Land Economics 96(4), November 2020
"Best Management Practices and Nutrient Reduction: An Integrated Economic-Hydrologic Model of the Western Lake Erie Basin" by Hongxing Liu, Wendong Zhang, Elena Irwin, Jeffrey Kast, Noel Aloysius, Jay Martin, and Margaret Kalcic

Appendix D

Table D1. Combinations of tax and cost-share payments

Tax (%)	Total revenue (million dollars)	Matching payment for subsurface placement ($/acre)
20	22.30	10
40	43.42	20
60	63.35	30
80	82.10	40
100	99.66	45
200	173.57	170
300	218.00	200
400	234.21	210

For each level of tax revenue, we find the most efficient way of using it as cost-share payment, i.e. the level that leads to highest adoption rate. For example, the 20% fertilizer tax will collect $22.3 million dollars, if used for payment for subsurface placement, it can pay $10/acre which leads to 50.25% of adoption. Note that this adoption rate is lower than current adoption rate without policy intervention, which is because we use the Lewis and Plantinga (2007) method take into account of the uncertainty in future adoption, even for current adopters. Similarly, if budget is used for cover crops payment, it can pay $25/acre which leads to about 30.65% of adoption. Note that the current adoption rate is lower for cover crops, which requires higher payment to increase.

In Figure D, we plot the percent changes in loadings as a function of the fertilizer tax across a wide range of tax rates to investigate the tax rate that minimizes loadings in both the tax-only and hybrid policy cases, according to Equation [4] and as described in section 3.2.3, which forces us to consider unrealistic levels of a fertilizer tax. We find that total tax revenues are maximized at about an 800% tax, and that the tax rate at which loadings are minimized in both the tax-only and hybrid tax scenarios is closer to 1000% percent. At a 1000% tax, the model predicts that the average fertilizer application is driven to 0, which makes this tax a "choke price." The result is a corner solution: the effectiveness of reduced fertilizer application in reducing loadings dominates the effectiveness of either BMP in reducing loadings, and therefore the most effective approach to reducing loadings is simply to reduce fertilizer application.

Clearly these are highly unrealistic scenarios, and we include them only for illustrative purposes to examine the relative differences in the policies and the potential trade-off in loading reductions from the hybrid policy. As explained in section 3.2.3, this approach omits a broader consideration of cost and benefits, included the foregone profits from massive increases in fertilizer costs that drive application rates to zero. The optimal tax would account for these forgone profits while also considering the social benefits of reduced loadings in terms of improved ecosystem services. Both effects are likely to be substantial, and thus a full analysis of the optimal tax policy is important, but beyond the scope of this paper.

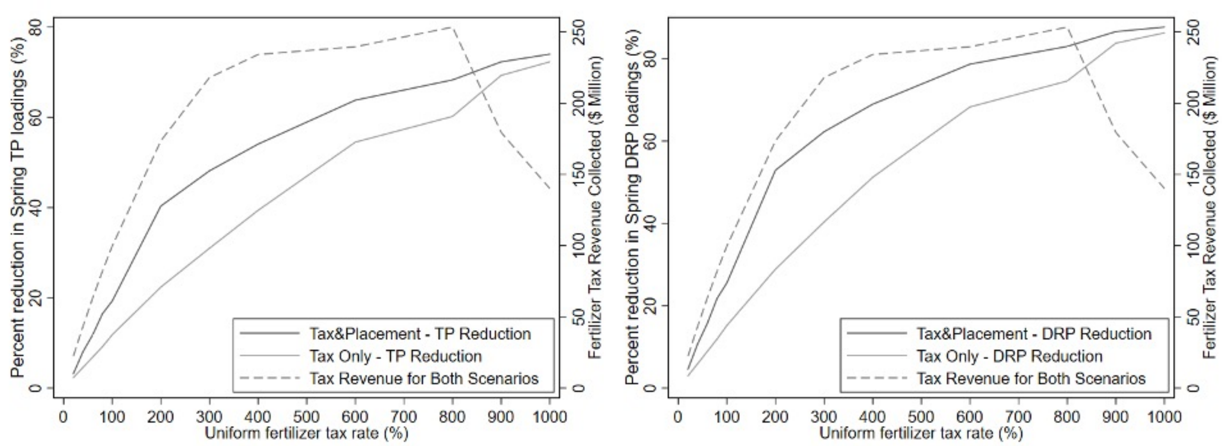

Figure D1. Comparison of TP and DRP reduction of tax policies