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An accounting model for assessing full-cost recovery of environmental public utilities

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WORKING PAPER SERIES IN ECONOMICS

An accounting model for assessing full-cost recovery of environmental public utilities

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Abstract

Recent European legislation adopts the concept of Full-cost recovery (FCR) as the guiding line for pricing of environmental services. In this paper, the meaning of the FCR concept is analysed and the economic rationale for its application is discussed. The basic idea developed is that FCR is a misleading concept, since costs are by definition recovered, and the problem becomes to assess *how* it is covered. After presenting the various options available for cross-subsidisation, an accounting framework for analysing the structure of cost recovery of an environmental service is proposed. Alternative ways of financing the service are listed according to their distance from the pure long run marginal cost, representing the economic optimum. Applications to a set of case-studies recently developed by the author are finally presented in order to clarify the potential usefulness of the proposed methodology.

Keywords:

Economic instruments, Full-cost recovery, Pricing of public utilities, Water supply and sewerage, Waste collection and disposal

JEL: H42, Q25, H54

An accounting model for assessing full-cost recovery of environmental public utilities

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1. Introduction

European legislation has adopted the concept of full-cost recovery (FCR) among the guiding lines for both solid waste and water resources management policies. This concept is intended to be an application of the polluter-pays principle (PPP) and provide a basis for charging the use of environmental resources in such a way that provides users with appropriate incentives for a sustainable use of the environment (Eu-Dg Environment, 2001).

Many studies and debates have been carried on in recent years in order to discuss methodological and empirical aspects of FCR. At the political level, the issue of FCR has revealed to be a very sensitive one, since some countries (notably, Northern European ones) have complained other countries' reluctantness to engage in cost-recovering policies before asking for structural subsidies. Financing policies of European Investment Bank have also been reproached because of the need to better ensure that FCR is guaranteed.

Yet the most part of the debate, either at the scientific or at the political level, suffers from the vagueness of the FCR concept and for the lack of a consistent and agreed methodology for individuating costs and revenues to be accounted for (Ecologic, 1997, 1999; Correia et al., 1999).

According to the national conventions, member countries could reciprocally blame each other for admitting hidden subsidies. Apparently, there are some degrees of ambiguity: FCR is in fact used with many different meanings and purposes.

The first one is *internalisation* of externalities. The adoption of the PPP requires each user of environmental resources to compensate the society for the subtraction of resources to other beneficial uses in the present or in the future.

The second one is *incentivation* of environmental sustainability. Independently on the price *level*, direct payments may be structured in order to provide resource users with adequate incentives for sustainable resource use.

The third one is the avoidance of *subsidies*. Many uses of natural resources have been encouraged in the past by the fact that users did not pay the full cost. This attitude also encouraged the expansion of the supply base far beyond the economic and social optimum. Charging the full industrial cost is seen as a prerequisite for obliging users to consider economic and social constraints to expanding demand and possibly to evaluate the opportunity of adopting resource saving measures.

The fourth one – that is never mentioned too explicitly, yet is probably the decisive one for ensuring service operators' support to the policy – is the willingness to ensure that utilities dispose of *adequate financial resources* in order to sustain the costs even with a decreasing role of the public sector in the service economy. In this last meaning, FCR is functional to privatisation policies.

This paper presents the idea that, in reality, the FCR concept is somewhat misleading. Costs are by definition "recovered" either from direct charges or taxation, and if they are not, this means that an intergenerational externality is occurring.

The allocative benefits of FCR are sometimes confused with those associated to long-run marginal cost pricing (LRMC). Yet the economic theory shows very clearly that the two are not synonimous, since the latter may be lower – thus requiring public sector intervention – at least wherever public good dimensions are present; and the former might be actually achieved even if allocation rules are not based on the marginal cost.

In principle, the economic first best would require the application of LRMC to the private goods and the production through the public sector of public goods. Once the latter have been singled out, therefore, the economic approach to FCR could be to charge the LRMC to each individual consumer for the private good supplied by utilities.

However, this might not be an optimal policy. The theoretical arguments not favouring the application of LRMC are thus reviewed, basing on the standard theory of public sector economics (Stiglitz, 1986; Brown and Jackson, 1990). Transactions costs associated with low demand elasticity; distributive effects and declaration of environmental services as "position goods"; recovery of sunk costs and allocation of the economic risk are the three basic concepts developed.

In fact, as is shown in par. 2.3, LRMC is never applied literally on an individual base in European environmental services.

Once the pricing rule deviates from the othodox LRMC, the choice of the pricing structure is by far a second-best solution, whose pros and contras originate from other reasons than allocative efficiency.

FCR is justifyable on pragmatic grounds, since it ensures adequate revenues to service operators in a trend of privatisation and since it creates a basis for the application of environmental economic instruments without incurring into the constitutional complications that are needed for the creation of new taxes. Yet in order to achieve these objectives, a reasonable price signal to relevant target actors is more than enough, without requiring too complex accounting of the full cost.

Our suggestion is that instead of asking for FCR, legislation should require that externalities should be avoided. On the other hand, subsidies that do not entail externalities but simply enact redistributive policies among the present generation should be allowed as far as a democratic decision has legitimated them.

Building on this insight, a methodology for assessing the cost recovery structure is proposed. This is based on a simplified accounting scheme that adopts the different categories of costs as "uses" and alternative ways of financing as "sources".

Ultimately, the citizen pays either as a user of the service, or as a taxpayer, or as a consumer, or finally as a polluter. The cost recovery structure might entail cross-subsidies at the territorial level, or among different services, or of fiscal nature.

A crucial distinction that is proposed here is that between "endogenous" and "exogenous" sources. Endogenous sources are payments that are directly obtained from service users, regardless the nature of the payment (fiscal or not), with the only requirement that payments are correlated with service consumption and dedicated to the separate accounting of the environmental service.

Exogenous sources are payments that are made to general budgets, which on their turn contribute, yet without a direct relation, to the service balance.

The accounting scheme can be used at different territorial levels in order to enlighten territorial cross-subsidies, that might arise even when the full cost is actually recovered by charges on a wider territorial base.

According to our approach, FCR in a strict sense is guaranteed, provided that endogenous sources cover the total cost, including environmental external costs. In order to achieve sustainability, however, this is not sufficient. Sustainability is well compatible with some perequation schemes; on the other hand, once a strong sustainability approach is adopted, environmental externalities cannot be traded off with financial payments

Environmental sustainability is thus achieved as far as inter-generational externalities are avoided, independently on how each generation decides to allocate the current cost among endogenous and exogenous sources. Intra-generational sustainability, in turn, requires that current resource allocation patterns are democratically accepted, basic environmental functions are guaranteed and those who suffer from negative externalities are adequately compensated.

Three applications of the proposed accounting model are finally presented. The first one concerns the analysis of cost recovery levels in the irrigation sector in some European countries. The second one is an assessment of the allocative and distributional consequences of the recent reform of solid waste management services in Italy, on a national base. The last one concerns the public water supply and sewerage network in the Province of Udine, in the North-East of Italy.

In all cases, the proposed framework allows to contradict some well-radicated commonplaces and to enlighten the financial structure of the two industries.

2. The concept of full cost and full cost recovery

2.1 - Industrial cost, resources management, externalities: a taxonomy of the full cost of environmental services

What do we mean by “cost” of an environmental service?

Environmental economists have long understood that when dealing with natural capital it is not only the “financial” cost that is relevant, since there is also an “external” cost to be accounted for (Pearce and Turner, 1989; Spulber and Sabbaghi, 1994; Pearce, 1999).

The cost of environmental services is not just the cost of the goods and services that are required in order to make the environmental resource available for use, but also the costs that society has to bear by means of reduced opportunities of using the “natural capital” in alternative ways, and the costs that are necessary for maintaining and improving the quality and quantity of the “natural capital” itself up to a level that is considered sufficient in terms of long-run sustainability.

This concept is now well radicated in the European policy (European Commission, -Dg Environment, 2000; 2001), even if not fully in all national legislations of the Member Countries that still do not adopt the concept of external cost.

This definition can be better articulated, in order to consider the specificities of each. In particular, financial costs can be further broken down according to their belonging to the private or public good component of the service; while external costs can be classified according to the territorial and temporal dimension in which the externality occurs.

According to the approach to sustainability that is adopted, non-monetary values might also be considered: in this last case, of course, they cannot be accounted for as “costs” since they are unmeasurable in monetary terms, yet they might be figured in satellite accounts (Ekins, 2000). Figure 1 summarises the main components of the full cost.

Industrial cost is the cost of economic activities that provide waste management as well as water and sewerage services. It includes all the phases of water management, from abstraction to discharge; as well as the financial costs for collecting, disposing and/or recycling municipal waste.

According to the standard economic definition, we deal here with opportunity costs and not pure financial costs. In the water and waste industries, it is reasonable to assume that at least some fractions of the value added originate from non-competitive markets: this is due to the territorial monopoly in which utilities operate in each local market, but also to the economic rents that are contained in segments such as waste disposal facilities (when privately controlled) or technological equipment. These complications should be accounted for in order to assess the true economic cost, otherwise the adoption of FCR would simply mean to pass through the cost of monopoly rents to consumers.

