ECONOMIC INSTRUMENTS FOR WASTE MANAGEMENT IN BRAZIL*

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Abstract

This paper presents some proposals to introduce pricing mechanisms to solid waste management in the activities of generation and recycling of package waste in Brazill based on estimates of the social benefit of recycling.. These mechanisms are opportunities to adopt fiscal devices already in place and under discussion in law bills to enhance efficiency and equity performance in the package and recycling markets in the country.

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This present proposals to introduce pricing mechanisms in policy related to solid waste management in the activities of generation and recycling of package waste in Brazil based on estimates of the social benefit of recycling in Brazil. These proposals are opportunities to adopt fiscal devices already in place and under discussion in law bills to enhance efficiency and equity performance in the package and recycling markets in the country.

Introduction

This article presents some possibilities of introducing economic instruments to improve waste management in Brazil

The service of urban waste collection covers approximately 70% of the Brazilian households and its expansion has been at the pace of urban population growth. Moreover, less than a quarter of this collected waste is properly disposed of and treated. Municipalities are facing serious budget constraints to cope with the increasing demand on these services.

Estimates of recycling levels in Brazil are shown in Table 1. Considering only paper and aluminum cans, the Brazilian levels are as high as those observed in most OECD countries.

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To clarify this paper's aims, we present the following rationale. Waste management problems can be generalized in physical terms, as:

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W = Y - R

Where:

W = total solid waste to be collected and treated

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Y = total materials produced which can be end up as waste

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R = materials which were recycled

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TABLE 1

Recycling Levels in Brazil — 1997

	Aluminum Cans	Glass	Paper		Plastic			Steel
			Office	Cartoon	Film	Rigid	PET	
Recycling Level as % of Primary Production	61	28	37	60	15	15	21	18

Source: CEMPRE (1997)

This paper will not address the problems of financing the collecting and treating of W, although it recognizes them as an important issue. This study, instead, is devoted to analyze and present proposals to reduce the level of Y and increase the level of R. In doing so, the level of W will also decrease, thereby reducing budget constraints of waste management services.

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In the last decades, the increase of urbanization and industrialization intensities in the Brazilian economy have also increased the level of package waste in total waste generated in urban areas. Therefore, we will focus our analysis on package waste.

The following section analyses options of economic instruments whereas the third section estimates economic benefits of recycling. Based on that, the next section indicates some results for the proposed economic instruments. Finally, we present some brief conclusions.

The Choice of Economic Instruments

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The use of economic instruments (EIs) in waste management is usually related to pricing mechanisms[1], such as, subsidies for recycling activities, taxes on package contents, tipping fees and so on.

[1] *See, for example, Curzio et alii. (1994).*

In this study we will only take into account indirect devices, such as subsidies and package taxes. In Brazil, fees and payments for waste generated and disposed face legal and fiscal constraints stricter than those subsidies and product taxation. Moreover, we are aware of the institutional fragility in the country to cope with illegal dumping which usually arises with direct waste pricing.

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However, any pricing instrument has, firstly, to make explicit its pricing criteria. That is, what are the pricing criteria to be applied on the chosen instrument?

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Pricing procedures, however, can be applied to accomplish three distinct criteria:

Achievement of the optimal use level: pricing full negative external costs in production and consumption activities to adjust output to optimal levels.

Improvement of cost-effectiveness: pricing natural resource users in order to allow them for more flexibility to achieve environmental goals with lower costs.

Generation of revenue:. pricing natural resource uses to generate revenue.

The choice of one of these three criteria is also important and is not always recognized through the design, implementation and performance analysis of an economic instrument.

Moreover, the conciliation of them in a single criteria is not trivial. Based on that, three criteria can be suggested to formulate pricing rules for EIs: externality prices; behavior prices; and financing prices.

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Externality pricing adopts the pigouvian tax concept of internalizing full degradation costs into producer's marginal cost functions in order to equalize marginal social costs to marginal benefit costs, as a first order condition to market efficiency. In doing so, it is possible, for example, that market

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clears at the social optimum level of pollution. Here, damage cost functions are the paramount to pricing set. Such task of environmental damage estimation is always complex and controversial, particularly with multiple damage sources and variant assimilative capacity[2].

