Embedding Landfill Diversion in Economic, Geographical and Policy Settings Panel based evidence from Italy

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Summary

This paper analyses the process of delinking for landfilling trends embedding the dynamics in a frame where economic, geographical and policy variables enter the arena We aim at investigating in depth what main drivers may be responsible for such a phenomenon, and whether differences may be observed focusing the lens on a decentralised provincial based setting. We exploit a rich panel dataset stemming from Official sources (APAT, Italian environmental agency) merged with other provincial and regional based information, covering all the 103 Italian provinces over 1999-2005. The case study on Italy is worth being considered given that Italy is a main country in the EU. Thus it offers important pieces on information on the evaluation of policies. Evidence shows that the observed decoupling between economic growth and landfilling is driven by a mix of structural factors, as population density and other waste management opportunity: local opportunity costs and landfill externalities matter in shaping waste policies and local commitment to landfill diversion. But not only structural factors are relevant. If on the one hand landfill taxation is a significant driver of the phenomenon, even at the more coherent regional level, where the tax is implemented, waste management instruments, when we exploit the provincial dataset, are associated to high significant negative effect on landfilled waste. A good performance on managing waste according to economic rationales helps reducing the amount that is landfilled. In association to the features of the tariff system, we also underline the key role played by the share of separated collection. Both the evolution of collection and tariff system are joint factors that may drive a wedge between the comparative waste performances of northern and southern regions. We finally note that lock in effects linked to the intensity of incinerator sites in the area are relevant for landfilling: past investments in incineration lock in the region in this technological path, which may be associated to less opportunity cost and lower external effects. Summing up, landfill diversion is stronger where the economic cost deriving from high population density, a structural factor, are higher, and waste management collection systems and economic instruments are associated with higher performances.

Keywords: Landfill Policies, Incineration, Landfill Tax, Policy Effectiveness, Waste Management, Delinking, Landfill Trends, Kuznets Curves

JEL Classification: C23, Q38, Q56

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1. Introduction

Reducing the amounts of waste going to landfill is a primary aim of European environmental policies related to climate change. The effectiveness of European policies will be based on sound implementation at the levels where waste is being generated and disposed of.

European efforts towards reducing landfill are a priority in the waste hierarchy, and one of the pillars of EU waste strategy is the 1999 Landfill Directive (EEA, 2007), which is being implemented at member state level in association with national efforts regarding waste management, such as separate collection, recycling, incineration, and disposal and usage of waste. These actions are devoted to diverting waste from landfill and reducing waste generated at source, to achieve a decoupling of different stages of the waste production chain.

Indicators of this 'decoupling' are becoming increasingly popular for detecting and measuring improvements in environmental/resource efficiency with respect to economic activity. Extensive research on decoupling to produce indicators for reporting and policy-evaluation purposes, is being carried out by the Organisation for Economic Cooperation and Development (OECD, 2003, 2002). Various decoupling or resource-efficiency indicators are included in the European Environment Agency's (EEA) state-of-the-environment reports (EEA, 2003a,b,c). The EU policy 'thematic strategies' on resources and waste, include reference to 'absolute' and 'relative' indicators of delinking (EC, 2003a,b; Jacobsen et al., 2004): the former being a negative relationship between economic growth and environmental impacts, the latter a positive but decreasing in terms of size, association. They show a positive, lower than unity elasticity in economic terms. Figure 2 sketches the 'decoupling / EKC' framework in an intuitive way.

The EEA has acknowledged that:

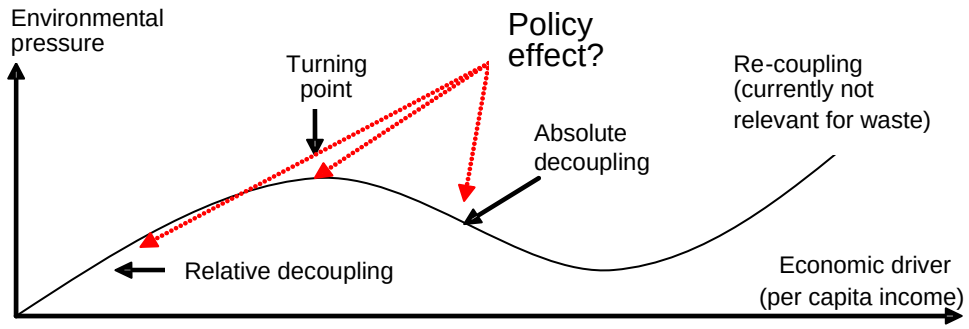
> "It is increasingly important to provide answers to these questions because waste volumes in the EU are growing, driven by changing production and consumption patterns. It is also important because there is a growing interest in sharing best practice and exchanging national-level experience across Europe, with the common goal of achieving more cost-effective solutions to the various problems being faced" (EEA, 2007)

The EEA shows that countries can be categorised under three waste management 'groupings', according to the strategies for diversion of municipal waste away from landfill, and the relative shares of landfilling, materials recovery (mainly recycling and composting) and incineration. The first grouping comprises countries that have high levels of materials recovery and incineration, and relatively low levels of landfill. The second grouping includes countries with high materials recovery rates and medium levels of incineration, and medium dependence on landfill. The third grouping comprises countries where levels of both materials recovery and incineration are low, and dependence on landfill is relatively high (EEA, 2007). Though northern Italy has some rapidly evolving strategies for high levels of recycling, composting and incineration, on average, disposal of waste is still dominated by landfill, as the recent dramatic news from southern areas, such as Campania, confirms. However, some northern regions of Italy are encountering landfill criticalities based on the increasing scarcity of land in physical and economic terms (opportunity costs) and the non-decreasing or stabilised, trend in waste generation.

