

Summaries

The double dividend issue: modeling strategies and empirical findings

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The paper reviews recent developments in the study of the so-called 'double dividend', i.e. the possibility of improving the environment and, at the same time, reducing the distortions of the tax system through revenue-neutral green taxes. Roughly speaking, the double dividend literature can be divided in two strands. A first group of contributions focuses upon the distortions of the tax system, before and after an environmental fiscal reform. The emphasis of this notion of double dividend, referred to as weak or strong double dividend, is typically on individual welfare, with less attention being paid to the specific modes in which the tax revenues are recycled and their consequences for the economy. We call this type of double dividend 'welfare double dividend'. A second crop of papers looks at the impact that recycled fiscal revenues can have on relevant macroeconomic variables, especially employment, output, or growth. The papers in this area are motivated by the persistently high levels of unemployment which have now afflicted Europe for a decade. This specific form of double dividend where both emissions and unemployment are reduced by the fiscal reform, is usually named 'employment double dividend'.

This paper aims at providing an updated review of the advances in the study of the double dividend issue. In particular, we distinguish between studies that analyze the double dividend in terms of welfare, and studies that focus on the double dividend in terms of employment. In each section, we first review a number of very recent theoretical studies and discuss their implications for empirical analyses. We then present the findings of existing empirical investigations and provide an assessment of their reliability and policy implications. The main goal of the analysis is to identify the relationship between the modeling strategy and the double dividend results. The paper provides a complete overview of the empirical literature on the double dividend hypothesis and examines its relationship with major theoretical findings.

Construction of a fund for the sharing of benefits from the utilization of plant genetic resources for food and agriculture

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A major issue in international multilateral negotiations is the creation of a fund for the fair and equitable sharing of benefits arising out of the utilization of plant genetic resources for food and agriculture (PGRFA). This paper provides a conceptual understanding of the economic value of PGRFA, identifies proxies for this value that can be used to determine the relative contribution of each country to the benefit-sharing fund, and evaluates the suitability of each proxy to this task.

The international debate over benefit sharing can be divided into Northern versus Southern camps. Agricultural biodiversity 'hotspots' tend to be in the developing world, while modern commercial varieties based on PGRFA from these hotspots tend to be developed and marketed by developed countries. As such, many active promoters of benefit sharing assert that developed countries are benefiting more from the utilization of PGRFA from developing countries than do the developing countries themselves, and that these developing countries are not being compensated in return for the use of these resources. On the other hand, while developed countries benefit from new varieties produced using PGRFA supplied by developing countries, consumer and producers in developing countries may use these new varieties as well, and, hence, benefit from the product development performed in developed countries.

There is no doubt that PGRFA are economically valuable. Breeders need them as inputs to producing new varieties, and, furthermore, to the extent that downstream producers as well as consumers benefit from these new varieties, they benefit from PGRFA as well. However, the number of potential suppliers of PGRFA is high enough that the market price for PGRFA is essentially driven to zero, giving PGRFA the characteristics of non-rivalness and non-excludability in consumption, and thereby complicating the estimation of the value of these goods.

From an economic standpoint, it seems reasonable to tie a country's contribution to the benefit-sharing fund to the benefits it receives from its use of PGRFA. Every country benefits from utilization of PGRFA in the production of new goods, but some countries may benefit more than others. Unfortunately, as discussed in this paper, these benefits cannot be quantified, except perhaps in limited case studies. Hence, given that political considerations dictate that a benefit-sharing fund be created, an alternative can be to appeal to indicators that take equity and development considerations into account in determining contributions, and that acknowledge at

least some of the characteristics of the benefits of PGRFA. Thirteen potentially feasible indicators are examined in this paper. All the feasible indicators are deficient in some ways. Perhaps surprisingly, from this set of indicators, in weighing the pros and cons of each indicator, the ones that seem to be the most satisfying are the value of agricultural production (VAP) and agricultural gross domestic product (AGDP), even though they appear to have little correlation with the value of PGRFA. If each country's percentage of the total contributions to the fund is the ratio of its indicator value to total world value of the indicator, then application of either of these indicators will be progressive in the sense countries with higher VAP and AGDP pay more than those with lower values, but, at the same time, all countries have to contribute. On the other hand, while indicators, such as the value of commercial seed production, focus on stakeholders most dependent on access to PGRFA, they ignore downstream benefits to farmers, food processors, and consumers. Finally, the paper notes the importance of earmarking the fund for conservation and sustainable use of PGRFA or related food security activities in helping the fund distinguish itself from other forms of development aid.