Other inputs, conversely, might be supplied by the public sector for free or at a subsidised price (eg education and vocational training).

On the other hand, we need to consider the crucial importance of the variable time, whose role is particularly delicate in the water sector, given the very long depreciation schedule of fixed assets. Artificial transformation of the water environment cannot be easily distinguished from the “natural capital” [1]; even if only water supply and sewerage infrastructure is considered, equipment life, especially in the case of reservoirs and pipelines, have economic lives of many decades or even a century.

Figure 1 – The full cost of environmental services and its components

Component	**Sub-components**	
Financial cost	Industrial cost	Operational cost
		Infrastructure maintenance cost
		Capital cost
	Resources management cost	Administrative and regulatory cost
		Public goods and basic infrastructure regarded as “merit good”
External cost	For the present generation	Local scale
		National and global scale
	For the next generation	Local scale
		National and global scale
	Non-monetary externalities	

Since capital equipment is very long-lived and market failures are likely to occur given the myopic behaviour of private capital markets, a very delicate issue for defining the full cost is that of the interest rate and the depreciation schedule to be applied. As Barraqué (1997 and 2000) clearly shows, interest rates required by the private capital market would result in a drastic increase (in the range of 200-300%) of the total cost with respect to public accounting procedures that do not apply market interest rates; yet the point here is that private investors require much shorter repayment schedules (and thus higher interest rates) in order to achieve risk/return profiles that are comparable with the rest of the economy, while the public sector can – and according to some, should – be less pessimistic and prudent.

Should the market interest rate or a social discount rate be applied to such investments is a long-debated and never definitively resolved issue in public sector economics (Florio, 1991) and more specifically in environmental economics (Pearce and Turner, 1991; Bromley, 1996; Ekins, 2000). It seems justified, in any case, to consider water artificial capital by the same standards as reproducible natural capital, given the sustainability issues that are associated with it (Barraqué, 1997); and therefore, apply the same discount rate that is applied to choices affecting natural capital.

In the waste industry this problem is less crucial, since the economic life of assets is far more “normal”; market interest rates can be used for sure without market failures.

It is also important to note that the financial cost entails an inter-generational dimension, given that part of the infrastructure costs are transferred onto the next generations (e.g. because of technological lock-in, or bad maintenance of long-lived assets). The artificialisation of the water system in this meaning represents a mortgage on the future generations. A sort of an “option value” should therefore be considered as a further component of the industrial cost. This component is nonetheless very difficult to quantify.

The category of resources management cost should include the cost of all public goods that are supplied by the state. Clearly, administrative and regulatory costs belong to this category, as well as public research and development, education etc.

[1] For example, the territorial landscape of Northern Italy has been modelled during centuries with a long series of public works that definitely altered the “natural” pattern of water flow: the Po plain was actually an immense wetland. The conservation of the “natural environment” of the lagoon of Venice would entail the complete disruption of the city.

Public good dimensions are often present also in the output of the utilities themselves. A water reservoir, for example, might provide useful services for flood protection and restorement of river habitats. Street cleaning and public hygiene are further examples.

This is usually a very delicate point since it often occurs that in the valuation process public goods are overestimated in order to justify government subsidies to the new infrastructure (Barraqué, 2000). Most of the ongoing new projects for water resources development in Europe, for example, fail to pass the cost-benefit test unless a public good dimension is also considered in the valuation (Massarutto, 2001a). Uncertainties in the estimation of variables such as the potential damage caused by a flood and the way to consider alternative means to provide the same public goods are the most critical points.

The third category, external cost is less problematic to define, even if not completely easy to calculate in practice (IVM-EFTEC 1998). The external cost is in the end the opportunity cost of water, air and soil, that is its best value in an alternative use.

External costs might be intra-generational (for example, water pollution obliges downstream users to sustain extra costs for treating water up to satisfactory quality standards) or inter-generational (for example, soil pollution due to abandoned landfills and industrial sites causes aquifer contamination; excess pumping causes saline intrusion into the water table).

Empirical work done in the last 20 years shows that the magnitude of these costs varies highly in the case of water resources, due to site-specific variables (Tihansky, 1975; Fontana and Massarutto, 1995; Gibbons, 1989; Turner and Postle, 1994). When important recreational and landscape conservation dimensions are present, the value of this external cost might well be high enough so as to overcompensate the value of “productive” uses; yet this occurs only in special cases, while in normal ones, once there are no losses critical natural capital involved, the magnitude can be supposed as far lower.

In the case of waste disposal, the convergence of values determined in empirical studies is higher (European Commission, Dg Environment, 2000; Ascari and Fontana, 1998; Baroni and Lorenzoni, 2000). External costs vary normally in the range between 10 and 30 E/t, representing a fraction of 10-30% of the total cost.

When exhaustible resources are considered, a scarcity cost – or resource user cost – should also be accounted for (Pearce, 1999). This dimension is more obvious in the case of fossil energy, yet there might be linkages with the water and waste management services as well (eg considering the void space in a given area as exhaustible). To our knowledge, however, there have been no serious attempts to quantify this dimension in the case of water and solid waste management.

2.2 - Price, charges, taxes: who bears the cost of the public service?

Figure 2 represents a schematic diagram of the financial transactions that may occur in the value chain of an environmental service.

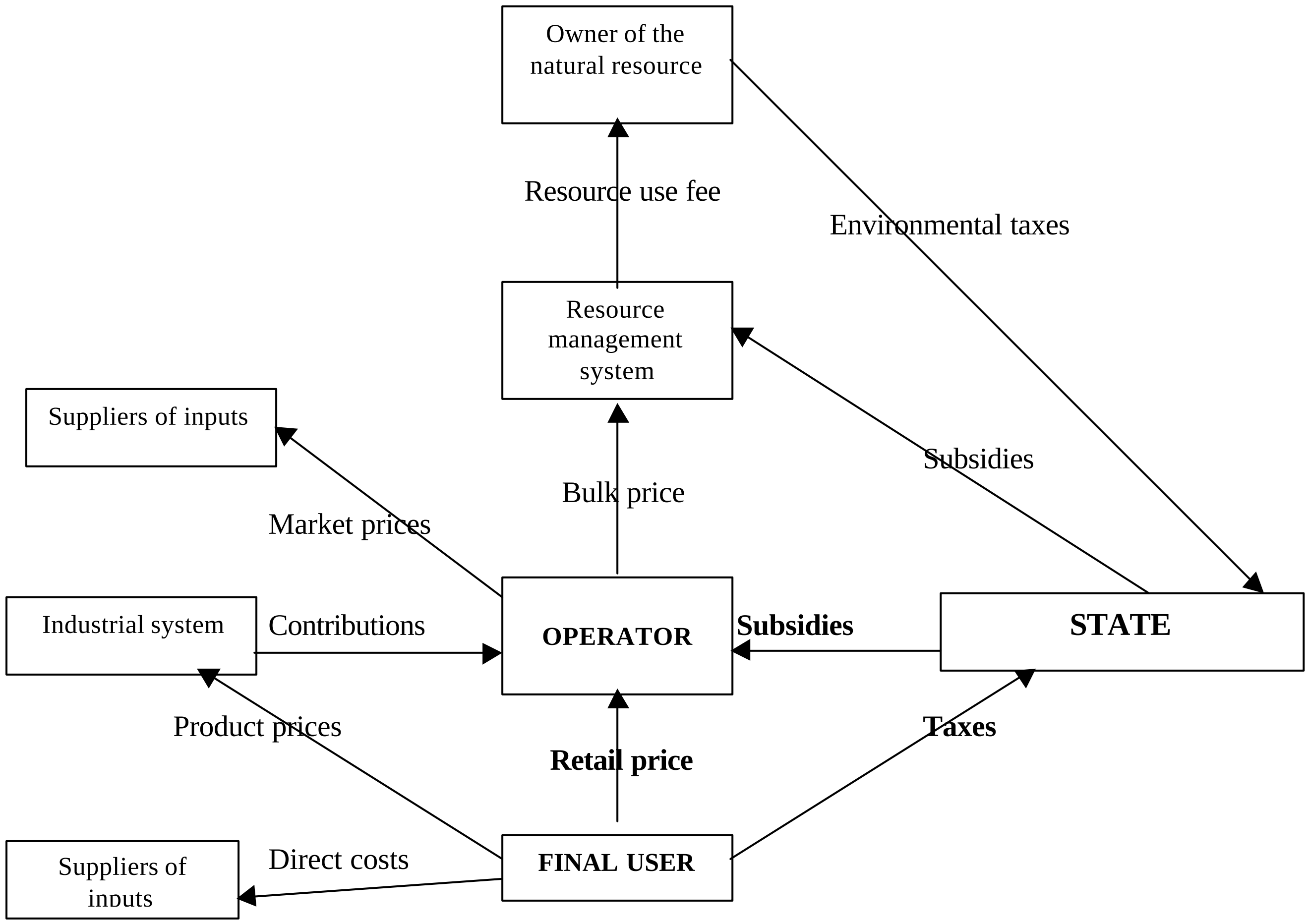
We have represented in bold the basic elements of the public utility: utility operators, final consumers and the state.

