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Abstract

Policy makers in many countries have perceived plastic-bag littering, its associated waste disposal and consumer behaviour as a cause of environmental problems. It is for this reason that many governments are now taking action. The plastic-bag legislation in South Africa combined elements of regulation with a levy per bag, similar to that applied by the Irish, in an effort to reduce the consumption of these bags. Charging for bags ensued in May 2003 with a fixed nominal price of 46 rand cents for 24-litre bags across all retailers. The level of the levy charge in South Africa is too small; hence, it has only been successful in reducing plastic-bag demand in the short term. Over time, the effectiveness of the levy is diminishing despite its comprehensive application at checkout points. Hence, the findings of this study suggest that the levy has failed partially. It is evident that the levy should be set sufficiently high if consumer behaviour is to be influenced.

1 Introduction

South Africans consume approximately 8 billion plastic carrier bags annually. The carrier bags in question are the thin-filmed plastic bags. They are ‘free of charge’ and not recyclable. In reality, their cost generally is built into the product cost. Due to the extensive use of these bags, an acute solid waste problem has ensued. With most of these bags littering the streets, they have become known as the country’s ‘national flower’.

Plastic bags create litter due to their light weight and their tendency to ‘balloon’ with the wind. The problem is further exacerbated in developing countries like South Africa, where the bags tend to be blown by wind at land disposal sites due to open dumping. The impact of this litter is magnified by the persistence of the material in the environment and its ability to harm animals, particularly marine, wild animals and livestock. In particular, there are concerns with regard to the impact of plastic-bag usage on resource consumption and litter.

This paper is an extension of the paper by Hasson, Leiman and Visser (2007). The objective of this study is to examine the effectiveness of the plastic-bag legislation in South Africa in the long term; the study posits some reasons for the limited success of this legislation. This paper will summarise the key regulatory and price shifts of this period and analyse their effects.

2 Regulations Governing Plastic Bags in South Africa

In September 2002, the South African government, representatives of labour and of industry, signed a memorandum of agreement concerning use of disposable polythene shopping bags. The main elements of the agreement were:

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- regulation of the minimum thickness of plastic bags,
- disclosure and transparency regarding the costs of plastic shopping bags,
- regulation of the type and amount of ink to be used in the printing on bags,
- promoting a market for recycled materials,
- imposing a levy to support this,
- preventing the importation of plastic bags.

The first legislative effort affected both the thickness of the plastic used and the price of the bags. The minimum gauge of the plastic used was intended to rise from 17 microns to 30 microns, though the allowed latitude of 6 microns meant an effective minimum gauge of 24 microns. An earlier recommendation that the minimum gauge be 80 microns (Govt Gazette, May 2002 No. 23393) was dropped because of opposition from commerce and industry.

When the agreement came into effect on 9 May 2003¹, it fixed the thickness of plastic bags at 30 microns, with a five-year allowance during which bags with a gauge of 24 microns would be allowed. It also restricted printing to 25% of the surface area of plastic bags, with the proviso that this could increase to 50% if the ink was environmentally friendly.

While the heavier gauge of plastic used was an attempt to encourage reuse of the bags, additional efforts were made to promote recycling. This was done through the formation of a non-profit company, *Buyisa-e-Bag* with a mandate to ‘promote waste minimisation and awareness initiatives in the plastics industry, expand collector networks and to create jobs, as well as to kick-start rural collection (Small Medium and Micro Enterprises), SMMEs and create additional capacity in Non-governmental organization (NGOs²)’.

At the same time, a nominal fixed price of 46 rand cents per bag was set. In addition, a 3 rand cents levy was imposed – increased to 4 rand cents in March last year, ostensibly to subsidise the recycling efforts of Buyisa-e-Bag (though a recent study by Nahman (2009) indicates that only 13% of the levies collected were reaching them). Some retail and recycling representatives claim that they do not know what happens to the levy. They therefore question the government’s motives behind the increase in the levy. Transparency and/or communication need to be enhanced in this regard.