Carbon emissions and economic development: future trajectories based on historical experience

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This paper uses country-level data on per capita carbon emissions and gross domestic product (GDP) to estimate historic development trajectories for per capita carbon emissions. The paper uses updated and revised data, showing that while emissions are increasing in GDP, there is a diminishing marginal propensity to emit carbon. We combine this estimated relationship with plausible projections for GDP and population growth to construct a model that we believe offers useful insights regarding the future level and distribution of global emissions. The advantage of this approach is its simplicity and the fact that it is driven by the historical data on carbon emissions and GDP.

We predict rapid increases in global carbon emissions for the foreseeable future. Indeed, our aggregate projections are broadly consistent with the business-as-usual forecasts generated by the larger structural models, thereby providing independent confirmation of those forecasts. The model predicts rapid emissions increases despite the presence of a diminishing marginal propensity to emit. This is partly a result of the skewed global

income distribution. Although the United States and a few other high-income countries are currently responsible for much of the global emissions total, our model highlights concerns that other countries might follow in our footsteps. Much of the world's population is at a stage of development that has historically been associated with high marginal carbon emissions—along with rapid rates of growth in both GDP and population.

One novel feature of our analysis is that we explore the possibility of integrating world energy prices into our carbon emissions model. We use the year effect estimates from our carbon–GDP equation as dependent variables in a subsidiary regression on world oil prices, thereby seeking to identify oil price-related shocks that might have affected carbon emissions. The estimated model has the predicted sign—higher world oil prices tended to be associated with lower per capita carbon emissions (holding per capita GDP constant). However, the magnitude of this effect was small, so that even fairly rapid global oil price increases would not be expected to slow substantially the pace of global carbon emissions. We urge caution in interpreting this finding, however. *Domestic* energy prices often differ greatly from *global* energy prices. Our study suggests that scarcity-driven global energy price increases are unlikely to slow global carbon emissions, but this should not be interpreted as evidence concerning the effectiveness of within-country energy price policies in slowing a country's own emissions of carbon.

The effect of development on the climate sensitivity of agriculture

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This paper develops a theoretical model that explores how development might affect the sensitivity of agriculture to climate change. The theoretical model generates two conflicting hypotheses: development could make agriculture more climate sensitive if new technologies were specifically designed to enhance farming in optimal settings. In contrast, development could make agriculture less climate sensitive if new technologies increased productivity in more marginal locations.

The paper examines empirical evidence from Brazil, India, and the United States in order to test which hypothesis is correct. The study relies on the Ricardian method, a cross-sectional approach that compares one farm to another within each country. The results suggest that development

will reduce climate sensitivity. The models predict that developing countries are likely to be more climate sensitive. However, future development will likely reduce the climate sensitivity of developing countries by the time warming occurs.

Water pollution abatement cost function: methodological issues and an application to small-scale factories in an industrial estate in India

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Formulation and estimation of a correctly specified abatement cost function would be the corner stone of sound policy regarding imposing taxes or user-fees as well as of sharing social costs in the presence of environmental pollution. Often in research, adequate attention has not been paid to the specification of the abatement cost function. Econometric studies on the pollution abatement cost function have mostly followed the general econometric literature on cost function and have taken for granted the form that the abatement cost function should take. Very few studies have paid attention to the underlying production function and made an attempt to derive the cost function from the production function. In this paper, we deal with these issues. We point out certain problems of interpretation within the framework of Rossi, Young, and Epp (1979) which has been taken as a basis for the abatement cost function estimated in several subsequent studies. We note some other inadequacies of the functional specifications used in econometric studies on the abatement cost function. We underscore the need to define explicitly the output of abatement activity and incorporate it as an argument in the abatement cost function. We suggest an alternative framework in which output of abatement activity is defined in terms of pollution load reduction and derive a form of cost function consistent with the framework.