Consumers do usually pay an amount of money to operators of public utilities in exchange for the service they receive (retail price). These payments are called with different names (prices, taxes, charges, fees etc) and might also have different juridical nature (eg they might be compulsory or not; they might be charged directly by the operator, or by the public authority first, and then paid to the operator according to contractual arrangements); whatever the name or the nature, however, they correspond, very broadly, to the cost of the service, in the meaning that they are charged by the service operator and represent (one of) the revenues accruing to the operator.

It would seem easy then to assess the level of cost recovery by calculating the share between direct payments and the total cost sustained by the operator, while the difference would be covered through subsidies [2].

However, this model applies only in particular cases. In the reality, important parts of the service are supplied by separate agencies. The "value chain" of the public service entails different steps, and what needs to be assessed is the value chain in its entirety. In other words, in order to assess the full-cost recovery we need to know the structure of the value chain and the different transactions occurring along it.

Figure 2 – The value chain of environmental services and the transactions occurring along it



For example, in the case of water, local distribution networks often acquire bulk water from large regional establishments, usually under public control. The price paid represents a cost for the local retail supplier; provided that this bulk price is reflected in the final retail price together with distribution costs, the retail supplier can claim that FCR is achieved. However, if the regional agency underprices water (eg. for regional development purposes) the total cost will not be recovered.

The same occurs very often in the case of waste disposal facilities, that might be owned by different subjects than those providing the collection service; according to their belonging to the private or the public sector, they might follow their own pricing conventions entailing subsidies and/or rents of various kinds.

[2] Problems might arise when payments are supplemented by direct taxes (eg environmental taxes); as far as these payments are finally destined to the economic balance of the service, however, they should be accounted for as well as tariffs. Ear-marked taxes, like in the French example, might indeed originate territorial cross-subsidies within the same utility industry.

A further complication arises particularly in the case of services that are dedicated to business premises: unlike individual consumers, these are likely to produce at least some parts of the service value added directly. For example, an industrial polluter might wish to treat water internally before discharging it into the public system, in order to benefit from lower charges. Farmers may wish to manage their own boreholes instead of connecting to a collective irrigation system.

If these cases are not accounted for, inter-country comparisons might result hampered: the cost that is directly sustained by the user is by definition “recovered”; when its magnitude is not known, however, cost recovery figures arising from the above described price/cost ratio would be misleading.

One last opportunity that should be considered is the involvement of the private industry in the provision of the service. The concept of extended producer responsibility has been widely applied in a vast number of cases, particularly those concerning waste recycling. Industry, retailers and all actors involved in the value chain of a given product or material are charged with the responsibiity of financing waste minimisation and resource recovery from waste. In practice, this means that a part of the cost of the public utility (eg separate collection) is not paid by the final user of the service, but rather by industry, that will later transfer this cost to consumers via the price of the manufactured goods. This means in practice that the burden of the cost will finally be passed on to the individual citizen, yet this time as a consumer and not anymore as a service user or as a taxpayer.

Much the same occurs, even with no incentive effects, when commercial and industrial customers are receiving the same public service as households and pay a higher price, therefore generating a cross-subsidy. This cost will in fact be reflected in the general cost of the commercial premise and be transferred on prices.

2.2 - The economic rationale for full-cost recovery

According to the economic theory, optimal pricing of any goods or services should reflect their long run marginal cost (LRMC). Each customer should pay according to the additional cost that her demand causes to the service operation.

In certain cases – namely, when costs are sub-additive and/or marginal costs are difficult or complex to calculate – the willingness to recover fixed costs has suggested a second-best alternative, namely average-cost pricing (AC).

FCR in the strict meaning is a further relaxation of both concepts: it requires a correspondence between total costs and total revenues, without going too precisely into the issue of which customers pay for which costs[3].

Environmental services might include – and in fact often do include – components with the character of the public good, in the sense that they are non-rival and non-excludible. Since in this case no marginal cost is occurring, the full cost results higher than the LRMC.

In these cases, as a long-time established theory in the public sector economics shows, the optimal solution is to provide the service through the public sector and finance it out of general or local taxation. At least, once the public good dimension is clearly distinguished, a two-part tariff should be applied, in order to recover the fixed cost out of a flat-fee assimilable to a tax and the variable cost out of a variable charge proportional to consumption.

The main argument we wish to develop in this section is, first, that there are economic and practical

[3] Normally, the FCR is specified as if the full cost be matched by charges on each territorial unit in which the service is supplied by an independent operator. Yet this very criterion leads to very different outcomes in Europe: to make only an example, England and Wales have only 10 large water supply and sewerage systems, while Italy or France count the separate undertakings in the order of 10,000. It is clearly not the same thing to require balance of costs and revenues for each individual undertaking, or for larger aggregates.

costraints, as well as political reasons, that might limit the applicability of the marginal costs; second, that the more the pricing rule deviates from the marginal cost, the more it loses its allocative benefits. Therefore, FCR *without* marginal cost pricing cannot be justified on the ground of allocative efficiency. As we shall see immediately after, there can be many other good reasons for requiring adequate recovery ratios of the full cost; these should not be intended, however, as if any kind of subsidy should be eliminated.

The limits to the application of LRMC are of three types:

- the marginal cost principle is an optimal pricing rule only if the monitoring of individual consumption is difficult/costly and demand is rigid enough
- allocative efficiency is not the only goal of public agencies; once the allocative benefit of the marginal cost pricing is lost, the price paid acquires a fiscal nature, and there is no reason but a political one to use the PPP instead of a progressive criterion for allocating the tax burden
- recovery of sunk costs in the long run might not be guaranteed by the strict adoption of LRMC

With respect to the first argument, the economic theory demonstrates the superior allocative efficiency of providing the service through the public sector when the allocative benefits of the adoption of market-clearing prices (function of demand elasticity) are overcompensated by transactions costs (Stiglitz, 1988).

In our case it can be believed that monitoring costs are quite high both in the water and in the solid waste sector.

In the water sector, monitoring individual consumption – better to say, individual marginal contribution to the total cost, that is not only a function of quantity of service consumed – would mean to install individual meters in any single households; moreover, meters should be able to measure not only consumption, but also periods of time in which consumption occurs, given that costs are a function of resource availability and level of use of infrastructure. The necessary equipment requires a relevant investment cost either where water consumption is not metered (like in the UK) or where metering is practiced for larger consumption units (eg blocks).

In the waste sector, while the weighing of individual waste production is viable only in particular circumstances and is indeed quite costly, the most promising solutions entail a fee-for-service approach (eg by charging the exposure of individual bins at the curbside).

On the other hand, the empirical evidence of the benefits of volumetric water charges is overall quite weak, and probably overcompensated by the high cost of installing individual meters (Barraqué, 1997)[4].

In the case of waste, again, volumetric charges are practiced somewhere in Europe and are correlated with impressive growth of separate collection. However, it is simplistic to attribute this effect to the economic instrument (Massarutto, 2001b).

More research should be done in order to clarify this aspect, since the existing empirical evidence is far from conclusive.

It must also be stressed that many water users need not connect to collective facilities, since they could rely on self-supply (or self-treatment of discharges). These practices are still very common in many rural areas as well as in intensely industrialised regions, and are often causing environmental problems (e.g. overexploitation of aquifers). In these situations, the connection to a public network should be considered also as an environmental policy instrument, and charging policies should not discourage the abandonment of environmentally unfriendly practices.

Much the same occurs for many commercial and small industry waste flows: in many European countries,

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[4] Many authors seem to believe that price elasticity of water demand is in fact higher than we assume here. Among these, for example, Herrington, in Oecd, 1999. In fact, empirical studies do sometimes report a correlation between price and demand. These results should nonetheless be carefully interpreted. For example, in England and Wales it is apparent that metered per capita consumption is much lower than non-metered one. However, the choice of the meter is left to the individual consumer, since the very costly investment program aimed at compulsory installation of meters in all single houses has been stopped by Ofwat because of its excessive costs. Therefore, the correlation might be explained very simply by assuming that only those consumers knowing that their water consumption is low had asked for the meter.

local authorities find it preferable to compulsory connect these users and apply a flat price, in order not to encourage illegal practices.

Of course, the FCR might be applied without incurring into any of the free-rider problems, simply by compelling everybody to connect to the service and pay a definite share of the cost. Yet in this case the allocative efficiency would be lost.

With respect to the second argument, the strict application of LRMC might have undesired social and distributive consequences given that consumption of these services is only weakly correlated with income.. This is particularly true in the case of water resources, since natural availability is very unequal even within the same country or region.

Since the access to basic services is often regarded as a "social right" to be guaranteed independently from the readiness to pay, it might be considered unfair to charge the full cost to any individual consumer. Again, the cost-revenues correspondence might be searched for at a greater territorial scale, even when multiple suppliers exist (for example, through compensatory lump-sum payments). If this compensation is done, however, the allocative benefits would be once more lost, and there are no allocative reasons for preferring this solution to another one based on general taxation.