Given the high consumption levels, it is hoped that the plastic-bag legislation will contribute to an alleviation of the litter problem. The main aim of the legislation is to reduce the negative impact that plastic carrier bags have on the environment. To be more specific, the objective is to reduce bag use in South Africa by 50%. The new law means that consumers now either have to purchase new plastic bags when they go shopping, or reuse their thick and stronger plastic bags for subsequent shopping. The bag policy is criticised for excluding plastic bags that are used by other sectors, such as clothing retailers. Although the clothing retailers have always provided thick plastic bags, they still provide the bags for ‘free’. A legitimate question is whether this lowers compliance³ by food retailers.

3 Literature Review

Policy makers in many countries have perceived plastic-bag litter as a problem, and they have used a variety of regulatory tools to address it. These have ranged from traditional command and control regulation, including explicit prohibitions against the use of plastic bags in places like Dhaka

¹Government Gazette notice 24839, No. R625.

²National Environment Management: Waste Bill.

³A recent study commissioned by the government found a 58% level of non-compliance with the current 24-micron minimum gauge. Accordingly, it has been decided that the minimum thickness of plastic bags will remain at 24 micron until 1 June 2010 and will only be increased to 30 micron thereafter (The Plastic Federation of South Africa).

(Bangladesh) and Taiwan (where the ban was reversed after three years), to regulatory systems that incorporate price-based charges such as deposit/refund schemes, and pure price-based tools such as recycling subsidies (Convery, McDonnell, and Ferreira 2007; Nolan 2002; Rayne 2008; UNEP 2005).

There is a long-standing academic consensus on the superiority of market instruments over direct controls and regulation (Austin 1999; Baumol and Oates 1988; Convery *et al.* 2007; Graaf 1971; Knowler 2008; Lotspeich 1998), in terms of both static and dynamic efficiency. The idea that a charge for plastic bags could be used as an optimal Pigouvian intervention is problematic on a number of counts.

Firstly, in terms of pure theory, it presumes that pricing a product at its marginal social-cost pricing is welfare maximising. This is a common assertion, but also one that fails if a considerable set of underlying assumptions do not hold. Since these assumptions include the universality of marginal-cost pricing, the absence of free trade, contentment with the existing distribution of wealth, and the use of single-period short-run costs rather than long-run ones, marginal-cost pricing is rarely a justifiable recommendation (Graaf 1971).

At a practical level, the idea that the number of plastic bags issued can be optimised by using a single basic charge or subsidy is flawed on a variety of grounds. One is the difficulty involved in identifying the nature and extent of the externality. A second is the inappropriateness of having a constant charge across the whole country. A third is uncertainty that any negative impacts of plastic bags is better addressed by reducing the quantity of bags issued than by finding other ways to dispose of them, e.g. using old plastic bags as a fuel source to augment coal in thermal power stations.

Finally, the plastic bag may be (and probably is) a symbol of uncaring abuse of the environment, without being intrinsically problematic. Indeed, plastic bags may impose fewer negative externalities than substitutes like paper bags. As such, one could argue that the marginal external cost should in fact be negative.

When market instruments are used to control environmental impacts, a common concern is the welfare losses that might follow. In principle, lowering levels of negative externalities should enhance welfare. It is worth considering, however, that environmental quality appears to be a normal good (Christiansen and Smith, 2008). If the instrument is a lump-sum tax, the overall impact could be regressive, hurting the poor and benefitting the rich.

Any study of plastic shopping-bag taxes consequently needs to address income-distributional impacts and their implications for consumer sensitivity to changes in bag quality and price. The monopsony power of the larger retailers has also affected costs, as it has enabled them to secure bags at lower base prices. Knowler (2008) mentions variations in the amount of colour and printing on plastic bags as critical factors influencing the cost of plastic bags to retailers.

The study by Convery *et al.* (2007) evaluated the performance of the 15 euro cent levy on plastic bags issued at supermarkets from mid-2002 in Ireland. According to the Litter Monitoring Body (2004; 2005) plastic-bag litter made up 5 percent of national litter composition during the pre-levy period in Ireland. This fell to 0.32% in 2002, 0.25% in 2003 and 0.22% in 2004. In order to understand the success of the charge, a sample of households and retailers was surveyed. An overwhelming majority of the household respondents indicated that the levy had a positive effect on the environment, producing a noticeable reduction in plastic-bag litter. The success of the charge was partly attributable to its popularity following an advertising awareness campaign and the public recognition of its success. The drop in bag consumption in Ireland was due to the levy being set sufficiently high.