Behavior pricing moves away from social optimization to individual optimization since it assumes that there is a previously established environmental target, not necessarily the economic optimum, which has to be met. Once this target is defined, prices will create the incentive for private agents to behave in a way that the aggregation of their individual use levels will meet the desirable target. Note that in this case, targets are ambient standards and agents are free of individual standards. Agents will behave accordingly to their own optimization strategies equalizing their marginal user costs, arising from user prices, to their marginal costs of reducing the use level. In this approach, for example, a polluter will equalize pollution prices to its marginal control costs to determine its optimum pollution level at this price level. Such flexibility allows for cost-effectiveness since all pollution with control cost lower than the pollution price, set by the EI, will be willing to abate. In this case, regulators need to know agent's marginal control or opportunity costs which cannot be easy if information asymmetry is relevant between regulator and polluters.

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Financing pricing is one related to optimal prices to attain certain budget needs rather than to meet optimal degradation levels or private optimal control levels. In other words, optimal prices are set to achieve a certain level of revenue and, therefore, it is basically related to the agent's demand curves of the natural resources being priced. That is, the public prices rule[3] criteria which state that prices should be set by marginal provision costs inversely proportionate to each

[2] *In Serôa da Motta (1998) a comprenhesive review of methodological issues and case studies on environmental valuation is presented.*

[3] *Ramsey rule, see Serôa da Motta (1998 a), where it is applied to water pricing.*

user's demand price-elasticity. In doing so, users with less elastic demand pay more than those with more elastic demand in order to avoid revenue losses. In this case note that regulators have a budget goal to make provision of some services to which an EI will be applied to finance this budget. Knowing users' provision marginal costs and demand price-elasticities, a price set can be determined. As can be seen, such information requirement is less complex, although pricing may be politically weak since demand characteristics will be the key pricing factor without any environmental justification.

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Note that any of the criteria above presented can be set with restrictions based on distributive criteria on their objective functions, such as ability to pay and minimum free use level. That is, prices will be set with a distributive weighting.

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Figure 1 shows the range of policy instruments which can be used in environmental policies and their degree of flexibility and market orientation. As can be seen, fines and sanctions and litigation are the most common instruments currently used everywhere and they are known as command and control (CAC) instruments. Those usually recognised as EIs are charges, taxes and fees and market creation mechanisms.

Literature on EIs is vast and it is not intended to be reviewed here. However, before some examples are presented in the following section, reader must bear in mind that EIs are widely regarded as being an economically efficient and environmentally effective alternative to strict CAC approaches. As pointed by Serôa da Motta, Huber and Ruintenbeek (1999), in theory, by providing incentives to control pollution or other environmental damages, EIs have lower compliance costs and can provide much needed revenue for local government coffers. Administration costs associated with EIs, however, may be higher. Monitoring requirements and other enforcement activities remain as for CAC, and additional administration efforts may be required to cope with the design and institutional changes arising from EI application. The recognition of this extra institutional burden is one of the main determinants of EIs successful implementation.

FIGURE 1

Environmental Management Mechanisms Incorporating Economic Incentives

<------CONTROL-ORIENTED------>	<------MARKET-ORIENTED------>		<------LITIGATION-ORIENTED------>	
Regulations & Sanctions	Charges, Taxes, & Fees	Market Creation	Final Demand Intervention	Liability Legislation
General Examples				
Standards: Government restricts nature and amount of pollution or resource use for individual polluters or resource users. Compliance is monitored and sanctions made (fines, closure, jail terms) for non-compliance.	Effluent or User Charges: Government charges fee to individual polluters or resource users based on amount of pollution or resource use and nature of receiving medium. Fee is high enough to create incentive to reduce impacts.	Tradable Permits: Government establishes a system of tradable pollution or resource use permits, auctions or distributes permits, and monitors compliance. Polluters or resource users trade permits at unregulated market prices.	Eco-labels: Government supports a labelling program that requires disclosure of environmental information on the final end-use product. Eco-labels are attached to ‘environmentally friendly’ products.	Strict Liability Legislation: The polluter or resource user by law is required to pay any damages to those affected. Damaged parties collect settlements through litigation and court system.

