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Voluntary recycling despite disincentives

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This paper assesses the determinants of take-up of a voluntary waste separation scheme, in a scenario where residents sorted, stored and paid for collection of recycling waste even though mixed waste was collected at the kerbside more conveniently, free of charge and without any quantity limits. Uptake of the scheme was positive, persistent and diverse across localities, offering an opportunity to assess the factors determining voluntary participation in the presence of disincentives. We employ a unique panel data-set ($n = 4,644$) from Malta, including data on recyclable waste kilogrammes collected over the first 86 weeks of the scheme's operation. Drawing on insights from environmental economics and psychology, a model is empirically estimated. Results indicate that uptake is suppressed by the initial constraints households may face and stimulated by collection frequency. Political vote is an important determinant of participation and this interacts with scheme promotion to create diverse uptake rates.

Keywords: voluntary; recycling; vote; policy; regional

1. Introduction

Driven by the need to address landfill costs and natural resource depletion, waste recycling constitutes an important policy objective in many regions of the world – often with mandatory supranational targets attached (Hoornweg and Bhada-Tata 2012; European Environmental Agency 2013). Source separation of recyclable waste by households offers a promising solution, and there has been extensive economic research on how to stimulate it, mainly focusing on the role of incentives and convenience-based intervention. In practice, however, regional authorities often have limited budgets and limited mandates to leverage taxes. Moreover, fee-based interventions may be less attractive than has been suggested by standard economic theory, for reasons that include high administrative and political costs and the prospect of avoidance and illegal disposal (Kinnaman 2009).

Understanding the circumstances and interventions that can stimulate *voluntary* pro-environmental cooperation by households offers policy-makers an opportunity for win-win interventions that promise lower administrative burdens (Ostrom 2010), cultivate public-spirited motives (Bowles 2008) and enhance well-being (Helliwell 2014). Although empirical evidence of voluntary pro-environmental behaviour is diffused and often undocumented (Shogren and Taylor 2008), waste-separation is one domain where

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households are known to cooperate (Kinnaman and Takeuchi 2014). The phenomenon is considered to be driven by moral and social motives – the investigation of which is receiving increased attention within environmental economics (Gsottbauer and van den Bergh 2011; Croson and Treich 2014; Shogren and Taylor 2008).

We present a study of a particular case from Malta, the European Union's smallest nation, where households not only voluntarily separated waste, but also paid for its disposal. They did this in a context where it was also less convenient to dispose of separated waste than mixed waste: door-to-door collection of mixed waste continued to be offered completely free-of-charge, for unlimited quantities on a quasi-daily basis. We consider this an interesting scenario, capable of offering new insights into both the potential of voluntary cooperation, as well as the roles of initial household conditions and policy intervention. Recent studies on household cooperation have reported voluntary waste separation in the absence of fees or fines (e.g. Fiorillo 2013), estimated positive opportunity costs of time among participating households (e.g. Halvorsen 2008), and even derived a positive *hypothetical* willingness to pay to sort waste (e.g. Czajkowski, Kądziela, and Hanley 2014; Gillespie and Bennett 2013). This study is different in that it assesses the determinants of actual kilogrammes of separated waste collected from households, who paid more to recycle.

Given the dearth of studies that track uptake at the point of roll-out of new recycling schemes, we further consider this study to offer useful insights to local authorities and campaigners interested in initiating and sustaining voluntary participation (Tucker and Spiers 2003). As this is the first study to focus on the determinants of participation in the kerbside recycling scheme across Malta, it provides particularly useful insights to policy-makers and scheme operators to increase uptake in Malta.

We estimate a model of recycling participation using a unique merged data-set, which includes low-level aggregated data on the kilogrammes of separated waste collected per capita and demographic data on each of the 54 localities on the island of Malta. The data-set also includes attributes of the recycling scheme during the first 86 weeks of its operation. In this regard, our study is similar to others that employ regional data in estimating a model of household behaviour (Callan and Thomas 2006; Sidique, Joshi, and Lupi 2010; Hage and Söderholm 2008). We are aware that regional data is an imperfect substitute for household-level micro-data, but it carries the advantage of being available at low cost, of being easily replicable and of giving useful first insights to policy-makers as to the kind of demographics that predict this kind of cooperation. Regional data, in this case, also carries the advantage of measuring actual rather than self-reported recycling effort/intent.

2. Literature review

The policy attributes that make recycling attractive to households have been extensively researched in the economics literature (OECD 2008). Like several other public goods in the environmental domain, the benefits of recycling efforts accrue collectively to all members of society (Yau 2010). Based on the assumption that decision-makers are rational and self-interested, traditional economic wisdom would predict that individuals will tend to free-ride on the efforts of others to improve environmental quality, rather than contribute to it themselves through their own scarce resources (Baumol and Oates 1988). The incidence of voluntary recycling is, therefore, expected to be limited and temporary, possibly in error (Palfrey and Prisbrey 1997), or confined to cases where individuals derive some private leisure-type benefits from the process of recycling

(Bruvoll, Halvorsen, and Nyborg 2002). In such scenarios, government intervention is considered necessary to re-address the cost/benefit trade-off and tip decisions in favour of the social good (Hahn 1989) – in the case of waste management, in favour of waste separation.

From the earliest papers on household waste recycling (Hong and Adams 1999; Fullerton and Kinnaman 1996), to more recent studies (Bucciol, Montinari, and Piovesan 2014), much of the work in environmental economics has focused on the role and design of price-based instruments (Watkins *et al*. 2012; Kinnaman 2009) to induce waste separation. Theoretically, tariffs/fees can be set to internalise the environmental costs of waste generation, thereby stimulating more environmentally friendly alternatives (Kinnaman and Fullerton 2000; Fullerton and Kinnaman 1996). Assuming that households (with income constraints) derive benefits from using income in ways other than paying for waste (such as consumption), and assuming that they take decisions that maximise their own utility, then, as the marginal price of mixed waste disposal (relative to that of separated waste) rises, mixed waste disposal should decline and separated waste should increase.

The broad finding of a considerable literature assessing price-based interventions is, indeed, that waste separation is positive in price differentials (Callan and Thomas 2006; Dijkgraaf and Gradus 2004; Ferrara and Missios 2005; Sidique, Joshi, and Lupi 2010; Bucciol, Montinari, and Piovesan 2014; Bartelings and Sterner 1999; Yau 2010), with some authors also reporting significant waste reduction effects (Dahlén and Lagerkvist 2010). In studies that look at reward (rather than tariff) schemes, a significant positive relationship has also been found between reward and per-household weight of recyclables collected. As argued by the authors, however, such schemes can result in a heavy financial burden on operators in the longer run (Yau 2010). Meta-reviews of price-based intervention reveal a relatively low elasticity of response overall (Watkins *et al*. 2012; OECD 2008).

Parsing out the net effect of price is confounded by the fact that per-unit fees are generally accompanied by expanded door-to-door collection systems (Kinnaman 2006) and/or intense promotion and education programmes (Thøgersen 2003). Once other effects are carefully controlled for, some studies find the effect of fees to be insignificant (Fullerton and Kinnaman 1996; Jenkins *et al*. 2003; Fullerton, Leicester, and Smith 2010). Some authors detect larger elasticities in the long-run as households find ways to react to the price (Dahlén and Lagerkvist 2010), but others find that, over time, the effect of tax actually wears off (Suwa and Usui 2007). In a context where households recycled without charges or penalties, household members' judgements on waste disposal charges appear to have no effect on the recycling effort (Fiorillo 2013).

Besides low response rates, other issues that stack up against the use of price-based mechanisms in waste management include political unpopularity, administrative and enforcement costs, as well as the possibility that fees provoke avoidance like waste compaction or illegal dumping (Fullerton, Leicester, and Smith 2010; Fullerton and Kinnaman 1996; Ichinose and Yamamoto 2011). The possibility that price incentives crowd-out moral motivation and suppress voluntary co-operation in waste management (Nyborg and Rege 2003) has also been tested, but not found to be a significant concern to date, at least not in the domain of household waste (Halvorsen 2008; Thøgersen 2003).

The degree of convenience has also emerged as a key factor in determining recycling participation; recycling scheme attributes that reduce, or are perceived to reduce, the time, space or effort needed to recycle, boost participation. Recycling increases in the presence of kerbside services (Jenkins *et al*. 2003; Sidique, Joshi, and Lupi 2010), and of increased accessibility and proximity of collection (Ando and Gosselin 2005). Recycling responds positively to higher frequency of collection (Ferrara and Missios 2005; Kuo and Perrings 2010), and even to the possibility of combining recyclables (Judge and Becker 1993). This type of intervention relieves the constraints that households may face in recycling, such as storage space (Ando and Gosselin 2005; Jenkins *et al*. 2003) or limited time (Hage and Söderholm 2008; Suwa and Usui 2007; Halvorsen 2008). While improved convenience is, arguably, the most reliable predictor of increased uptake (Ferrara and Missios 2012), this can come at a considerable cost to regional or central governments (Kinnaman 2009).

The overall message that emerges from this literature is that financial incentives and increased convenience can, and often do, augment participation in recycling programmes. But the extent to which households would recycle voluntarily in the absence of either is an open question (Kinnaman and Takeuchi 2014). In recent studies (e.g. Halvoren 2008, Brekke, Kverndokk, and Nyborg 2003), economic models of household behaviour have included consideration of the possibility that by contributing to public goods, household members derive a ‘warm glow’ from the process of giving (Andreoni 1990), or avoid the ‘cold shiver’ of not contributing (Brekke, Kverndokk, and Nyborg 2003). In the case of recycling, such latent motives can be revealed in response to the introduction of kerbside collection (Abbott, Nandeibam, and O’Shea 2013). Indeed, people recycle voluntarily despite having a positive opportunity cost of time (Halvorsen 2008), and even express positive hypothetical willingness to pay to recycle (e.g. Czajkowski, Kądziela, and Hanley 2014, Gillespie and Bennett 2013). Relaxing the neoclassical assumption of narrow self-interest to include this kind of ‘impure’ altruism (Andreoni 1990) results in different predictions as to the level of contribution that individuals may be willing to make to public goods, and, consequently, on the type of government intervention that may be appropriate (Nyborg and Rege 2003).