Figure 1 Income-environment relationships, dynamic trends and de-coupling

The reasoning around de-coupling can be framed by referring to the EKC model, that describes the state of the dynamic relationship between environmental pressures and economic drivers. This model proposes an inverted U-shape relationship between per capita income and environmental pressure (figure below). The model implies that in the first stage an increase in income leads to an increase in environmental pressure. In a second stage, above a certain level of income, the environmental pressure will decrease as the economy will be able to invest in less polluting technology, consumers will reallocate expenses in favour of greener products and there will be more awareness raising campaigns, etc. Even policies, that are aimed at re-shaping the 'business as usual' trend towards more environmentally efficient and sustainable paths, are likely to be implemented with an increasing strictness and effectiveness along economic development. At a later stage, there might be a potential re-coupling, observed for some pollutants, where environmental pressure grows in spite of increasing income. Scale effects of growth again outweighs improvements in efficiency of resource use and management. Recoupling could thus emerge in well-organised waste management systems, if pressures from production of the goods and final disposal economic and environmental effects are taken into account following an LCA perspective.

In this context environmental pressure is either: waste generation, landfilling or incineration. We further explore how this relationship is altered by the inclusion of socio-economic and policy drivers. Drivers are divided into three categories: economic, socio-economic and policy-based.



Source ETC/RWM (2008)

This paper analyses the process of delinking of landfill trends, within a framework in which economic, institutional, geographic and policy variables play a role. On the basis of recent decreases in amounts of landfilled waste at EU level, we investigate what are the main drivers of this phenomenon, and whether there are differences if the focus is on decentralised, provincial settings. We exploit a rich panel dataset from official sources (APAT, Italian environmental agency) which is merged with provincial and regional based information, covering the 103 Italian provinces, in the period 1999 to 2005. This extended, decentralised and recent source of data is of major interest for an investigation of waste processes and for policy evaluation, where evidence is typically scattered, poor quality and rather scarce. This evidence will complement EU level analyses (Mazzanti and Zoboli, 2005; Andersen et al., 2007)[1] on the driving forces of past and future waste trends, and is a consequence of recent studies on the drivers of waste generation in Italy; it demonstrates that Environmental

[1] See also EEA (2007, p. 7, fig.1), which shows historical and projected (to 2020) waste generation and landfill trends: the former is not expected to be associated to delinking, while landfill, will show weak delinking Country heterogeneity is a problem – and there are some critical regional hot spots.

Kuznets Curve (EKC) evidence is far from being fact for many regions, and that waste strategies may play a role that is complementary to exogenous drivers, such as income (Mazzanti et al., 2008a,b).

The value added of this paper is multiple. Firstly, it offers unique evidence on landfill diversion trends. This is highly relevant as existing waste analyses suffering from a lack of robust econometric panel based evidence. Secondly, it exploits a wide array of drivers related to economic, geographic and policy factors and suggests outcomes useful for ex post policy evaluation of landfill and assessment of Kuznets delinking trends for landfilling. Policy levers are investigated at the levels of waste management (collection) and final disposal (landfill tax, incineration regional strategies), in order to check direct and indirect effects along the waste management - disposal chain. Thirdly, it relies on a very decentralised dataset; at this level Kuznets shapes can be assessed more robustly since they exploit richer heterogeneity. In the case of Italy this is of especial importance as this country presents high structural diversification between the northern and southern areas, differences that are extremely relevant to waste management and disposal. Fourthly, the analysis complements EU level, panel based investigations on delinking and policy evaluation for waste generation, recycling and landfilling, and analyses of waste generation delinking trends for Italy conducted in recent years. The complete set of evidence will be an important source of information for policy makers and researchers, on the set of dynamics operating in the waste sector.

A case study on Italy is considered valuable as Italy is an important member of the EU, thus it can provide useful information on the evaluation of policies such as the 1999 landfill Directive. Also, its heterogeneous and problematic economic, institutional and environmental performance provides the basis for an interesting analysis of how economic and policy levers impact on the dynamics of landfilling in such settings. Finally, as waste management and landfill policies are implemented at a very decentralised level, this case study analysis provides fodder for other policy making processes in place or being planned along similar lines.

The paper is structured as follows. Section 2 presents a short survey of the studies on waste and delinking, which highlights the lack of comprehensive empirical analyses on landfilling, compared to waste generation and other environmental issues, and other analyses on landfilling, including the evaluation of costs and benefits. Section 3 presents the empirical model and describes the panel data source. Section 4 comments on the empirical evidence at both regional and provincial levels. Section 5 concludes with policy implications and suggestions for further research.

2. Waste generation and disposal: the state of the art of the empirical literature

In this section we provide a brief survey of the still scarce evidence on waste delinking and waste management, and evaluation of policy tools. The aim is to highlight the incremental value of our paper and suggest future research directions. We group the works by geographical area of analysis and focus (EKC, waste drivers, policy evaluation, etc.).

