

Classifying Market-Based Instruments for Ecosystem Services: A Rough Guide to the Literature Jungle

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Abstract

Although market-based instruments (MBIs) gained prominence in discourses and practice in the field of biodiversity conservation and provision of ecosystem services, their definition and underpinning theory are yet unsettled matters. A review of MBIs – including Payments for Environmental Services, taxes and subsidies, mitigation or species banking, certification, etc. – clearly shows that this label encompasses an extremely diverse array of instruments. Their only shared characteristic might be that monetary values are associated with nature, yet in different ways and not necessarily in conjunction with economic valuations of the benefits / impacts associated to biodiversity and ecosystem services. Their links with markets are often loose, at least contrasted if not questionable in many cases, and the nature of “markets” differs dramatically. This pleads for a better and theory-based typology of such a large collection of policy instruments in order to better inform policy making. The proposed typology is based on the links between MBIs, economic theory, and markets. It includes six generic categories: regulatory price changes, Coasean-type agreements, reverse auctions, tradable permits, direct markets, and voluntary price signals.

Further analysing an extensive review of academic articles on MBIs (146 references found on Web of Science with selected keywords, and 106 references eventually deemed relevant), we attempted to see if our theoretical categories of MBIs were well reflected in the scientific literature and if some policy lessons could be drawn. We found that the proposed typology could prove useful to classify existing instruments; nevertheless, the analysis of the literature on MBIs also revealed the great diversity in research methods and evaluation criteria, as well as in the terminology used. This lack of a common theoretical and empirical framework in the scientific corpus prevents practitioners to draw robust policy-relevant results on MBIs and thus calls for further research and harmonisation of methods to be applied to better defined categories of MBIs with key shared characteristics.

Keywords

Market-based instruments, incentives, conservation, biodiversity, ecosystem services, typology, Payments for Environmental Services, subsidies, auctions

1. Introduction

While the use of market-based instruments (MBIs) for managing ecosystem services¹ is currently booming (Pattanayak et al., 2010), the scope of applicability of these tools is still an unsettled matter (Muradian et al., 2010). The frontier between market-based and other types of policy instruments remains blurred, and the use of the term “markets” might be intentional and at the same time subject to contrasted understandings. Interestingly, this terminology may even give the (wrong) impression that the law is forgotten in the process of developing solutions for the environment. The influential

¹ In this article we mention ecosystem services but also include biodiversity. These concepts are closely related and our analysis intends to cover both as far as policy instruments are concerned.

report “The Economics of Ecosystem & Biodiversity” (TEEB, 2009) refers to “*market-based instruments, such as taxes, charges or tradable permits*”; according to Ruhl et al. (2007), “*the component that is least developed in the literature on ecosystem services is the law*”. Yet, can’t a system of taxation be considered as a part of the law? Furthermore, the term “markets” has both positive and negative impacts for the adoption of instruments that, ironically, do not really deserve this name: “*After all [environmental service markets] are seldom true markets*” (Wunder and Vargas, 2005).

It is therefore necessary to undertake a clearer conceptualisation and framing of these instruments, if only to contribute to the debate, given that “*policy-makers’ enthusiasm for market development [for ecosystem services] is not matched by practical understanding*” (Landell-Mills and Porras, 2002). For instance, Europe is very strong in its support for these instruments as is reflected in key documents: the EU Biodiversity Strategy to 2020 states that “[Europe] *will promote the development and use of innovative financing mechanisms, including market-based instruments*” (EC, 2011). This statement is reinforced by Europe’s flagship initiative on resource efficiency that prioritizes these instruments. Yet contrasted positions are to be found in other parts of the world, certainly as ideological as those in favour of markets. Negotiations on climate change in the framework of the UNFCCC have experienced great resistance from a group of countries led by Bolivia; by way of illustration, this group fiercely opposed any reference to carbon markets for the implementation of the REDD+² mechanism. Wunder and Vargas (2005) also comment on the efforts by donors to promote these MBIs: “*there remains much doubt, particularly in the Southern Hemisphere, about the ultimate desirability of markets*”.

The terminology and definitional issues of MBIs are at the core of the present article, which departs from as broad an understanding of MBIs as it is to be found in the literature. In other words, we include in the analysis the most open and flexible range of instruments as possible, with some of them certainly not referred to as MBIs by a number of authors. Hence, we do not oppose these MBIs to other policy instruments such as those explicitly relying on law and imposing courses of action.

As the analysis will show, there is a thin line, if any, between MBIs and economic instruments or positive incentives as considered by authors and policy-makers. When McNeely (1988) authors an IUCN book that discusses “economic incentives”, does he cover the same field as ours? When a key book like Sterner (2003) that addresses policy instruments for the environment, takes care to avoid isolating “economic instruments” from the others as they lack a clear definition and scope, does it mean that the same applies to MBIs? We cannot judge by ourselves and *a priori* whether these MBIs constitute a relevant category; on the other hand, we do aim to verify whether this category includes instruments that are worth putting on the same level within one and the same category.

This article thus aims to contribute to the analysis of market-based instruments for ecosystem services by proposing a clarification of their scope and nature, by informing on their heterogeneity in terms of their genuine economic characteristics, and by discussing these theoretical inputs in light of a large review of the scientific literature. A first section will build on key references from the grey and scientific literature in order to briefly present the main MBIs in practice, their shared characteristics, and their key definitional features. This first part will end with a typology of our own as the result of theoretical analysis.

A second section will build on a systematic literature review of more than one hundred references to discuss our typology. It will provide extensive material to investigate whether the scientific literature reflects our theoretical typology, provides relevant examples for all of our categories, provides consistent justifications for MBIs, and enables policy-makers to make an assessment of their potential and impacts. This two-step research will lead to a number of statements on the reality of MBIs and recommendations on future research in this field and the very special role played by such a bizarre animal as Payments for Environmental Services (PES).