This argument was decisive at the begininning of the XX century when ideas such as "municipal socialism" and "position goods" were elaborated (Montemartini, 1917). In our times it has probably lost some of its importance, given the declining weight that public services have in the average income of affluent societies. Yet recent privatisation policies in many countries such as the UK have revealed that once prices have been brought to the full cost recovery level for an increasing number of services, their aggregate weight is not anymore negligible, even in developed countries; *a fortiori* this argument is valid for developing countries, where the application of full marginal cost of water would simply make the connection to the public system unaffordable for most families.

Particularly during the expansive phases of the investment cycle, when new infrastructure is developed, the adoption of the FCR may cause dramatic increases in charges, especially caused by the financial cost of capital.

These negative effects could be nonetheless compensated without sacrificing completely the idea of LRMC, for example by foreseeing compensative payments or other equivalent measures (e.g. vouchers) in aid of the low-income families (Oecd, 1999).

These solutions face nonetheless political difficulties in many countries.

With respect to the third argument, the meaning of LRMC is different once we consider new facilities and already existing ones. In this last case, that occurs very often in Europe, charging the LMRC could entail that the infrastructure loses its economic utility for customers, and no one will ever use it in the future; however, this might not result in an optimal outcome, since there are sunk costs to be considered (barriers to exit, decommissioning costs etc). This might occur because infrastructure was subsidised in the past, but also because of planning mistakes and unanticipated future events conditioning the economic viability of a project.

In other terms, once sunk costs have been actually incurred into, pricing at the LRMC would mean that the economic risk of the investment is fully assumed by the public budget: customers will buy the service only if the value (i.e. their willingness to pay) is higher than the charge. Otherwise, the service will not be bought: the sunk cost will not be repaid and this will entail an economic loss for the supply operator, that is usually the state or some private establishment whose contract with the public sector normally entails that the risk is sustained by the public sector.

On the other hand, there are many long run costs whose occurring is actually unforeseeable at the moment when the initial investment is decided; therefore, they cannot be accounted for for the evaluation of the project. The same occurs for the estimation of the willingness to pay of future users, that might be lower than initially predicted (e.g. thanks to technological innovation).

In fact, full-cost pricing in the general theory of management and accounting, is suggested as a good solution when the demand is inelastic. This is in fact what we just argued above about environmental utilities, yet this might not always be the case, particularly if we consider the level of bulk supply – where, indeed, the most of the public subsidies are usually concentrated. In other words, while the individual consumer can hardly be believed as sensitive to marginal price variations, the application of the full cost of a complex infrastructure might impact so greatly on the price so as to make it absolutely undesirable for the user to use that infrastructure.

It might be assumed, for example, that domestic consumers have no alternatives for receiving water supply but to connect to the distribution system, therefore their demand is captive and not too much price-elastic. The same is not true for the distribution system itself, that might have different alternatives for obtaining bulk water to distribute (eg connect to a large water transfer scheme or invest in technology for cleaning up and maintaining local underground resources). If the cost of the large transfer scheme rises suddenly, the local distributor might find it cheaper to give up buying bulk water and start producing it from local resources.

In the case of irrigation, the decision whether to irrigate depends on the differential value created by irrigation. If this value is completely absorbed by the price, the farmer will stop using water and converto to dryland farming, or possibly enter into some other land management strategy. The already built supply system and irrigation facility would then be left unused and the sunk cost abandoned to the agency that financed the investment.

A similar case occurs for waste disposal facilities like incinerators: once the investment has been made in order to secure waste disposal solutions to forecasted waste flows, these might result smaller because of changing trends in waste generation. The vicious circle then starts: lower quantities to treat means higher average fixed costs and then higher prices. Municipalities might then found it cheaper to invest more in the separate collection schemes, with a further reduction of waste destined to the incinerator[5].

FCR should then be justified on other grounds than allocative efficiency.

First of all, the adoption of FCR corresponds to a widely and increasingly agreed concept of equity, that requires the adoption of the polluter-pays principle when sensitive environmental values are involved.

Second, FCR allows the direct charge base to increase and to be modeled in order to provide environmental (pigovian) incentives to key actors in the supply and demand chain. While FCR alone is hardly effective as an environmental tax, it is also true that environmental taxes, for being effective, need that the economic value involved is significant and noticeable enough in the economy of the target group (Opschoor and Turner, 1994).

Moreover, while the introduction of green taxes faces a strong political resistence, FCR is easier to justify, even outside the formal framework of budget laws in which new taxation is usually discussed.

A third important argument in favour of FCR lays in the guarantee of economic balance of service operators, with particular reference to their credibility on the private financial markets. The increasing privatisation trend of public services is ultimately motivated in the field of environmental utilities by the bankruptcy of the welfare state face to an increasing investment requirement.

Being forced to finance new investment on the private capital market, the waste and water industries are compelled to acquire adequate credit rating, which is normally correlated with the size and the predictability of turnover. Project and corporate finance operations are acceptable for private financial markets only as far as revenues are well defined in terms of size and timing: this is typically not the case of public transfers.

In the search for qualified entrepreneurial inputs, skilled manpower etc, the environmental utility industries are obliged to offer them adequate compensation and to raise a margin for financing other activities in the value chain, like professional vocational training and applied research, that despite their public good nature, are not efficiently supplied by the public sector[6].

Finally, full cost recovery is also an indirect way to force public agencies to adopt economically correct accounting systems, particularly concerning the long-run depreciation of capital assets.

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[5] This is exactly what happened in Germany and the Netherlands during the 90s.

[6] For example, this is clearly the case of the French water industry, as is shown by Prost (1998).

Even if the recovery of costs is not total, the simple fact of being compelled to evaluate and monitor the "true" cost is regarded as an excellent stimulus to efficiency in the political choices of the administration and indirectly to the search of cost reduction alternatives.

All of these "pragmatic" reasons are in fact well sufficient to justify FCR; however, none of them is strong enugh so as to advocate a drastic recovery of 100% of costs through individual charges, nor to eliminate completely compensative subsidies.

What needs to be assessed, therefore, is not the mere existence of subsidies, but rather the overall financial structure of the service at the national and local level, as well as the structure of the incentive system arising from this financial structure.

2.4 - Charging regimes in practice

To sum up then, because of the constraints discussed so far, individual payments might well diverge from the marginal cost rule and even from its "weaker" version based on average costs.

Once the payment diverges from the marginal cost, the application of the FCR loses much of its usefulness as an allocative measure. FCR might indeed be useful for more practical and political reasons.

However, at this point, it becomes very difficult to distinguish prices from taxes. In fact, most service charges of environmental utilities have many of the typical features of taxes.

The British "water price", for example, is often paid in proportion of the size of private properties. The service cannot be suspended to those who do not pay; the customer is not totally free to give up the connection and stay on his own; at least, this possibility is only theoretical, since everybody is connected. The water charge is in fact a property tax, whose yield is dedicated to the water service operator.

On the other hand, the French "water taxes" are in fact environmental prices, paid in proportion of water consumed or discharged, and used as an income source for financing water-related investment within the same river basin.

In Germany and in many other countries, consumers actually pay tariffs that match with the total costs of a large number of services, including electricity, water, waste collection, gas distribution and heating. In other words, the cross-subsidisation occurs among different services in the same territorial area, rather than among customers of the same service in a broader area like in France or the UK.

Connection to sewage collection systems is usually compulsory in most EU countries, unless in special cases, and it requires a compulsory payment to the service operator.

In the case of waste, in most European countries households pay a local tax that is normally calculated as a property tax, with only a few cases in which a fee-for-service base charge is adopted (Ascari et al., 1995; Massarutto, 2001b). Despite it is often labelled as a "tariff", it is again a property tax, or a poll-tax, partly parametered with individual waste generation patterns; nobody can refuse to pay it nor demonstrate that she is not benefitting from the service.

Nonetheless, this local tax is usually ear-marked to the waste disposal service and calculated according to total service costs. The foremost exception is the UK, where the local tax is not specifically due for this service, but rather as a general tax paid to the municipality (community charge).

As these examples show, it is often a pure terminologic convention that of considering revenues either as direct charges or taxation. What really matters is who pays, for what purpose and how much, and what is the customer actually obtaining in exchange of what is paid. Ultimately, whether the citizen has to pay for a public service as a user or as a taxpayer is by large a political decision, provided that in both cases it faces the same incentives to sustainability.

There are many intermediate solutions, all entailing some degree of cost-recovery, but with compensation and cost-sharing mechanisms that involve communities of different nature and sizes. Cost recovery could thus be intended strictly for each individual consumer, or for groups of consumers (e.g. the ones served by the same water facility), or for larger territorial aggregates. Even when some costs are subsidised through general taxation, some degree of FCR could be pursued, at least as an "intra-generational" recovery, in the sense that no costs are transferred to the next generation.

Indeed, in the concrete practice of European countries FCR is never adopted literally.

