Reconciling theory and practice in environmental accounting

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Conclusions

Main results

The main objective of this thesis has been to reconcile theory and practice in green/environmental accounting, which led to the research question: what are the possibilities to narrow the gap between theory and practice in green/environmental accounting? The research question was addressed by investigating different domains: the classic case of the extraction of a non-renewable resource and how to estimate costs of depletion; the emerging area of ecosystem accounting; wealth accounting; and, an application of environmental accounting in the form of environmentally extended input-output analysis.

Chapter 3 reviewed a number of depletion measures that have been recently brought forward in the context of environmental accounting ('practice') and green accounting ('theory'): depletion as a change in total wealth; depletion as 'using up' of the resource; depletion as net savings; or, depletion as net investment. The differences in assumptions between these measures are clarified by contrasting their approaches with the classic theory of a firm engaged in extraction. All measures are evaluated using a time series of data on Dutch natural gas reserves. The main findings are that correcting for the cost of depletion would lead to significant adjustments of both level and growth rates of Dutch net national income, with a strong dependency on the chosen measure. The chapter counters criticism that accounting in practice would necessarily underestimate depletion as shown by a counter example. It is argued that the choice for a depletion measure should be determined by the context of use: measurement of social welfare or sustainable income. The physical measure put forward in the SEEA Central Framework can be justified by its consistency with the income concept that underlies the SNA, whose objective is to provide an aggregate measure of economic activity.

Chapter 4 identified four key methodological challenges in developing ecosystem accounts: the definition of ecosystem services in the context of accounting, their allocation to institutional sectors; the treatment of degradation and rehabilitation, and valuing ecosystem services consistent with SNA principles. The different perspectives taken on these challenges are analyzed and a number of proposals are presented to deal with the challenges in developing ecosystem accounts. These proposals comprise several novel aspects, including (i) presenting an accounting approach that recognizes that most ecosystems are strongly influenced by people and that ecosystem services depend on natural processes as well as human ecosystem management; and, (ii) recording ecosystem services as either contributions of a private land owner or as generated by a sector 'Ecosystems' depending on the type of ecosystem service. We also present a consistent approach for

recording degradation, and for applying monetary valuation approaches in the context of accounting.

The World Bank (2011) recently published times series of comprehensive wealth and adjusted net savings (ANS) estimates for over 120 countries. Chapter 5 reviewed and refined these estimates for the Netherlands, by comparing them with official Dutch statistics. The main empirical findings are that our ANS estimates are 13% of gross national income compared to 15% according to the World Bank due to higher degradation costs as a wider range of pollutants is covered. We also find that that intangible capital constitutes a far smaller share of total wealth (59% when a residual approach is followed; 66% when using direct estimates) than found by the World Bank (around 80%). This can be explained by the use of generic assumptions by the World Bank in combination with the use of different data sources, which result in large differences in the valuation of urban land, produced and financial capital. Another reason is due to the fact that the World Bank includes educational expenditures in its derivation of total wealth, whereas according to the underlying model these should rather be considered as an investment in human capital. Several directions for future improvement of wealth and ANS estimates were suggested such as obtaining country specific estimates for urban land values, as well as using a broader scope of pollutants in measuring degradation costs (a point also made by Ferreira and Moro, 2011). The chapter also contains a critical review of Ferreira and Moro (2011) who have done a similar exercise for Ireland and it is argued that the environmental degradation costs which are the main driver of their negative ANS estimates are severely overestimated. In the near future, more research is clearly needed on estimating human capital directly as human capital constitutes such a significant part of wealth and because using the residual approach is highly sensitive to assumptions used concerning the discount rate and time horizon.

In Chapter 6 bilateral emission trade balances (ETBs) for The Netherlands are constructed with 17 countries/regions and the results are compared for 1996 and 2007 for three different greenhouse gases. We establish a cross-sectional analysis of bilateral ETBs into a volume of trade, composition and technology effect. In order to analyze the driving forces of changes over time we perform a structural decomposition analysis of embodied import and export emissions. The main findings are that the embodied import greenhouse gas emissions have increased by 37% whereas export emissions increased by only 3%, which is primarily driven by CO_2. The 2007 bilateral balances are positive with OECD countries but negative with economies such as Russia, Africa and China. The analyses demonstrate that the worsening of the ETB is to a large extent caused by the changing composition

of trade: the Dutch economy increasingly exports clean products and imports dirty products.