² Reducing Emissions from Deforestation and Degradation. This mechanism is supposed to financially support the fight against deforestation in developing countries.

2. MBIs for ecosystem services: A theory-based typology

In this first section only key references from both scientific and grey literatures are considered for developing the analysis. This will end up with the presentation of a typology of our own, comprising six categories, and based on the specific economic characteristics and links to markets of MBIs. It is the result of a theoretical reasoning – yet informed by descriptions of existing instruments in the literature – in contrast with typologies derived exclusively from existing applications of these instruments (e.g. Wunder, 2006, Laurans et al., 2012). This method is justified by the need to move away from the confusion in terminology and definitions in order to focus on the intrinsic characteristics of these instruments.

2.1 An overview

Key references from the grey and institutional literature give us a first overview of existing instruments, of which we provide below a brief synthesis.

Fiscal policies are designed to change relative prices, and taxation is widely used. Applied to the environment, it follows the principle of the Pigouvian tax – also named eco-tax – according to which the presence of negative environmental externalities of production processes and activities require public authorities to change a course of action through market signals. It can target the damage indirectly, either through a unit of input (tons of fertilizers) or an area (m² of land that are developed), or more directly (tons of CO₂-equivalent emitted). The heavily debated “carbon tax” is an emblematic example of such an MBI, as it would oblige CO₂ emitters to pay for the alleged damage to the climate. Subsidies can be understood as a Pigouvian tax in reverse whereby rewards target positive externalities. Agri-environmental Measures (AEM) within the Common Agricultural Policy (CAP) are representative of this type of instrument: European states distribute payments to farmers based on their national modalities and for different kinds of ecosystem services. Similar schemes are also developed in the US (Claassen et al., 2008).

Payments for Environmental Services (PES) may be understood as a principle – paying for the provision of a service – or as a specific type of instrument, as in Wunder’s (2005) widely used definition. In the first case, it is arguable that many policy tools are part of this category; any transaction in favour of the service provider, whether in the form of subsidies or more tailored schemes, could in fact be included. In the second case, the definition is more specific and hardly applies, because it is too burdensome in practice (Pirard and Billé, 2010). Two emblematic PES-labelled schemes are (i) the Vittel case in France, whereby the company has signed contracts with surrounding farmers whereby they undertake either to change their practices or give up their production in exchange for payments in order to maintain the quality of mineral water (Perrot-Maître, 2006), and (ii) the Costa Rican “*pago por servicios ambientales*”, which was established in 1996 and proposes payments to land owners according to their land uses – forest conservation, reforestation, sustainable management, etc. – with the justification that these land uses generate ecosystem services either locally or globally (Sanchez-Azofeifa et al., 2007).

Existing markets can be used by producers and consumers to promote goods and services with positive environmental externalities, at their own initiative. The rationale is to provide producers with a premium and/or greater visibility and market shares in order to favour virtuous practices. A good example of this is forest certification: FSC and PEFC are two prominent certification schemes in which forest producers engaged in sustainable forestry can sell their raw or processed timber to niche markets. The same principle can be applied to other products and numerous labels have flourished particularly for agricultural products. Cashore et al. (2004) refer to these institutions as “non-state market-driven governance systems”.

Tradable rights or permits can be exchanged among producers or landowners for the use of a given resource, usually after regulations have constrained full potential use. They are justified by the search for an optimal situation where producers and landowners with the best characteristics in terms of

ecosystem services provision, production costs and economic profitability prospects are encouraged to take over from other producers and landowners by purchasing their rights. This system can be applied in many ways: cap-and-trade systems for greenhouse gas emissions; Individual Transfer Quotas (ITQ) for fisheries, which allow fishermen to purchase quotas giving them the right to produce; mitigation banking, whereby land developers who degrade biodiversity are required to purchase certificates issued for land restoration elsewhere; or transferable development rights in Brazil, where landowners in rural areas are legally required to set aside a percentage of their lands but can purchase rights to develop more if other landowners accept to develop less (Chomitz, 2004).

2.2 A catchall for instruments with a pricing element?

It is not clear whether and how the terms “economic instruments”, “market-based mechanisms”, “incentive-based instruments”, “environmental markets” and others overlap substantially. But we believe that, for the sake of clarity and usefulness, markets should be referred to for specific reasons rather than being just a substitute term for “monetary” or “economic”. Yet this is rarely verified in practice. By way of illustration, the eftec & IEEP (2010) report reviews the concepts and theoretical background and defines MBIs... before reminding us that the Rio Declaration on Environment and Development (1992) promoted “*the use of economic instruments*”.

The confusion between MBIs and economic instruments is striking in many documents that seemingly use one or the other indifferently. If we look at the “Green paper on market-based instruments for environment and related policy purposes” released by the EC (2007), the same assimilation is to be found: “*The EU has increasingly favoured economic or market-based instruments – such as indirect taxation, targeted subsidies or tradable emission rights*”. No definition is given. MBIs are approached through their assumed ability to correct market failures in various ways. And we can hardly expect to gain deeper insight through mysterious statements such as “*At the EU level, the most commonly used MBIs are taxes, charges and tradable permit systems. In economic terms these instruments work in similar ways. However, they also differ in notable aspects*”.