Warm-glow effects can arise from the fulfilment of conformity preferences in situations where household members believe recycling to be the norm (Brekke, Kverndokk, and Nyborg 2003; Halvorsen 2008). Normative effects have been documented in several studies (e.g. Bezzina and Dimech 2011; Viscusi, Huber, and Bell 2011; Valle *et al*. 2005), but results are generally nuanced and the possibility of reverse causality is rarely ruled out (e.g. Videras *et al*. 2012; Tucker 1999). Such effects seem more likely to operate when the visibility of the behaviour is high (Vining and Ebreo 1990) and when there is a stronger sense of community or relationships among neighbours (Miller and Buys 2006; Kurz, Linden, and Sheehy 2007). Furthermore, the more similar the ‘others’ are, and the more durable the relationship, the stronger the benefits of conformity (like building a good reputation) and the costs of non-conformity (such as embarrassment or ostracism) (Ostrom 1998; Gachter and Thoni 2005). In the case of recycling, the association between stronger social ties and participation may also be explained by easier access to information, lower costs of engagement (neighbourly help), as well as stronger felt influences (Videras *et al*. 2012). In recycling studies that use regional data, attachment to one’s community and neighbourly relationships is sometimes proxied by home ownership (Ferrara and Missios 2005) or other regional data like city size, extent of urbanisation, and extent of ethnic diversity (Callan and Thomas 1997; Hage and Söderholm 2008; Halvorsen 2008; Dijkgraaf and Gradus 2004).

The presence of social norms may, in turn, inform or supplement personal moral (pro-environmental) norms (Schwartz 1977). Several studies that assess the private benefits from recycling, in fact, focus on the benefit of adhering to one’s personal pro-environmental norms (Bezzina and Dimech 2011; Brekke, Kipperberg, and Nyborg 2010; Bruvoll and Nyborg 2004; Hage, Söderholm, and Berglund 2009; Halvorsen 2008; Valle *et al*. 2005; Thøgersen 1996). Personal norms are presumed to exist when individuals are aware of consequences, feel a responsibility to act, and believe in the efficacy of their actions (Schwartz 1977; Stern 2000; Biel and Thøgersen 2007). Recycling studies document higher participation among those with stronger environmental/recycling awareness levels, and among communities benefitting from educational or promotional campaigns (Callan and Thomas 2006; Sidique, Joshi, and Lupi 2010). The perceived credibility of sources of information is one of the factors that seems to influence the effectiveness of such campaigns (Nixon and Saphores 2009).

Recent research further suggests that more attention should be paid to political preferences to predict moral motivation. Green-party support (Kahn 2007), left-wing ideology, and political interest are generally associated with stronger pro-environmental behaviour (Dupont and Bateman 2012; Torgler and García-Valiñas 2007), the latter possibly linked to enhanced knowledge and awareness (Fiorillo 2013). Voting data is easily available in many countries, but tested in the field of recycling, its role as a predictor of recycling uptake remains unclear. In a Norway-based study, Brekke, Kipperberg, and Nyborg (2010) control for political party affiliation, and find it to be an insignificant factor. They do argue, however, that ignoring its effect could lead to exaggerated predictions of other moral motives, including social learning, responsibility, and duty-orientation effects (Brekke, Kipperberg, and Nyborg 2010). In another study in Norway, it was *non*-voters who recycled more, a finding which the authors argue may have been a form of protest against the (mixed) waste collection policy (Halvorsen 2008). In Sweden, municipalities with higher levels of green-party support registered higher (plastic) recycling levels (Hage and Söderholm 2008). The possibility that political preferences interact with promotional effort offers a more nuanced explanation for the effects observed (Costa and Kahn 2013). In two USA-based studies, recycling varies along party lines (higher among Democrats and Liberals) but only among those with a high interest in political news (Coffey and Joseph 2013), or subject to the way recycling benefits are framed (McBeth, Lybecker, and Kusko 2013). Political preferences not only shape policy views and perceptions (Campbell *et al*. 1960), but may even result in screening out of information (Marsh 2006), and influence contributions to public goods (Baudreau and MacKenzie 2014).

Taken together, phenomena like social norms, community connectedness, and political interest constitute some of the key dimensions of social capital (Putnam 1993); the presence of which is also associated with positive externalities in several domains (Durlauf and Fafchamps 2005), including environmental ones (Torgler and Garcia Valinas 2007; Pretty 2003). A recent study examines the simultaneous impact of several dimensions of social capital on voluntary recycling and concludes that the phenomenon is an important determinant of cooperation. Membership in associations, political (and news) interest, as well as church attendance were all found to be significant determinants of recycling participation by households in Italy (Fiorillo 2013).

A synthesis of this literature would conclude that greater contributions can be expected from households (or regions characterised by households) whose members are socially or morally motivated to contribute, and who benefit from interventions that make recycling easier or cheaper than the alternative of disposing of mixed waste. Against this backdrop, the fact that the Maltese paid more for a less convenient new recycling service strongly suggests the fulfilment of latent preferences to contribute to the public good. Having a handle on such preferences, together with those of household constraints and scheme attributes, constitutes a useful place from which to start for scheme operators banking on purely voluntary uptake.

3. Model, context. and data

3.1. Theoretical motivation

In line with similar work (Halvorsen 2008; Brekke, Kverndokk, and Nyborg 2003), we consider, conceptually, that a household acts in a manner so as to maximise utility subject to its constraints. We consider that voluntary participation in waste separation activity is mainly driven by its members' desire to gain utility from the fulfilment of its moral and social preferences. Given that household members also derive utility from consuming other goods and services, and from enjoying leisure time and domestic space, and given further that they face constraints (time, dwelling space, and income), then if separating waste requires time, space, and payment, this activity implies a trade-off: faced with a decision on whether to take up recycling or not, household members may weigh the marginal benefits derived from fulfilling their moral preferences against the marginal costs that recycling imposes on their time, space, and income (in a context where recycling comes at a higher price than disposal).

Variations in policy design, such as price differentials and frequency of collection, can affect the cost/benefit trade-off. Price differentials (making separated waste cheaper or mixed waste more expensive) can alter the demands that household waste management decisions make on income; collection frequency can relieve the demands that recycling makes on space; and possibly serve to enhance pro-recycling norms. Campaigns promoting scheme attributes can relieve the time/effort needed to recycle (or perceptions thereof) and also increase the utility from recycling – by boosting awareness and efficacy beliefs. Finally, a household's political preferences not only inform its moral motivation but may also impact the effectiveness of such governmental communication, given different perceptions of source credibility.

Within this conceptual framework, a number of forces can be considered as exogenous variables, capable of influencing the decision to take up recycling. These are the initial conditions that a household faces in maximising its utility, including its constraints and preferences, and the attributes of the waste separation intervention. This framework provides the basis for the empirical estimation:

$$Y_{\mathrm{it}} = \alpha + \beta_1 X_{\mathrm{it}} + \beta_2 G_{\mathrm{it}} + \beta_3 C_{\mathrm{it}} + u_{\mathrm{it}} \qquad \text{(Model1)}$$

where i indexes the locality of observation, t indexes the time units (week), Y_{it} are the kilograms of separated waste collected per capita (locality i, during week t), X_{it} is a vector of household constraints including leisure, space, and income, G_{it} is a vector of policy interventions, C_{it} captures social and moral preferences, and u_{it} represents the error term.

Our a-priori expectation is that separated waste Y_{it}

(1) increases with lower constraints of time, storage space and income (X_{it});
(2) increases with intervention attributes that include higher relative price of mixed waste disposal, higher frequency of collection of recycling waste, and promotional effort (G_{it}); and
(3) increases with stronger moral and social preferences (C_{it}).

3.2. Context

The recycling data employed in this study are drawn from a nationwide voluntary waste-separation scheme introduced in Malta in May 2008, called ‘Recycle Tuesdays’ (RT).[1] In 2007, three years after its accession to the European Union (EU), recycling rates in Malta were still the lowest of all EU citizens. At that point, the Maltese were generating among the highest quantities of municipal solid waste per capita in the EU, following what was estimated to be the highest rate of growth of municipal solid waste over the previous 12 years in the EU (European Environment Agency 2013). Of an estimated 265,947 total tonnes of municipal waste per year in total, less than 3,000 tonnes of paper, plastic, cans, and glass were separated at various receptacles (bring-in sites) and civic amenity facilities in all localities of Malta. Waste separation and recycling, including source separation by households, were fast becoming a high priority for the government (Ministry for Tourism, the Environment and Culture 2012).

The RT scheme offered collection of waste for recycling (paper, plastic, metal), at the kerbside, on a weekly basis, in semi-transparent grey bags. The bags could be purchased at certain outlets at a fee of approximately 1 euro per pack of 10 bags. This may not have been a high price, but it was not zero. This consideration is relevant in a context where the substitute service was free, a condition known to generate disproportionate demand (Shampanier, Mazar, and Ariely 2007). At the start of the scheme, one pack of recycling bags was made available free of charge to all households.

The responsibility for implementing this scheme was shared between central government, a governmental entity responsible for waste management (Wasteserv Malta Ltd), and local councils (municipalities), whose constituent population ranged from some 250 to 22,416 persons. Some subcontracting of services occurred later on in the scheme’s operation (beyond the period considered here). There was significant promotion of the logistics of the scheme in various media by the Ministry for Resources and Rural Affairs. Among the localities, there were variations in the frequency/time of collection, as well as in the extent of the promotion undertaken. Meanwhile, the collection of mixed municipal solid waste continued to be offered at the kerbside in all localities, on a quasi-daily basis, without any restrictions on quantities disposed of, or the receptacle used, and free of charge. The possibility of disposing of separated waste at the various designated waste disposal sites was also retained throughout the weeks under consideration.

Despite the fee and the presence of cheaper and more convenient alternatives, by the first six months of its operation in 2008, the RT initiative was generating 140 tonnes per week of separated waste for recycling. Correcting for the fact that bring-in sites also received glass, the scheme had already more than tripled the voluntary recycling activity (of paper, metal, and plastic) that had previously been recorded. Across the islands, people had taken up the practice of purchasing special bags, separating waste, storing it for a week, and duly bringing it out on their doorstep for collection. Over the first year and a half of the operation of the recycling scheme (Figure 1), the total kilograms collected from voluntary kerbside recycling increased from zero to at an estimated average of one bag per week per three households (National Statistics Office Malta 2013), but there was significant variation in the take-up among the various localities of Malta (Figure 2). This variation lends itself to econometric investigation with a view to understanding what drove households in Malta to make the effort to contribute to a collective good despite disincentives, and what may have suppressed their efforts.