In spite of the significant environmental, policy and economic relevance of waste issues, there is very little empirical evidence on delinking, even for major waste streams, such as municipal and packaging. Analyses of policy effectiveness are similarly scarce. Existing work is largely oriented towards the optimization of waste management or evaluation of externalities, regarding landfill and other waste disposal strategies, with a few

purely theoretical analyses on waste management and landfill management (Calcott and Walls, 2005; Daskalopoulos et al., 1998; Andre and Cerda, 2004; Ozawa, 2005) The relatively major focus on cost benefit analyses on specific waste streams and policy packages (Pearce, 2004), and on landfill siting decisions aimed at solving for the known NIMBY problem (Quah and Yong, 2007) is in part due to the lack of reliable panel data at country level.[2] The EU (EUROSTAT data) and a few individual countries have produced detailed and reliable (panel) data that gives robust empirical insights into diverse waste issues. Analysis of endogenous and exogenous drivers, including policies, is an important area, to which this paper aims to contribute, that brings together environmental Kuznets curve analyses (EKC; WKC - Waste Kuznets Curve - for waste)[3] and ex post studies of policy effectiveness.

There is some macro level evidence, exploiting cross country regression analysis of data from the1980s, which was presented in the international report that gave birth to the EKC literature (World Bank, 1992). Other recent reports (DEFRA, 2003) provide evidence of positive elasticities in waste generation to income, as a primary policy concern: in terms of CO_2, which has been associated in some studies with evidence of a Turning Point (TP), waste generation seems still to be characterized by a strict relationship between economic drivers and environmental pressures.

One of the first WKC studies was by Cole et al. (1997), who found no evidence of an inverted U-shape in relation to municipal waste. They used municipal waste data for 13 OECD countries in the period 1975-90; they found no TP, and showed that environmental indicators (municipal waste generation) monotonically increased with income over the observed range. Seppala et al. (2001), in a study of five industrialized countries including Japan, the US and Germany, and covering almost the same period (1970-1994), also found no evidence of delinking regarding direct material flows. Therefore, we could expect that the evidence varies for waste generation and waste disposal. Fischer-Kowalski and Amann (2001) analysed the richest OECD countries and found that the intensity of materials input with respect to GDP shows a relative, but not absolute delinking, with volumes of material growing over 1975-1995 for all countries. They note that an absolute delinking holds for landfilled waste, but not for waste generated.

Few WKC studies include waste policy analysis. The study by Karousakis (2006), which is not primarily focused on WKC, deals with policy evaluation, and presents evidence on the determinants of waste generation and the driving forces behind the proportions of paper/glass recycled, and the proportion of waste that is landfilled. The panel database includes 30 OECD countries observed over four years (1980-2000, 120 observations). He found that municipal solid waste (MSW) increases monotonically with income and that urbanization exerts an even a stronger effect on waste generation, while the time-invariant policy index is not significant. This is one of the few studies that studies socio-economic and policy drivers for landfill diversion. However, the evidence is undermined by the not always high quality of the OECD data on waste indicators, given that very different countries and very different waste measurement systems are pooled. Also, the policy index is generally capturing

[2] We quote among the others Powell and Brisson (1995), Miranda et al. (2000); Eshet et al. (2004), Brisson and Pearce (1995), Dijkgraaf and Vollebergh (2004), Seok Lim and Missios (2007). Caplan et al (2007) offer an example of how economic evaluation techniques may inform landfill siting processes.

[3] We refer to Cole et al. (1997), Dinda (2004), Stern (2004, 1998), for major critical surveys and a discussion on the theoretical underpinnings of delinking and EKC, which mainly analyze air and water emissions, mainly CO_2, with a limited focus on waste streams.

countries' environmental policy commitments, rather than specific waste management and policy indicators. However, it constitutes a first analysis and the basis for subsequent more detailed and better quality studies.

For European countries, Mazzanti and Zoboli (2005) and Mazzanti (2008) find neither absolute nor relative delinking. There is no WKC evidence for municipal waste and packaging waste in European panel datasets, respectively, for 1995 to 2000 and 1997 to 2000. Estimated elasticities of waste generation with respect to household consumption are close to unity. Andersen et al. (2007) recently estimated waste trends for the EU-15 and EU-10 new entrants, and found that waste generation is linked to economic activities by non-constant trend ratios, which is in line with WKC reasoning. This somewhat descriptive analysis of delinking in EU countries provides forecasts in favour of relative delinking; however, it does not confirm WKC evidence. Projections for 2005-2020 for the UK, France and Italy, show an increase in MSW of around 15-20%, which, at least at first sight, may be compatible with relative delinking with respect to GDP and consumption growth. A new study by Mazzanti and Zoboli (2007) analyses EU-15 and EU-25 panel data for all waste trends (from generation to landfill, including recycling and incineration) for 1995-2005, and finds some weak evidence of delinking and signs of policy effectiveness. This is one of the first studies to provide robust empirical evidence on the drivers of landfilling at an international level. Policy commitment seems to be an important pillar of diversion to landfill.

