The Journal of Science Policy & Governance

POLICY MEMO:

WHERE THE ENVIRONMENT AND LABOR SUPPLY MEET: EMISSIONS PRICING, INNOVATION, AND PRODUCTIVITY

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To: Office of the President of the United States, Energy & Environment

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Tax policy has significant implications for real output and economic growth. One way that tax policy affects economic activity is through its implications for labor supply. While nearly all developing countries have exhibited a general decline in the average hours worked among households (Aguiar and Hurst, 2007), there are large, quantitative differences among these countries that can be explained by differences in their marginal tax rates (Ohanian et al., 2008; Rogerson, 2006; McGrattan, 1994). In developed countries, Prescott (2004) showed that tax policy alone can account for the fact that citizens in Germany, Italy, and France work 50% fewer hours on average, relative to the United States.[1] Because individuals make intertemporal decisions, economic policy has the potential to either enhance or adversely affect individual outcomes in not only the short-term, but also the long-term.[2]

Although there is not a complete consensus, tax policy unambiguously is a major factor undergirding differences in hours worked across countries. *Yet, when policymakers consider greenhouse gas emissions pricing schemes, such as tradable permits and carbon taxes, little attention is directed towards their implications on the labor supply.* Put simply, if there were a price mechanism that internalized the external costs of pollution, what would the consequences be for labor supply? On one hand, such a pricing scheme would correct a significant market failure; on the other, there would be further—and possibly large—adverse effects on labor

[1] Scandinavian countries are frequently cited as counter-examples, given that their labor productivity is similar to the United States' yet have higher effective tax rates. Rogerson (2003) addresses this concern by incorporating social services in household preferences in his general equilibrium model, accounting for the cross-country differences.

[2] There is not a complete consensus in the literature over whether marginal tax rates are the leading factor explaining cross-country differences in hours worked. For example Alesina et al. (2006) argue that labor unions in Europe play a large role. However, both Hayashi and Prescott (2002), in the case of U.S.-Japan, and Bergoeing, Kehoe, Kehoe, and Soto (2002), in the case of U.S.-Chile, provide additional robustness to the theory that tax rates fundamentally affect individuals' labor supply.

supply across countries. Because emissions pricing schemes, even if they are initially directed towards firms, lead to increased costs of production, the cost of emissions is necessarily passed onto households in the form of higher prices.[3] To the extent that this raises relative prices of consumption goods and lowers households' real incomes, households are likely to substitute away from labor supply as the price of leisure becomes increasingly more attractive. Given that the International Energy Agency estimates that $40 trillion is needed in additional global energy investments between now and 2035 to accommodate growing energy demands, even seemingly small distortions to labor supply can have large effects on our ability to meet this demand and prosper economically.

My objective in this brief note is not to discourage emissions pricing policies, but rather to emphasize the multifaceted challenge of addressing pollution criteria externalities in an efficient fashion. In particular, I will focus on (1) the relevance of cutting-edge advances in macro-labor economics for environmental-labor economic analysis, (2) elements of Makridis (2013b) that explicitly model environmental-labor phenomena, and (3) an alternative way to conceptualize environmental policy, namely through the establishment of simple environmental policy rules that involve transparent feedbacks between aggregate indicators, such as the level of emissions and real output, and the price of clean air. These simple rules are developed in Makridis (2013a) and should be understood as analogs to John Taylor's empirically successful Taylor Rule (1993) for central banking, which is consistent with the approach of central banking that sustained the Great Moderation during Paul Volker's oversight.

Background

Environmental policy necessarily involves two externalities. On one hand, there is no price for atmospheric greenhouse gas concentrations (among other pollution criteria), so

[3] Fabra and Reguant (2013) provide empirical evidence on this in the case of the EU ETS.

environmental policies must establish a price on emissions commensurate with the level of marginal social damages caused by anthropogenic emissions; these are a function of the extent to which society is willing to pay for improvements in environmental quality and to avoid damages caused by human interference with the climate system. On the other hand, some clean technologies (those that would reduce pollution) are not yet viable because there is not enough research and development for them (Laffont and Tirole, 1994). That is, effective environmental policy is tasked with not only pricing pollution criteria in order to discourage overproduction of carbon intensive energies, but also promoting the socially efficient level of research and development funding for technological innovation. All of this is complicated by the presence of path dependence in technological change: once a particular technological trajectory is set in motion, it becomes harder to deviate from it, even if it is not socially efficient (Acemoglu et al., 2012).