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<------CONTROL-ORIENTED------>	<------MARKET-ORIENTED------>		<------LITIGATION-ORIENTED------>	
Regulations & Sanctions	Charges, Taxes, & Fees	Market Creation	Final Demand Intervention	Liability Legislation
Specific Examples				
Pollution standards Licensing of economic activities Land-use restrictions Construction impact regulations for roads, pipelines, ports, or communications grids Environmental guidelines for urban road alignments Fines for spills from port or land-based storage facilities Bans applied to materials deemed unacceptable for solid waste collection services Water use quotas	Non-compliance pollution charges Greening of conventional taxes Royalties and financial compensation for natural resources exploitation Performance bonds posted for construction standards Taxes affecting inter-modal transport choices Taxes to encourage re-use or recycling of problem materials (e.g., tire taxes, battery taxes) • **Source-based effluent charges to reduce downstream water treating requirements** Tipping fees on solid wastes User charges for water	Market-based expropriation for construction, including 'environmental values' Property rights attached to resources potentially impacted by urban development (forests, lands, artisanal fish) Deposit-refund systems for solid and hazardous wastes Tradable permits for water abstraction rights, and water and air pollution emissions	Consumer product labelling relating to problem materials (e.g., phosphates in detergents) Education regarding recycling and re-use Disclosure legislation requiring manufacturers to publish solid, liquid and toxic waste generation Black-list of polluters	Damages compensation. Liability on neglecting firm's managers and environmental authorities Long-term performance bonds posted for potential or uncertain hazards from infrastructure construction "Zero Net Impact" requirements for road alignments, pipelines or utility rights of way, and water crossings

Source: Serôa da Motta, Huber and Ruitenbeek (1999).

In this study we will only analyze externality pricing devices which can be used to reduce package contents and increase its recycling.

The Social Benefit o Recycling in Brazil

As already proposed by Pearce and Brisson (1994), the social net benefit of recycling (SNBR) can be calculated as such:

SNBR = WCE + ED + (RWS - ICR)

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where:

WCE = actual expenditure on urban waste collection and treatment.

ED = environmental damage due to the lack of proper collection and treatment of urban waste;

RWS = raw (primary) material savings due to recycling; and

ICR = industrial costs incurred to undertake recycling

The value of SNBR can be seen as the externality value of recycling and, therefore, it can be used as reference for subsidies or taxation levels based on externality pricing.

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WCE was estimated from average costs incurred by major municipalities in Brazil. To skip from the complexity of direct estimation of environmental damages, we account for ED the cost of providing the adequate waste collection ad treatment services which would avoid these environmental damages.

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The estimation of (RWS-ICR) was based on two assumptions:

1. The current price of materials sold for recycling is a good proxy of their opportunity costs in term of material savings since recycling market can be considered functioning efficiently.

2. Recycling market is not perfect, either oligopsonic or oligopolist, and, therefore, market prices are not the efficient ones. The component (RWS - ICR) is measured as the total

material savings, deducted from processing costs, which is possible to gain with recycling minus the cost of a selective collection which makes that possible by offering good waste quality for recycling.

In the assumption 2 we based our estimates on Calderoni (1997) for material savings and IPT/CEMPRE (1994) for selective collection costs.

Estimations in both assumptions were made for tons of waste and are presented in Table 2.

TABLE 2

Estimates of SNBR (1997 R$/t)

Assumption 1					
	Aluminum	Glass	Paper	Plastic	Steel
WCE	23.98	23.98	23.98	23.98	23.98
ED	19.02	19.02	19.02	19.02	19.02
RWS-ICR	459.33	39.29	73.52	113.23	36.27
Total	502.33	82.29	116.52	156.23	79.27
Weighted Total	5.58	13.72	50.49	32.98	14.10
Average Value =	117.00				
Assumption 2					
	Aluminum	Glass	Paper	Plastic	Steel
WCE	23.98	23.98	23.98	23.98	23.98
ED	19.02	19.02	19.02	19.02	19.02
RWS-ICR	431.72	-119.45	190.71	1262.02	81.74
Total	474.72	(76.45)	233.71	1305.02	124.74
Weighted Total	5.27	(12.74)	101.27	275.49	22.18
Average Value =	391.00				

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Weighted total is given by the share of each material in the total package waste generated in urban areas in Brazil. Average value is the sum up of each material value.

Results in Table 2 indicate that market imperfections may reduce private agents perception of recycling value from R$ 391.00 to R$ 117,00/ton. Since we cannot precisely identify these imperfections, externality reductions from recycling may vary along this range in urban areas of Brazil.

Formulating the EI

In Brazil, material residuals (those generated from both production and consumption phases) which are introduced again in industrial processing do not pay the industrial value added tax. However, this material once paid the tax as a final product. Therefore, we have designed a subsidy which is offered as a tax credit for the value added tax contents (tax actually paid) of the package which is recycled.

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Note that this tax content when accruing as tax credit reduces the final value added tax (VAT) payments of those who introduce them in their industrial processing, thereby reducing their tax burden.

The subsidy credit tax level (C) is then a proportion (β) of the VAT level levied on the pacakage (I), such as:

$$C = \beta \times I \qquad (1)$$

According to externality pricing criteria, the maximum amount of subsidy (S_{max}) should be equal to social benefit of recycling, as follows:

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$$S_{max} = SNBR \times Q_s^* \qquad (2)$$

where Q_s^* is the quantity of material residuals for recycling.