As already mentioned, the economic analyses on landfilling have predominantly focused on cost benefit assessments of relative externalities. A rare case is the IVM report (IVN, 2005) on landfill tax effectiveness in the EU. Some specific studies have been done on the evaluation of the EU landfill Directive and the well established (since 1996) UK landfill tax (Turner et al, 1998 provides a rare evaluation based specifically on externalities). Given the lack of firm data, these studies provide interesting, but only qualitative assessments. During the first phase of implementation of the UK landfill tax, Morris et al. (1998) offered some insights on its potential and expected contribution to sustainable waste management, analysing its general structure, comparative landfill costs and the waste hierarchy. Morris and Read (2001) and Burnley (2001) provided updates to this analysis, highlighting certain operational weaknesses and debating some preliminary reviews. Burnley linked the EU directive to national UK implementation. Another interesting assessment, which is quite pessimistic in its conclusions, was provided by Martin and Scott (2003), who stress that tax has failed to significantly change the behaviour of domestic waste producers. The UK landfill tax was intended to motivate to a transition from landfilling of waste, towards recovery, recycling, re-use and waste minimization. Martin and Scott find evidence for progress towards recycling, but none in relation to re-use or waste minimization.

Among more recent works, we would refer the reader to Davies and Doble (2004), who monitored the UK landfill tax from its introduction, and offer insights on future evolutions, criticalities and externality evaluation. Such works are by definition qualitative, given the lack of data and the aims of these analyses.

Phillips et al (2007) provide one of the most recent UK-specific regional assessments of waste strategies. However, regional based analyses are non existent, or at best rare.

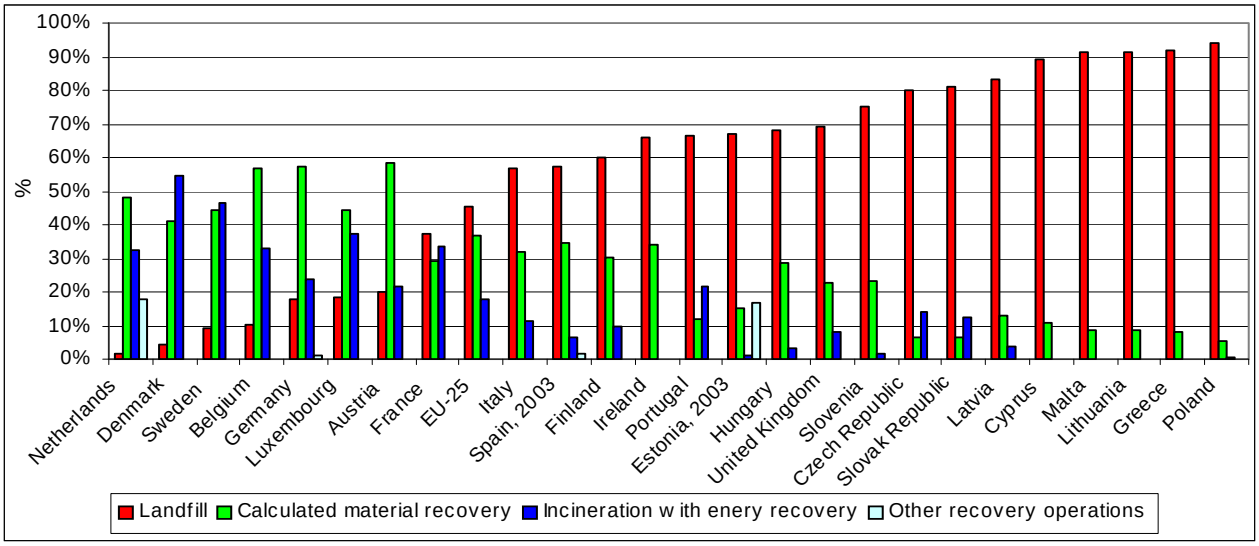
Outside the UK, the situation in terms of detailed studies is no better. Taseli (2007) presents an assessment of the effects of the EU landfill Directive in Turkey, a potential incoming country that may be compared to some eastern European new members states. This study highlights the great difficulties that will be experienced by such countries in achieving the targets even in the long run, and provides a clear analysis of the EU framework.

Though the analysis makes extensive use of data to support the arguments put forward, statistical investigation was neither the aim nor was it possible.

This survey of the literature, which is still developing slowly even within the waste framework, lacks any in depth investigation of driving forces and policy effects, and does not contain any single country case studies or investigations of homogenous policies in force over sufficiently long periods of time. Also, landfill oriented analyses are in the minority even within the area of waste. In our study we have tried to bring together different strands of research and analyse exogenous and endogenous landfill diversion drivers by exploiting the intrinsic higher heterogeneity of decentralised regional data. We provide a specific focus on waste management and policy levers. It should be noted that some waste management strategies are to an extent endogenous, being driven by income and geographical differentiation (something that we comment on in a subsequent section). The different commitment and performance of the northern and southern regions in Italy, is a clear example here.

Overall, it can be said that landfilling is still the predominant option for the treatment of the EU's municipal waste, and that Italy's performance in terms of waste disposal is being constantly monitored and evaluated. In 2004, about 45 per cent of total municipal waste in Italy was landfilled while 18 per cent was incinerated. However, there are significant differences in how dependent different countries are on landfilling. Figure 2 shows that several countries – the Netherlands, Denmark, Sweden and Belgium – have already achieved very low rates of landfill. These countries not only have substantial levels of incineration, they also have high levels of materials recovery. In general, there seem to be two strategies for diverting municipal waste from landfill: high materials recovery combined with incineration, or materials recovery that includes recycling, composting and mechanical biological treatment (EEA, 2007).