Similar studies were conducted into the plastic-bag taxes imposed in Italy and Denmark. In 1989, Italy introduced a 5 euro cent levy on the production of plastic bags. The Italian tax⁴ made

⁴In 1989, Italy introduced a tax on plastic bags. Abandoned plastic bags were an eyesore on Italian beaches and on the sea, and posed a danger to dolphins that could die from ingestion of plastic bags. The new tax sought to have the price of bags better reflect the cost that they imposed onto society and on the environment. By levying a tax of 100 lira (about 8.5 cents) per plastic bag on importers or producers, the Italian government created a new signal to

the bags more expensive than substitutes such as paper bags. Denmark's tax structure⁵ targeted larger packaging firms; as a result, this tax was not apparent to final consumers. The reduction in demand for plastic bags was 66% in Denmark, compared to 90% in Ireland where it has⁶ stayed low. It is evident from the findings that the point-of-application of any tax measure appears to play a critical role in the success of the initiative (Rayne 2008).

The plastic-bag legislation assessed in this study combined elements of regulation with a levy per bag similar to that applied by the Irish. While Nolan (2002) argues that this can be achieved if there is an understanding of the elasticity of demand for plastic bags, the diverging outcomes of similar policies around the globe suggest that more profound issues than simple price elasticity are involved. We hope that this study will contribute to this understanding.

4 Methodology

If, as in Ireland, controls on plastic shopping bags reflect the public will, their success appears certain. The point of sale levy on shopping bags becomes a perennial reminder to an already conscientious public. This success is far less assured when the tariff is intended to coerce reluctant consumers into changing their behaviour. In such cases, success is predicated on the correct estimation of price elasticity. One determinant of elasticity is time; another is income.

These two concerns lie at the core of our analysis. The former is relatively easily addressed: one simply observes over time how consumer behaviour adapts to a price change. The system is technically under-identified, but it does give a rough indicator of the long and short-run elasticities involved. Naive economic theory (e.g. Lipsey & Chrystal 2007; Parkin 2009; Stigler 1966) argues that elasticity rises with time as the number of substitutes for a product grows. Consumers, in this vision of the world, become accustomed to carrying re-usable bags with them, and the range of substitutes (string, cotton and plastic) grows⁷. Accordingly, a plastic-bag levy should become more successful the longer it is in place. This is the first hypothesis we test.

In contrast to the time determinant, income is more problematic. A common failing of direct lump-sum taxes is regressivity. Given that the plastic shopping bag is especially useful to low-income consumers, a fixed charge on such bags could be particularly problematic for the poor of a third-world country. With this in mind, we felt that an understanding of the impact of plastic-bag controls and levies on different income groups would be valuable.

Historically the retail sector in South Africa has been structured around identifiable income segments. Each of the major retailers is targeting well-known and clear income groups. In recent time, however, this clarity has been obscured by the shifting strategies of the four retail chains who provided the data used in this study, to capture lower segments of the market.

Over the past five years, the growth of South Africa's urban middle class has encouraged some

the market economy — the cost of plastic bags was now greater compared to alternatives. The tax was about five times as great as the manufacturing cost per bag. From 1989 to 1992, the government raised over 250 billion lira (around \$212 million) through this tax.

Source: Environmental Taxes and Charges. Proceedings of an International Fiscal Association seminar. The Hague: Kluwer Law International, 1995, p. 165.

NB: The substitutes included, among others, paper bags.

⁵Denmark introduced a tax on plastic bags in 1994; however, the retailers pay this tax. As a result, retailers strongly promote the use of alternatives to shoppers. This has resulted in a 66% drop in plastic bag use, though that has levelled out.

Source: Clean North: The Sault Ste. Marie and Algoma District Recycling Association.

⁶Ireland managed to impose a higher plastic levy in comparison to other countries because it imported most of its bags. Therefore, politically it was easy as the prospect of job losses was minimal.

⁷Reviewers have pointed out that they understood our argument, but not if it becomes habitual to carry plastic bags, as habitual goods have lower elasticity. This is correct, and implies that the levy is likely to be ineffective in the long term. The authors have obviously suggested an alternative argument. In the presence of evidence from the Irish levy, strong advertising awareness campaigns conveying the rationale behind the introduction of the levy and high charges can influence consumer behaviour. Based on this evidence, the authors prefer the former argument.

of these firms to diversify their branding and to reposition themselves in the market. These retailers have invested large amounts in upgrading or expanding their outlets, and on their marketing.