Given the insistence on pointing out significant differences between MBIs, one can reasonably wonder whether it is legitimate to have such a broad and vague category and whether some of these instruments do not share more characteristics with instruments outside this category than with others inside the MBIs’ category. In the same vein, a prominent academic paper by Salzman (2005) on markets for ecosystem services makes a notable distinction – especially in light of institutional reports – between subsidies and taxes: “*Despite their poor reputation [...] government payment schemes are surprisingly common [and] should be favoured over the more traditional regulatory and tax-based approaches*”. We find here a conceptual distinction between subsidies and taxes from the perspective of MBIs, which is very different from the statements found in OECD reports (2003) for instance. All in all, these elements plead for a better definition and categorization of the various ways of influencing / orienting decisions and managing the environment.

Taking stock of the numerous tentative definitions, it seems that the “markets” referred to by almost all authors is not the perfect and self-expanding market of economics handbooks, or even something approaching this. A first distinction here can be made between markets and “the market”, the latter being a coherent and all-encompassing system that underpins capitalism as a way of structuring society for the sake of maximal human well-being through a multiplicity of transactions between agents, while the former refers more to the capacity for a number of agents to exchange specific goods and services in a competitive manner and in specific places. “The market” has been considered to have emerged hand in hand with modern capitalist societies as a conscious plan to organise relations between agents in a very artificial way and not necessarily in the interest of society as a whole (Polanyi, 2001). Furthermore, while capitalism is supposedly justified by its reliance on the market, it does not necessarily translate into a myriad of competitive markets. As Braudel (1979) argues, capitalists have very frequently defended monopolistic markets in their obvious interest.

It is clearly beyond the scope of this article to examine the foundations of capitalism and the associated market principle, but at least we should build on these observations in order to make the point that market ideology is different from the existence of multiple competitive markets, and does not necessarily translate into these markets. This observation finds a direct application in the analysis of MBIs for ecosystem services. Indeed, the very brief description of the main MBIs suggests already that they do not fit with a definition of markets according to which more than three agents are in competition to produce and exchange a good or service, with accessible information on its characteristics.

Actually, what can be found in practice seems more akin to transactions and trade, but these can easily occur outside real markets. This is in line with what Wunder and Vargas (2005) state when referring to PES: “*Instead of true markets, what we mostly find in the real world [...] are bilateral, mutually-negotiated agreements between ecosystem service users and providers*”. Apparently many of these “markets” do not host any process of commodification through which a good or service becomes replaceable by another with close characteristics for the sake of trading (see Kosoy and Corbera 2010 for an analysis of “commodity fetishism” in the case of ecosystem services). While perfect markets hardly ever exist in the real world, the fact that most “markets” referred to for ecosystem services are at the other end of the spectrum gives good reason to be cautious about MBI terminology. Is any improvement foreseeable? Maybe not if we agree that “*ecosystem services, while clearly of tremendous value, are ecologically, geographically, and economically more complex than any other kind of commodity or service, which has made tapping into their value a challenge that has yet to be made*” (Ruhl et al., 2007).

All in all, the only common characteristic for all these “MBIs” seems to be the fact that a price is attributed to nature to different degrees and in different ways. This does not mean that economic valuations are applied to the environment in order to set a price, or that these economic valuations (when performed) actually value the benefits obtained from the environment, as they may also be targeted at production costs (e.g. specific agricultural practices) or opportunity costs (e.g. forest conservation). It simply means that monetary values are associated with nature, whether for market exchange or for direct deals between a limited number of stakeholders, or for whatever other purpose.

2.3 A theory-based typology

In light of our analysis so far, there is unquestionably a need to clarify the existing confusion. A typology of these various instruments would be useful in distinguishing between groups of instruments with little in common. Knowledge about their strengths and weaknesses, their scope of application and other important characteristics can be improved, in our opinion, only if analysis is applied to homogeneous groups of instruments.

The following typology thus aims to distinguish between the various instruments on the basis of their intrinsic economic characteristics, the nature of their relations to markets, and the nature of the “market” that is considered with the instrument (alternatively classified as competitive market, transaction, exchange, payment, etc.).

Two points have to be made here: First, as we deconstruct the very notion of MBI in relation to its “market” component, we do not dismiss any potential definition of a market and thus we also include bilateral negotiations for unique goods and services (e.g. water regulation in a given location) as opposed to mature markets for commodities (e.g. standard agricultural products). Second, we acknowledge that in practice instruments will be even more diversified as these “intrinsic characteristics” may be transformed in the process (Hahn, 1989).

We have chosen to keep the vast range of MBIs that are named as such in our selected review of the literature. Indeed, at this stage, we have preferred not to endorse the responsibility of making decisions about the eligibility of each instrument, as this overarching terminology seems to stem largely from social considerations and the views held by society. Instead, we have focused on making

classifications within this large family that are based on an instrument's characteristics in the realm of economics. The typology categories therefore have generic names, and they do not refer to the names of existing instruments such as mitigation banking, certification or Payments for Environmental Services (See Table 1). For this reason, the typology is obviously not as detailed as a list of specific instruments would be.

Table 1 Market-based instruments for ecosystem services: A theory-based typology

Category	Exclusive characteristics	Specificities	Relation to markets
Direct markets	A market where an environmental product can be directly traded between producers and consumers (or processors)	Can be framed at the international level with specific rules for each country and a great variety of deals (genetic resources), or as a more classical market with more or less processed products (NTFP)	Proximity to the market definition depends on cases and the degree of commodification
Tradable permits	An <i>ad-hoc</i> market where users of an environmental resource need to purchase “permits” that can be further exchanged among resource users, thereby creating artificial scarcity	Designed to either serve a clear environmental objective (with bio-physical indicators) or based on acceptable social costs (market price for carbon)	Creation of a specific market for a given environmental objective, information are expected to be revealed
Reverse auctions	A mechanism whereby candidates to service provision set the level of payment (if accepted) in response to a call by public authorities to remunerate landholders	Aimed at revealing prices and avoiding free-riding and rent seeking	Creates an auction-based market that favors competition among bidders for achieving cost-efficiency
Coasean-type agreements	Ideally spontaneous transactions (free of public intervention) for an exchange of rights in response to a common interest of the beneficiary and the provider	Requires clear allocation of property rights, highly site-specific and difficult to replicate on a large-scale	Usually not following market rules, more of a contractual nature
Regulatory price changes	Consists in regulatory measures that lead to higher or lower relative prices	Part of a fiscal policy (including subsidies) with environmental objectives and complete control by public authorities	Based on an existing market
Voluntary price signals	Consists in schemes whereby producers send a signal to consumers that environmental impacts are positive (in relative terms) and consequently gain a premium on the market price	Still limited as an incentive for action due to relatively low willingness to pay by consumers	Uses existing markets to identify and promote virtuous activities

