

Summaries

Green accounting using imperfect, current prices

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Green accounting has two related aims. One is to measure the current value of the contribution of the environment to human welfare and to incorporate that value into an extension of the net national product (NNP). The other is to evaluate current environmental change and to incorporate the values of net changes into NNP. The values are expressed as the products of accounting prices and realized quantities. Under ideal conditions, green NNP is a precise measure of the contribution of economic activity, broadly defined, to social welfare. However, if there are exogenous forces (forces uncontrolled by humans) acting on the economy or distortions of the economy away from optimal performance, further investigation of the interpretation of green NNP is required.

If there are exogenous forces ('drift') but no distortion, then the performance of a decentralized economy is optimal; there is no impairment of the welfare interpretation from the use of market prices. In addition, a current, accounting price should be included for the value of drift. If all human forces acting on the economy are measured, the value of drift may be small. In any case, the contribution to welfare can be expressed in terms of current values.

A parallel development for a distorted economy yields the same expressions for accounting prices and similar interpretations. Although they are not ideal, market prices can be used for marketed goods as in traditional NNP. If there is no market price, an accounting price must be estimated.

Green NNP is only as accurate a measure of welfare as the prices that are used. Still, the measure is suggested by that of an ideal economy, and is the best attempt to include what ought to be included. If its limitations are understood, green NNP is a useful, current economic statistic. Since most of the accounting prices correspond to prices arising in microeconomic models, microeconomic tools can be applied in evaluating green NNP.

Green national accounting: the case of Chile's mining sector

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The economy of Chile rests heavily on the exploitation of its mining resources (and copper in particular), which have a large influence over some fundamental economic variables determining the welfare of the Chilean population as well as the management of the country's economic policy. It is important then, that the national accounts of the country reflect in the best possible way the performance and evolution of its mining sector.

Empirical evidence from several countries confirms that significant errors exist in the estimation of national economic income using the income measures of the traditional national account system (NAS). Additionally, various arguments exist to explain the relevance of incorporating natural resources in the traditional NAS. First, very often natural resources have incompletely defined property rights. This situation produces incentives to overexploit such natural resources, which differs from other forms of capital that presumably have well-defined property rights. Second, indicators obtained from the NAS are traditionally used as the criteria for evaluating the performance of the economic authority. This can generate incentives for the authorities to establish myopic policies and development schemes, favoring short-term objectives at the expense of long-term objectives. As a result of this, there might be a pattern of intertemporal use of the country's natural resources that would limit the welfare of future generations. Finally, even if this is not the case, myopic policies can generate important social costs by deviating the economy from the optimal path of intertemporal use of natural resources.

This article uses the welfare foundations for the usual net domestic product (NDP) income measure of the NAS provided by Weitzman (1976, 2000), and the propositions of Hartwick (1993) and Hamilton (1994a) to correct this measure in order to obtain a green (sustainable) measure of economic income. It estimates four different green measures of the economic income of Chile's mining sector for the period 1977–1996. These four green NDP measures employ different methodologies regarding, on the one hand, the valuation of mining resources and, on the other, the exploration expenditures in the mining sector.

The results clearly show that the usual income measures of the traditional NAS overestimated the economic income generated by the Chilean mining sector during the period by 20–40 per cent, and its rate of growth by 3–20 per cent. Moreover, this overestimation has increased in recent years. These empirical results are remarkably similar for the different methodologies used to calculate the four green measures of the

mining sector's economic income. The empirical evidence produced in this work, together with that provided by other studies, leads to the conclusion that Chile's outstanding recent economic growth has not delivered the amount of economic income recorded by its NAS, since a significant part of it corresponded to depreciation of the country's natural capital.

Trade integration, environmental degradation, and public health in Chile: assessing the linkages

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This paper uses an empirical simulation model to examine links between trade integration, pollution and public health in Chile. Using a general equilibrium framework, we synthesize economic, engineering, and health data in a way that elucidates this complex relationship and can support more coherent policy in all three areas. The basic tool of analysis is a 72-sector calibrated general equilibrium (CGE) model, incorporating monitoring functions for 13 effluent categories and a variety of mortality and morbidity indicators. While the methodology supports more general applications, present attention is confined to atmospheric pollution and health status in the Santiago metropolitan area.