The mere existence of subsidies is not a proof of unsustainability nor of allocative inefficiency; rather, subsidy schemes should be carefully examined and understood in order to identify the incentive system that the pricing mechanism generates for key actors in the production chain of the service.

We can distinguish different alternative perequation schemes that can be considered as intermediate solutions between individual LRMC and complete externalisation of the cost (fig. 3).

Figure 3 – Alternative perequation schemes

ENDOGENOUS

- From users of the same service
  - ➔ On individual base (individual marginal cost)
  - ➔ On a collective base
  - ➔ Compensating among categories of customers according to the charging criteria adopted
  - ➔ At different territorial levels, through contributions financed by ear-marked taxes
- From the local community
  - ➔ Cross-subsidies among services operated by the same authority;
  - ➔ Cross-subsidies among users of the same environmental resource
  - ➔ Cross-subsidies from industry through extended producer responsibility
  - ➔ Local taxes
- General taxation:
  - ➔ Direct subsidies (grants for new investment; coverage of operational deficits)
  - ➔ Indirect subsidies (eg. low-interest loans; under-pricing of commodities and services supplied by the public sector)
- Transferred elsewhere as an external cost:
  - ➔ To other water users (intra-generational externalities: eg pollution of a river used for bathing / fishing)
  - ➔ To the next generations (inter-generational externalities: eg bad maintenance of assets, public debt for covering operational expenditure, permanent contamination of a water table)

EXOGENOUS

First of all, if FCR is adopted, it is normally intended for industrial costs only, while resource management is more often financed partly through charges, partly through the general budget and through undue transfers to future generations. England and Wales represent a partial exception since administrative costs are also charged through the abstraction and sicharge fees (intended as cost-recovery instruments for Environment Agency). Denmark, some German Laender and other Northern European countries have also started to apply environmental taxation with significant values; the intent is nonetheless to implement an incentivating system, rather than to internalise external costs.

A significant part – if not 100% - of external costs then is normally not accounted for. Despite the success achieved in the past 30 years of environmental regulation, virtually no European country could claim to have reached a pattern of water use or waste management that is fully sustainable for the environment, and this unsustainability is partially suffered by the present generation itself (polluted rivers) and partially transferred to future generations (e.g. accumulation of pollutants in the underground, eutrophication of lakes, landfilling of waste).

Even with respect to industrial costs, the recovery rate varies considerably. Where considerable investment in new infrastructure is needed, state subsidies are generally used for financing the first-time capital expenditure. At the moment this occurs notably in Southern European Member Countries, yet all Countries, in one way or the other, have used fiscality as a way to provide the initial capital for infrastructure development. Even countries like the UK, that have now reached some equilibrium with this respect, have subsidised water infrastructure in the past, and the effect of this subsidy is still perceivable in reduced prices[7]. In fact, the British consumer pays only the capital cost of *new* investment that is basically a marginal improvement to an already consolidated network of facilities. In Southern Europe, where considerable effort is carried out, especially for sewerage and for the compliance with the European Wastewater Directive, the European structural funds are playing a fundamental role.

The use of fiscality is certainly the most typical and obvious way to subsidise the cost of water and waste – as well as any other public service. Yet there are also other aspects to consider. In all European countries, mechanisms for tempering the impact of the individual cost pricing have been long adopted and practised.

This occurs for example on a territorial base. The regionalisation of water undertakings in Britain (completed in 1973) and the ongoing concentration process in Italy (that will lead in the medium term to 100-200 undertakings out of the existing 13,000) were both inspired by the idea that a larger management unit allows the spreading of cost amongst a wider number of consumers, therefore statistically compensating for areas with high and low marginal costs of supply.

An alternative strategy is the use of ear-marked taxes, that remain "internal" to the water economy, even though they enact a compensation mechanism between areas. This is best exemplified by the French *Agences de l'Eau* that mobilise, through abstraction and discharge taxes, nearly 15% of the whole expenditure for water: this money is given back to municipalities and water users in order to support water investment, at no interest. A similar mechanism, though on a smaller territorial scale, operates when collective associations are created for managing water-related issues, even including different water users: these are quite common in central Europe and even in Italy, for the sake of urban and rural draining, irrigation, sewerage and occasionally water supply.

A third possibility, widely used particularly in Southern Europe, is to adopt different financing mechanisms for the basic infrastructure needed for the "local" service and resources management.

While the former can be considered as a normal local service, the general budget contributes to the large infrastructural projects, with the aim of "evening out" the natural resource availability; the public agency responsible for the large infrastructure later sells its services to local operators for free or at a "political" price. Similar financing practices are common for large water storage and transfer schemes in Spain and Southern Italy, and also for sewage treatment and waste disposal. Countries with many institutional layers, like Italy or Germany, have generated in this way, a deeply-entrenched system, to which any territorial level contributes in many different ways, with a high degree of flexibility.

A fourth case is represented by cross-subsidisation among different utilities at the municipal or inter-municipal level. This model is well exemplified by the German *Stadtwerke* and by the Italian equivalent of *aziende municipalizzate*, that have commonly managed financial flows arising from different utilities in order to compensate amongst services. While sewerage has typically been a net beneficiary of these cross-subsidies, a notable difference between Italy and Germany lies in the fact that the former has long subsidised water supplies out of other services (gas and electricity above all), while the latter has intended water supply as a source rather than a destination of cross-subsidies.

It is thus evident that subsidies – or in other words deviation from the "economic first best" theoretically represented by the LRMC principle – are largely adopted, and can hardly be eliminated. Their heterogeneous nature makes it very difficult to engage into a meaningful comparison of the cost-recovery policies adopted in different countries.

Nonetheless, there is also increasing awareness that ill-conceived subsidy schemes can have serious shortcomings, since they can encourage over-capacity and discourage municipalities and individuals both from feeling fully responsible for service assets and for their proper use and maintenance.

Either because of this understanding of the shortcomings of subsidies, or because the use of the fiscal leverage has been further reduced by budget restraints, most countries have reviewed or are reviewing their

[7] In fact, at the moment of privatising the Regional Water Authorities, their debt was cancelled by the Government in order not to prejudicate the selling of water assets on the market.

policies in this respect.

The general trend observable in Europe shows an increase in the cost-recovery potential of charging schemes, together with a higher transparency of subsidies and the search for incentive related structures – for example, through a generalised adoption of co-financing measures and performance-based subsidies. Even countries like Italy, whose attitude to the use of the public budget has been more favourable than others, is re-orienting itself towards a model in which sources of capital for new investment arise from a mix of public contributions and self-generated cash flows, with an increasing confidence in project financing models.

This trend is nonetheless constrained by the emerging social opposition to price increase. Environmental utilities have more and more an important weight of the family expenditure. If the cost of water and waste disposal services becomes visible in the overall average expenditure, this is far more true if only low income households are considered, given that the demand for environmental services is very weakly correlated with income.

The price of water and sewerage, as well as of waste management, is becoming more and more a hot and delicate issue of public policy, thus requiring a sensible approach to the achievement of cost recovery.

3. An accounting scheme for evaluating FCR

The coverage of costs: users, polluters and taxpayers

The above considerations may be used in order to describe the financial structure of an environmental public utility at any desired territorial level. The proposed framework could be used in order to set up a coherent base for inter-country comparisons and give practical implementation to the quite ambigous formulation of FCR contained in the European directives.

The following equation describes the basic financial balance between sources and uses.

$$\Sigma(P_{ij}) + \Sigma(ET_{ij}) + IP_j = (OPC_j + IMCj + KC_j + \Pi_j) + RMC_j + (EMS_j - EMT_j) - ISS_j + (CPS_j - LT_j) + (S_j - PT_j - T_j) + (LE_j + LE_{gj}) + (KD_j + IGE)$$

with:

Pij = service price charged to customer i in the area j net of all taxes
ETij = environmental taxes paid by consumer i in area j
IPj = service price charged to industrial and commercial premises in the area j (= service cost that is passed on to commercial premises and industry and later passed on consumers)

OPCj = operational cost of the service in area j
IMCj = maintenance cost of existing infrastructure in area j
KCj = cost of new investment in area j
Πj = profit of the service operator in area j
RMCj = cost of resources management and for the provision of service-related public goods in area j

EMSj = ear-marked subsidies obtained by area j
EMTj = ear-marked taxes raised in area j
With Σ (EMSj – EMTj) = 0;

(EMS – EMT) = net territorial cross-subsidy

ISSj = inter-service subsidy (net inter-service cross-subsidy)

LTj = Local taxes raised in area j including concession fees from the service and profit for the municipality
CPSj = Cost of all other public services in area j

Tj = general taxes raised in area j
PTj = excise taxes and other direct and indirect taxes on the service j (VAT, corporate charge)
Sj = government transfers obtained by area j

LEj = externalities suffered by other users of the resource in area j (present generation)
LEg = externalities suffered by the national and global community (present generation)

KDj = net depreciation of capital assets (economic externality on the next generations)
IGE = net inter-generational environmental externality

The left side of the equation corresponds to what we call "endogenous" revenues, that is revenues that are directly linked to the service and are raised in area j. The different components can be interpreted as the different premises on which the payment is based: citizens pay as service users (P), as consumers (IP), as polluters (ET) and as local taxpayers.