Two categories refer to instruments that lead to a change in the price of a product (or its production costs) in order to account for the externalities during the production process. These two categories – “regulatory price changes” and “voluntary price signals” – differ substantially in the way they operate. These price signals can be sent through either mandatory or voluntary measures, with important consequences for their links with public policies and regulations. For this reason, their scope of application is contrasted: regulations are much more likely to be applied than purely voluntary premiums that consumers would agree to pay for. These types of instruments rely on existing markets and, in the case of voluntary price signals, require the existence of both a product that is clearly

associated with these positive externalities and a biodiversity component (or ecosystem service) that is easy to communicate to a wide consumer audience. With regulatory price changes, it is possible to identify and target more services for specific fiscal policy components. Furthermore, regulations can modify market prices directly (e.g. consumer-paid taxes on gas) or production costs (e.g. subsidies provided to farmers for virtuous practices). The range of applications is certainly the widest of all categories, and has the longest history in the case of fiscal policies.

The economist Ronald Coase (1960) has advocated an approach to environmental externalities that is totally different to regulations using price signals, and this underpins our “Coasean type agreements” category. According to the Coase theorem, economic agents can more or less spontaneously make deals and exchange rights in order to improve their mutual welfare if transaction costs remain low. In practice, this approach relies on property rights relating to natural resources use and/or ownership that might be frozen or enhanced in order to provide services. As such, it also prolongs the theory of property rights that applies perfectly to environmental externalities (Demsetz, 1967). This approach can be viewed from two opposite angles in terms of its relation to markets. It could be considered that it is not market-based because these transactions are contractual, tailored to each specific case and seldom create new commodities (standard products) that could be exchanged on the marketplace. But it could also be legitimately argued that these numerous transactions re-create the conditions of a market with “prices” (in reality most often “payments”) that are set as the result of these multiple transactions and bargains. We can also observe that these experiments may sometimes lead to more institutionalized markets with more standardized products, as is observed with carbon. This category was perfectly embodied by Wunder’s (2005) widely used definition of Payments for Environmental Services.

The rationale of “tradable markets” as another category is to create a new market for a particular environmental problem in order to efficiently and sustainably manage a scarce resource, such as fish stocks. They can even create the scarcity artificially, as in the case of greenhouse gases in order to limit emissions once commitments are negotiated. The market is then supposed to lead to more cost-efficient outcomes for a given environmental objective – which is agreed upon at the outset – with all stakeholders being free to exchange allowances (or permits, quotas, credits, certificates...) depending on their costs, benefits, reactivity, or any factor that may impact their decision process. In this sense, it is probably the closest to what economists would expect as “market-based instruments” for the management of ecosystem services. Yet it is important to note that these markets are usually extremely dependent on political will, because their *raison d’être* and necessary conditions of existence rest on prior political decisions – and they thus differ substantially from ordinary markets that can arise spontaneously or in response to a social need. Mitigation banking could barely exist without the associated regulations on conservation and the resulting legal framework, and carbon markets would never take off without the Kyoto Protocol. Current difficulties in negotiating further reduction commitments at the international level perfectly illustrate this point, and voluntary carbon markets do not represent a credible substitute.

Another category – “reverse auctions” – refers primarily to an instrument whereby stakeholders set the price for a given activity which results in the provision of ecosystem services. Its logic is clearly driven by the search for information in order to select the most appropriate candidates for achieving a specific objective. In this sense, it is one of the most interesting MBIs from the perspective of economics and what this science can truly contribute to ecosystem services. The rationale is to first decide on the range of activities appropriate for a given environmental objective (e.g. fallows on agricultural lands) and then organize a call for bids to select the best candidates in terms of their (secret) financial offers. The available financial resources are then distributed among the candidates with the lowest offers. The scheme can be adapted and made more complex, but its capacity to reveal information on costs and avoid free-riding and rent-seeking through genuine competition remains its main characteristic and strength.

A last category is named “direct markets” and includes all markets that are created in view of exchanging environmental products alone, with no external interference and without combining them

with other products and characteristics. Yet a “direct market” can take on as many forms as there are environmental products, and it may be challenging to put genetic resources and non-timber forest products, for example, on the same level. Certainly, the modalities for packaging and marketing may differ substantially. Furthermore, the respective abilities of these markets to ensure long-term conservation and provision of ecosystem services might be very different. While ecotourism may result in preserving a given area in a good condition, the over-exploitation of non-timber forest products is not necessarily sustainable.

3. The typology in light of the scientific literature

We now turn to a more systematic review of existing studies about MBIs in order to assess (i) whether the scientific literature reflects our theoretical typology, and (ii) what is the available evidence on the impacts of MBIs and their *raison d'être*.