Answer to research questions

Returning now to the main research question of this thesis, we will start by discussing the first sub question about the main causes for the existence of a gap between theory and practice.

First of all, as Chapter 3 demonstrated, there is a lot of confusion between theory and practice about *basic concepts* such as 'rent' and 'price'. For instance, a standard formulation according to the 2008 SNA and the SEEA CF is that the value of an asset consists of the sum of discounted resource rents. However, this use of the notion resource rent already seems to differ from how rent is usually understood in (environmental) economics where 'current rent' equates the current change in market value of the asset. We also saw in Chapter 3 that there are many different price notions: the SNA focuses on market prices for transactions defined as *the amounts of money that willing buyers pay to acquire something from willing sellers* (para 3.119). The SNA makes clear in the same paragraph, that this implies that market prices need not be similar to free market prices (assuming the existence of a competitive market), or the going price, or world market prices etc. Furthermore, in the SNA output is recorded at basic prices, while use of products is recorded at purchaser's prices. Differences between the two are due to taxes and subsidies, trade and transport margins, predictable quality changes (e.g. maturing wines), holding gains during storage etc. (ibid., para 3.148) On the other hand, many theoretical contributions require shadow prices; these will however be different from market prices due to distortions and externalities. Confusingly, shadow prices are sometime called 'accounting prices' (e.g. by Hamilton and Ruta, 2009; and Mäler et al., 2009). Quite often – as we saw in Chapter 3 – theoretical contributions have to resort to market prices by lack of observability of shadow prices. Finally, although not analyzed in detail in this thesis, the notion capital gain is also a frequent source for misunderstandings.

A second reason for the existence of the gap is due to the existence of *different contexts of use*. Chapter 3 distinguished – when discussing adjusting income measures for the cost of depletion – between assessments of i) social welfare

ii) sustainable income, and iii) aggregate economic activity.[1] Underneath these contexts of use lie different traditions which are concerned with different questions. A lot of the theoretical work on green accounting has clearly focused on measuring welfare, an analysis which requires a foundation in a macro economic model including welfare functions. Environmental accounting from its inception has been oriented towards estimating sustainable income departing from notions of Hicksian income, hence the initial focus on estimating a 'green GDP'. The SNA makes clear that it is about measuring economic activity and not about measuring welfare. Another example about the importance of distinguishing between different contexts of use was encountered in Chapter 4, when we discussed the valuation of ecosystem services. The literature on ecosystem services has often focused on what is referred to as total economic values which includes consumer surplus. This is understandable given that these values are often used for cost benefit analysis or environmental assessment strategies. On the other hand, the SNA (and SEEA) depart from the notion of market exchange value which excludes consumer surplus, and is often referred to as marginal valuation.[2]

A third reason for the gap may be due to *different objectives*: the focus of a statistical office is on publishing the best possible data for a single country. Furthermore, national accounts often focus on compiling estimates in volume terms, that is, excluding the change in value that is due to changes in the structure of prices. Estimating growth rates therefore often trumps estimating levels of macroeconomic indicators. It is only during a revision that national accounts are again benchmarked to underlying data sources. By contrast, the objective of theoretical contributions such as the World Bank's wealth accounts discussed in Chapter 5 (but also UNU-IHDP and UNEP, 2012) is on making a solid comparison across countries rather than across time for a single country. A key issue for the latter therefore becomes how to reconcile official data from individual countries with the need to consistently estimate data for a large panel of countries, relying on uniform and generic assumptions. The possibility to compare countries often trumps individual country estimates. As we have seen in Chapter 5, the discrepancies between official statistics and estimated data can be very significant, at least for the Netherlands. A similar example was encountered in Chapter 6 on input-output modeling. The use of MRIOs which combine and integrate multiple data sources from numerous countries often implies that significant adjustments are made to individual country

[1] Heal and Kriström (2005) distinguish between income as expenditure level that can be continued in the future and income as a welfare measure; Vellinga and Withagen (1996) distinguish between three purposes of NNP: welfare, cost-benefit analysis and sustainability.

[2] Confusingly, shadow prices are also marginal in the sense that they can be defined in terms of partial derivatives of the welfare function e.g. as the resulting welfare effect when a constraint is relaxed with one unit.

data, as evidenced by the example of the Netherlands, when comparing with the GTAP database.

The second sub question is whether it would be possible to strengthen environmental accounting practices by underpinning them with a theoretical foundation. The possibilities here seem limited.