On the right side of the equation we find the "uses" (that is the costs), broken down by category.

The balance is represented by the second half of the right side, that might be interpreted as "exogenous" sources. More in detail:

- EMSj – EMTj represents the net territorial cross-subsidy obtained by area j.
- (CPSj – LTj) represents the net contribution of the local taxpayer
- (S – T) represents the net contribution of the national fiscality
- (S – T) + EXT represents the share of the service cost in area j that is not covered by endogenous revenues.

Using the equation, we might identify different balances that correspond to different degrees of cost recovery. For example we can we can talk about

- Strict FCR in area j if both EMSj – EMTj = 0; ISS = 0; (LT – CPS) + (S – T + EXT) = 0.
- Weak FCR if only the latter condition is respected.
- Industrial cost recovery (ICR) if endogenous sources, net of environmental taxes, balance operational and capital cost
- Local cost recovery (LCR) if costs are covered by endogenous revenues plus net local taxes.
- Operational cost recovery (OCR) if the same is true for operational costs only.

The equation is suitable for other elaborations, for example with respect to sustainability, either in the weak or in the strong version[8].

If we adopt a weak sustainability approach, it is required that the net degradation of natural assets are compensated by a net accumulation of man-made assets, while externalities on the present generation (LEj + LEg) are matched by environmental taxes (ET).

If we adopt a strong sustainability approach, however, this is not sufficient: we need to prove that the environment is not losing any of the critical natural capital dimensions, while the externalities on the present generation should be actually compensated without any declared welfare loss for any of the involved individuals.

Figure 3 illustrates a scheme of a reclassified consolidated account showing the most important balances

[8] For a definition of weak and strong sustainability see Turner (1994); Ekins (2000).

The application of the suggested accounting equation requires some reclassification exercise starting from available data.

The most crucial information regard the true capital cost: as we argued before, this value is highly dependent on the chosen interest rate and on the value of existing infrastructure[9].

A practical solution could be that of considering the reinstatement value of infrastructure, that is normally easier to estimate given the physical data on the infrastructure network that is usually available.

Figure 3 – A reclassified economic account of sources and uses

Sources (+), uses (-) and balances (=)			
Endogenous revenues	Direct charges	$\Sigma(P_{ij})$	+
	Local direct taxes		+
	Environmental taxes	$\Sigma(ET_{ij})$	+
	Charges to commercial customers	IP_j	+
Operational cost		OPCj	-
Margin for depreciation (OCR)			=
Full industrial cost	Maintenance cost	IMCj	-
	Capital cost	KCj	-
	Profit	Πj	-
Direct Industrial cost recovery (DICR)			=
Net ear-marked subsidies		$(EMS_j – EMT_j)$	+
Strong Industrial cost recovery (SICR)			=
Local cross-subsidies	Interservice cross-subsidy	ISS_j	+
	Net local public contribution	$(CPS_j – LT_j)$	+
Local cost recovery (LCR)			=
National cross-subsidies		(S – T + EXT)	+
Weak Industrial cost recovery (WICR)			=
Resource management cost		RMCj	-
External cost	Present generation	$(LE_j + LE_{gj})$	-
	Next generation	$(KD_j + IGE)$	-
Full cost recovery (FCR)			=

Administrative and regulatory costs are also not appearing normally in the accounts, unless there are dedicated agencies with accounting autonomy, like in the British case.

As a first approximation, these costs might be simply estimated by adding a certain ratio to the industrial cost (this normally lays in the range of 5% of operational expenditure).

It is far more difficult to identify the cost of all other public goods (eg research, education, nature conservation). National statistics can provide some help since they report direct expenditure for the environment broken down by category.

The most uncertain figure is the one regarding the value of externalities; in the lack of a comprehensive assessment, figures might be approximated with the help of some of the pioneering studies that are being carried on in the economic literature and especially within the RTD programs funded by the EU (IVM-EFTEC, 1998; European Commission, Dg Environment, 2000)

From the methodological point of view, externalities for the present generation, and particularly those

[9] One of the causes why German accounts for water service costs are much higher than those in the rest of Europe, for example, is the fact that German accounting rules require the systematic updating of book value at the reinstatement value.

affecting use values, are easier to assess through the well-consolidated techniques of environmental economic valuation.

Inter-generational externalities might be approximated with the aid of techniques used in the environmental accounting, namely through the measurement of the depletion of the natural capital stock.

4. Application to selected case-studies

4.1 - Full-cost recovery assessment in selected case study

In the present section we outline the results of three studies that have been carried on with very different purposes and approaches, nonetheless all united in the common methodological perspective on the definition of cost and cost recovery concepts.

The aim of the study was never that of assessing FCR as such.

In the first case-study, the focus was on understanding the consequences that the European water framework directive, requiring "adequate recovery of costs", would have on the irrigation sector, considering alternative scenarios for the reform of Common Agricultural Policy. The actual level of cost recovery was used as a starting information for making assumptions on the expected water price increase and its impact on farmers' income and water demand.

The study demonstrates that subsidies are in fact present, yet concentrated in the bulk water supply schemes, while distribution at the sub-regional level already exhibits good cost recovery records.

It is also pointed out that FCR of industrial cost – occurring by definition for those farmers using own abstraction points instead of connecting to collective systems – is not necessarly leading to more sustainable water use: on the contrary, self-supplied irrigation is likely to have the highest environmental impact, while subsidised water tranfers – though often economically inopportune – are not necessarily causing external costs. According to this conclusion, large water transfers are often criticizable because they represent a waste of money, not necessarily a waste of water.

The second case study is an attempt to evaluate the allocative and distributive consequences that the recent reform of solid waste collection charges in Italy, aiming at a widespread use of economic instruments for fostering waste minimisation and recycling. The level of FCR is hereused in order to assess the potential magnitude of the total revenues from environmental taxes and their expected incentivating power.

The conclusion is that the magnitude of the financial manouvre – in the order of 50 E/inh/year – is not likely to have important "pigovian" effects; rather, it can be used as an accompanying measure for easing the diffusion of separate collection and make it more acceptable.

The third case regards the long term development of the water industry, and more precisely is concerned on the assessment of the long run affordability of the water price once all the costs are accounted for on a private accounting basis and recovered in the water price. The chosen area is one of the best positioned in Italy, given the availability of good quality freshwater and the favourable environmental quality of rivers. Nonetheless, the expected price increase is very high, crucially depending on the depreciation schedule of capital costs.

For the sake of the present study, we do not go too much into the single case-studies, but rather we concentrate on the methodology that has been followed in each study for assessing the FCR and the data constraints that have been encountered.

4.2 - The full-cost recovery of irrigation

The first application of the accounting approach described in the previous section regards the sector of irrigation in Europe.

According to a well-radicated belief, irrigation is the most subsidised water use, thanks to the waterworks projects financed by governments in the past, for the sake of territorial development as well as with the aim of sustaining agricultural income.

Table 1 presents the state-of-the-art of irrigated surfaces and water consumption patterns in Europe in the last decade. It is easy to note that three countries (Italy, Spain and France) account for the largest quantities of irrigation water consumption; yet the development of irrigation is notable in central and northern Europe as well.

Table 1 – Irrigation in Europe in the 90s

	Total abstractions	**Irrigation**		**Irrigated surface**		**Efficiency**
	km^3/year, 1995	%	hm^3/y, 1995	,000 ha, 1993	% of UAS, 1995	m^3/ha/y
Austria	2,2	9	200	4	0,3	50.000
Bel. + Lux.	7,1	-	18	1	0,1	18.000
Denmark	0,9	16	140	435	17,1	322
Finland	2,4	2	58	64	2,5	906
France	40,6	12	4.918	1.485	7,6	3.312
Germany	46,3	3	1.389	475	3,9	2.924
Greece	5,0	80	5.659	1.314	37,6	4.307
Italy (*)	42,0	50	20.136	2.710	22,8	7.430
Ireland	1,2	-	-	<1	-	250
Netherlands	7,8	1	1.128	560	29	2.014
Portugal	7,3	59	4.307	791	21,0	5.445
Spain	33,3	72	24.109	3.453	17,6	6.982
Sweden	2,7	4	105	115	4,1	916
UK	11,8	1	141	108	1,8	1.306
EU-15	210,6	29	62.451	11.603	13,0	5.382

Source: Massarutto, 2001a.

This obvious disparity should not be misinterpreted: environmental impact of irrigation is not correlated with absolute quantities, but rather depends on local conditions. In fact, as an increasing evidence shows, this impact is not negligible even in Countries such as the UK or Sweden.

What is most important to note, the structure of irrigation water supply is quite different in Northern and in Southern Europe.

In the first case, water is abstracted directly from the farmer: this means that financial costs are by definition covered by the user; on the other hand, externalities might be higher because of the uncontrolled use of the aquifer.

In Southern Europe, it is more common that water is supplied by collective bodies – usually famers' associations with public or private status – that charge associates for their services. Given their public nature, they are also entitled to receive public contributions, what often occurs. In case large water transfers are in place, it is also possible that second-level institutions are in place. These are usually public agencies or state-controlled establishments.