3.1. Methodology

In order to build an extensive and representative database of scientific articles presenting and analysing MBIs as a means to maintain environmental services and/or conserve biodiversity, we used the authoritative ‘Web of Science’ website. As part of it, the ‘Social Sciences Citation Index’ (SSCI) is an interdisciplinary citation index product of Thomson Reuters' Healthcare & Science division. At the time the search was made (28 March 2012), this citation database was covering 2,474 of the world's leading journals in social sciences across more than 50 disciplines from 1956 to the present day.

We undertook two searches with this service:

- i) all references that included ‘market-based’ AND (‘biodiversity’ OR ‘ecosystem services’ OR ‘environmental services’) in the “topic” field. Practically this means these words were either in the title, abstract, author keywords or Keywords Plus®; the latter category refers to index terms created by Thomson Reuters from significant, frequently occurring words in the text of an article’s cited references.
- ii) all references that included ‘market’ in their title AND (‘biodiversity’ OR ‘ecosystem services’ OR ‘environmental services’) in the “topic” field (see above for details).

In total the search engine found 166 references. Excluding book reviews, and articles we could not download from available databases, we ended with a database of 146 peer-reviewed scientific articles; this means we could read and analyse a majority of relevant references as identified with our keywords (94%).

Out of this we identified 40 references that do not actually deal with the issue addressed in the present article, and that were therefore classified as irrelevant. Indeed, in most cases these references discuss i) issues and methods related to economic valuations of ecosystem services and biodiversity and ii) the relationship between commodity markets (e.g. timber, agricultural products, bush meat) and the state of biodiversity. However, in this latter case the market is not intentionally set for biodiversity and/or ecosystem services conservation so that we do not include the reference in the analysis.

In total, we analysed 106 articles that were considered relevant³. We focused our attention on the most salient points that characterize each article: the method, the type of MBI discussed, the alleged rationale for such an instrument, the evaluation criteria on which the assessment is made (e.g. efficiency or equity), and the positive or negative conclusions of the assessment. Each article was then coded through a cross-checking by the two authors of this article. We were thereby able to discuss any disagreement between the authors in order to reach a consensual decision for each reference in the review.

3.2 Is the typology reflected in the scientific literature review?

³ We do not imply here that all 106 relevant references do provide an impact evaluation of MBIs.

Based on our analysis of the scientific literature, we first attempted to validate (or invalidate) the typology in table 1. Focusing on the main characteristics of MBIs as presented in each reviewed article, we located each instrument in one of the categories. We do stress the fact that a number of MBIs in the literature review were quite not well defined and thus could be located in several categories at a time, or in none of these⁴. Indeed, this issue of fuzzy boundaries and imprecisely defined MBIs will be discussed later so as to show the preliminary nature of such an exercise.

3.2.1 Illustrations of our typology⁵

Direct markets: this category was represented in 9.5% to 12% of reviewed articles. The literature shows that biodiversity and ecosystem provisioning and cultural services, including agricultural products, venison and recreation, are directly sold on markets. In this context, markets, by valuing ecosystem product and services, can provide incentives to sustainably manage resources and ecosystems, whether those that are traded (e.g. rubber) or those that are associated with the traded product (e.g. natural forest and its biodiversity with jungle rubber). Testing this hypothesis in the context of Mediterranean cork forests, Ahlheim & Frör (2011) show for instance that the willingness from wine consumers to specifically buy bottles closed with cork stoppers could help preserve depleted cork forests as their sustainable cultivation would become profitable for southern European farmers. Similarly, Kirkby et al. (2010) demonstrate that ecotourism activities in the Peruvian amazon can have higher financial returns than currently practiced alternatives – including unsustainable logging, ranching, and agriculture – and thus can help preserve the Amazon forest.

Tradable permits: this category was represented in 20% to 27% of reviewed articles. In the well-represented field of carbon sequestration & mitigation, articles are mostly devoted to either the Clean Development Mechanism (CDM) or REDD+, which are both more or less related to the cap-and-trade system negotiated at the international level for reducing greenhouse gas emissions. The other well-represented field is mitigation banking and its various applications and derivatives (biodiversity banking, species banking, habitat banking, wetland banking) where a regulatory rule and/or cap is set on ecosystem or biodiversity degradation with economic actors compelled to compensate. Notably, the US Clean Water Act has fostered the emergence of mitigation markets and the associated exchange of tradable permits. Hence, Robertson (2006; 2009) and Robertson and Hayden (2008) show that entrepreneurial wetland banking has particularly thrived and is now increasingly perceived as an efficient approach to reach biodiversity targets.

Reverse Auctions: this category was represented in 8.5% to 10% of reviewed articles, and is particularly studied in Australia as all articles presented an experiment in this country. The BushTender and EcoTender programs attracted a lot of interest (Salzman, 2005; Eigenraam et al., 2007). In the State of Victoria, Lowell et al. (2007) present a process whereby landowners identify areas on which they are willing to establish forest plantations, and then bid (tender) the amount of money they request from the government. Based on scientific and economic models in order to estimate the quantity of ecosystem services provided for one monetary unit, the State government thereafter chooses the successful bidders. According to most authors, auctions thus enable the revelation of farmers' opportunity costs and better allocation of public resources.

Coasean-type agreements: this category was represented in 19% to 30% of reviewed articles. Referring to negotiation processes between stakeholders to reach a deal, these articles include mostly payments for upland, watershed and forest services, as well as and conservation easements. Empirically, Corbera et al. (2007) give evidence from meso-America that payments directly negotiated and paid act as a significant incentive for local farmers' participation and hereby for forest and biodiversity conservation. Quite paradoxically, theory-oriented articles (e.g. Abildtrup et al., 2012)

⁴ As a consequence, in the following paragraphs we provide ranges rather than single figures for the percentages.