Our suggested methodology is applied to water pollution abatement activity in small-scale factories in Nandesari Industrial Estate in Gujarat, India. This estate has about 250 small-scale factories, which produce different kinds of organic and inorganic chemicals and pharmaceuticals. Effluent treatment is done in two stages: a primary treatment within the factory premises mainly for controlling chemical oxygen demand, suspended solids, and dissolved solids, and a secondary treatment with the

help of a Common Effluent Treatment Plant for controlling chemical oxygen demand (COD) and biological oxygen demand (BOD). Data for 38 factories for three years, 1993–1994 to 1995–1996, are used for econometric analysis. The estimated cost function indicates low substitution possibilities among inputs. The results reveal substantial scale economies and high marginal abatement cost in wastewater treatment in small-scale factories. The elasticity of abatement cost with respect to wastewater volume is found to be 0.35, which implies that a 10 per cent increase in wastewater volume leads to 3.5 per cent increase in abatement cost. The estimated marginal abatement cost is Rs 43 for 100 grams of COD (at the COD concentration of level of 250 mg/l in the effluent which is the standard set by the State Pollution Control Board). This is much higher than comparable estimates available for medium and large-scale factories in India (below Rs 8). A comparison of the results based on our model and the conventional model indicates that the conventional model overestimates marginal abatement cost for high levels of abatement. Therefore, the use of the conventional model for studying abatement cost may lead to prescription of pollution tax at rates much higher than the optimum. Our model is superior in this respect and also has a better analytical foundation.

Worth of watersheds: a producer surplus approach for valuing drought mitigation in Eastern Indonesia

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This study combines hydrological modeling with applied micro-econometric techniques to value a complex ecosystem service: drought mitigation provided by tropical forested watersheds to agrarian communities. Although parks in tropical countries have been envisioned as integrated conservation and development projects (ICDP) for more than a decade, few studies have attempted to quantify how conservation of tropical forests may facilitate economic development. This study addresses the gap in the policy literature by evaluating the hydrological benefits of Ruteng Park, an ICDP established in 1993 by the government of Indonesia to protect 32,000 hectares of forests in the highest watersheds of the Manggarai region on the island of Flores in Eastern Indonesia. The estimated economic value of drought mitigation is positive and significant. There is some evidence, however, that increased watershed protection will increase profits through greater baseflow only in watersheds with a

unique mix of physio-graphic, forest, climatic, and land use features. We model the hydrological service by approximating it as the change in baseflow in the hydrological system, an index that is derived by using a water-balance model. Spatial variation in current baseflow allows estimation of drought mitigation values as the marginal profit accruing to agricultural households. The paper shows that this uncommon focus on producer (not consumer) surplus measures is appropriate for valuation as long as markets for commodities related to the environmental services are complete. An agricultural profit function exploits all of the available information by estimating a system that includes additional equations for output supply and input demand. Market prices and environmental variables are the most important regressors in the estimated model, and the statistical test for the critical structural assumption regarding the completeness of markets is satisfied. For the typical household, the estimated marginal profit and profit elasticities are positive, validating the central hypothesis that baseflow makes positive contributions to agricultural profits and hence welfare of agricultural households *ceteris paribus*. A baseflow regression model predicts that drought mitigation attributed to increased forestation is typically concentrated in the wetter southern watersheds. Therefore, to fulfill the goals of the park management plan 'to provide conservation benefits to communities in the buffer zone' through watershed protection, policy makers should consider a selective approach targeting specific watersheds. The estimated economic models and the parameters provide some signals for policy makers and management information to Ruteng Park managers regarding the spatial distribution and economic magnitude of watershed protection benefits. They also provide some support for the hypothesis, put forward by hydrological science and the Indonesian Government, that protected watersheds can supply latent and unrecognized ecosystem services to local people.