Table 2 tries to provide an overall picture of the pricing structure. Three components of the water price have been individuated, corresponding to the three basic transactions that may occur:

- Abstraction charge: price paid to the uowner of the resource – i.e. the state – in exchange of the right to use water. In most countries an abstraction charge is foreseen; its value is highly variable, yet in any case of some orders of magnitude lower than the supply and distribution prices, with the only exception of the Netherlands and Denmark. This is the only component of the water price that is actually paid where individual abstraction is practiced.
- Resource management fee: it is the price paid to the operator of large transfer shemes. In Italy and France, and less often in Greece and Portugal these are sometimes separate entities, sometimes integrated. In Spain, the same authorities that license water use (Confederaciones hidrograficas) also supply bulk water transfers. Only in France and in a single spanish case, the Tajo-Segura, the price paid to these public entities is meaningful, even if not covering the 100%. In Italy and in Greece the price is just a symbolic one.
- Supply and distribution (also involving resources management in some Italian and Frenche cases): here is where the largest part of the price is concentrated. Prices are either volumetric or more frequently on a per-hectare basis, with fixed water quotas.

Table 2 – Average price of irrigation in some European countries (E)

	Components of irrigation water price			Price structure
	Abstraction charge	Resource mgmt	Supply and distribution	
France	0,005 – 0,01 E/m^3	225 E/ha + 0,057 E/m^3		Flat-rate or binomial
Italy	0,0000006 E/m^3	-	60-100 E/ha or 0,04-0,07 E/m^3	Flat-rate, sometimes volumetric
Greece		n.a.	90-210 E/ha or 0,02-0,07 E/m^3	Flat-rate, sometimes volumetric
Portugal		n.a.	120 E/ha + 0,02 E/m^3	Flat-rate or binomial
Spain	0,001 – 0,006 E/m^3		120 E/ha or 0,01 – 0,04 E/m^3	Flat-rate, sometimes volumetric
UK	0,01-0,03 E/m^3	-	-	Volumetric
NL	0,09 E/m^3	-	1,44 E/m^3 (from PWS)	Volumetric

Source: Massarutto, 2001a

With these premises, the study was intended to explore the potential consequences of the combined policy package represented by the Water Framework Directive (WFD) and the reform of Common Agricultural Policy (CAP): the former aiming at the achievement of a “reasonable” recovery of costs through water prices paid by users, the latter restructuring the structural aid to the agricultural sector through the gradual abolishment of subsudused commodity prices and their substitution with direct lump-sum payments.

In order to assess this outcome, a preliminary assessment of the cost recovery structure was made, in order to understand how much water prices would have to grow in order to comply with the WFD.

In the absence of reliable studies aimed at calculating the external costs of irrigation on a site-specific base, the analysis has been concentrated on industrial cost.

The study has revealed that, leaving apart large water transfers the cost recovery is much more significant than usually believed. Operational costs are recovered almost everywhere but in certain Southern Italian and Greek collective establishments. Direct charge allow resources for maintenance of existing infrastructure, less frequently for the depreciation of capital assets. Nonetheless, Northern Italy (where the investment has been carried on many decades ago) and France

By definition, individual irrigation recovers costs completely; however, there are good reasons to believe that involved external costs are much higher than in the case of collective irrigation.

Table 3 exemplifies some of the basic results obtained in the study.

Table 3 – Structure of cost recovery in European irrigation systems (%)

	OCR	SICR	Notes
Italy			
North	70-100	50-80	Storage infrastructure shared with electric power generation and flood protection
South	20-100	20-30	Storage infrastructure shared with public water supply
France			
Individual (north)	100	100	
Collective, unregulated	100	52	
Collective, regulated	100	35	Mixed private-law public companies created for regional development have financed large investment projects
Collective, small systems	100	97	
Spain			
Continental	80-100	15	Large storage schemes administered by Confederaciones hidrograficas
Mediterranean	100	100	Mostly individual abstractions
Greece			
Individual	100	100	
Collective	30-100	-	
Portugal			
Individual	100	100	
Collective	90	-	

Source: Elaboration on Massarutto, 2001a

4.3 - The Italian municipal waste management sector[10]

The recent Dlgs 22/97 and Dpr 158/99 have radically reshaped the municipal waste management sector in Italy by introducing the principles stated in the parallel European legislation on waste. The pillars of this policy are the self-sufficiency and proximity principles, as well as the "ladder principle" requiring waste minimisation and recycling and finally safe disposal for the remaining unrecoverable waste. The introduction of the polluter-pays principle is seen as a prerequisite for a widespread use of environmental economic instruments as well as for ensuring that operators are provided with adequate economic resources in order to face this effort.

Previously, waste management services were financed through a dedicated local tax, whose overall revenue was intended to equal costs. Coverage did never occur for the 100% of the cost for all municipalities; recent estimates show that the coverage rate has reached figures of 80-90% in the late 90s. The cost accounting rules allowed direct labour organisations to consider only direct costs (therefore, depreciation of capital and other common costs were not included). In practice, costs were clearly recognisable only for those municipalities that chose the alternative of contracting out the service or create an own enterprise with separate budget.

The municipal waste collection tax was then charged with respect to property surfaces; it was in fact a property tax, whose payment was obligatory (regardless the quantity of waste generated), and whose revenues could vary annually according to the recorded cost.

[10] This case is based on Massarutto, 2001b.

Moderate cross-subsidies were in place between commercial and residential customers, with the former producing 35% of waste and paying 45% of the total cost.

The reform introduced by Dpr 158/99 is based on these pillars:

- Standardisation of criteria for calculating costs on a full-cost basis, including capital costs and coommon costs
- Obligation to reach 100% cost recovery within a given time schedule
- Individual tariffs will be based on a two-part structure, with a fixed part that will continue to be allocated on property size, and a variable part that will be parametered to individual waste generation – either actually measured or presumed
- Extended roducer responsibility widely applied to many waste flows, the most relevant of which is that of packaging. The consortium of packaging producers and users, CONAI, has adopted the strategy of reimbursing the differential cost of separate collection with respect to ordinary indifferentiated disposal.

The following table 4 and 5 show the results of the reclassification exercise done at the national level. Four alternative situations are examined. The first one corresponds to the national average figures of 1999, adequately reclassified. The second one corresponds to a sample of municipalities selected by the National Environment Agency (Anpa) that already started to adopt the new framework and show already nearly complete cost coverage ratios, though the development of the service is not yet complete. The third and fourth columns describe two alternative future scenarios that assume desktop estimation of cost increase after the reform has reached its complete fulfilment. In the second scenario, cost increase is higher, and for this reason a compensative ear-marking taxation system is also assumed.

Our exercise shows very clearly that the shift from “taxation” to “tariff” is far less revolutionary than in the expectations of many, at least as far as macroeconomic financial flows are concerned.

The reform entails a substantial increase in the charges paid by domestic customers: this effect is partly due to the overall increase of costs due to the expected modernisation of waste management practices, partly to the adoption of the FCR.

Contributions from the taxpayer disappear, and rather become negative (this means that there is a surplus for the public budget, that has been posed by construction equal to the environmental cost and destined to the compensation of damaged people.

The removal of the cross-subsidy from commercial to domestic consumers is partially compensated by the introduction of the Conai system, financing the extra cost of packaging waste recycling.

The accounting model shows the expected size of charge increase due to the adoption of FCR or, conversely, shows the level of cost recovery that can be achieved under different alternative policy package.

What is also important to note is that, although distributive effects are not particularly severe, the reform creates the possibility of adopting incentivating policies. For example, the introduction of Conai maintains some degree of cross-.subsidisation between the “consumer” and the “waste producer”: however this cross subsidy in the past was generic, while in the new system it originates from the application of extended producer responsibility. In other words, in the previous system the indifferentiated consumer paid an indifferentiated subsidy; in the new system, consumers pay in proportion of the quantity of packaging they accept to buy, thus with an embedded incentive to minimise the use of packaging.