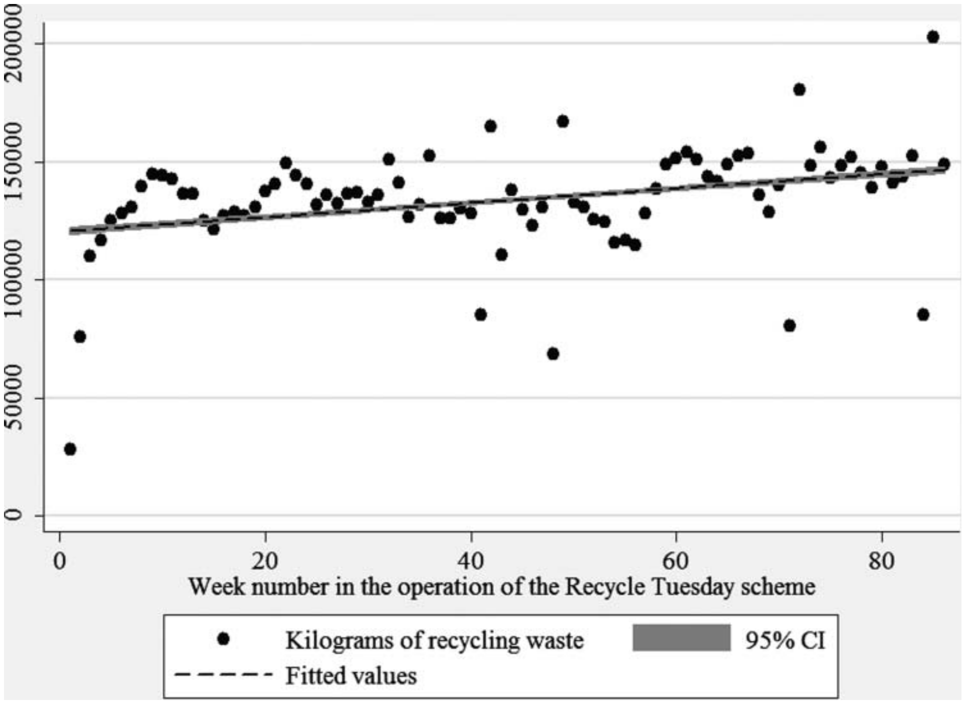

Figure 1. Recycling waste collected door-to-door.

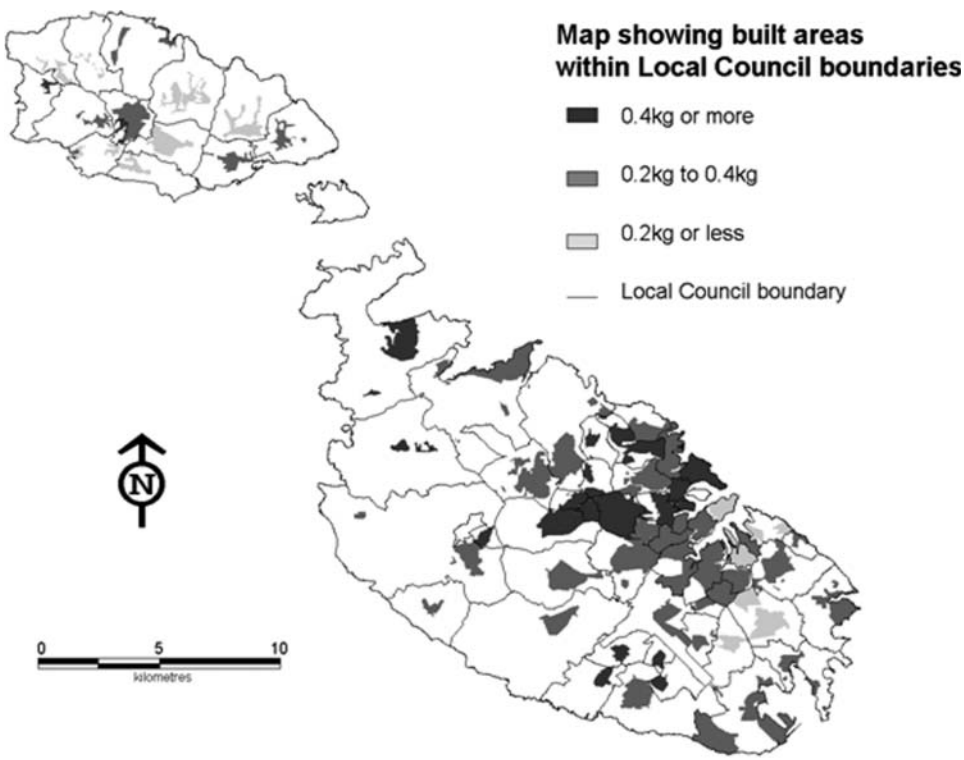

Figure 2. Recycling waste collected by local council (mean weekly kilograms per capita).

Table 1. Definition and description of variables.

Variable	Label	Mean	SD	Min	Max
RECYCLING	Kilos per capita of recycling waste collected	0.373	0.299	0.000	2.980
PROMOTION	Dummy variable for extent of promotion of scheme	0.593	0.491	0.000	1.000
REC-FREQ	Number of days per week recycling waste collected	1.029	0.167	1.000	2.000
WASTE-FREQ	Number of days per week mixed waste collected	5.755	1.257	0.000	7.000
HOLIDAY	Dummy variable for a public HOLIDAY clash with recycling collection	0.034	0.181	0.000	1.000
FREE-BAGS	Dummy variable first 15 weeks – free recycling bags	0.163	0.369	0.000	1.000
RETAILTAX	Dummy variable for retail plastic bag tax	0.500	0.500	0.000	1.000
POVERTY	Fraction of population on supplementary allowances	0.071	0.037	0.011	0.188
DENSITY	Thousands of persons living in built-up zone per square kilometre	7.373	2.756	2.370	19.031
GRADUATES	Fraction of population with tertiary education	0.078	0.040	0.022	0.187
ELDERLY	Fraction of population aged over 60	0.220	0.072	0.070	0.378
NON-RESIDENTS	Tourist beds per resident	0.075	0.215	0.000	1.140
VOTE	Fraction of voters voting pro government in 2007/2008	0.440	0.150	0.198	0.831
WEEK	Week number in the operation of the Scheme	43.50	24.827	1.000	86.00

3.3. *Variables and data*

Recycling data for each of the first 86 weeks of the scheme were made available from the Malta Environment and Planning Authority, measuring tonnes of separated waste collected for recycling, at the kerbside, from households in all the different localities in the island of Malta. Values for the recycling rate were obtained by dividing recycling kilograms collected from each separate locality by that locality's (permanent) resident population. Data at the level of local councils (municipalities) are very limited in Malta (National Statistics Office Malta 2007a, 2007b) but, in 2009, the Maltese National Statistics Office issued its first ever report on social benefits by locality, yielding a data-set which was useful to this study (National Statistics Office 2009). In addition to this data, information was also collected from the local councils on variations in scheme attributes during the first 86 weeks of its operation. Table 1 summarises the variables used in the estimation of Model 1.

A variable was employed to capture income constraints (POVERTY), as part of the constraints vector X_{it}. This measured the proportion of individuals in each locality receiving income supplements (National Statistics Office 2009). Average income data is not available for the localities of Malta, but the prevalence of low-income households (receiving supplements) captures diversity in income at a meaningful level. Low income could constrain both the ability to generate waste (from which to draw recyclables) and, in the case of this scheme, to pay for recycling.

To capture variation in time costs, we employed a variable (GRADUATES) representing the proportion of residents with tertiary education (National Statistics Office 2007a), on the a-priori expectation that graduates may have higher opportunity costs of leisure time (Halvorsen 2008; Bruvoll, Halvorsen, and Nyborg 2002). This approach differs from some other studies which use educational levels as a proxy for moral motivation or awareness (Ando and Gosselin 2005; Bartelings and Sterner 1999; Jenkins *et al*. 2003; Saphores *et al*. 2006), but builds on others that find education to be negatively and significantly related to recycling (Hage and Söderholm 2008).

An additional variable measured the proportion of individuals in each locality at pensionable age (ELDERLY), using adjusted 2005 figures (National Statistics Office 2007a), on the expectation that non-working elderly have lower time constraints and possibly higher conformity preferences (Fiorillo 2013; Hage, Söderholm, and Berglund 2009; Bruvoll and Nyborg 2004). Both of these may exert a positive influence on recycling, as suggested by a number of studies (Vining and Ebreo 1990; Meneses and Palacio 2005; Saphores *et al*. 2006).

Space constraints are often proxied by crude population density (Callan and Thomas 2006; Suwa and Usui 2007). Given that some localities in Malta enjoy larger tracts of land which are non-residential, and which would have distorted the actual measure of density of residential accommodation, we employ a measure of population density within the built-up zone of each locality (DENSITY). Data on the size of the built-up zone in each locality were obtained from the Malta Environment and Planning Authority.