The trade integration scenarios examined include Chile's accession to the North American Free Trade Agreement (NAFTA), the Common Market of the South (MERCOSUR), and unilateral opening to world markets. The latter scenario induces substantial worsening of pollution and expansion of resource-based sectors, partly because it facilitates access to cheaper energy. NAFTA and MERCOSUR integrations are environmentally benign in terms of pollution emissions. NAFTA accession, relative to other trade integration scenarios, actually reduces environmental damage. This results because trade diversion reduces reliance on cheap energy, unlike the other two trade integration scenarios.

We find that emissions of small particulates (PM-10), SO₂, and NO₂, have the strongest impact on local mortality and morbidity. These three pollutants appear to be complementary in economic activity. For several types of emissions, accession to the NAFTA appears to be environmentally benign. Integration via unilateral liberalization has a negative effect on the environment and upon urban morbidity and mortality. Damages due to

rising morbidity and mortality are of similar magnitude and substantial. Integration based on unilateral trade liberalization induces damages equal to 8 percent of the income gains arising from the trade integration. Unilateral trade integration combined with a tax on small particulates brings welfare gains, which are about 16 percent higher than those obtained under unilateral trade reform alone.

Technological change and tropical deforestation: a perspective at the household level

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In this paper we address the question of whether technical change in agriculture accelerates or decelerates tropical deforestation. Conventional wisdom holds that technical progress reduces pressure on remaining forest stocks ('it takes fewer hectares to feed a given number of mouths'), thus contributing to future *conservation*. In contrast, however, economic theory predicts that technical progress will in general make agricultural lands more valuable ('more food can be produced from clearing an additional hectare'), thus triggering future *conversion*. We assess both claims using a theoretical model, finding that the overall conclusion is ambiguous. Specifically, whether and how technical change in agriculture affects forest stocks depends on the form of technological change, the institutional setting (especially the degree of market development), and the specifications of production and utility functions. This implies that the effects will vary with the local situation. We conclude that agricultural intensification is certainly not the panacea that some believe it to be.

Econometric analysis of forest conservation: the Finnish experience

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Forest conservation policies have been more widely adopted both in the developed world as well as in the developing countries in recent years. This policy change may reshape the global forest sector perhaps more profoundly than any other single issue. In this paper we take some steps towards establishing what market consequences might result from national forest conservation policies.

We focus on the Finnish case, which provides a tractable example for empirical research on the effects of conservation with its newly adopted conservation policies and well-defined timber markets and land tenure. From the viewpoint of development economics this case is relevant, because governments in developing countries and countries with economies in transition are commonly simultaneously reforming their land privatization and environmental protection policies. A popular trend is to invigorate private land-tenure also with respect to forestland and to create working markets to ensure the sustainability of forest management. In the light of this, it is in these countries' interest to learn about the various linkages between forest conservation and private timber markets.

In this study we specify a structural dynamic timber market model augmented with forest dynamics. In the model we build a two-equation system for timber demand and supply to which a third equation is added which describes the timber asset dynamics. The historically early established national forest inventory system in Finland allows us to incorporate the private timber stock increment equation in the empirical analysis.

Econometric tests indicated that the system of equations was not misspecified. Statistically the structural system behaved well, and it was used as a basis for an impulse response analysis. With this method we were able to track the long-run dynamic pattern of the effects of a negative shock on privately owned timber assets. Both the effects on the volumes traded and price impacts were estimated.

The results show that the price impacts are substantial as a result of forest conservation in Finland. In the long run, timber prices will increase close to 4.5 per cent as a result of a 10 per cent reduction in the growth of commercially available timber assets under private ownership. Traded volumes come down by some 4 per cent in the long run. The results imply that the remaining timber stocks will be more intensively utilized as compared to the forest assets prior to conservation.

The timber markets seem to be able—to some extent—to correct themselves even on a national level when an external conservation shock is imposed on them. Because the remaining forests are managed more intensively than before, the timber price increase is not as high as expected from

the reduced magnitude of commercially available timber assets. This result is similar to those found for the global timber market effects of forest set-asides and conservation measures.

