see a rebound effect due to biofuel policies, an effect which recent work (Stoft 2010) has shown to be significant and we believe should be included in addition to ILUC in estimating the lifecycle effects of biofuels.

As regards other indirect effects, many of these are important, at least to certain stakeholders, but are not explicitly a focus of fuel policy. These include food security, rural economic development and employment, biodiversity and energy security. All of these are complicated and deserve serious research, and policy design of mechanisms by which they could effectively join carbon intensity in the machinery of actual implementation of biofuel policy. Energy security, for example, includes:

(i) reduced dependence on foreign suppliers of fossil fuels but also:

(ii) increased risk of energy supply disruption through the vagaries of nature and correlated risks like epidemic plant disease, resistance acquisition by pests and weeds, and the like and

(iii) a possible role of food-sourced biofuel cultivation as a buffer against food scarcity resulting from drought, infestation, floods, and the like.

In sum, the recognition of other indirect GHG emissions caused by biofuels should logically conclude with a call to include them in fuel policy and not to exclude the one indirect effect that is currently included.

Producers of biofuel have no control over their iLUC penalty.

This is patently false. In fact, producers in the real world can choose among feedstocks and if they are consequentially aware of differential ILUC effects of these, for example through the GWI ratings in the California LCFS, they will factor this into their economic and environmental decision making. Hence, they do have control. In fact, the inclusion of an iLUC estimate in GWI provides an incentive to advance biofuel technology that can (for example) process waste streams.

Basic principles of public economics suggest that all emitters of GHGs in the world are held responsible for their own activities

These principles indeed suggest that they should be but in **the real world all emitters are not held responsible for their emissions, and adopting a policy because it would work if the world were different is simply romantic fecklessness**. **This is a call for the willful ignorance of reality**. It is extremely unlikely that we will get a comprehensive global cap on emissions that includes land use in the near future, unlikely in the medium run, especially if implementation effectiveness is counted. While it is important to strive for this ideal scenario, policy in the interim should be designed to minimize leakage into unregulated sectors and deal with the world as it really is. A larger fraction of the total consequential lifecycle of biofuels comes from land use change when compared to other energy pathways like wind, solar, petroleum, etc. Hence by setting indirect land use change emissions to zero for biofuels, we will be unfairly penalizing these other pathways by systematically overestimating the GHG savings of biofuels.

An ILUC penalty will discourage investment in R&D for second generation biofuels because it is uncertain.

The credible, long-term existence of any ILUC "penalty"[1] regardless of its actual value will, it can be argued, divert more resources from first generation to second generation biofuels thereby accelerating the advent of second generation biofuels relative to the baseline. This is because, while the ILUC value may be uncertain for any given feedstock, it is quite certain that second generation feedstocks will have a lower iLUC value than first generation feedstocks. Hence, investors will receive a clear, long-term signal that second generation biofuels will be preferred in carbon reducing policies over first generation. On the contrary, if investors are uncertain about the existence of ILUC, they will tend to underestimate the relative preference of second generation biofuels and therefore tend to underinvest.

Other indirect effects of biofuels are not included in the LCAs of biofuel, and thus the inclusion of indirect land use is inconsistent with other regulatory criteria

The non-inclusion of any important indirect effect in current policies should lead to the call for its inclusion, not for the elimination of any indirect effects currently included on an unexamined second-best-theory expectation that the errors might be offsetting. This is like calling for the removal of the warning label that smoking causes lung cancer because it was found that it also causes high cholesterol levels.

When the final seller of a biofuel, say an oil company, is held accountable for the lifecycle emission, it may be much more effective in obtaining information and affecting choices throughout the supply chain than a government entity when it attempts to regulate each entity separately.

This argument makes little sense because the lessened administrative burden is not the main reason regulators hold a final seller responsible for the entire supply chain. They do so when they are trying to regulate for actions (like GHG emissions) in areas where they have no jurisdiction but risk endangering the efficacy of the policy if these actions are not controlled. Hence, the only means available to the regulator is to hold someone within their jurisdiction responsible who can in turn control the actions of suppliers further up the chain.

Summary

Indirect Land Use Change GHG discharges are real, consequential, and important. Recognizing them in consequential policy is essential to an incentive environment that will move the world towards more, better, climate stabilization.

[1] We disapprove of this language in the present context in any case. Estimating ILUC as well as we can and incorporating it into regulatory practice is no more a *penalty* against a given fuel than fairly grading all the questions on an exam in calculating a student's grade.

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