Assuming this environmental restriction, C can be determined from:

$$C \times P_s \times Q_s^* \leq SNBR \times Q_s^* \qquad (3)$$

Using expression (1), we have:

$$\beta \leq SNBR / P_s \text{ x} \qquad (4)$$

where P_s is the price of material residuals for recycling

Note that the lower the SNBR is the lower will be β and thereby the total amount of subsidy.

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Considering the current fiscal crisis in Brazil, we have applied a fiscal constraint on the estimation of β. This constraint was to make subsidy amount equal to VAT revenue from recycled products, such as, :

$$C_F \text{ x } P_s \text{ x } Q_s^* \leq I_r \text{ x } P_r \text{ x } Q_s^* \qquad (5)$$

where C_F is the fiscal constrained C while I_r and P_r are the tax level and price of the recycled product. Note that in the previous expressions, price and tax levels are related to material residuals while in expression (5) they are those prevailing for the recycled product made of the processing of residuals.

Then $C_F = \beta_F \text{ x } I_r$, where β_F is the relevant proportion of I_r to be credit to those producing recycled products, such as:

$$\beta_F \leq P_r / P_s \qquad (6)$$

Note that fiscal restrictions in expression (6) are related to price differences between recycled and residuals and not to SNBR as in the environmental case of expression (4).

As already pointed out elsewhere, only recycling subsidies do not maximize efficiency gains on waste management[4], particularly in the case of packages. Subsidy-tax schemes are more efficient. In addition to a subsidy, then, a tax on package production should be levied as well. Such "deposit-return" production scheme, can also compensate for losses on tax revenue.

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[4] *See, for example, Palmer and Walls (1997).*

This tax level should be set in order to make private package costs (P^*_m) equal to its social costs. Following the same rationale for estimating β, one can set this tax level (E) as:

$$E \leq SNBR / P^*_m \quad (7)$$

A bill has been proposed in the National Congress to set up a deposit-return scheme of 5% on the price of products with packages made of PET. A new bill covering other types of packaging materials is now under discussion. If deposit-return levels (G) are estimated following our procedures, they would be, for each material, equivalent to:

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$$G = SNBR / P_p \quad (8)$$

where P_p is the product price.

Using our estimates of SNBR and current market values for P_r, P_s, P_p and P^*_m, we present in Table 3 some estimation exercices for C, C_F, E and G for Brazil considering some package materials.

TABLE 3

Estimates of Subsidy and Tax Levels

Material / Tax Level	C	C_F	E	G
Aluminum - Case 1[1]	85%	146%	6%	0%
Aluminum - Case 2[2]	85%	18%	6%	-
Glass[3]	996%	116%	86%	14%
Glass[4]	996%	300%	50%	3%
Plastic[5]	346%	159%	22%	1%
Paper[6]	532%	125%	34%	-

Notes:[1] Cans; [2] Bars; [3] Beer one-way; [4] Mayonnaise [5] Soft drink PET; [6] Paper box

As can be seen, in Table 3, C values, as expected, are much higher than C_F ones since they are not constrained by fiscal restrictions. E values are being applied on package prices

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and therefore cannot be compared to subsidy values, although they are theoretically equivalent to C values. For G values, one can see that they are very much away from the 5% level proposed by the bill.

Final Comments

Our study was an attempt to analyze options of EIs applicable to reduce waste and stimulate recycling, particularly pricing devices based on externality correction. As our estimation exercise has shown, this requires a great deal of effort and data collection.

Regarding options for recycling subsidies, the current tax structure in Brazil offers options based on VAT credit whereas, for package taxes, there will be a need to pass a law creating this new tax. The deposit-return scheme is already under discussion in the National Congress.

We have also tried to formulate these options regarding the current fiscal crisis and estimating subsidies based on budget constraints. In this case, the environmental benefit achieved with such subsidy level can be only estimated if one knows the demand function of primary and residual materials, which was not within the scope of this study.

Our estimates have shown that environmental costs are key parameters to set subsidy, tax or deposit-return levels. However, they are very sensitive to market assumptions and data availability. Bearing this in mind, one can accept *ad hoc* proposals of these levels to avoid controversial estimation procedures and values.

Finally, the importance of recycling must be emphasized for the labor market of non-qualified workers in urban areas of Brazil. This other social cost was directly not taken into

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account in our estimate, but it would certainly increase our estimate of the social net benefit of recycling[5].

[5] *See Serôa da Motta nad Saygago (1998) for an overview on these issues.*

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