The results also indicate that even if the timber markets do stabilize in the long run after an exogenous conservation impact, short-term disruption will occur in the form of the increased variability of the markets. Thus, as many governments in the less-developed world aim at increased private ownership of land, and are establishing environmental conservation policies at the same time, they should coordinate these two policies in such a way that conservationist measures interfere as little as possible with timber markets. The policy makers may want to restrict the forest set-asides on publicly owned forestland, and ensure commercial access to timber on private land. Naturally, it remains an issue of further research to find out how widely the results obtained here can be extrapolated to other countries.

The implication of property rights for joint agriculture–timber productivity in the Brazilian Amazon

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Development of a frontier region where all the land is initially in the public domain has often been encouraged through the granting of private land titles. In Brazil, government title granting activities took place primarily during the 1970s and 1980s. Special policies were phased out by 1987. Only permanent and cumulative effects of these policies should be observable by 1995. This paper examines the effects of these policies on the productivity of agricultural and timber industries in the Brazilian Amazon in 1995.

Productivity of agricultural and timber production is first measured for the counties of the Legal Amazon in 1995. Productivity is measured with respect to (1) quantities of outputs that can be produced using a given amount of land, labor, and other inputs—physical productivity—and (2) value of the outputs that can be produced using a given amount of these inputs—revenue efficiency. The measures give a ‘snapshot’ of how productivity varies across the counties of the Amazon region. Then a second-stage model is developed to determine if these productivity measures vary systematically across counties with different histories of government title-granting activities.

Provision of private land titles is found to increase physical productivity. While the initial purpose of the granting of land titles was to encourage immigration into the Amazon, these policies also have evidently caused a long-run improvement in physical productivity. Governmental expenditures, including expenditure to secure property rights, are also found to increase physical productivity in the agricultural industry.

Policies that encourage private ownership of cleared land do not necessarily increase revenue efficiency. Such policies do improve revenue efficiency of agricultural products, but they do not improve revenue efficiency when both agricultural and timber products are considered. Counties with higher shares of privately titled land are found to produce too much agricultural output and too little timber output to maximize county revenues at the set of prices prevailing in the region in 1995.

Results suggest that land-title policies may ultimately increase agricultural yields and reduce the amount of cleared land needed to produce a given quantity of agricultural output. But they also are found to encourage too much agricultural production and too little timber production to maximize gains from economic development. Thus the land-titling policies can have both beneficial and harmful effects on the development of the Amazon region.

Local and global benefits of subsidizing tropical forest conservation

COLIN HUNT

Papua New Guinea is well endowed with tropical rainforest rich in biodiversity. A community-based forest harvesting system—formed around a small-scale or ‘walkabout’ sawmill—is adopted by some 100 small-scale operations in Papua New Guinea. The operations are set up to cut timber from 1,000 hectares of rainforest in an ecologically sustainable manner. An increasing number of groups are achieving certification, towards which subsidies are provided by donors through local or international NGOs, or directly by the European Union. Modelling of a typical operation suggests that these subsidized enterprises are profitable and indeed can compete with logging as an income earner for the forest owners (except where conversions to high-value agriculture is an option). In turning to an economic appraisal of eco-forestry that encompasses non-market benefits, and other forest and land uses, it is necessary to assess the benefits and costs of logging. The economic appraisal also requires modelling of local and global benefits of eco-forestry: importantly, the prevention of damage

costs of carbon lost to the atmosphere together with the prevention of the loss of other environmental and ecosystem services. The model also caters for the carbon fixation and environmental recovery through a 50-year forest regeneration period. These benefits are not only non-market, they are external to the local community and the nation. The economic returns to tropical forest conservation where it replaces logging are positive at an 8 per cent discount rate where the level of carbon emissions prevented is the higher of the two levels modelled. However, the necessity to make such assumptions concerning the value of environmental benefits means that results must be approached with caution, while the sensitivity analysis points to the importance of the generation of more accurate data on carbon losses from logging operations. It also suggests that if carbon losses can be reduced by improved logging practices then investment in eco-forestry is difficult to justify. Easily overlooked in the analysis is the substantial opportunity cost—in the form of log export taxes foregone—to the national government. This cost will become the focus of attention if eco-forestry and directly subsidized forestry projects make significant inroads into areas earmarked for industrial logging concessions. Direct subsidization of forest conservation is as efficient—in terms of the level of economic benefits—as eco-forestry. However, the direct subsidy cost to donors is substantially higher than for eco-forestry because, in contrast to eco-forestry, it generates no financial return. It is pointed out that direct subsidization is, as yet, an unproven practice that must cope with operational and management difficulties posed by strong customary tenure.