These expenditures have affected their (income-determined) target markets. Table 1 indicates the firms' market shares, income target segments prior and post the plastic-bag legislation. Some retailer representatives expressed a concern that the data might be of value to their competitors. In order to maintain a measure of anonymity we therefore refer to them merely as indicated in the first column in table 1 below. Information from these firms came through interviews with their representatives and from their annual financial reports.

Despite the changes in target markets, the four firms remain sufficiently distinct in their target markets to provide a heuristic insight into the welfare implications of the levy that are driven by South Africa's heavily skewed distribution of income. As Table 1 showed, these four retail chains target different income groups, whilst each also has a significant share in the market.

A point to note is that, despite the rapid urbanisation of recent years, most of South Africa's poor are to be found in rural areas. The low-income retailer is present in small centres throughout the country's rural areas. Despite their potential threat to livestock, plastic bags are useful assets to non-urbanised households. This issue has been poorly addressed in the literature, and is one we will try to clarify in this paper.

Our approach to the problem is straightforward. We have time series data reporting the number of bags issued monthly by each supermarket chain. While the series is interesting, trends in it would be misleading if interpreted in isolation. The demand for bags is co integrated with volume of consumers' purchases: *ceteris paribus*, a rise in supermarket sales should mean a rise in the number of plastic bags issued. To overcome this problem we estimate variations in the number of bags used to carry a certain volume of purchases, such as bags used per R1 000 of purchases in constant 2008 rands, giving us an indication of lags. Additionally, the price of the bags has to be corrected for inflation. Only then can approximate Marshallian price elasticity be determined.

It is important to stress that, in our analysis, we use the number of plastic bags corrected for total real retail sales⁸. Estimates were recalculated to account for changes in the consumer price index (CPI) over each firm's financial year. The revenue segmentation for all the firms was based on the geographic location of consumers, in this case meaning that the revenue estimates only referred to their South African operations. The real value of sales divided by the number of bags sold yields the amount of actual shopping put in an average bag.

5 Analysis of Charging for Plastic Bags in South Africa

The new plastic-bag regulation was accompanied by a standardisation of bag sizes (8 litres, 12-litres and 24-litres). The 24-litre plastic carrier bag dominated and still dominates the retail market and is the unit used in this study. In the six-year period since the agreement came into effect, retailers have been charging for plastic bags. The prices have fluctuated considerably, both over time and between retailers, as have consumer reactions to them.

Knowler (2008) reports that, following the levying of a charge of 46 rand cents, the use of plastic bags fell by 90 percent. Hasson *et al.* (2007) made similar observations in an earlier study. A representative of one of the major retailers indicated that they experienced a 70% reduction in bag consumption in the three months immediately after the legislation's introduction (Marketing Manager 2008).

Thereafter, following pressure from the plastic-bag manufacturers, the charge per bag fell, individual retailers internalised differing amounts of the charge and firms began charging different prices.

⁸Ideally, we want to use the number of plastic bags per thousand rands of real retail sales in each month, or the real amount of goods packed in the average bag (real sales divided by number of bags). If we cannot get the real value of retail sales per month from each store, then we have to estimate it, and use a monthly (and inflation-corrected) index of retail sales across the whole country to do the correction.

The prices have since fluctuated considerably, both over time and between retailers. A significant recovery in sales after the firms subsidised the bags, combined with an increase in their costs, resulted in retailers increasing their prices independently from one another.

A survey carried out by one of the major retailers reported that an overwhelming majority of people did not reuse the plastic bags for shopping purposes as was intended by the act. Shoppers tend to buy new bags with each visit to the supermarket. A major reason cited was the inconvenience of carrying plastic bags from households to shopping centres. While the plastic bags were reused, this was typically for a range of other household services, including use as rubbish bags. Most bags therefore end at city waste dumps (Agen 2008). In light of the challenges faced by developing countries with regard to their open dumping system, and assuming that a significant percentage of bags are disposed to landfills, the findings of the survey have serious implications in the environmental assessment of the impact of carrier bags.