The Great Recession has further complicated the task of crafting efficient environmental policy. Although not uncontroversial, significant quantitative evidence suggests that the low level of real output—and looming forecasts for low future real output—are sourced in high policy uncertainty (Baker, Bloom, and Davis, 2012; Taylor, 2011) and expectations of higher future tax rates (Kydland and Zarazaga, 2012; McGrattan and Prescott, 2012). Nijkamp and Poot (2004) conducted a comprehensive meta-analysis of the relationship between taxes and economic growth. They found that the vast majority of top tier research documents a negative relationship between higher marginal taxes (more generally, the size of government) and economic growth. Russo et al. (2007) extended these results with heterogeneous agents and showed that allocating tax revenues to subsidize aggregate demand results in lower aggregate productivity. Makridis (2013c) shows how tax policy affects the fundamental incentives for human capital accumulation, which accounts for almost half of cross-country differences in income (Klenow and Rodriguez-Clare, 1997).

All of these drags on economic growth and efficiency could amplify the negative effects of prospective environmental policies, such as carbon taxes or tradable permits. For example, if there is large policy uncertainty, introducing a carbon tax could propagate uncertainty even further since households would face uncertainty over not only future marginal effective tax rates, but also future marginal tax rates on carbon emissions that feed into the price of consumption goods. My previous research showed that, within countries that implemented environmental tax reforms, there was great uncertainty over how revenues would be reallocated and how the future price on clean air would change year-to-year (Makridis, 2013a). Put simply, discussions of environmental policy need to be contextualized within the broader economic constraints. *This does not imply ignoring deteriorating environmental quality or the impacts of climate change, but rather it accentuates the importance of modeling relevant features of the economy that might be interacting with the particular phenomenon targeted by the environmental policy.*

II. **Environmental-Labor Implications**

Carbon taxes and tradable permit schemes are the most frequently discussed mechanisms for resolving the problem of greenhouse gas pollution externalities since they create an explicit price on the concentration of greenhouse gases in the atmosphere. Surprisingly, there has been relatively little study over the effects of their effects on labor supply. That is, in the presence of market for clean air, how would households adjust their labor supply on either the intensive (i.e. how much to work) and extensive (i.e. whether to work) margins? The answer depends fundamentally on the pass-through of the cost of emissions: to what extent is the price on clean air that impacts firms passed onto households in the form of higher prices? Fabra and Reguant

(2013) conducted an empirical study of the European Union Emissions Trading System (ETS) and confirmed the assumption of complete pass-through. Under a carbon tax, the assumption is equally, if not more, plausible since firms face less price uncertainty (since it is fixed by the tax) and can more easily pass the cost onto consumers.

Although many countries have "environmental taxes," only a few have explicit prices on carbon; these countries include: Denmark, Finland, Netherlands, Norway, Sweden, and the United Kingdom. In Makridis (2013b), I generate average environmental and carbon taxes for these countries based on the OECD's environmental tax database.[4] There is a surprising level of variation across countries. Below, I plot average environmental tax and environmental tax revenues for these countries.[5]

[4] For further details, see Makridis (2013b). I consider any tax that taxes carbon intensive inputs as part of the carbon tax.

[5] That is, if E energy is used with a price p, then the total cost, with the carbon tax, call it τ, is $(1+\tau)pE$.