Figure 2. Landfilling, incineration and materials recovery as treatment options: 2004



Source: EEA (2007), Eurostat Structural Indicators on municipal waste generated, incinerated and landfilled, supplemented by national statistics.

3. The Empirical framework

3.1 Data sources and research hypotheses

The analysis uses two datasets, a regional and a provincial one, that exploit the statistical information in the available yearly editions of the Italian Environment Agency's waste report (APAT, 2001, 2002, 2003, 2004, 2005, 2006). These reports provide a very rich set of waste data, produced according to Eurostat and EEA guidelines (EEA, 2003a,b,c).

The provincial dataset includes data on MSW generated (collected) and landfilled in all the Italian Provinces (n=103) and covers the period 1999-2005. We merge these data with official data on provincial level economic drivers. Although consumption is often used as coherent driver in analyses of waste trends (Andersen et al., 2007), we do not have provincial level data on consumption; thus, value added is the only reliable economic driver available. Additional socio-economic variables relevant for waste, such as MSW generated and incinerated, share of separately collected waste and population density, are tested. We also check for tourist-related flows, a crucial factor in waste generation and collection for many Italian provinces. Finally, we include decentralised policy-related variables especially: (a) the share of provincial municipalities and the provincial population covered by the new 'waste tariff' regime, which substitutes for the old 'waste tax' regime; and (b) the percentage of waste management costs covered by the tariff. With respect to the policy-related variables, the waste management *tariff* was introduced by Italian law no. 22/1997, and substitutes for the former waste management *tax*. The tax, however, is still in force in many Italian municipalities because law 22/1997 provides for a transition phase that is quite gradual and slow. The tax was calculated on the size of household living spaces, while the tariff is based on principles of full-cost pricing for waste management services.[4] Effective

[4] Part covers fixed costs and part refers to the variable management costs. The former correlate to the size of household living space and, as a new element, to the number of people in the family. The variable part is associated with the (expected) amount of waste produced, which is calculated on the basis of past trends and location-related features. The variable part is

implementation of the tariff system remains highly dependent on local policy decisions and practices and is partly based on the choices made by the municipalities. Early implementation of the new tariff-based system, therefore, may be a sign of policy commitment. We note that implementation is heterogeneous even across areas with similar incomes and similar social economic variables. The shift from tax to tariff should also capture the incentive effect of the latter, although the impact on waste generation, if any, is not visible in the short term.
The regional dataset includes all the information in the provincial dataset plus data on annual household consumption expenditure per component, and landfill tax (both variables are available only at regional level) Tables 1 and 2 present the dependent and independent variables, the descriptive statistics and the research hypotheses related to the provincial and regional datasets respectively.

2.2 The model

We estimate the model by specifying our research hypothesis with the following general, panel-based reduced form (Dijkgraaf and Gradus, 2004, Stern, 2004):

(1) $\log(\text{landfilled MSW per capita}) = \beta_{0i} + \alpha_t + \beta_1 \log(\text{economic driver})_{it} + \beta_2 \log(\text{socio-economic factors})_{it} + \beta_3(\text{environmental policy}) + \varepsilon_{it}$

where the first two terms are intercept parameters that vary across regions or provinces, and years.
Different specifications are tested by including as the dependent variable either landfilled waste per capita (or per area) or landfilled waste in total terms; accordingly, value added is either per capita or total.
Other socio-economic factors are added to the core specification as controls, and possible additional significant drivers of waste generation. In our model, they include population density, percentage share of separately collected waste, incinerated waste per capita, tourist numbers and, related to environmental policy, recovery capacity of waste services costs, and share of population (or municipalities) subject to waste tariffs (rather than waste taxes). The main research hypotheses associated with the examined explanatory factors are commented on below and are summarized in Tables 1 and 2.

abated by around 10-20% if households adopt domestic composting and/or join garden-waste door-to-door collection schemes.

Table 1 – variable description and Research hypotheses

Acronym	Variable description	Mean	min	max	Research hypothesis
LAND-WASTE	MSW yearly generated and landfilled (kg per capita)	326,38	0	1133,78	Dependent variable
VA	Provincial yearly value added per capita (€2000)	17653.6	9369.12	28796.07	Positively correlated with income, the objective is assessing whether relative or absolute delinking is present
DENS	Population/surface (inhabitants/km2)	244.10	36.43	2640.92	Positive and negative correlations may emerge depending on factors such as economies of scale and land opportunity costs in urban and densely inhabited areas
COLLEC	Share of separated collection (%)	18.40	0.03	67.57	Negatively affecting landfilled waste per capita
INC-WASTE	MSW generated yearly and incinerated (kg per capita)	49.93	0	581.81	Negatively affecting landfilled waste per capita
INC-AREA	Number of incinerators / provincial area (squared metres)	0.0000026	0	0.000094	Negatively affecting landfilled waste per capita
LAND-AREA	Number of landfills / provincial area (squared metres)	0.000018	0	0.00023	Positively affecting landfilled waste per capita through lock in effects
TAR POP	Share of population living in municipalities that introduced a waste tariff substituting the former waste tax (%)	9.00	0	99.72	Possibly reducing MSW generation through indirect feed back effects, though the direct effect is at waste management level. Possible endogeneity given the positive correlation with respect to income.
TAR MUN	Share of municipalities that introduced a waste tariff substituting the former waste tax (%)	5.03	0	100.00	
COST-REC	Cost recovery of waste management services (tax/tariff revenues on variable service costs, 2004 data only) (%)	85.61	53.3	104.2	
TOURIST	Annual tourist numbers (per capita)	7.18	0.40	58.83	Positively affecting landfilled waste per capita