The subsequent price increases were introduced by the retailers themselves. They cited the increase in the cost of buying the bags as the main reason for the price increments. They also emphasised that they were not making any profits from the bag sales. The increase in the bag consumption accorded with comments and observations from the representatives of the four selected retailers.

The cost of the base material naturally influences the cost of the bag to the retailer. Although polyethylene polymers are produced from coal in South Africa, they are more generally produced from oil. Despite this, the base price has been less volatile than the oil price; the London Metal Exchange (LME) price of soft polyethylene rose from under \$1100 per tonne in 2006 to a peak of roughly \$1700 in July 2008 and was down to \$1450 by September 2008⁹. Although the price rises were not as significant as the changes in the oil price, they have further prompted growth in PET (polyethylene) recycling.

Although there has been some success in recycling of PET bottles and other items marked with a recycling logo, there has been little success with plastic shopping bags. Reasons for this, and potential solutions to it, will be addressed later in the paper. According to Van Deventer (2008), a polymer recycler, Transpaco, is currently not feasible to recycle plastic bags that have been used to hold household waste because of the resulting contamination. Contamination¹⁰ of shopping bags has kept the yield on recycling very low.

6 Assessment of the results of the plastic-bag levy

6.1 Data Results

Given South Africa's heavily skewed distribution of income, we deliberately sourced data from retailers with distinct target markets. Data on the number of bags issued by each of the selected retailers has been collected from the start of their 2002/3 financial year to 2007/8. It therefore covers periods from shortly before the introduction of regulations and charges on plastic bags, to the recent past.

The data on historic bag use is first corrected for changes that have taken place in the size of bags issued. A standard 24-litre bag is the most common unit issued at the checkouts of all four selected retailers. Prior to the introduction of the regulations, some firms were using 18-litre and 21-litre bags. Where the size of a standard bag changed with the legislation, a correction is included. It is important to note that smaller (8 and 12-litre) bags are also available; although fewer of them are issued, there may be minor substitution effects between these items.

⁹London Metal Exchange: Plastics Market Data

¹⁰The failure of this aspect of the legislation has been so serious that local recyclers have suggested a system of colour-coding shopping bags. Dry wastes are typically non-contaminating while wet wastes such as food are problematic. The proposed aim is to educate households about which waste to throw in which bag and thereby to increase the yield on plastic bag recycling.

The high-income retailer already had better-quality bags during the pre-legislation period; however, their bags were also ‘free’. In the case of the low-income retailer, extra-heavy gauge bags were also offered, but at a price. Bag sizes were not standardised, hence where post-legislation changes in bag size occurred, a correction for bag volume is made.

Charging for bags ensued in May 2003 with a fixed nominal price of 46 rand cents (real price of 42 rand cents) for 24-litre bags across all retailers. This price was maintained for the first three months. Thereafter, following pressure from the plastic-bag manufacturers, the charge fell; moreover, firms began charging different prices. Overall, the price fell by 46%, with the upper middle-income retailer experiencing the highest decline of 62%, while the low-income retailer experienced the least decline of 19%. Figure 1 below shows the consumption patterns in South Africa over the past six years across the four selected retailers.

The sections marked with a circle in the diagrams show the end of issuing of the ‘free’ 8-litre ‘flimsy’ plastic bags. The price¹¹ movements were not precisely in accord, however, they generally tracked each other very closely. The consumption of plastic bags was relatively stable until the introduction of the plastic-bag legislation in May 2003.

With the introduction of the levy, the use of plastic bags fell sharply across retailers, with the exception of the low-income retailer. The marginal reduction in the price of bags relative to those in other retailers may partly be the reason for the slight fall in bag use at this retailer.

With the exception of the low-income retailer, the fall in plastic-bag use was only stabilised by a significant reduction in their prices. The revival of demand only became noticeable a few months after the initial bag-price reduction. The immediate result, as elsewhere in the retail sector, was a rise in the amount of goods packed in each bag. This was reflected in a sharp fall in the number of bags issued per R1 000 of real retail purchases, except at the low-income retailer. The slight fall in consumption of bags for the low-income retailer is perhaps two-fold. Firstly, the price of bags remained high, relative to other retailers. Secondly, the consumers were already accustomed to paying for bags prior to the introduction of the levy.