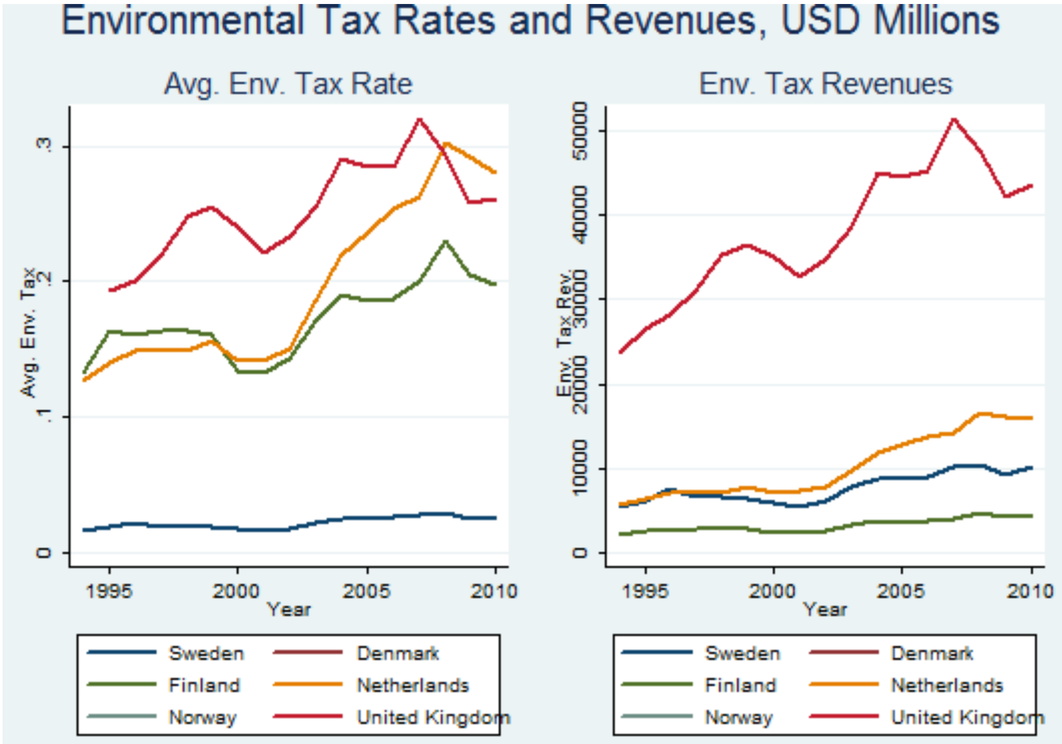

Figure 1.

These differences in carbon tax rates are not trivial, especially given the size of the intermediate and primary polluting sectors that the tax affects. It is natural to suspect, in the presence of a complete pass through of the cost of emissions, an effect of the carbon tax on labor supply. Although far from causal evidence, my analysis, in Makridis (2013b), motivates these plausible effects by running the following regression for the i-th country in the t-th year

$$h_{it} = \beta_0 + \beta_1 \tau_{it}^d + \beta_2 \tau_{it}^h + \beta_3 y_{it} + \beta_4 w_{it} + \beta_5 \upsilon_{it} + \phi_t + \psi_i + \varepsilon_{it}$$

where the dependent variable is hours worked and the independent variable coefficients are, in order, the environmental and labor income tax rates, respectively, real output, real wages, an OECD measure of trade union density, fixed effects on years, fixed effects on countries, and the standard mean zero error term; a few alternate regressions are run for different specifications and different samples, but this is the benchmark specification including Denmark, Finland, Netherlands, Norway, and the UK from 1994-2009.[6] While this period contains rich cross-sectional and temporal variation in tax policy, the macroeconometric regression can only characterize correlations at best, conditional important covariates. Focusing on columns 3 and 4 in Table 1, the results suggest that environmental taxes have an economically and statistically significant negative correlation with hours worked.

Table 1: OLS with Fixed Effects Results

	Theory	(1) Avg. Hrs. b/se	(2) Avg. Hrs. b/se	(3) Avg. Hrs. b/se	(4) Avg. Hrs. b/se	(5) Avg. Hrs. b/se
Real output	?	.0000	.0000	-.0000	.0000	.0000
		(.0000)	(.0000)	(.0000)	(.0000)	(.0000)
Carbon tax	-	131.3673***	140.8091***	-11.8386	9.2031	-30.9701**
		(9.2394)	(8.4841)	(9.1591)	(7.3370)	(12.1219)
Labor Inc. Tax	-	-9.6541***	-14.4090***	-10.3761***	2.8172	-7.3109***
		(1.0674)	(5.1117)	(1.5511)	(3.9019)	(2.0387)
Wages	?	-.0002***	-.0002***	.0001*	-.0005***	.0002***
		(.0000)	(.0000)	(.0000)	(.0001)	(.0001)
Union Dens.	-	3.5767***	3.9190***	-3.9115	-7.3789	-7.6344***
		(.3059)	(.3715)	(2.4675)	(4.3959)	(2.7703)
Constant		1304.2912***	1487.5905***	2099.5060***	2229.8035***	2164.3111***
		(168.4870)	(216.7066)	(250.1118)	(442.0723)	(256.8513)
Year FE		Yes	Yes	Yes	No	Yes
Region FE		No	No	Yes	No	Yes
Observations		70	56	70	14	56
R^2		.8855	.9303	.9855	.8587	.9919
F-test		21.9014	27.4262	144.9221	9.7219	198.1966

Standard errors are in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

For further suggestive evidence, consider a set of first difference correlations.[7] Again, there is a strong negative correlation between carbon taxes and average hours worked.