First, as explained in Chapter 2, environmental accounting is essentially a satellite system to the SNA based upon the same principles. As indicated in Chapter 1 the SNA has gradually moved towards a system that aspires to be multipurpose and theory neutral. It derives its legitimacy not so much from an underlying theoretical framework but rather from the fact that it is the outcome of an intergovernmental process that takes comments by many different stakeholders into account. Moreover, it is not a fixed document but being revised every 10–15 years. A fortiori, a large part of the environmental accounts derives its legitimacy from being a satellite system to the SNA. Severing ties with the SNA, for instance by placing environmental accounting on a sustainable income footing, may risk undermining its legitimacy and appeal.

Second, an issue that is easily overlooked is that the SNA and SEEA cover a wide range of issues (choice of units; system boundaries; classifications; etc.) that is not so easily replaceable by a single theory. Moreover, the SNA and SEEA are no longer stand-alone frameworks; they are part of the whole edifice of economic statistics which includes manuals on balance of payments, government statistics, index theory etc. And, as the discussion on whether or not to capitalize R&D expenditure has shown in the context of the European System of Accounts, even though there could be compelling theoretical reasons, the availability of reliable country data is also of great concern.[3)]

Third, as exemplified by the discussions in Chapters 3 and 5 there are several rival theories (e.g. inclusive wealth; comprehensive wealth; sectoral income theory). Obviously, a difficulty for choosing a theoretical underpinning for accounting is that the accounts may become vulnerable to criticism of the underlying theory. The adoption of the SEEA CF as an international statistical standard bears testimony to the fact that environmental accounting can be successful without a strong theoretical underpinning.

[3)] Although in this case the decision was eventually taken in favor of capitalization.

We are now in a position to answer the main question of this thesis: what are the possibilities to narrow the gap between theory and practice in green/environmental accounting? Due to the existence of different contexts of use and objectives and difficulties in underpinning environmental accounting practices by a foundation from the theoretical literature, there are few direct possibilities. The reconciliation should be primarily sought in enhancing mutual recognition of different contexts and approaches. Practitioners and researchers often seem to not have been fully aware of the different contexts they operate within. As an illustration, one of the respondents to the Global Consultation held within the Netherlands on the draft SEEA Experimental Ecosystem Accounting guidelines expressed that he found the distinction between total and marginal values an 'eye opener'. This mutual recognition will be enhanced by increased cooperation between the statistical and research communities.

Policy implications

Turning now towards policy, several lessons can be learned from this thesis.

First of all, given the existence of multiple contexts of use and valuation principles, valuation exercises could be designed in such a way that the results are useful for multiple contexts of use. For instance, ecosystem services valuation studies could be designed in such a way that they are useful both for ecosystem assessments and for accounting. To give an example, suppose we want to value the recreational service of a specific forest that is open to visitors without any entree fee. An outcome in the form of a euro value per hectare based on a contingent valuation study may not be directly useable for accounting as it will include consumer surplus. However, a demand curve which specifies the expected number of visits as a function of hypothetical entree fees would be very useful. Indeed, given such a demand curve, taking the actual number of visits multiplied by the corresponding price from the demand curve would allow to obtain an estimate of the SNA consistent value of the amenity service.

Second, the thesis shows that the potential of a single 'green GDP' type of indicator is limited. As shown in Chapter 2, although quite a few countries have experimented with compiling 'green GDP' types of indicators, there are few (e.g. Mexico) examples of successful integration in policy making. There are a number of reasons that may help explain this. First of all, the definition of 'green GDP' itself is unclear. For instance, as shown in Chapter 3, the precise definition and recording of depletion remains (at least until the standardization reached by the SEEA CF) controversial. The recording of degradation and/or ecosystem services, which was

discussed in Chapter 4, proves even more difficult, as we have seen that the type of adjustment critically depends on the chosen approach. Furthermore, there may also be various consistency issues at stake between the methods used for valuing degradation and the accounting framework.[4] Furthermore, as the Stiglitz-Sen-Fitoussi report (Stiglitz et al., 2009) argued, even if we were to have perfect 'green GDP' measures, it would not tell us whether we are becoming more sustainable or not.[5] Moreover, several studies (e.g. Brouwer et al., 1999; Advisory Committee, 2002) have concluded that adjusting GDP quickly requires modeling which may lie beyond the realm of statistical offices (in fact the 2003 SEEA referred to this as 'greened economy modeling'). Therefore, it remains to be seen to what extent estimating adjusted income aggregates should be the responsibility of the statistical community. Finally, when 'green GDP' is approached from a theoretical model (as shown in the Appendix of Chapter 5) it faces the issue described by Pezzey (2003, p.666) as "dependency of the adjustment prescription on model specifications"; the correction terms required to calculate a 'green GDP' depend on the choice of the underlying model.