The relevance of the article to the rest of the world is, first, in demonstrating how the benefits of conservation might be evaluated and, second, in identifying the parameters that need to be quantified if more rigorous insights are to be gained into the local and global benefits of forest conservation.

Development policies, resource constraints, and agricultural expansion on the Philippine land frontier

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This paper examines ways in which development policies interact and influence incentives for agricultural expansion in frontier areas of developing countries. In such areas, land expansion and the conversion of forests to agricultural production poses severe environmental threats to

watersheds, river systems and the biological integrity of remaining forests. On existing agricultural land, the allocation of plots among crops can also have environmental implications in terms of on-site soil productivity loss rates, or the intensity and frequency of pesticide applications.

The argument that market and policy incentives drive farmers' decisions is widespread but based on mainly circumstantial evidence. Using survey data we present the theoretical and empirical analysis that represent household responses to economic stimuli, conditional on agronomic and household characteristics. We use three years of farm household data gathered from low-income corn and vegetable farms near a national park in the southern Philippines. We find that within farms, land allocation is responsive to relative crop prices and yields. However, different economic stimuli elicit different responses. In particular, some crop expansion takes place primarily through land substitution and intensified input use, while changes in prices or yields of other crops induce an expansion of total farm area. Land and family labor constraints—limits on the availability of skilled managerial labor, for example—bind at different points for different crops. These results suggest that because multiple policies interact, environmental policies must have multiple strands in order to replace incentives to further land expansion.

Plant size, industrial air pollution, and local incomes: evidence from Mexico and Brazil

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Three main questions are posed in this paper: Are small manufacturing plants dirtier than larger plants? Are mortality rates from manufacturing air pollution greater in low-income or high-income areas? What is the relative contribution to projected mortality of small versus large plants in low- and high-income areas?

The first question is examined using a new data set on air pollution by 5,797 manufacturing plants in Mexico. Of these plants, 2,345 have less than 21 employees. Most prior evidence relating plant size to pollution refers to water pollution, rather than air pollution, and compares medium with large plants. The Mexican data offer an unusual opportunity to compare air pollution by small, medium, and large plants in a developing country. The analysis reveals that air-borne, suspended particulate emissions per employee, by plants with 20 or less employees, are significantly greater

than by plants with more than 20 employees within the same (three-digit) manufacturing sector.

The remaining questions are addressed in the context of another new data set on some 156,000 factories in Brazil. The Brazilian data do not report air pollution emissions. For present purposes, particulate emissions by each factory are therefore simulated using emissions per employee within the same manufacturing sector and plant size category from the Mexican data set. The advantage of the Brazilian data over the Mexican data is that in the former the municipality is reported in which the factory is located, whereas location is not documented in the Mexican data. For each of 4,313 municipalities in Brazil, the median wage of earners, total population, and area are also available.

From the Brazilian data it is shown that relative employment in small plants, with less than 21 employees, is greater in lower wage municipalities. Indeed the decline in relative importance of small plants is almost continuous over the span of low to high wage municipalities. Moreover the fraction of manufacturing employment within the six dirtiest manufacturing sectors declines from low to high wage municipalities.

Combined with the observation from the Mexican data that small plants are more pollution intensive one might be tempted to conclude from these results that low wage areas suffer from higher levels of pollution. However, this is not the case. What matters to human health is the total levels of emissions. In higher wage areas, the size of the manufacturing sector is generally larger (with the exception of the very highest wage areas). As a result, projected human mortality from manufacturing air pollution rises from low wage municipalities to high wage municipalities. This is not simply a reflection of the greater prevalence of manufacturing in urban areas, for the rising projections of human mortality among higher wage municipalities hold, even controlling for population density. Moreover, most of the projected deaths result from particulate emissions from large plants, despite the greater pollution intensities of small plants.