[6] Sweden is excluded from this analysis, although is a large subject of analysis in the formal paper.
[7] This involves differencing the current from the prior year for all relevant variables. An attraction is that it removes any time invariant heterogeneity or seasonal trends.

Table 2: Correlations, N=Without Sweden

	(1)					
	FD Avg. Hrs.	FD Carbon Tax	FD Output	FD Labor Tax	FD Wage	Union Density
FD Avg. Hrs.	1					
FD Carbon Tax	-0.228 (0.0940)	1				
FD Output	0.183 (0.180)	0.730*** (2.55e-10)	1			
FD Labor Tax	-0.0498 (0.718)	0.904*** (3.40e-21)	0.856*** (8.04e-17)	1		
FD Wage	-0.565*** (0.00000693)	0.864*** (2.03e-17)	0.652*** (6.85e-08)	0.793*** (5.50e-13)	1	
Union Density	0.235 (0.0839)	0.0306 (0.824)	0.0880 (0.523)	0.0790 (0.566)	-0.0395 (0.775)	1
Observations	56					

b coefficients; p in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Although outside the scope of this brief policy note, these correlates in Makridis (2013b) are used as motivation for developing a much more rigorous quantitative model of the general equilibrium feedbacks in an economy with optimizing households and firms, given a set of government tax policies. Although a number of simplifying assumptions are made, the results suggest that labor supply is indeed adversely affected by the carbon taxes in most countries that have implemented them.

Prior literature, such as Goulder et al. (1999), Goulder (1995), has emphasized that the allocation of carbon tax revenues are important, but Makridis (2013b) also emphasizes the important, and previously ignored, complementarity between labor and environmental quality. In particular, as environmental quality improves, households are more likely to allocate a greater fraction of their time towards leisure activities, such as hiking and recreation. If the goal of environmental policy is to improve environmental quality, this complementarity with increased leisure must be explicitly modeled. Of course, there are clear benefits, but there are also meaningful costs: hours worked declines, leading to lower household incomes and a reduction in aggregate economic activity. Again, the inference is not that emissions pricing policies should be avoided, but rather that their consequences for labor supply must at least be documented and accounted for; this is the objective of Makridis (2013b).

The Solution: Rules, Rather than Discretion

Economic theory suggests that the price on carbon (i.e. a carbon tax) should be equal to marginal damages of greenhouse gas pollution. Even if we were fully confident with our estimates of marginal damages—which we are not given the complexity of ecological systems—we still observe quantitatively disparate environmental taxes across countries, as evidenced by exemptions to certain industries across countries and differences in the willingness to pay for improvements in environmental quality. My previous work showed that these deviations from the so-called optimal environmental policy—pricing according to marginal damages—are due to fundamental problems of time inconsistency, which occur when policymakers commit to a policy that is optimal in a given period, but subsequently find it optimal to deviate from it at a later period (Makridis 2013a). While much greater detail is provided in my referenced paper, the key insight is that a change in information is neither a sufficient, nor a necessary condition for time inconsistency; on the contrary, it is driven by the latencies within a given policy that give rise to incentives for policymakers to renege on commitments.

The problem of time inconsistency was developed by Kydland and Prescott (1977) in order to characterize macro- and monetary economic phenomena relating to inflation and unemployment. As Makridis (2013a) showed, these same insights have fundamental implications for crafting environmental policy, namely the converging consensus that economic efficiency and sustained growth requires commitment and credibility through sound policy rules. To the extent that these policy rules (feedbacks) can be made flexible, they can greatly reduce uncertainty and unpredictability, both of which are major sources that undermine growth.

By thinking about environmental policy in terms of its broad general equilibrium effects, policymakers can better discipline their discussions to match the likely costs and benefits of prospective policy. Furthermore, the goal of establishing simple environmental policy rules can better avoid these challenges by increasing transparency, predictability, and sustainability of policy. For example, a policy rule, like the one introduced in Makridis (2013a) that features a feedback between the number of emissions allowances and a function of real output and the stock of emissions is clear, straightforward to implement, and economically attractive. An added benefit is that such a policy may be more politically palatable because constituents can better understand the rule, rather than another new set of complicated, ambiguous, and subjective tax laws open to extensive litigation because it is developed through administrative rule-making. By relying on rules, rather than discretion, environmental policy can flexibly address market failures without imposing unnecessarily high economic costs in the process.

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Bio

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