Table 2. Descriptive statistics and research hypothesis (*regional* dataset): dependent and independent variables

Acronym	Variable description	Mean	Min	max	Research hypothesis
LAND-WASTE	MSW generated and landfilled (kg per capita)	358.07	80.00	620.00	Dependent variable
GDP	Gross domestic product per capita (€2000)	20331.3	12740.92	27904.56	Positively correlated with income, the objective is to assess whether there is relative or absolute delinking
CONS	Household consumption expenditure (per component)	9716.78	6504.48	13423.56	Positively correlated with income
DENS	Population/surface (inhabitants/km2)	176.12	36.43	426.11	Positive and negative correlations may emerge depending on factors such as economies of scale and land opportunity costs in urban and densely inhabited areas
COLLEC	Share of separated collection (%)	15.85	0.70	47.76	Negatively affecting landfilled waste per capita
INC-WASTE	MSW generated and incinerated (kg per capita)	36.00	0	170.00	Negatively affecting landfilled waste per capita
LAND-TAX	Landfill tax (€/kg, 2004-2005 data only)	0.015	0.005	0.023	Negatively affecting landfilled waste per capita
TAR POP	Share of population living in municipalities that introduced a waste tariff substituting the former waste tax (%)	8.91	0	65.68	Possibly reducing MSW generation through indirect feed back effects, though the direct effect is at waste management level. Possible endogeneity given the positive correlation with respect to income.
TAR MUN	Share of municipalities that introduced a waste tariff substituting the former waste tax (%)	4.19	0	36.49	
COST-REC	Cost recovery of waste management services (tax/tariff revenues on variable service costs, only one data for 2004) (%)	63.40	47.05	72.03	
TOURIST	Annual tourist numbers (per capita)	8.44	1.72	41.26	Positively affecting landfilled waste per capita

Using provincial data only, we estimate a semi-logarithmic model to deal with the zero values that correspond to the absence of a landfill site.[5] Spatial econometric analyses are a definite future extension of this work that would investigate the role of flows between provinces by analysing contiguity and distance.

3. Empirical evidence

3.1 Regional analysis

Analysis of the regional dataset involves a panel of 140 observations (20 regions observed over 7 years: 1999-2005). Most variables are time variant, thus we can compare the REM (random effects models) and the FEM (fixed effects models) through the usual Hausman test. We subdivide the empirical investigation and comments

[5] In the observed period, 5 provinces did not have a landfill site. A few other observations present zero values due to the closure of landfill sites or their non-existence in 1999-2005.

into three separate, but consequential steps: analyses of baseline specifications, assessment of additional structural and socio-economic factors and the effects of policy elements. Regarding the latter, some policy aspects capture both cross regions and time heterogeneity/dynamics, others (landfill tax) do not vary over time, due to data availability. However, landfill tax is not usually adjusted on an annual basis, so this lack of variance is a minor problem compared to the value of having fully decentralized information on landfill tax for all regions of a country such as Italy. This analysis is in line with the assessment of landfill tax implementation given that the levy is managed by regional authorities.

The model of reference for the regional analysis is:

(2) $\log(\text{landfilled MSW per capita}) = \beta_{0i} + \alpha_t + \beta_1 \log(\text{gross domestic product})_{it} + \beta_2 \log(\text{socio-economic factors})_{it} + \beta_3(\text{environmental policy})_{it} + \varepsilon_{it}$

where the first two terms are intercept parameters that vary across regions, and years.

All variables are in logarithmic form unless they present 0 values. In contrast to the provincial level analysis (see later), this is not the case for the dependent variable. At regional level, landfilling is not and probably never will be zero for some regions, even if faced with decreasing waste landfill.

First, we comment on the baseline specifications. Linear forms are not significant, though the coefficient associated with GDP shows the expected negative sign (Tables 3 and 4). This negative relationship becomes significant if we introduce the squared term: the U shape shows a potential up-turn of the relationship. Nevertheless, this is currently only a potential threat: in fact, the observed TP is around €19,000 per capita, and the average is around €20,000. This signals that, without corrections, becoming richer may induce an increase in the amount of landfilled waste per capita.[6]

Table 3. Landfilled waste per capita: regional data for 1999-2005 (FEM and REM)

Specification / Variables	1	2	3	4
Constant	-	2.225 (0.420)	-	148.78 (0.188)
GDP/POP	-0.2819 (0.737)	-0.3350 (0.229)	-85.93 (0.006)***	-30.11 (0.189)
(GDP/POP)^2	…	…	4.35 (0.006)***	1.512 (0.194)
N	140	140	140	140
Model[§]	FEM	REM	FEM	REM
Hausman test (p-value)[ç]	0.9464		0.0207	

Note: Coefficients and significance are shown (10%*; 5%**; 1%***). [ç] p-value < 0.10 favour FEM.