The vector of variables forming G_{it} required data on the extent of promotional activity, frequency of collection of separated and mixed waste, as well as bag fees. This information was collected in 2010 from all the local councils with the assistance of the Department of Local Councils and the Malta Environment and Planning Authority. The fact that some local councils engaged in awareness activities, while others did not, is captured by the binary variable (PROMOTION). Kerbside collection relieves the constraint of storing waste and could also provide normative information, given the visibility of the grey bags. A dedicated variable (REC-FREQ) captures collection frequency for recycling waste, while another (WASTE-FREQ) captures collection frequency for (mixed) municipal solid waste, both measuring collection days per week. Some collection dates clashed with national holidays and this was accounted for by employing an additional dummy variable (HOLIDAY).[2]

The government fee for recycling did not vary between the localities during the weeks under investigation: the disposal of separated waste in grey bags for recycling cost 1 euro per pack of bags. Practically all localities distributed at least one pack of (10) bags for free, sometime within the first four weeks of the scheme. This effective waiving of the recycling fee was represented by a dummy variable, FREE-BAGS, that distinguishes the first 15 weeks of the scheme from the rest, and approximates the time span in which households used the free bags. No municipal waste disposal fee was introduced in the period under assessment. A potentially relevant change happened in March 2009. During this month, a 0.15 euro fee was introduced on retail plastic bags. The practice of re-using excess retail plastic bags as a garbage bag for mixed waste was common in Malta (*Times of Malta* 2009a). The retail-bag fee meant that households would now have to resort to ordinary (black) garbage bags for mixed waste disposal, which retailed at between 0.06 and 0.10 euro per bag (or else reuse the retail bags which cost 0.15 euro). The price disincentive of separated waste disposal may have been diminished as a consequence. To control for this possibility, we employed a dummy variable (RETAILTAX) for the weeks subsequent to the retail-bag fee.

As part of the preferences vector C_{it}, we adopted a similar approach to other regional studies which employ proxies for social conformity preferences such as city size, extent of ethnic diversity, or temporary residents which are typically considered to suppress neighbourly relations, community attachment, or social influence (Callan and Thomas 1997; Hage and Söderholm 2008; Halvorsen 2008; Dijkgraaf and Gradus 2004). While ethnic minorities constituted a very small percentage of the population in Malta, tourists are an important factor. Malta receives some 1.5 million tourists per year (compared to 0.4 million Maltese residents) totalling over 11 million nights, concentrated within a few localities. Tourist beds per resident range from zero to one and this was considered a meaningful metric of the extent of non-permanent residents. We obtained data from the Malta Tourism Authority on tourist beds in each locality, to define this variable (NON-RESIDENT).

To capture moral motivation, we followed similar studies (e.g. Hage and Söderholm 2008), and utilised locality level data on voting outcomes. Malta reports exceptionally high voter turn-outs in a very polarised political environment (IDEA 2004), where votes are split between the Nationalist Party (NP), a party with Christian-Democratic orientation and the Labour Party (LP), a Democratic Centre-Left party (Briguglio 2009). The NP was the party in government responsible for the introduction and promotion of household recycling, through the kerbside (RT) scheme in May 2008. It had secured a victory in the national elections only two months earlier with a mere 1,500 votes over the LP. In this context, a novel scheme introduced shortly after a divisive national election as a government scheme, could receive stronger support from households which had voted for the party in government. Such households may hold stronger trust and efficacy beliefs in government (Lenz 2009; McBeth, Lybecker, and Kusko 2013) as well as stronger identification with and responsibility for government objectives (Green, Palmquist, and Schickler 2004). The opposite may be true among those voting for the opposition – where strongly felt identification with the party in opposition could cause resistance to the promotional effort of the party in government (Marsh 2006). Efficacy belief, felt responsibility, and awareness are the three important priors to the activation of moral motivation (Schwartz 1977; Stern 2000; Biel and Thøgersen 2007), and we, therefore, expect higher levels of moral motivation in areas with higher NP support. The variable VOTE measures the percentage of votes going to the NP in local council elections between 2007 and 2009 (Lane 2009).

Finally, to control for the possibility that recycling programmes become more effective over time, that residents gain experience with effort (Jenkins *et al*. 2003; Bucciol, Montinari, and Piovesan 2014), or even form the habit of recycling (Knussen and Yule 2008), a control variable accounting for the week number in the scheme was also employed in this study (WEEK). This variable could also have captured the gradual (if small) increase in total waste generation over time, from which recycling waste is drawn.

In line with the literature and our model, we set out to examine the following hypotheses:

(1) Recycling is higher in localities characterised by households with lower constraints,

H1a: where households have lower space constraints, measured by (lower) DENSITY;

H1b: where households have lower income constraints, measured by (lower) POVERTY;

H1c: where households have lower time constraints, as measured by (fewer) GRADUATES and (more) ELDERLY.

(2) Recycling is higher during weeks when and in localities,

H2a: where recycling demands less space to store waste, measured by (higher) REC-FREQ;

H2b: where recycling comes at a lower price, measured by FREE-BAGS and RETAILTAX;

H2c: where the scheme attributes are promoted, measured by PROMOTION.

(3) Recycling is higher in localities where moral motivation is stronger,

H3a: where social ties are stronger, measured by (fewer) NON-RESIDENTS;

H3b: where pro-government is stronger, measured by (higher) pro-government VOTE.

4. Results and discussion

There being no a-priori theoretical reasons for a different specification, a linear econometric model (including a constant) was estimated. In total, 4,644 observations were available, pertaining to 54 localities over 86 weeks. Estimation was first carried out using the random effects method (with Generalised Least Squares estimators), under the assumption of strict exogeneity between the explanatory variables and the disturbance term, and no omitted variable bias. We considered random effects to be a superior way of estimating the model (relative to fixed effects), given that we were interested in estimating the effect of the time-invariant differences across localities – fixed effects would have absorbed differences in the intercept. The Breusch–Pagan Lagrange (1980) multiplier test confirmed the presence of random effects (rejecting the null hypothesis that the variance across the entities is zero, with $p < 0.001$). A side-by-side comparison of the fixed effects and random effects coefficients showed no significant differences for the comparable coefficients and the Hausman (1978) specification test did not reject the null hypothesis that random effects yielded consistent estimates (the overall statistic Chi^2 reports a $p = 0.9997$).[3] The coefficients reported in Table 2, therefore, capture both between-entity and within-entity effects (wherever panel data were available). The interpretation of the coefficient is the average effect of the variable on recycling kilograms per capita, when that variable changes across time and between localities by one unit. Cluster–robust standard errors are reported (in parentheses) to address the possibility of heteroscedasticity, this being frequently observed in cross-sectional data-sets where demographics are involved and its presence not having been rejected in our post-diagnostic tests.[4]

The results of our estimation indicated that all the significant coefficients, with the exception of that on RETAILTAX (weeks in which retail bags were subject to a tax) had the expected signs, and the results confirmed our expectations. As is typical in regional analyses, a large proportion of the variance in the waste separation effort was due to non-observed variables ($r^2\_o = 0.196$).[5] Nonetheless, the variables in the specification did help explain parts of the observed differences in collection rates. The F-test confirmed that the coefficients in the model were different from zero and that the model was correctly specified ($p < 0.001$).

The results broadly confirm our first hypothesis that higher recycling rates are likely to be observed in localities characterised by residents with lower constraints. Density (H1a) (indicative of smaller storage space) exerts a negative pressure on recycling per

Table 2. Determinants of recycling participation.

Variables	Model a	Model b
PROMOTION	0.124 (0.062) **	−0.195 (0.114) *
REC-FREQ	0.191 (0.065) ***	0.19 (0.066) ***
WASTE-FREQ	0.039 (0.025)	0.039 (0.025)
HOLIDAY	−0.200 (0.028) ***	−0.200 (0.028) ***
FREE-BAGS	0.009 (0.010)	0.009 (0.010)
RETAILTAX	−0.081 (0.021) ***	−0.081 (0.021) ***
POVERTY	−2.821 (1.155) **	−2.358 (1.231) *
DENSITY	−0.021 (0.010) **	−0.021 (0.009) **
GRADUATES	−2.28 (1.443)	−1.639 (1.334)
ELDERLY	0.387 (0.552)	0.282 (0.519)
NON-RESIDENTS	−0.236 (0.080) ***	−0.332 (0.092) ***
VOTE	0.737 (0.332) **	0.360 (0.257)
PRXVOTE		0.746 (0.305) **
WEEK	0.002 (0.000) ***	0.002 (0.000) ***
CONSTANT	−0.034 (0.136)	0.0706 (0.147)

Notes: This table shows coefficients, robust standard errors in parentheses, and confidence levels (*, **, ***Indicate statistical significance at the 10%, 5%, and 1% levels, respectively)
Model a. Observations = 4,644; Councils = 54; $r^2\_o = 0.196$; chi$^2 = 162.6$; $p < 0.001$; rho = 0.7;
Model b. Observations = 4,644; Councils = 54; $r^2\_o = 0.196$; chi$^2 = 162.2$; $p < 0.001$; rho = 0.7.

capita, suggesting that lower volumes of waste separation occur in localities where living quarters are tight. The prevalence of low-income households (H1b), as measured by the percentage of the population receiving supplementary allowances, suppresses uptake in the scheme, possibly because of lower volumes of waste from which recycling material is drawn, and higher price elasticity of recycling. The results confirm findings in similar studies where lower incomes are associated with lower recycling rates (Ferrara and Missios 2005; Jenkins *et al*. 2003; Sidique, Joshi, and Lupi 2010; Suwa and Usui 2007; Viscusi, Huber, and Bell 2011).

As also observed in earlier studies (e.g. Nixon and Saphores 2009; Sidique, Joshi, and Lupi 2010), and contrary to our hypothesis (H1c), a higher proportion of graduates did not yield a significant pressure on regional recycling. The negative pressure of cost of time may have been off-set by the positive pressure of stronger pro-environmental motives, sometimes also associated with higher educational levels (Saphores *et al*. 2006; Jenkins *et al*. 2003; Ando and Gosselin 2005; Hong and Adams 1999). Neither were localities with a high percentage of elderly people (presumed to have lower opportunity costs of time) associated with higher recycling per capita, a finding which has been also documented elsewhere (Hage and Söderholm 2008). These results also confirm the findings from the only other study carried out in Malta (Bezzina and Dimech 2011), where no significant differences for recycling behaviour/intent were observed by age or educational level.

The results also confirm our second hypothesis that enabling policy is associated with higher recycling rates. Higher recycling rates were observed in instances of higher frequencies of collection of recycling waste. This was hypothesised (H2a) on the basis that higher collection frequency relieves the space required to store waste. Higher collection frequencies could also have increased the visibility of recycling effort by others, although it is not possible to parse out these effects with the present data. The extent of the promotion undertaken by the localities also made a statistically significant positive difference to recycling uptake as anticipated (H2c). But price effects, at least in as much as they could be identified by time dummy variables, yielded results contrary to our hypothesis (H2b). The first 15 weeks of the scheme, characterised by free-bag distribution, had no significant effect on recycling per capita. We cannot exclude that this is due to measurement error.