Despite experiencing the least decline in the number of bags per R1 000, the real purchase per bag at the low-income retailer doubled compared to those in other retailers (which is more than at any other retailer). After the legislation the consumers with the lowest income consume the highest number of bags per R1 000 of shopping compared to the other three firms, but this is partly due to the fact that the value per bag at the low end of the income spectrum is lower. Based on this trend, we conclude that the plastic-bag tax is regressive.

Although the amount of goods in each bag initially rose sharply, this soon declined as consumers became accustomed to paying for the bags. Despite this fall, the value of goods in an average bag is still significantly higher than it was prior to the legislation. This difference was validated non-parametrically. Again, as elsewhere, consumers became accustomed to the plastic-bag charge, and there was a rise in the number of bags used to carry R1 000 of purchases at constant prices. Although the number of bags used per R1 000 is lower than the prior-legislation period, there has been a steady increase since their initial decline.

6.2 Consumer sensitivity to price changes

It is interesting from a distributional perspective that taxing plastic bags had the greatest response for the luxury purchases of the upper-income group, as well as for the poorest segment of the market,

¹¹Although all four firms are primarily grocers, the high-income retailer targets more affluent customers and sells items designed and priced for them. Real purchases per bag at this retailer are therefore higher than at other firms. It is worth mentioning that although the high-income retailer sells food and clothes, the legislation affects the bags they issue for food items. The upper-middle-income retailer had only two price changes fewer than any other firm did. Their price of 16 rand cents per bag was also the lowest. The real purchases per bag at the lower-middle-income retailer are much higher than for other firms. The low-income retailer is the only one of the four firms where the quantity of bags consumed is still less than prior to the introduction of the legislation. This could be due to its price being the highest as compared to other firms.

since purchases per shopping trip is low in both cases. It is important to consider when comparing the high and upper-middle-income retailers with lower-middle and low-income retailers that the value per item in each bag is probably much higher – therefore high and upper-middle income retailers have the opportunity to increase the number of items per bag, and decrease the number of bags used per R1 000.

The lower-middle and low-income retailers’ customers buy cheaper goods and hence for the same value per bag the higher-income shoppers have already filled a bag (purchased a greater volume), and hence their ability to increase real value per bag or decrease the number of bags drops to zero.

Consumers were sensitive to the first two price changes across all the selected retailers. The initial price increase (of 100 percent) led to consumers using fewer bags per R1 000 of shopping across the retailers, hence price elasticity of demand is negative as expected. The low-income earners responded the least.

The overall second price reduction of 44 percent resulted in relatively more bags being used, hence price elasticity of demand is positive as expected. However, the consumers were not sensitive to the subsequent price changes (mostly increases) that followed. The price elasticity of demand is unexpectedly positive following these subsequent price increases (*see the Appendix for illustration of the unexpected positive price elasticity*).

7 Discussion

Economic theory predicts that the price elasticity of cheap goods is normally low (Stigler 1966); this has indeed been the case with plastic bags. The second point that stands out is the relationship between elasticity and time. The conventional view is that demand is price inelastic in the short run and elastic in the long run. The findings of this study are the opposite. This may be rooted in psychological issues like those raised by Kahnemann and Tversky (1979). This came as no surprise – perhaps ‘the low proportion of income’ factor that pulls elasticity down, dominates the ‘long run’ factor that pulls it up¹².

Prospect theory states that perceptions of price changes in specific consumer items may be influenced more by their purchase frequency than by their expenditure weight and that price increases may have a bigger impact on perceptions than price decreases (Kahnemann and Tversky 1979).

It seems the price is seen as ‘high’ and therefore depressing demand, not so much as an absolute, nor even relative to other goods, but relative to the price consumers are accustomed to paying for the product. In this case, a rise in price from zero to 41 and 42 rand cents respectively was a shock to consumers, who resisted and cut the quantity they demanded. During this period, there was a 58% decline in the public’s demand for plastic bags per R1 000 of shopping.

Perhaps some consumers were simply ‘protesting’. Contingent Valuation Method (CVM) literature is perhaps more relevant under protest votes of very high willingness-to accept (WTA¹³). Indeed, WTA scenarios in contingent valuation studies are likely to result in high levels of protest responses (Hanley *et al.* 2008; Arrow *et al.* 1993).