[6] Table 4 presents estimates with landfilled waste per regional area, rather than per capita, as the dependent variable. Estimates do not substantially differ, so we do not comment further other than to note that, according to landfill external and market costs, per capita measures better capture the intensity of the problem in a given area.

Table 4. Landfilled waste per area: regional data for 1999-2005 (FEM and REM)

Specification / Variables	1	2	3	4
Constant	-	2.084 (0.661)	-	345.61 (0.010)**
GDP/POP	-0.2781 (0.732)	-0.2826 (0.557)	-84.30 (0.005)***	-70.14 (0.010)**
$(GDP/POP)^2$	…	…	4.276 (0.005)***	3.549 (0.010)**
N	140	140	140	140
Model§	FEM	REM	FEM	REM
Hausman test (p-value)ᶜ	0.9946		0.4768	

Note: Coefficients and significance are shown (10%*; 5%**; 1%***). §ᶜ p-value < 0.10 favour FEM.

This baseline model may also be deficient in explaining landfilling trends. If we include the most relevant control structural factor, population density, this becomes highly significant, while GDP loses its explanatory power (Table 5). It seems, then, that structural factors matter more than pure economic drivers. This result does not signal that waste is not economically driven: the significance for density, as expected, shows that where opportunity costs are higher (in urban areas, in densely populated areas) and disamenity effects are affecting more people, landfill diversion is stronger. For example, in the far east, where the value of land is especially high and population density reaches world peaks landfill studies have flourished (Lang, 2005, Ozawa, 2005), and the size of the coefficient s high, as is its statistical significance.

As well as GDP based explanations of waste generation (Mazzanti et al., 2008a,b), there are other factors that impact on the final stage, of waste disposal. GDP does not a coherent, direct impact. It may act as an indirect lever, as we show below. Also, and rather counterintuitive in relation to Italy, the geographical dummies are not significant (this is confirmed at the provincial level), and tourist flows do not affect landfilling trends, although they have an impact on waste generation (Mazzanti et al., 2008a,b).

Second, returning to our discussion, we observe that there are other socio-economic levers that are relevant. One factor, that is a combination of policy, institutional and local cultural aspects, is the share of separated waste collected. As expected, it is significant. In the regression that includes GDP, and also the regression that includes only density, both variables are highly significant. Overall, it seems to outweigh the previously mentioned economic effect, being linked more directly to the chances of landfill diversion. The coefficients signal that 1% more of separated waste reduces landfill by 0.08-0.2%. This may indicate problems in transforming collection performance in landfill diversion. An increased level of separated collection could not (in the short term) automatically generate more innovative waste management; it is unlikely that the entire filiere would be structured on landfill diversion options and technologies.

It should be noted that adding in the relevant socio economic factors generates regressions where the FEM is plausibly chosen as the preferred specification, given that we are reasoning based on the entire population, not a sample of regions.

Table 5. Other specifications with landfilled waste per capita (20 regions, 1999-2005)

	Specification									
Variables	1	2	3	4	5	6	7	8	9	10
Costant	-	2.278	-	3.133	2.29	-	2.924	1.929	-	-
GDP	-0.6829	-0.348	2.362**	-0.4361	-0.255	-.04208	-0.3151	0.4106	-0.7430	-0.5296
DENS	-7.34***				-0.166*	-6.93**	-0.2277	-0.2397	-7.74***	-5.89***
North west		0.126								
North east		-0.104								
Centre		0.290								
South										
Islands		0.225								
COLLEC			-0.22***							
TOURIST				0.0516						
N. incen/area					-25314.2					
N. land sites/area						3449***				
LAND-TAX							-.0554			
COST-REC								-1.430		
TARPOP									0.0007	
TARMUN										-.0062*
N	140	140	140	140	140	140	140	100	140	140
Model§	FEM	REM	FEM	REM	REM	FEM	REM	REM	FEM	FEM
Hausman test (p-value)ᶜ	0.000	-	0.0002	0.3973	-	0.0000	-	-	0.0000	0.0000

Note: Coefficients and significance are shown (10%*; 5%**; 1%***). Empty cells mean the variable is not included in the regression ᶜ p-value < 0.10 favour FEM.

Other waste related structural factors, which we deem to be exogenous (driven by institutional, policy and geographical factors in the short run), are the ratio of incinerators and landfill sites in both per capita and per area terms. We see that the first factor (incinerators) is not significant, while the number of landfill sites per area drives up the amount of waste that is landfilled. This result seems somewhat tautological; nonetheless, it signals and proves the existence of lock-in effects due to past investments in disposal sites. Lock-in effects may characterize technology, even recycling and incineration. The decision to invest in a landfill strategy locks the region in, for the time during which the investment is being made, and typically is not a short term, fully reversible phenomenon.