Furthermore, contrary to our expectation, the introduction of a retail-bag tax, which might have suppressed the price disincentive effect, actually exerted a negative pressure on recycling. The tax on retail plastic bags may well have provided a direct signal to reduce consumption of plastic bags themselves, but it also seems to have suppressed recycling participation. The introduction of the 15 euro cent fee on plastic shopping bags was highly controversial in Malta (*Times of Malta* 2008, 2009b), unlike the success of the same kind of fee introduced in Ireland in 2002, which had followed extensive consultation (Convery, McDonnell, and Ferreira 2007). It is plausible that once households had to resort to the use of black garbage bags (which came at a price), some may have tried harder to fill them before disposal, including by disposing of some recyclable waste streams in the same bag. Compaction is a common problem encountered when waste fees are levered on volume rather than weight (Hage and Söderholm 2008). There may also have been some negative backlash on the moral motivation to contribute following the introduction of the plastic bag tax; however, the data do not allow us to test this.

Our third hypothesis was that participation ought to have been higher in localities where social and moral motivations were higher. In controlling for social pressures, we confirm the hypothesis that households in touristic localities recycled less, holding other factors constant (H3a). On the island of Malta, where the number of tourists in some localities can be equal to the number of permanent residents, the presence of tourism reduces recycling participation, possibly through a dilution of community and normative pressures. Although it could be argued that touristic localities have different waste composition, if anything, this is more likely to be characterised by higher (not lower) fractions of recyclable waste due to disposables.

We also find (as per hypothesis H3b) that, in localities characterised by higher votes for the Nationalist Party (the party in government responsible for the introduction of the scheme), higher per capita volumes of separated waste were collected. The coefficient on the VOTE variable (which ranged from 0.19 to 0.83, capturing fractions voting for the NP) was both statistically significant (at the 5% level), and meaningful, at a value of 0.74, considering that the average recycling in our study stood at 0.37 (kilos per capita per week). Recent research has called for increased attention to political data as an important predictor of environmental behaviour (Dupont and Bateman 2012), and these results suggest that a pro-government sentiment is associated with higher uptake of a public good scheme, at least when the scheme is voluntary, novel, and promoted by government. That greater levels of support for the party in government were associated with higher uptake could have been driven by stronger credibility of scheme promotion, government efficacy beliefs, or stronger identification with government objectives. Our data do not allow us to parse out the effect of these possible underpinnings.

Finally, the impact of the passage of time was positive and significant, possibly capturing habit, experience, and higher levels of waste, given the waste generation trend over recent years.

Given that the scheme was promoted as a government initiative, a further round of analysis was undertaken to explore how voting preferences may have interacted with the extent of promotion that occurred in the localities. Table 2, model (b), reports results when model (a) is re-estimated with the inclusion of a variable interacting vote with promotional effort. The coefficient on this interaction term is positive and significant, absorbing the effect of the VOTE variable and leaving the effect of the PROMOTION variable to be negative and significant.[6] This finding suggests that promotional effort may have interacted with political preferences in Malta and created asymmetric effects. Promotion by government may have increased uptake among households (and localities) with a pro-government sentiment, but may actually have had the unintended effect of suppressing participation among households that voted for the opposition. The possibility that political preferences interact with public good promotion has provoked interest in recent work (John 2013; Costa and Kahn 2013). Our result supports findings in two recent recycling studies, the first where benefit framing interacted with political preferences to determine recycling intent (McBeth, Lybecker, and Kusko 2013), the second where recycling was higher among Democrats and Liberals in the USA, but only if they showed high news interest (Coffey and Joseph 2013). The results also echo findings in an earlier study which found that the credibility of sources used in promotional efforts mattered in terms of level of participation (Nixon and Saphores 2009). This offers additional insights as to why communication campaigns sometimes fail to contribute significantly to recycling effort (Valle *et al*. 2005).

The findings were tested for robustness by estimating a number of different models, reported in Table 3. As discussed above, in estimating models (a) and (b) reported in Table 2, the variable ELDERLY represented the percentage of the population at pensionable age, and was intended to proxy the time available for households to engage with recycling. The variable did not prove to be a significant determinant. We re-estimated the model replacing this variable with one that captured the relative size of the working age population (WORKING) in each locality. In model (c), the pressure of a larger fraction of working age population is negative, but once again, not significant. In comparison with model (a), the remaining coefficients remain intact (though the effect of POVERTY is now slightly larger). We also examined (not reported in Table 3) whether having a greater fraction of children (0−15) can explain variation in recycling uptake, but, once again, a higher fraction of people in this age group did not offer additional explanatory power (similar to Fiorillo 2013). Neither did the fraction of young adults (16−30). Testing average age to capture other variations in the locality also proved to be unproductive.

The education variable is often found to be a positive determinant in studies at household level (e.g. Fiorillo 2013), but was also found to be insignificant in models (a) and (b). To further investigate the role of this demographic, we re-estimated the model with variables capturing the percentage of population at primary level and secondary educational levels. As indicated in model (d), the effect of education (even at lower levels) is still not significant. No change in coefficients or in model fit were observed with the exception of smaller effects on POVERTY and VOTE, suggesting some interplay between education (at secondary school level), income and vote. The variance−covariance matrix of coefficients of the model did, in fact, reveal some correlation between GRADUATES and VOTE. We, therefore, also re-estimated the model without the VOTE variable. We noted that the results on education remained robust. We then estimated the model *without* the GRADUATES variable and found that the resultant coefficient on VOTE remained significant if slightly smaller (0.481^{**}), which suggests that VOTE then captures some of the (negative) effect of GRADUATES.

Table 3. Determinants of recycling participation – further tests.

Variables	Model c (age)	Model d (education)	Model e (dwelling)	Model f (social)	Model g (month1)	Model h (full)
PROMOTION	0.132 (0.061) **	0.146 (0.069) **	0.132 (0.066) **	0.107 (0.062) *	0.123 (0.061) **	−0.304 (0.133)**
REC-FREQ	0.191 (0.065) ***	0.191 (0.065) ***	0.191 (0.065) ***	0.193 (0.065) ***	0.191 (0.063) ***	0.193 (0.064)***
WASTE-FREQ	0.039 (0.025)	0.038 (0.025)	0.039 (0.025)	0.042 (0.027)	0.033 (0.026)	0.0379 (0.028)
HOLIDAY	−0.2 (0.028) ***	−0.2 (0.028) ***	−0.2 (0.028) ***	−0.199 (0.029) ***	−0.196 (0.028) ***	−0.195 (0.028)***
FREE-BAGS	0.009 (0.010)	0.009 (0.010)	0.009 (0.01)	0.011 (0.010)	0.040 (0.013) ***	0.042 (0.013)***
RETAILTAX	−0.081 (0.021) ***	−0.081 (0.021) ***	−0.081 (0.021) ***	−0.083 (0.022) ***	−0.068 (0.019) ***	−0.0697 (0.019)***
POVERTY	−3.113 (1.408) **	−1.659 (1.116)		−3.947 (1.455) ***	−2.769 (1.165) **	−3.076 (1.63)*
DENSITY	−0.021 (0.010) **	−0.018 (0.009) **	−0.018 (0.01) *	−0.023 (0.012) *	−0.021 (0.01) **	−0.021 (0.010)**
GRADUATES	−2.271 (1.599)		−0.463 (1.162)	−2.873 (1.608) *	−2.248 (1.445)	−1.751 (1.458)
ELDERLY		−0.284 (0.722)	−0.56 (0.406)	0.933 (0.493) *	0.395 (0.551)	0.738 (0.487)
NON-RESIDENTS	−0.248 (0.081) ***	−0.217 (0.071) ***	−0.133 (0.100)	−0.29 (0.112) ***	−0.234 (0.079) ***	−0.387 (0.120)***
VOTE	0.705 (0.332) **	0.416 (0.202) **	0.657 (0.320) **	0.942 (0.421) **	0.74 (0.333) **	0.439 (0.334)
WEEK	0.002 (0.000) ***	0.002 (0.000) ***	0.002 (0.000) ***	0.002 (0.000) ***	0.002 (0.000) ***	0.002 (0.000)***
WORK-AGE	−0.846 (0.922)					
EDUCATION		−1.098 (0.949)				
DWELLING			0.198 (0.170)			
CHURCH				−0.55 (0.449)		−0.447 (0.420)
TURNOUT				0.245 (0.249)		0.419 (0.274)
MONTH1					−0.180 (0.033) ***	−0.183 (0.033)***
RECPRXVOTE						0.951 (0.348)***
Constant	−0.846 (0.922)	0.524 (0.546)	−0.318 (0.198)	−0.046 (0.251)	−0.003 (0.138)	−0.1 (0.262)

Notes: Table 3 shows coefficients, robust standard errors in parentheses and confidence levels (*, **, ***Indicate statistical significance at the 10%, 5%, and 1% levels, respectively)
Model c: $n = 4{,}644$; councils = 54; $r^2\_o = 0.198$; chi$^2 = 160.8$; $p < 0.001$; rho = 0.7 and WORK-AGE is fraction of population aged 16−60, with mean = 0.636, min = 0.525 and max = 0.719 (NSO 2007a).
Model d: $n = 4{,}644$; councils = 54; $r^2\_o = 0.185$; chi$^2 = 179.6$; $p < 0.001$; rho = 0.7 and EDUCATION is fraction of population having more than primary education, with mean = 0.511, min = 0.416, max = 0.568 (NSO 2007a).
Model e: $n = 4{,}644$; councils = 54; $r^2\_o = 0.185$; chi$^2 = 182.7$; $p < 0.001$; rho = 0.7and DWELLING is fraction of single family dwellings, with mean = 0.756 min = 0.263 max = 0.976 (NSO 2007b).
Model f: $n = 4{,}558$; councils = 53; $r^2\_o = 0.218$; chi$^2 = 171.5$; $p < 0.001$; rho = 0.7, CHURCH is fraction of population attending mass regularly in 2005, with mean = 0.462, min = 0.326, max = 0.723, (Discern 2006), and TUROUNT is fraction voter turnout at local council elections with mean = 0.768, min = 0.502, max = 0.924 (Lane 2009).
Model g: $n = 4{,}664$; councils = 54; $r^2\_o = 0.206$; chi$^2 = 181.4$; $p < 0.001$; rho = 0.7 and MONTH1 is a dummy variable for weeks in the first month of scheme, with mean = 0.035, min = 0, max = 1.
Model h: $n = 4558$, councils = 53; $r^2\_o = 0.268$; chi$^2 = 217.5$; $p < 0.001$; rho = 0.7.