When the price was set at a lower level, the quantity demanded rebounded. As people became accustomed to paying for bags, the demand continued to climb. Overall, the price of bags is low compared to an overall shopping bill, hence demand will appear price inelastic as soon as the consumer has become accustomed to paying. As a result, the low levy has resulted in people eventually absorbing the charge into their grocery budget.

The general price increases that followed the initial price reduction induced proportionally different reactions from consumers. In general, consumers continued steadily to increase their consumption

¹²A reviewer has asserted this point. The authors agree with this comment, and are grateful to the contribution made by the reviewer in this regard.

¹³A reviewer pointed out that the high protest bids are usually uncounted in CVM studies where WTA is used to elicit WTP. This is a valuable contribution from the reviewer. The authors simply expand on this point.

levels despite the different price increases. This is despite substitute products such as cloth-carrying bags being popularly and widely available to purchase from these retailers. The general long-term inelasticity of plastic-bag demand may be explained in part by the relatively low prices of these bags in comparison to customers' disposable income, even by the standards of the poor. These bags may be more expensive compared to plastic bags but are certainly more durable, which should adequately make up for their high prices.

8 Conclusion

Our data show that the overall fall in the consumption of plastic bags per R1000 of shopping is approximately 44%, with the high-income retailer and the low-income retailer experiencing 57% and 50% reductions respectively. Based on the trends illustrated in figure 1, our predictions are that the increase in carrier-bag consumption will continue over time, despite the price increases. A point to note is that, despite the subsequent increases in the bag price that followed the initial reduction, the overall price of plastic bags is still significantly less (38%) than when the charging was introduced.

There is no data available to assess the extent to which the plastic-bag levy, and the current lower consumption levels relative to the period prior to the legislation, had on the litter stream in South Africa. Due to lack of evidence in this regard, and given the gradual increase in bag use since it reached a low around 2005, it is not possible to determine the impact of the levy on the environment. However, given the steady increases in the number of bags used for a R1 000 of shopping, it is reasonable to expect that the plastic littering problem will persist. The inelasticity of bag consumption in the long term suggests that the consumer behaviour has not changed much.

The main objective of the plastic-bag legislation in South Africa was to reduce the demand for plastic bags. The steady increase in the demand for plastic bags is evidence that the policy has failed partially. The South African levy has only succeeded in reducing consumption in the short term. Our results suggest that the effectiveness of the levy is diminishing over time, despite it being applied at the checkout points. This is in contrast to the Irish levy that resulted in sustained lowering of consumption (Convery *et al.* 2007).

The level of the levy charged in South Africa is clearly too small; hence, it was only successful in the short term in reducing plastic-bag demand. It is evident that the levy should be set sufficiently high to achieve sustained reduction in the consumption of plastic bags¹⁴.

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¹⁴The authors do not claim to know what the optimal levy charge should be, but rather argue that perhaps the initial charges from zero to 41 and 42 rand cents, that resulted in significant declines in the number of bags consumed per R1 000 of shopping in the short-term, should have being left unchanged. In our view, the fact that these charges achieved such drastic reductions suggests that they were sufficiently high.