Future outlook

Chapter 2 demonstrated that environmental accounting is a growing area of statistics. There appears to be increasing international recognition of the importance of environmental accounting as a framework for deriving indicators: indicators to measure societal progress as expressed by Stiglitz et al. (2009); sustainable development indicators (UNECE, 2009); and indicators for assessing green growth (OECD, 2011b).

In terms of the type of indicators, the focus has gradually shifted from 'green GDP' type of indicators towards wealth based indicators (UNU-IHDP and UNEP, 2012; World Bank, 2011); footprint indicators and efficiency/productivity types of indicators as evidenced by green growth strategies (OECD, 2011a). Moreover, the focus has also shifted from finding a single summary or headline indicator (such as

[4] For instance, when degradation costs are estimated using impacts on human health, there are two issues. First, human capital as such is not recognized as an asset within the SNA so it is a bit cumbersome to degrade it. Second, part of the impacts on health may be already reflected in the accounts in the form of reduced output.

[5] The report credits the World Bank's adjusted net savings indicator and the ecological footprint indicator for addressing this issue. However, as argued by Edens and De Haan (2010), we believe that the SSF report does not do full justice to the SEEA CF. As evidenced by the fact that SEEA is classified under 'adjusted GDPs', the report takes a narrow view of the types of indicators that the system has to offer. Essentially the system is reduced to what may have been its primary purpose in earlier versions –'green GDP' – but as we have illustrated in Chapter 2 does not reflect its current multipurpose character. The SSF report somehow misses one of the main building blocks of SEEA – the asset accounts - which can be used for wealth accounting.

'green GDP' or a composite index) towards choosing a number of headline indicators (e.g. recommendation 11 of the SSF report calls for a dashboard of indicators).

In order to fulfill these policy demands, this thesis has argued that it is of paramount importance to stimulate enhanced cooperation between theorists and practitioners in environmental and green accounting, in particular in the following domains.

First of all, the area of environmentally extended input-output analysis. There is a growing interest in consumption based indicators such as carbon footprints, virtual water or indirect resource use. As the calculation of these indicators requires environmental data that is integrated with economic statistics, there is a growing demand for environmental accounting data. The current state of the art is the use of Multi-Regional Input-Output (MRIO) tables which provide an integrated trade linked structure of the world economy (see Hoekstra et al., 2012). The development and maintenance of MRIOs lies due their huge data requirements typically beyond the scope of individual NSIs. Moreover, many individual IO tables have certain specifics (e.g. certain economic sectors are recorded gross instead of net) which may severely distort the outcomes of a global analysis when such details are overlooked. With the replacement of the 1993 SNA by the 2008 SNA guidelines, which strictly follow criteria of economic ownership, national accounts are increasingly disconnected from the underlying physical flows (Van Rossum et al., 2010), which will also pose additional challenges for the field of input-output analysis. Addressing those issues would benefit from a collaborative effort.

A second area of cooperation lies in wealth accounting. Several recent contributions (e.g. Dasgupta, 2009; Heal and Kriström; Arrow et al., 2003a) question the welfare economic theory of green accounting, and emphasize the importance of using wealth based measures. This approach holds the promise of uniting two traditions mentioned above, of assessing sustainability and welfare.[6)] This seems to have lead to a surge of interest in so-called wealth accounting of late. An important aspect will be to gain a better understanding how wealth estimates compiled *for* countries are related to national accounts data on balance sheets compiled *by* countries – the third context of use that was distinguished. When the valuation principles and/or the asset boundary used by national accountants differ from those employed in research studies there is a risk that users may become confused.

6) Dasgupta (2009) shows that wealth defined as the sum of stocks at shadow prices moves in the same direction as well-being, 'one is dual to the other' (ibid., p.5).

The lack of official statistics in the area of wealth accounting continues to be an issue that needs further scrutiny.

A third area of cooperation is ecosystem accounting. So far, the use of spatially explicit data such as remote sensing data within environmental accounting has been limited. This may change, as land and ecosystem accounting is an emerging area within environmental accounting. The use and integration of such data set however requires further cooperation between multiple scientific disciplines (Obst et al., 2013).