The results in Table 2 revealed, as expected, that the larger the percentage of the population receiving supplementary income allowances, the lower the volumes of recycling waste generated per capita. Recognising, however, that poverty is an imperfect proxy for average income, we considered (in the absence of actual income data) the prevalence of single-family dwellings (as a percentage of total dwellings) as a measure of wealth. The statistical signal given of this variable is positive (as expected) but not significant. As indicated in model (e), there could also be some interplay between fewer single-family dwellings (and therefore more flats) and higher prevalence of tourists.

Although an important objective in the specification of the model was parsimony, omitting variables could possibly have weakened the explanatory power of the model. Empirical studies at a household level sometimes include other covariates to capture diverse elements of social capital. The prevalence of non-residents in Malta's localities did capture some of the diversity in social capital, but we considered whether other distinctions could contribute additional explanatory power. Following previous work, we considered the role of church attendance as a proxy for community connectedness, moral motivation (Owen and Videras 2007), and suppression of individual opportunism (Fiorillo 2013). We included a variable that captures the extent of attendance at mass in each locality (CHURCH), obtained from the Malta Curia (Discern 2006). We also included a measure of voter turnout (TURNOUT), as a proxy for political interest (Lane 2009). The results are reported in model (f) and suggest that, while the variables are not significant in themselves, their inclusion parses out some additional positive and negative influences on recycling uptake, yielding stronger coefficients on POVERTY, VOTE, GRADUATES, and ELDERLY.

Finally, to examine the validity and implications of our assumptions of a linear time trend, we re-estimated the model with variations on this variable. We first estimated the model without the time trend, and then with the inclusion of 86 dummy variables, 1 for each week in the scheme's operation. The coefficients on the estimates remained robust in both cases.[7] However, examining the plot of recycling uptake over time (Figure 1) reveals that, while linearity may be a reasonable simplifying assumption to make, a more sophisticated model could distinguish the first month of the scheme's roll-out from the rest. We, therefore, re-estimate the model with the inclusion of a dummy variable (MONTH1). As reported in Table 3 model (g), the impact of the first month on recycling uptake is negative and significant. This could possibly have been due to start up frictions (Tucker and Spiers 2003). Its inclusion leaves the coefficients on all other variables steady – with one exception: once this control variable is included, the impact FREEBAG in the first 15 weeks is positive. As originally hypothesised, the financial disincentive on recycling bags may well have reduced uptake. The model fit also improves with the inclusion of this variable.

Informed by these tests, we re-estimate the complete model, including the interaction term, and additional control variables CHURCH and TURNOUT (for social capital) and MONTH1 (for start-up effects). The results are reported in Table 3, model (h). In comparison with model (b), model (h) reports slightly larger coefficients on some variables (POVERTY, PRXVOTE, PROMOTION, and FREEBAGS) and a higher overall r^2 of 0.268. The results again confirm our a-priori expectations that recycling uptake is higher in localities characterised by stronger social (permanent residents) and moral (pro-government) preferences, as well as lower constraints (particularly space and income). Intervention that relieves constraints (through frequent collection and distribution of free bags) also generates higher uptake, while intervention in the form of promotion only generates a positive impact in those localities where government support is high.

It bears repeating that while the study employs small and meaningful low-level aggregates, it is subject to an important question that applies to most studies using aggregated data: whether it is possible to use such statistics to make inferences about households or individuals (Gelman *et al*. 2001). The data, for instance, do not allow inference as to how much of the overall take-up in recycling is actually due to more households/individuals joining in and how much is due to increased recycling effort per person. Behavioural outcomes can only be considered to represent household (or individual) level decisions if it is assumed that households within the locality are identical and have the same utility function. The analysis also assumes no spillovers between the councils and no great interdependence. These shortcomings must be weighed against the key advantage of using aggregated data, namely that it frees the research from dependence on intended or self-reported behaviour. The former is not necessarily predictive of actual behaviour (Ajzen and Fishbein 1977), whilst the latter may cause households to alter behaviour over time. Direct observation of recycling behaviour at household level is, in fact, very difficult. This explains why a number of other studies have utilised community-level data to assess the determinants of recycling behaviour (Beatty, Berck, and Shimshack 2007; Dijkgraaf and Gradus 2004; Hage and Söderholm 2008; Kinnaman and Fullerton 2000; Sidique, Joshi, and Lupi 2010). Using aggregate data also allowed us to employ variables like voting behaviour, which can be difficult to elicit in household surveys.

A further concern in empirical work of this nature is the possibility that some of the policy variables may be endogenous (Kinnaman and Fullerton 2000). The present study makes the simplifying assumption that the policy attributes were exogenous to the weekly recycling generated in a locality, that is, the variation (among the localities and over time) was driven by reasons other than the amount of separated waste collected itself. This is reasonable considering that over 86 weeks, the potential for local councils to respond through policy change was constrained, and that the variation of these variables in time was actually very limited. Omitting policy variables altogether from the model (a) results in a lower overall r^2 (0.147), but does not distort the main results on the variables describing preferences and constraints.

A further concern is the possibility that the kilograms of recycling recorded in the kerbside recycling programme may have diverted recycling away from facilities across the islands that previously received some separated waste. Although some studies have found that recycling centres are complementary to (and not substitutive of) kerbside collection (Saphores *et al*. 2006; Sidique, Joshi, and Lupi 2010), others indicate that kerbside collection may simply divert heavier and bulkier materials like glass away from collection centres (Beatty, Berck and Shimshack 2007). This material was not part of the RT scheme. Furthermore, while aggregate figures of recycling waste collected from other sites suggest that some diversion may have taken place with the introduction of kerbside collection, overall the volumes collected from all sources continued to increase throughout the period under study and beyond, and the percentage of household municipal waste separated increased from 2.73 in 2007 to 5.04 in 2009 (National Statistics Office Malta 2012).

It is also pertinent to recall that in all our estimates, the dependent variable represented the ratio of recyclable waste collected (in kilogrammes) per capita per week. Other studies (with some exceptions, e.g. Yau 2012) generally employ recycling waste per unit of total waste as the dependent variable, in order to examine the determinants of recycling rates.

Information on the weekly waste disposed by locality was not available in Malta, and although we control for time and income effects (which could capture some variation in total waste generation), the study leaves open the question of whether the diverse waste separation effort (defined as recycling kilograms per capita) made in the various localities of Malta actually reflected waste separation *efficiency* (defined as separated waste per tonne of total waste). The data on recycling waste itself were sourced from measures taken at the collection points of treatment facilities. It is possible that some contamination occurred in measuring the kilograms of waste collected from the individual localities, for different streams of waste (recyclable/not), and even from different sources (households and commercial), and we assume the measurement error to be random.

Finally, data pertaining to policy variables were sourced from the local councils with a time lag of a few months, which did not allow for detailed reporting. None of the socio-economic data from the National Statistics Office was available on a weekly basis, but changes in socio-economic data were unlikely to have been significant in such a short period of time.

5. Conclusions

This study has documented a rare case of purely voluntary pro-environmental behaviour in the absence of pecuniary or convenience-based incentives, indeed in the presence of financial disincentives. That people actually paid and contributed (in ever increasing volumes) to a public good, even though this required more time and space than the status quo option, offers considerable hope for voluntary policy approaches – including when benefits accrue collectively to all members of society. This is particularly useful in cases when incentivising behaviour through taxes is not an option, or in cases (for instance, in low-income regions) where budgetary constraints limit subsidies or expenditures on improving scheme attributes.

The findings also provide practical insights as to the kind of conditions which would favour voluntary uptake of a recycling scheme at its early stages: participation is likely to be higher in localities where households face lower constraints and have stronger social and moral preferences and where intervention attributes are sensitive to these initial conditions. In Malta, it was localities characterised by larger living space per capita, higher incomes, fewer tourists per capita, and stronger pro-government sentiment that witnessed stronger participation in the new kerbside recycling scheme. Effort responded (positively) to more frequent collection of recycling waste, and to the distribution of free bags (relieving the disincentive). And, in the context of heterogeneous political preferences, promotion by government created diverse outcomes – positive among those with pro-government sentiment, negative among those voting for the party in opposition. Within the constraints of the caveats outlined, these findings contribute fresh insights on the motives and barriers underpinning recycling efforts, on the kind of regional data that may proxy such phenomena and on the extent to which government intervention may stimulate – or suppress – cooperation.

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Disclosure statement

No potential conflict of interest was reported by the authors.

Supplemental data

A theoretical appendix which fleshes out the conceptual model in this article can be accessed here (online supplemental data).

Notes

1. In Maltese, the word 'Tlieta' means both 'Tuesday' and 'three,' referring to the number of waste streams that could be mixed in the grey bag for recycling.
2. In weeks 41, 48, 71, and 84, Tuesday coincided with a national holiday. In the few localities which collected on other days, public holidays were likewise accounted for.
3. The random effects estimator makes the assumption that differences across units are orthogonal to the regressors. The Hausman test examines this by comparing the results of the random effects estimator with those of the fixed effects estimator which does not make this assumption.
4. Random effects estimation makes the assumption that errors have a constant variance. Estimating robust standard errors returns the same coefficients but does not rely on the assumption of identical distribution of errors and independence within clusters.
5. Using the overall r^2 as a measure of goodness-of-fit involved considering both 'within' and 'between' variation.
6. The fact that VOTE is not statistically significant and that PROMOTION has negative sign may suggest that the variables are correlated, leading to biased estimate on PRXVOTE. However, the variables show very low levels of correlation (Pearson correlation coefficient < 0.054). Indeed regressing the variable PROMOTION on any of the initial conditions in the model produces no significant outcomes. PROMOTION can be partly predicted by week into the scheme.
7. In the case of the model estimated with time dummies, we are constrained to omit the variables that capture price effects (FREEBAG and MSWPRICE) due to multicollinearity.