⁵ Note that more than 20% of references mention 'market-based instruments' (MBIs) and 'incentive mechanisms' but do not clearly specify the type of instrument that is discussed. Thus they could not attempt be classified in our 6 categories.

push in the opposite direction and tend to downplay the applicability of the Coase argument on the ground with real negotiation conditions.

Interestingly, PES-labeled initiatives studied in the literature review, and included in this category, are often also simultaneously associated with other instruments as auctions, eco-labelling, ecotourism and carbon trading (carbon forestry). This strikingly shows how complex any classification remains and how much PES boundaries are difficult to define in relation to other MBIs.

Regulatory price changes: compared with their extensive use and implementation, especially in agriculture, relatively few reviewed articles focused on regulatory price signals, about 5.5% to 6.5%. Moreover, these articles remain theoretical and modeling/scenario-making exercises for a majority. They test either the potential impacts of subsidies to eco-friendly capital and agro-environmental subsidies, or pigouvian and land taxes. Seidl et al. (2003) describe federal subsidies in Switzerland that support farmers and argue that ecologically sound practices in agriculture highly depend on subsidies. Interestingly, far from proving that taxes and subsidies are not an important part of the scientific literature and environmental policy, this scarcity of empirical case studies might inform us, instead, that these instruments are usually not viewed as MBIs by scientists (contrary to the grey literature and institutional documents as presented in the first section).

Voluntary price signals: this category was represented in 6.5% to 7.5% of reviewed articles. They analyse price premiums for positive externalities or reduced negative externalities. They address eco-labeling in organic farming and in the coffee industry (e.g. shade-grown) for most of them. Perfecto et al. (2005) for instance assess the ability of shade coffee certification programs in Mexico to link environmental and economic goals for the sake of feasibility and effectiveness of the scheme.

Before moving to the next sub-section, we need to indicate that some instruments addressed in the literature review were extremely difficult to classify. Bioprospecting stands as a good example. Resulting in a commoditized and easily marketed product (e.g. medicinal products), bioprospecting seems a good candidate for the “direct market” category. However, it is also often characterized by a contractual negotiation between several stakeholder groups, in particular between pharmaceutical companies and indigenous communities for potential future benefits accruing from R&D and commercialization. If viewed in that perspective, bioprospecting stands as a good representative of Coasean-type agreements. We therefore understand that one instrument might be analysed from various points of view, and as a result be located in different categories.

3.2.2 The special case of “direct markets”

The literature review was useful in shedding light on the category “direct markets” in our typology. In several ways, it provided us insights on the different perspectives for considering these markets that we envisioned in the first place as a straightforward marketing of biodiversity and ecosystem services. What we had in mind was for instance the marketing of provisioning services such as timber or non-timber forest products, or cultural services such as landscape beauty through eco-tourism, or even genetic resources for further R&D and commercialization of derived products. The idea is indeed that biodiversity and ecosystem services are traded for direct consumption when they are subject to exclusivity with associated property rights.

This category is thus distinct from (i) tradable permits systems whereby units (i.e. pieces of paper, but not the good or service itself) of biodiversity and ecosystem services are exchanged as the result of specific regulations for maintaining stocks, and (ii) coasean-type agreements whereby biodiversity conservation and ecosystem services provision are addressed in negotiated contracts for delivery in future periods. We argue that these differences are crucial in terms of market relations, because the goods and services differ substantially (physical good for direct consumption, piece of paper to fulfill legal requirements, contractual agreement on future activities), as well as the connections to legal requirements and public authorities.

But the literature review also further expanded our knowledge and understanding of this category, and helped us make more explicit a couple of implicit assumptions behind our typology. Indeed, the literature exhibits a clear distinction between markets where natural resources are traded for their own characteristics on the one side; and markets where species and habitats are supposed to be preserved owing to the trade of specific natural resources that are part of the same ecosystems on the other. In other words, in the first case the resource is marketed without any special concern for biodiversity whereas in the second case the resource is marketed in order to generate positive impacts on biodiversity and ecosystems.

Two examples can illustrate this distinction: on the one hand, Morra et al (2009) study the market for monkeys that are consumed as food in Equatorial Guinea, and find that the harvest rate of monkeys is not sustainable. In this case monkeys are consumed to satisfy local needs, and conservation is certainly not a reason for stimulating this market. This article was thus classified as irrelevant for our review as were 4 other similar types of articles among the 40 irrelevant articles.

On the other, Lybbert et al (2002) study the impacts of argan oil commercialization for the sake of conservation of the dry forests of Southwest Morocco where argan trees are endemic. As they put it, this initiative relied on the paradigm that “[...] *because the target natural resource is insufficiently valuable for locals to protect, one must seek to create novel or expanded markets in order to increase locals’ valuation of biological resources so as to induce conservation*” (p. 125). Another interesting case of this category is described in Farrow (1995): the author studies the hypothesis according to which privatization is a means to avoid extinction of species, with two North American case studies – the passenger pigeon and the buffalo. Here the market approach is viewed through the lens of privatization, i.e. moving away from common property and its assumed adverse consequences for sustainable management.

3.3 The raison d’être of MBIs and their impacts

In a second stage, we attempted to uncover the main justifications for MBIs that are proposed in the literature, as well as synthesize the knowledge on the impacts of their implementation.

3.3.1 Three levels of justification

Three main arguments are most frequently proposed in the literature in order to allege the superiority of MBIs as compared with alternative instruments for biodiversity conservation, e.g. coercive / prescriptive laws: provision of incentives, better resource allocation / efficiency, capacity to fill the funding gap.