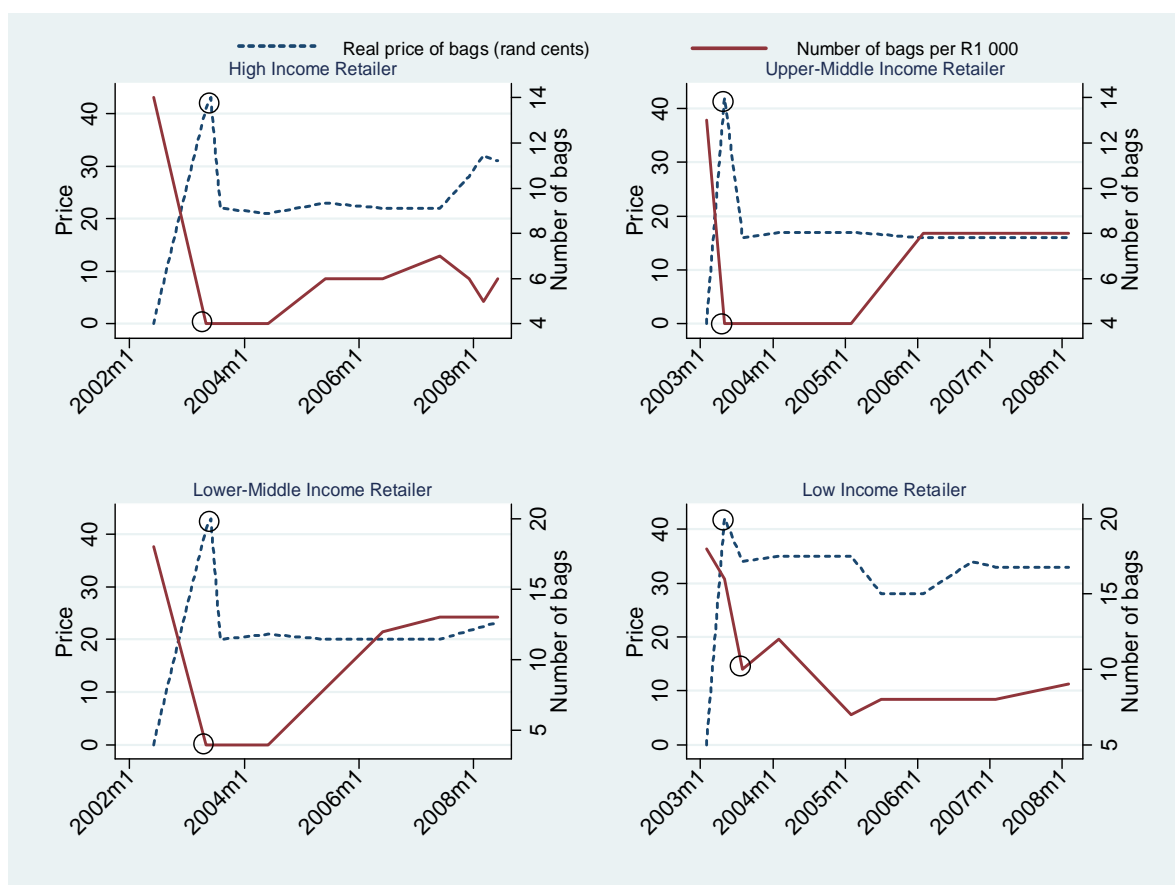
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Table 1. Retailer Information

Retailer	2003 Estimates		2008 Estimates	
	Market Share ¹	LSM ²	Market Share ³	LSM
High-Income Retailer	7%	7-10	9.20%	7-10
Upper-Middle-Income Retailer	36%	6-9	33.50%	4-10
Lower-Middle-Income Retailer	29%	3-8	29.30%	3-8
Low-Income Retailer	1%	1-6	2%	1-7

Figure 1. Demand for Plastic Bags per R1 000 of Shopping in South Africa



¹ Hasson, R., Leiman, A., Visser., M. 2007. The Economics of plastic bags legislation in South Africa. *South African Journal of Economics*. 75, 66-83.

² Hasson, R., Leiman, A., Visser., M. 2007. The Economics of plastic bags legislation in South Africa. *South African Journal of Economics*. 75, 66-83.

³ Statistics are sourced from annual reports for the financial year 2007/8 and from personal communications with the respective retailers' representatives.

Appendix

Elasticity of plastic bags

Table A1 shows the unexpected positive price elasticity of demand despite the subsequent price increases.

Table A1. Bags Elasticity per R1 000 to Changes in Prices

Phase	High Income Retailer		Upper-Middle Income Retailer		Lower-Middle Income Retailer		Low Income Retailer	
	% Δ in Price (Rand-Cents)	ϵ	% Δ in Price (Rand-Cents)	ϵ	% Δ in Price (Rand-Cents)	ϵ	% Δ in Price (Rand-Cents)	ϵ
Phase 1	0-41 (100%)	-33.3	0-42 (100%)	-18.4	0-41 (100%)	-37.8	0-42 (100%)	-12.1
Phase 2	41-23 (-44%)	191	42-16 (-62%)	63.7	41-20 (-51%)	58.1	42-34 (-19%)	59.4
Phase 3	23-22 (-4%)	392			20-23 (15%)	912.1	34-28 (-18%)	258
Phase 4	22-31 (41%)	0					28-33 (18%)	64.2