References

Abbott, Andrew, Shasikanta Nandeibam, and Lucy O'Shea. 2013. "Recycling: Social Norms and Warm-Glow Revisited." *Ecological Economics* 90: 10–18.

Ajzen, I., and M. Fishbein. 1977. "Attitude-Behavior Relations: A Theoretical Analysis and Review of Empirical Research." *Psychological Bulletin* 84 (5): 888–918.

Ando, Amy W., and Anne Y. Gosselin. 2005. "Recycling in Multifamily Dwellings: Does Convenience Matter?" *Economic Inquiry* 43 (2): 426–438.

Andreoni, James. 1990. "Impure Altruism and Donations to Public Goods: A Theory of Warm-Glow Giving." *The Economic Journal* 100 (401): 464–477.

Bartelings, H., and T. Sterner. 1999. "Household Waste Management in a Swedish Municipality: Determinants of Waste Disposal, Recycling and Composting." *Environmental and Resource Economics* 13 (4): 473–491.

Baumol, W.J., and W.E. Oates. 1988. *The Theory of Environmental Policy*. Cambridge: Cambridge University Press.

Beatty, T.K.M., P. Berck, and J.P. Shimshack. 2007. "Curbside Recycling in the Presence of Alternatives." *Economic Inquiry* 45 (4): 739–755.

Bezzina, F.H., and S. Dimech. 2011. "Investigating the Determinants of Recycling Behaviour in Malta." *Management of Environmental Quality: An International Journal* 22 (4): 463–485.

Biel, Anders, and John Thøgersen. 2007. "Activation of Social Norms in Social Dilemmas: A Review of the Evidence and Reflections on the Implications for Environmental Behaviour." *Journal of Economic Psychology* 28 (1): 93–112.

Boudreau, C., and S.A. MacKenzie. 2014. "Informing the Electorate? How Party Cues and Policy Information Affect Public Opinion About Initiatives." *American Journal of Political Science* 58 (1): 48–62.

Bowles, Samuel. 2008. "Policies Designed for Self-interested Citizens May Undermine the Moral Sentiments: Evidence from Economic Experiments." *Science* 320 (5883): 1605−1609.

Brekke, Kjell A., Snorre Kverndokk, and Karine Nyborg. 2003. "An Economic Model of Moral Motivation." *Journal of Public Economics* 87: 1967−1983.

Brekke, Kjell A., Gorm Kipperberg, and Karine Nyborg. 2010. "Social Interaction in Responsibility Ascription: The Case of Household Recycling." *Land Economics* 86 (4): 766−784.

Breusch, T.S., and A.R. Pagan. 1980. "The Lagrange Multiplier Test and its Applications to Model Specification in Econometrics." *Review of Economic Studies* 47: 239−253.

Briguglio, Michael. 2009. "Politics, the State and Civil Society − a Theoretical Framework." In *Social Transitions in Maltese Society*, edited by Josann Cutajar and George Cassar, 125−146. Luqa, Malta: Agenda.

Bruvoll, Annegrete, Bente Halvorsen, and Karine Nyborg. 2002. "Households' Recycling Efforts." *Resources, Conservation and Recycling* 36 (4): 337−354.

Bruvoll, Annegrete, and Karine Nyborg. 2004. "The Cold Shiver of Not Giving Enough: On the Social Cost of Recycling Campaigns." *Land Economics* 80 (4): 539−549.

Bucciol, Alessandro, Natalia Montinari, and Marco Piovesan. 2014. "Do Not Trash the Incentive! Monetary Incentives and Waste Sorting." *Scandinavian Journal of Economics*. 117 (4): 1024−1029.

Callan, S.J., and J.M. Thomas. 1997. "The Impact of State and Local Policies on the Recycling." *Eastern Economic Journal* 23 (4): 411−423.

Callan, S.J., and J.M. Thomas. 2006. "Analyzing Demand for Disposal and Recycling Services: A Systems Approach." *Eastern Economic Journal* 32 (2): 221−240.

Campbell, A., P.E. Converse, W.E. Miller, and D.E. Stokes. 1960. *The American Voter*. New York: John Wiley & Sons.

Coffey, Daniel J., and Patricia H. Joseph. 2013. "A Polarized Environment the Effect of Partisanship and Ideological Values on Individual Recycling and Conservation Behavior." *American Behavioral Scientist* 57 (1): 116−139.

Convery, Frank, Simon McDonnell, and Susana Ferreira. 2007. "The Most Popular Tax in Europe? Lessons from the Irish Plastic Bags Levy." *Environmental and Resource Economics* 38 (1): 1−11.

Costa, Dora L., and Matthew E. Kahn. 2013. "Energy Conservation 'Nudges' and Environmentalist Ideology: Evidence from a Randomized Residential Electricity Field Experiment." *Journal of the European Economic Association* 11 (3): 680−702.

Croson, Rachel, and Nicolas Treich. 2014. "Behavioral Environmental Economics: Promises and Challenges." *Environmental and Resource Economics* 58: 335−351.

Czajkowski, Mikołaj, Tadeusz Kądziela, and Nick Hanley. 2014. "We Want to Sort! Assessing Households' Preferences for Sorting Waste." *Resource and Energy Economics* 36 (1): 290−306.

Dahlén, L., and A. Lagerkvist. 2010. "Pay as You Throw: Strengths and Weaknesses of Weight-Based Billing in Household Waste Collection Systems in Sweden." *Waste Management* 30 (1): 23−31.

Dijkgraaf, E., and R.H.J.M. Gradus. 2004. "Cost Savings in Unit-Based Pricing of Household Waste: The Case of the Netherlands." *Resource and Energy Economics* 26 (4): 353−371.

Discern. 2006. "Sunday Mass Attendance, Census 2005, Preliminary Report. Maltese Islands" http://www.discern-malta.org/research_pdfs/census_2005.pdf.

Dupont, Diane P., and Ian J. Bateman. 2012. "Political Affiliation and Willingness to Pay: An Examination of the Nature of Benefits and Means of Provision." *Ecological Economics* 75 (0): 43−51.

Durlauf, S.N., and M. Fafchamps 2005. "Social Capital." In Vol. 1B of *Handbook of Economic Growth*, edited by P. Aghion and S.N. Durlauf, 1639−1699. Amsterdam: Elsevier North-Holland.

European Environment Agency. 2013. "Managing Municipal Solid Waste − a Review of Achievements in 32 European countries 2/2013." http://www.eea.europa.eu/publications/managing-municipal-solid-waste

Ferrara, I. and P. Missios. 2012. "A Cross-Country Study of Household Waste Prevention and Recycling: Assessing the Effectiveness of Policy Instruments." *Land Economics* 88 (4): 710−744.

Ferrara, I., and P. Missios. 2005. "Recycling and Waste Diversion Effectiveness: Evidence from Canada." *Environmental and Resource Economics* 30 (2): 221−238.
Fiorillo, D. 2013. "Household Waste Recycling: National Survey Evidence from Italy." *Journal of Environmental Planning and Management* 56: 1125−1151.
Fullerton, D., and Thomas C. Kinnaman. 1996. "Household Responses to Pricing Garbage by the Bag." *American Economic Review* 86 (4): 971−984.
Fullerton, D., A. Leicester, and S. Smith. 2010. "Environmental Taxes." Chap. 5 in *Tax by Design: The Mirrlees Review*, edited by J. Mirrlees. Oxford: Oxford University Press.
Gachter, Simon, and Christian Thoni. 2005. "Social Learning and Voluntary Cooperation Among Like-Minded People." *Journal of the European Economic Association* 3 (2−3): 303−314.
Gelman, A., D.K. Park, S. Ansolabehere, P.N. Price, and L.C. Minnite. 2001. "Models, Assumptions and Model Checking in Ecological Regressions." *Journal of the Royal Statistical Society: Series A (Statistics in Society)* 164 (1): 101−118.
Gillespie, Robert, and Jeff Bennett. 2013. "Willingness to Pay for Kerbside Recycling in Brisbane, Australia." *Journal of Environmental Planning and Management* 56 (3): 362−377.
Green, D.P., B. Palmquist, and E. Schickler 2004. *Partisan Hearts and Minds: Political Parties and the Social Identities of Voters*. New Haven, CT: Yale University Press.
Gsottbauer, Elisabeth, and Jeroen van denBergh. 2011. "Environmental Policy Theory Given Bounded Rationality and Other-Regarding Preferences." *Environmental and Resource Economics* 49 (2): 263−304.
Hage, Olle, and Patrik Söderholm. 2008. "An Econometric Analysis of Regional Differences in Household Waste Collection: The Case of Plastic Packaging Waste in Sweden." *Waste Management* 28 (10): 1720−1731.
Hage, Olle, Patrik Söderholm, and Christer Berglund. 2009. "Norms and Economic Motivation in Household Recycling: Empirical Evidence from Sweden." *Resources, Conservation and Recycling* 53 (3): 155−165.
Hahn, R.W. 1989. "Economic Prescriptions for Environmental Problems: How the Patient Followed the Doctor's Orders." *The Journal of Economic Perspectives* 3 (2): 95−114.
Halvorsen, Bente. 2008. "Effects of Norms and Opportunity Cost of Time on Household Recycling." *Land Economics* 84 (3): 501−516.
Hausman, J.A. 1978. "Specification Tests in Econometrics." *Econometrica* 46: 1251−1271.
Helliwell, John F. 2014. "Social Norms, Happiness, and the Environment: Closing the Circle." *Sustainability: Science, Practice, & Policy* 10 (1): 78−84.
Hong, Seonghoon, and Richard M. Adams. 1999. "Household Responses to Price Incentives for Recycling: Some Further Evidence." *Land Economics* 75 (4): 505−514.
Hoornweg, D., and P. Bhada-Tata. 2012. "What a Waste: A Global Review of Solid Waste Management." Urban Development Series*; Knowledge Papers No. 15*. Washington, DC: World Bank. http://documents.worldbank.org/curated/en/2012/03/16537275/waste-global-review-solid-waste-management
Ichinose, Daisuke, and Masashi Yamamoto. 2011. "On the Relationship Between the Provision of Waste Management Service and Illegal Dumping." *Resource and Energy Economics* 33 (1): 79−93.
IDEA. 2004. "Voter Turnout in Western Europe." http://www.idea.int/publications.
Jenkins, Robin R., Salvador A. Martinez, Karen Palmer, and Michael J. Podolsky. 2003. "The Determinants of Household Recycling: A Material-Specific Analysis of Recycling Program Features and Unit Pricing." *Journal of Environmental Economics and Management* 45 (2): 294−318.
John, Peter. 2013. "All Tools Are Informational Now: How Information and Persuasion Define the Tools of Government." *Policy & Politics* 41 (4): 605−620.
Judge, Rebecca, and Anthony Becker. 1993. "Motivating Recycling: A Marginal Cost Analysis." *Contemporary Policy Issues* 11 (3): 58−68.
Kahn, M.E. 2007. "Do Greens Drive Hummers or Hybrids? Environmental Ideology as a Determinant of Consumer Choice." *Journal of Environmental Economics and Management* 54 (2): 129−145.
Kinnaman, Thomas C. 2009. "The Economics of Municipal Solid Waste Management." *Waste Management*: 29 (10): 2615−2617.
Kinnaman, T.C. 2006. "Policy watch: examining the justification for residential recycling." *The Journal of Economic Perspectives* 20 (4): 219−232