First, 55% of reviewed articles mention the provision of economic incentives as a driving force in the development of MBIs. The theory of incentives refers to the fact that agents receive price signals and make decisions accordingly. Decisions are not imposed through coercive or prescriptive means, and agents have the opportunity to balance the costs and benefits of going one way or another. An optimum level is assumed to be easier to achieve due to the higher flexibility of incentives; in addition, incentives are considered more effective than coercion in inducing the right decisions by agents – especially in contexts with poor law enforcement. In other words, MBIs purportedly focus on achieving results through the self-interest of private entities.

Second, 28% of academic papers in the literature argue that MBIs help achieving a better allocation of resources. Indeed, MBIs purportedly allow buyers of ecosystem services to more efficiently find and choose providers with the greatest and most cost-effective contribution. Moreover, the market approach is temporally and spatially more flexible and allows biodiversity projects to periodically adapt and change their geographical location based on locally changing ecosystem services’ values and opportunity costs to produce services (this point is clearly made by Wissel and Wätzold, 2010, for habitat banking).

Third, 13% of reviewed articles designate MBIs as an innovative approach to fill the existing funding gap for biodiversity conservation. The last Conference of the Parties to the CBD in Nagoya in 2010 led to several important decisions including the adoption of a new strategic plan with a set of targets. In view of these, a Strategy for Resource Mobilization (SRM) was also adopted and Parties to the CBD have been invited to apply a set of financial and resources indicators by June 2011 to measure needs and gaps. This “funding gap” between the cost of achieving the biodiversity conservation targets and the funding available has long been identified, although the quantitative figures remain debated. The European Council also points to this gap as an argument in favour of MBIs for the EU Biodiversity Strategy to 2020. In the last SRM it is said that Parties should “*substantially increase resources [...] from all sources, including innovative financial mechanisms*”. In other words, public funding is far from sufficient and new sources must be sought.

Interestingly, 25% of reviewed articles do not specifically mention and analyse the economic rationale that underlies the rapid emergence of MBIs as a better alternative to regulatory instruments for biodiversity and ecosystem services. In these cases, the superiority of MBIs is merely assumed and their promotion as a policy-instrument is possibly driven by ideology rather than scientific evidence.

3.3.2 A diversity in terms, methods and evaluation criteria

Our systematic literature review reveals that academic research on MBIs is very heterogeneous and diverse and therefore lacks a uniting framework that would allow researchers and policy-makers to draw robust lessons from a common set of methods and associated results and pieces of evidence.

First, scientists consider MBIs through a broad range of lenses and analytical methods. A majority of articles (40%) are theoretical discourses that expose ideology-driven arguments, favourable or critical, about existing MBIs in general. Scientific evidence and empirical data are not truly at the centre of the analysis. In an additional 4% of reviewed articles, MBIs are even advocated and promoted without any sort of analysis and caution. Besides, 26% of reviewed papers are *ex-ante* modelling/scenario-making exercises that aim at predicting general economic impacts on prices, market-entry, welfare and environmental results of the implementation of a range of instruments, by using theoretical models and simulation (and occasionally testing these models against empirical data).

On the other side of the spectrum, 32% of the reviewed literature is composed of case studies that provide an *ex-post* analysis of the impacts. These case studies typically address a local experiment, supervised by a NGO, an international donor or local authorities. Most of these articles use empirical data collected at household and community levels, and provide assessments of these experiments. In addition, 22% of reviewed articles discuss a specific instrument at the sub-national or national levels. In these instances, the instrument tends to be analysed in an institutional / governance perspective, or with the comparison of several sites.

Diversity in the research agenda is even more striking when one analyses the terminology and wording used in the literature. While we attempted to categorise most of the instruments presented in the literature into six categories as presented in the typology, the variety of terms and their lack of precision emerged as a challenge. On the one hand, about 20% of reviewed articles remain general about the instruments that are analysed and mention these broadly as “economic incentives”, “market-based instruments” or “innovative incentive mechanisms”. On the other hand, the variety of terms for each category is amazing. Indeed, we found around 50 different names to designate market-based instruments, with so many of them applied to a same instrument. In an attempt to clarify and organise this diversity, only 10% of articles propose some sort of typology, yet with different scopes and varied rigor and associated justification, and most of the time in an extremely simple way (e.g. MBIs *versus* government regulations and “persuasive strategies”).

In line with such a great variety in terminology, wording, definitions and methods of analysis, our literature review also shows a heterogeneous range of criteria that serve as a basis for impact assessments of MBIs. While half of the articles assess MBIs’ environmental effectiveness (i.e. has the environment eventually benefited from their implementation) and about one third do focus on

efficiency (or “cost-effectiveness, i.e. assessing impacts against the costs of implementation), many other criteria are applied. We can quote equity (13%), feasibility (11%), potential for poverty alleviation (10%), adoption and participation (9%), contribution to development (3%), legitimacy (3%), food security (2%), freedom of choice (2%), governance (1%), etc.

In total, heterogeneous methodologies, diverse criteria for assessments, and an ill-defined set of terms for the instruments, prevent researchers and practitioners to easily compare MBIs in terms of design, costs and benefits, or impacts. Even more spectacular, we could not find any clear evidence of a positive or negative trend for MBIs’ impacts. The articles presenting positive, negative, and mixed results were in almost similar proportions in our review of 106 scientific references. Similarly there is no clear evidence that applying a specific method of analysis (case study of a local experiment with empirical data, case study of a national scheme, theoretical analysis, modeling and simulation, etc.) has led authors to uncover particular results, as no correlation was found between methods and results.

4. Conclusion

The analysis developed in this article leads to the conclusion that the instruments presented in the literature as “market-based instruments” (MBIs) constitute an extremely heterogeneous group with loose, questionable and contrasted links to markets, which in turn respond to various definitions. The market terminology seems to have been adopted by default, as a way of differentiating these instruments from all approaches that do not mix nature and prices. Indeed, our interpretation is that the term “MBI” serves as a catchall for all instruments with a price component. Wouldn’t “market transactions” be more appropriate as a term, as it would encompass mature markets as well as unique transactions just to mention both ends of a large spectrum?