Table 4 – Financial structure of the Italian municipal waste management industry, before and after the reform

		Before		During		After			
		Italian average 1999		Anpa sample, 2000		Scenario A		Scenario B	
		E/inh/year	%	E/inh/year	%	E/inh/year	%	E/inh/year	%
Sources									
User	Domestic customer charge	40	37%	50	48%	60	56%	59	51%
	Eco-taxes	3	3%	4	4%	7	6%	13	11%
Consumer	Commercial customer charge	33	30%	27	26%	32	30%	32	27%
	Conai fee	-	0%	2	2%	5	5%	5	4%
	Eco-taxes	3	2%	2	2%	4	3%	7	6%
Exogenous sources	Taxpayer	11	10%	8	8%	-10	-9%	-10	-9%
	Diffused externalities	20	18%	10	10%	10	9%	10	9%
Balance (residual externality)		31	28%	18	18%	-	0%	-	0%
Uses									
Industrial costs	Gross industrial cost	83	76%	87	85%	91	85%	99	86%
	Ear-marked subsidies	-		-		-		-10	
Administrative costs		6	6%	6	6%	6	6%	6	5%
Environmental costs		20	18%	10	10%	10	9%	10	9%

Source: Massarutto, 2001b

Table 5 – Consolidated account of municipal waste management in Italy (E/inh)

		Before		During		After			
		Italian average 1999		Anpa sample 2000		Scenario A		Scenario B	
Gross industrial cost	+	83	93%	87	94%	91	94%	99	94%
Administrative cost	+	6	7%	6	6%	6	6%	6	6%
Total financial cost	**=**	**89**	**100%**	**93**	**100%**	**97**	**100%**	**105**	**100%**
Conai fee	-	-	0%	2	2%	5	5%	5	5%
Net full cost	**=**	**89**	**100%**	**91**	**98%**	**92**	**95%**	**100**	**95%**
Domestic customer charge	-	40	45%	50	54%	60	62%	59	56%
Commercial customer charge	-	33	37%	27	29%	32	33%	32	30%
Gross subsidy	**=**	**16**	**18%**	**14**	**15%**	**-**	**0%**	**10**	**10%**
Environmental taxes	-	6	6%	6	6%	10	10%	20	19%
Net public sector balance	**=**	**11**	**12%**	**8**	**9%**	**-10**	**-10%**	**-10**	**-10%**
Environmental cost	+	20	23%	10	11%	10	10%	10	10%
Residual externality	**=**	**31**	**35%**	**18**	**20%**	**-**	**0%**	**-**	**0%**

Source: Massarutto, 2001b

4.4 - A water supply and sewerage “optimal management area”: the District of Udine

The final example we propose is related to the reform of Italian water and sewerage services. Until the early 80s, the largest part of the cost of water was covered through the fiscal system. Charges paid by consumers covered just a small part of the operational cost; the remaining part was covered by the municipal budget. Investment for new infrastructure was financed by very long term loans at subsidized interest rates, offered by the Cassa Depositi e Prestiti; or directly by State transfers. The State in fact has financed nearly 100% of the massive investment effort made between 1975 and 1990 in order to build up the sewage treatment infrastructure, plus all the largest waterworks, especially in the South.

This financial model came to an end in the late 80s, because of financial restrictions of the State budget combined with the increasing investment need of the sector. A gradual increase of water and sewerage prices allowed them to reach operational cost coverage, with some extra margin for depreciation, in the mid 90s; yet that was not enough in order to make the new investment in the water industry attractive to private capital markets.

The law 36/94 aims at an overall reorganisation of the national water industry, aimed at creating a viable environment for private investors. Full-cost recovery of costs, including capital costs, are then foreseen. In order to avoid a drastic increase in water prices, however, the adoption of FCR is subordinated to the gradual territorial integration of water management undertakings. The estimated 13,000 undertakings for water supply and sewerage would become 100-200 “optimal management areas”, within each of whom a single management system and a single water price would be applied. The strategy of the reform was, in other words, to use territorial cross-subsidies in order to smoothen the potentially dramatic impact of water price increases.

However, this solution is only partial, since it allows to mediate among neighbour areas in the same region / district, but not among the different areas of the country, where most of the cost differences are to be found. Moreover, the estimation of the financial impact of FCR was never seriously estimated. Basing on rough average estimates of the investment needs (around 50,000 million E in 10 years) one might expect that the average water price would more than double, what is in general not too problematic given the low starting level (an Italian average family pays an annual water bill of 150 E).

These averages might nonetheless hide very different situations, especially if we consider that where investment needs are higher, actual water prices are also higher, and vice-versa.

A further problem arises from the evaluation of the actual full cost, that has to be covered before starting the new investment. Of course, the coverage of actual costs cannot be assessed without a proper evaluation of capital cost; this is often difficult because the value of capital assets has never been updated, and because the choice of interest rate is very critical.

In order to assess these issues more precisely, we have done an explorative study on a single area that is candidate for becoming an “optimal management area”, namely the District of Udine. The area is already characterised by a satisfactory water service quality and acceptable environmental records; the most part of investment is needed for restoring and requalifying the existing network and updating it in order to comply with the European wastewater directive (91/271).

In the district we can detect three larger undertakings (Amga, Cafc and Poiana) and a number of small municipalities operating the service with direct labour. Since only Amga could provide adequate cost accounting, we have estimated the costs of the other undertakings with the aid of a statistical benchmarking formula based on the size of water supply and sewerage assets (metodo tariffario normalizzato, MTN).

The results are summarised in table 6. While the coverage of operational cost is not completely achieved yet in all municipalities, it is occurring on average. Water supply shows more equilibrated figures, while the lowest cost recovery records can be found in the case of sewage collection.

Table 6 – Full cost recovery of the public water supply and sewerage service in the District of Udine

		Whole district	**AMGA Ud**		**CAFC**	**Poiana**
		Inferred values	Closing 2000	MTN-based estimate		
Quantity of water sold (Mmc/year)		55,2	13,6		22	6,1
Operational cost (M E/year)		*28*	6,2	6,2		
Water supply		*14,8*	3,0	3,0		
Sewage collection		*4,2*	1,2	1,0		
Sewage treatment		*9,0*	2,0	2,2		
Charge revenues (M E/year)		*29,0*	8,4	5,6	12,9	3,4
Water supply		*16,6*	*3,6*	3,2	7,4	1,9
Sewage collection		*2,5*	*1,2*	0,4	*1,2*	*0,3*
Sewage treatment		*10,0*	*3,6*	2,0	*4,3*	*1,2*
Mean tariff (E/m3)						
Water supply		0,11 - 0,33	0,27	0,20	0,34	0,34
Sewage collection		0 - 0,07	0,09	0,07	0,07	0,07
Sewage treatment		0 - 0,26	0,26	0,26	0,26	0,26
Recovery of operational costs		104%	135%	90%		
Water supply		112%	121%	106%		
Sewage collection		59%	102%	39%		
Sewage treatment		111%	175%	91%		
Depreciation (M E /year)			1,03			
Water supply			0,88			
Sewage collection			0,09			
Sewage treatment			0,06			
Depreciation/revenues			12%			
Water supply			24%			
Sewage collection			8%			
Sewage treatment			2%			
Industrial cost recovery ratio						
r = 1%			53%			
r = 7%			20%			

Source: Massarutto, 2001c

Zooming-in to the area served by Amga, we notice that the surplus obtained especially from water supply and sewage treatment allows some financial cash-flow. This is not sufficient, however, for facing the whole investment needs that is expected, nor even to guarantee the long-term replacement of existing infrastructure. The two final rows are illuminating, since they show the drastic change occurring once we move from a public financing system with a low interest rate to a market rate. In the first case, the industrial cost recovery ratio is 53% (tariff would need to double to reach complete long term economic sustainability); in the latter case, the ratio is only 20% (tariff would need to be multiplied by 5).

In the terms of the accounting framework we have proposed in par. 2, the water management system achieves OCR, while DICR varies between 20 and 53% according to the interest rate adopted. Since DICR ratios are supposedly lower in the rest of the district, serious concerns can be raised about the viability of a pricing policy aimed at achieving FCR (or at least DICR) within a short time. The low starting levels of the water price are in some way reassuring, yet by no means it can be expected that doubling or tripling the water price will be an easy target to achieve.

5. Conclusions

This paper has presented a perspective on full-cost recovery based on the idea that alternatives for recovering the financial as well as the external cost of an environmental public service can be classified according to their closeness to the concept of LRMC. FCR is by definition achieved; what changes is the mix between the alternative financial sources, fiscal or private, local or general.

Instead of the dycotomic approach that is often implicit in the European directives aiming at FCR (according to which, FCR is either achieved or not, and can be measured in terms of the share of total costs coverd by direct charges), we argue that there is a continuum of alternative ways to finance environmental services, with alternative perequation schemes based on territorial, inter-customer or inter-service cross-subsidy, as well as on ear-marked taxation.

The real issue, according to the perspective adopted, is not to decide whether to adopt LRMC or not. In fact, there are theoretical as well as practical arguments in favour and against. What is really important is to decide which subsidy structure to adopt in order to avoid undesired externalities and provide relevant actors with adequate incentives towards economic efficiency and environmental sustainability.

Different typologies of subsidies have been examined and classified, and later summarised in an accounting equation of the financial balance of a service, that could be calculated at the single undertaking as well as at the regional or national level in order to disclose the financial structure of the service. Alternative financial sources, based on the various channels through which individual citizens actually pay, are balanced with the industrial, resource management and environmental costs. The resulting balances are interpreted as different degrees of FCR.

The proposed approach has revealed to be clear-cut in the application and rather easy to apply given the existing datasets. The most important difficulties regard environmental externalities – whose estimation is not yet practiced in a widespread manner nor with a consistent methodology – and the long-run cost of infrastructure, particularly in the water sector, where the delicate problem of choosing an appropriate discount rate has to be solved since it radically affects the magnitude of costs.

With these limitations, the methodological approach we described allows a comparative analysis of different European countries, whose accounting and fiscal conventions still diverge at the point that comparisons are often meaningless.

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