Kinnaman, Thomas C., and Don Fullerton. 2000. “Garbage and Recycling with Endogenous Local Policy.” *Journal of Urban Economics* 48 (3): 419–442.
Kinnaman, Thomas C., and Kenji Takeuchi. 2014. *Handbook on Waste Management*. Cheltenham: Edward Elgar Publishing.
Knussen, C., and F. Yule. 2008. “I’M Not in the Habit of Recycling.” *Environment and Behavior* 40 (5): 683–702.
Kuo, Yen-Lien and Charles Perrings. 2010. “Wasting Time? Recycling Incentives in Urban Taiwan and Japan.” *Environmental and Resource Economics* 47 (3): 423–437.
Kurz, T., M. Linden, and N. Sheehy. 2007. “Attitudinal and Community Influences on Participation in New Curbside Recycling Initiatives in Northern Ireland.” *Environment and Behavior* 39 (3): 367–391.
Lane, J, 2009, “Elections in Malta: The Single-Transferable-Vote System in Action, 1921–2009.” http://www.maltadata.com.
Lenz, G.S. 2009. “Learning and Opinion Change, Not Priming: Reconsidering the Priming Hypothesis.” *American Journal of Political Science* 53 (4): 821–837.
Marsh, M. 2006. “Party Identification in Ireland: An Insecure Anchor for a Floating Party System.” *Electoral Studies* 25 (3): 489–508.
McBeth, Mark K., Donna L. Lybecker, and Elizabeth Kusko. 2013. “Trash or Treasure: Recycling Narratives and Reducing Political Polarisation.” *Environmental Politics* 22 (2): 312–332.
Meneses, G.D., and A.B. Palacio. 2005. “Recycling Behavior: A Multidimensional Approach.” *Environment and Behavior* 37 (6): 837–860.
Miller, E., and L. Buys. 2006. “The Impact of Social Capital on Residential Water-Affecting Behaviors in a Drought-Prone Australian Community.” *Society and Natural Resources* 21: 244–257.
Ministry for Tourism, the Environment and Culture. 2012. *National Environment Policy*. Mriehel, Malta: Progress Press.
National Statistics Office Malta. 2007a. “Census of Population and Housing 2005. Volume 1: Population.” http://www.nso.gov.mt/docs/Census2005_Vol1.pdf.
National Statistics Office Malta. 2007b. “Census of Population and Housing 2005. Volume 2: Dwellings.” http://www.nso.gov.mt/statdoc/document_file.aspx?id=2096
National Statistics Office Malta. 2009. “Social Security Benefits: A Locality Perspective.” http://www.nso.gov.mt/statdoc/document_view.aspx?id=2586
National Statistics Office Malta. 2012. “Solid Waste Management in Malta 2004–2010.” http://www.nso.gov.mt/statdoc/document_view.aspx?id=3142.
National Statistics Office Malta. 2013. “News Release: Solid Waste Management in Malta 2004–2011.” http://www.nso.gov.mt/statdoc/document_view.aspx?id=3423.
Nixon, H., and J.D.M. Saphores. 2009. “Information and the Decision to Recycle: Results from a Survey of US Households.” *Journal of Environmental Planning and Management* 52 (2): 257–277.
Nyborg, Karine, and Mari Rege. 2003. “Does Public Policy Crowd Out Private Contributions to Public Goods?” *Public Choice* 115 (3/4): 397–418.
OECD. 2008, “Household Behaviour and the Environment: Reviewing the Evidence.” www.oecd.org/dataoecd/19/22/42183878.pdf.
Ostrom, Elinor. 1998. “A Behavioral Approach to the Rational Choice Theory of Collective Action: Presidential Address, American Political Science Association, 1997.” *The American Political Science Review* 92 (1): 1–22.
Ostrom, Elinor. 2010. “Beyond Markets and States: Polycentric Governance of Complex Economic Systems.” *The American Economic Review* 100 (3): 641–672
Owen, A.L., and J.R. Videras 2007. “Culture and Public Goods: The Case of Religion and the Voluntary Provision of Environmental Quality.” *Journal of Environmental Economics and Management* 54: 162–180.
Palfrey, Thomas R., and Jeffrey E. Prisbrey. 1997. “Anomalous Behavior in Public Goods Experiments: How Much and Why?” *American Economic Review* 87 (5): 829–846.
Pretty, J. 2003. “Social Capital and the Collective Management of Resources.” *Science* 302: 1912–1914.
Putnam, R. 1993. *Making Democracy Work*. Princeton, NJ: Princeton University Press.

Saphores, Jean-Daniel M., Hilary Nixon, Oladele A. Ogunseitan, and Andrew A. Shapiro. 2006. "Household Willingness to Recycle Electronic Waste: An Application to California." *Environment and Behavior* March (38): 183–208.

Schwartz, S.H. 1977. "Normative Influences on Altruism." In Vol. 10 of *Advances in Experimental Social Psychology*, edited by L. Berkowitz, 221–279. New York: Academic Press.

Shampanier, Kristina, Nina Mazar, and Dan Ariely. 2007. "Zero as a Special Price: The True Value of Free Products." *Marketing Science* 26 (6): 742–757.

Shogren, Jason, and Laura Taylor. 2008. "On Behavioural Environmental Economics." *Review of Environmental Economics and Policy* 2 (1): 26–44.

Sidique, Shaufique F., Satish V. Joshi, and Frank Lupi. 2010. "Factors Influencing the Rate of Recycling: An Analysis of Minnesota Counties." *Resources, Conservation and Recycling* 54 (4): 242–249.

Stern, Paul C. 2000. "Toward a Coherent Theory of Environmentally Significant Behavior." *Journal of Social Issues* 56 (3): 407–424.

Suwa, Tatsuo, and Takehiro Usui. 2007. "Estimation of Garbage Reduction and Recycling Promotion Under the Containers and Packaging Recycling Law and Garbage Pricing." *Environmental Economics and Policy Studies* 8 (3): 239–254.

Thøgersen, J. 1996. "Recycling and Morality a Critical Review of the Literature." *Environment and Behavior* 28 (4): 536–558.

Thøgersen, J. 2003. "Monetary Incentives and Recycling: Behavioural and Psychological Reactions to a Performance-Dependent Garbage Fee." *Journal of Consumer Policy* 26 (2): 197–228.

Times of Malta. 2008. "Local Shoppers Hoarding Plastic Bags." 6 November. http://www.timesofmalta.com/articles/view/20081106/local/shoppers-hoarding-plastic-bags.232012.

Times of Malta. 2009a. "Eco Tax on Plastic Bags From March." 29 January. http://www.timesofmalta.com/articles/view/20090129/local/eco-tax-on-plastic-bags-from-march-1.242668

Times of Malta. 2009b. "Labour Enterprise Criticise plastic bags eco tax system." 4 February. http://www.timesofmalta.com/articles/view/20090204/local/labour-enterprise-criticise-plastic-bags-eco-tax-system.243457

Torgler, Benno, and María A. García-Valiñas. 2007. "The Determinants of Individuals' Attitudes Towards Preventing Environmental Damage." *Ecological Economics* 63 (2–3): 536–552.

Tucker, P. 1999. "Normative Influence in Household Waste Recycling." *Journal of Environmental Planning and Management* 42: 63–82.

Tucker, P., and D. Speirs 2003. "Attitudes and Behavioural Change in Household Waste Management Behaviours." *Journal of Environmental Planning and Management* 46 (2): 289–307.

Valle, Do, Patrícia Oom, Efigénio Rebelo, Elizabeth Reis, and João Menezes. 2005. "Combining Behavioral Theories to Predict Recycling Involvement." *Environment and Behavior* 37 (3): 364–396.

Videras, J.R., A.L. Owen, E. Conover, and S. Wu. 2012. "The Influence of Social Relationships on Pro-Environmental Behaviours." *Journal of Environmental Economics and Management* 63: 35–50.

Vining, J., and A. Ebreo. 1990. "What Makes a Recycler?" *Environment and Behavior* 22 (1): 55–73.

Viscusi, W.K., J. Huber, and J. Bell. 2011. "Promoting Recycling: Private Values, Social Norms, and Economic Incentives." *American Economic Review* 101 (3): 65–70.

Watkins, E., D. Hogg, A. Mitsios, S. Mudgai, A. Neubauer, H. Reisinger, J. Troeltzsch, and M. Van Acoleyen. 2012. *Use of Economic Instruments and Waste Management Performances* Paris: Bio Intelligent Services. http://ec.europa.eu/environment/waste/pdf/final_report_10042012.pdf

Yau, Y. 2010. "Domestic Waste Recycling, Collective Action and Economic Incentive: The Case in Hong Kong." *Waste Management* 30 (12): 2440–2447.

Yau, Y. 2012. "Stakeholder Engagement in Waste Recycling in a High-Rise Setting." *Sustainable Development* 20 (2): 115–127.