Therefore, a common characteristic among “MBIs” could be that monetary values are associated with nature, whether for market exchange, for direct deals between a limited number of stakeholders, or for whatever other purpose. Their main (and only?) common characteristic is the use of monetary values through a process leading to the consideration of nature through the lens of utility. Worth noting, these monetary values may result from either exchanges between buyers and sellers according to the market logic, or from economic valuations, depending on the category to which the MBI belongs.

Their heterogeneity calls for the elaboration of a typology based on their economic characteristics, the nature of their relationships with markets, and the nature of the “market” that is considered with the instrument (alternatively classified as competitive market, transaction, exchange, payment, etc.). Designed after a theoretical analysis and inspiration from key references, the typology we proposed identifies six broad categories that are presented in Table 1. These categories possess contrasted characteristics and use markets in various ways: e.g. regulations or private initiatives that change relative prices according to the environmental impacts (“externalities”) of production processes or land uses; negotiated contracts between a limited number of stakeholders with no state intervention for the provision of ecosystem services; or the creation of specific markets that limit the use of a given natural resource and organize an exchange of permits for such use.

Admittedly, different typologies can be developed with their own justification and we do not pretend to provide categories that are undisputable (there might be a continuum of situations). Furthermore, it is a challenge to have truly mutually-exclusive categories that encompass the entire range of instruments. One reason is that most policy instruments are multi-dimensional and thus are difficult to capture with one single typology (except if extremely simple, such as monetary exchanges *versus* imposition of a course of action). Yet, our aim has been to deconstruct the term “MBI” and to show that contrasted understandings and categories were part of it.

In view of this heterogeneity, one can hardly expect that environmental management will automatically benefit from the assumed advantages of markets simply by designing and implementing “MBIs”. This is confirmed by the extensive and representative scientific literature review performed in a second step (with 106 relevant references from peer-reviewed journals, see section 3.1) that

shows a lack of consensus regarding the positive and negative outcomes of these instruments. Even more confusing, the diversity of research methods in all reviewed articles makes any comparison challenging, if not irrelevant. From empirical case studies to modelling, from *ex post* assessments of national schemes to *ex ante* theoretical analyses, how to draw general lessons from the literature? Furthermore, the ideological stances in both directions tend to affect the credibility of many of these scientific articles. In this context, our review found extremely few comparative studies in the literature; this then calls for further robust research and harmonisation of research methods applied which would help to compare MBIs against each other based on a common research agenda. Is this feasible? Are these instruments comparable?

This is all but certain. Indeed, the scientific literature review was also useful in that it shed light on the avenues for improvement of the proposed typology. Although it provided documented cases of instruments fitting in each of our categories, it also showed how difficult to systematically associate an instrument with a category. There are at least two reasons for this matter of fact: First, reality on the ground is complex and actual implementation is commonly far removed from the ideas developed by economists in their offices in line with sound economic theory as put by Hahn (1989): “[experience] shows how the actual use of these tools tends to depart from the role which economists have conceived for them”. Thus the MBIs in real life tend to differ from their initial conceptual descriptions (such as our typology).

Second, these instruments might not be mutually-exclusive and public policies seem to combine rather than include / exclude the approaches described in the categories presented in our typology. The instruments might also operate at different levels: e.g. (i) mitigation banking (“tradable permits” category) provides a regulatory framework for exchanging biodiversity offsets, (ii) these biodiversity offsets can be produced through contracts with land owners (“coasean-type agreements” category), and (iii) the selection of the service providers can rely on “reverse auctions” for the sake of cost-effectiveness.

In other words, there might be several crucial distinctions to make between instruments for the sake of understanding their impacts, positive prospects and risks. We suggest here one broad distinction that will need further investigation: funding mechanisms differ from incentive mechanisms and allocation mechanisms: (i) funding mechanisms aim at generating new sources of finance (carbon markets, water funds, biodiversity offsets), (ii) incentive mechanisms aim at orienting agents towards environmentally-friendly behaviours (subsidies, certification), and (iii) allocation mechanisms aim at ensuring the cost-effectiveness of measures (reverse auctions). Due to their contrasted objectives, and also due to the different agents that they target, there is no reason to either generalise their impacts (as tend to do those who promote or criticise MBIs in general) or use the same methods for assessing their specific impacts. This being said, having unified research methods for each category specifically is an interesting prospect that deserves exploration.

To conclude, terms may be misleading when they are interpreted and used in contrasted ways by diverse stakeholders. Payments for Environmental Services (PES) give a perfect illustration of terms that gradually become emptied of their meaning. This instrument occupies a special place in the realm of MBIs and economic instruments more broadly speaking. Indeed, while it is prominent in discourses devoted to economic approaches to the environment, its relation to markets is debated. We further discovered that the literature on PES was hardly represented in our review. As a matter of illustration, a search on the keywords ‘biodiversity’ OR ‘ecosystem services’ OR ‘environmental services’ in the “topic” field, AND either “Payments for Environmental Services” or “market-based” in the “topic” field generated respectively 191 and 87 references, but with only 14 common references.

Therefore, a comprehensive study of market and economic approaches to ecosystem services’ provision and biodiversity conservation might have to pay a special attention to this ill-defined object. And one possible reason for the overly small overlap between MBIs and PES in the literature might be that PES have progressively become one realm in itself in the field of conservation, ecosystem

services and the environment, thereby calling for a future application of the analysis we undertook for MBIs.

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