Finally, we test the relevance of: (i) waste management related factors; and (ii) regional landfill taxes. The latter turns out not to be effective. It seems that is not the direct cost of landfill taxes that drives landfill diversion, but that it is other opportunity costs (density), and to some extent waste management innovation that increase the financing and performance of collection, and separated collection. The not significant impact of landfill tax may be due to its quite recent implementation, and even more to its relatively low level, compared to other countries. However, we noted above that even in leading countries, such as the UK, some authors have cast doubt on the effectiveness of this instrument. Waste management may matter more, given its centrality in the waste chain.

Landfill pricing is the last option at the end of the waste production filiere. Diversion is driven more by actions taken before the landfill stage.

As far as waste management dynamics are concerned, we looked at the evolution of the waste tariff system from the tax based one, and the share of variable costs covered by the tax. Both elements proxy the dynamics of system privatization, seen as the move towards tariffs linked to volume of waste produced, and based on the ultimate goal of full cost recovery, i.e. the move from the provision of a pure public good to a user oriented approach. Within this approach, even public utilities may go 'private' by changing their objectives and behaviour. Most utilities in Italy are still publicly owned, or under shared participation: it is the management of these utilities that will change rather than ownership of the assets.

Though all the signs are negative as expected, we observe a significant coefficient only for the variable that captures the share of municipalities, within a region, linked to a tariff. This share is steadily increasing. It shows that more than the share of population - driven by the introduction of the tariff in large municipalities, it is the number of local authorities that matters. In other words, it seems that the *joint* transition of several municipalities matters more than a transition by some of the big cities. Given the high relevance of governance interconnections among local authorities for waste management in local/regional areas, this is not unexpected.

We compare these results with the provincial level analysis that exploits original data aggregated to enable the regional investigation.

3.2 Provincial analysis

This analysis is based provincial level data. The dataset offers a higher possibility of investigating the determinants of landfill diversion by exploiting a much heterogeneous and larger collection of data than are available at the regional level. Thus, it constitutes a robustness test for the regional analysis, and provides the possibility for new insights. Though the two are complementary investigations, we can state that, with one exception (landfill tax assessment), the provincial analysis is stronger overall. However, it will be seen that the differences are small and the two levels of analysis are coherent with one another.

The main methodological problem is the nature of the dependent variable, the landfilled MSW per capita, which, at province level, presents zero values: some (5, as previously noted) of the 103 provinces observed over 1999-2005 did not have a landfill sites for MSW, and thus did no landfilling. Others (e.g. Milan) closed their landfill sites during the time, thus they show zero values after that particular year.

We present and compare the outcomes for three specifications of the dependent variable: a semi log model where only the dependent variable is in non-logarithmic form, an unbalanced panel where zero values are omitted, reducing the number of units to 658 from 721, and as a third best way of coping with the problem, a fully logarithmic specification where previously we had substituted very low values tending to zero in place of 0. This is plausible if we assume that the statistical zeros in reality are very low values of landfilling.

Further investigations could examine autocorrelation and heteroskedasticity and, more importantly, the eventual specifications of a two stage Heckman model, which poses higher complexity, but addresses the eventual selection associated with the five provinces that did not have a landfill site over the study period, for perhaps political or idiosyncratic motivations.

The models of reference for the semi-log (balanced panel) and the log-log (unbalanced panel) specifications respectively are:

(3) landfilled MSW per capita= $\beta_{0i} + \alpha_t + \beta_1 \text{Log(Value added per capita)}_{it} + \beta_2 \text{Log(socio-economic factors)}^2_{it} + \beta_3(\text{environmental policy}) + e_{it}$

(4) log(landfilled MSW per capita)= $\beta_{0i} + \alpha_t + \beta_1 \text{Log(Value added per capita)}_{it} + \beta_2 \text{Log(Value added per capita)}^2_{it} + \beta_3(\text{socio-economic factors}) + \beta_4(\text{environmental policy}) + e_{it}$

where the first two terms are intercept parameters that vary across provinces and years.
We added to the core specification, as controls and additional drivers of landfilled waste, a set of other socio-economic and policy related factors. Next, we comment on the main findings.

3.2.1 Semi logarithmic balanced specifications

Semi-log specifications attached to model (3) show the following results. We include, in addition to the baseline speciation with VA (value added) and density, one factor at a time, to avoid collinearity problems. Thus, in our specifications there are three variables, two of which, VA and density, are always present as pillars of the model.
First, though the significance is the reverse in the REM, for the baseline specification (VA as the economic driver, and density as the structural control factor) in the FEM (strongly preferred by the Hausman test here and in all other regressions, which is a plausible result), both show a negative sign, with respectively a 10% and 1% significance (Table 6).[7] This evidence confirms that delinking relative to income growth is relevant, but it is mostly structural factors that have an impact, and should be included to account for the drivers of landfill diversion. This confirms the regional based analysis.

[7] Quadratic specifications are not significant when other controls such as density are included.

Table 6. Specifications for landfilled waste per capita (semi-log model, balanced panel), province analysis (N=721, 103 provinces, 1999-2005)

	Specificaton								
Variables	1	2	3	4	5	6	7	8	9
Constant						2.78***	2.92***		
VA	-0.191*	-0.169	-0.011	-0.20*	-1.59***	-0.21***	-0.164**	-0.142	-0.139
DENS	-1.403***	-1.423***	-1.269***	-1.41***	-0.03***	-0.034	-0.037	-0.809**	-0.726**
TOURIST		-0.036							
COLLEC			-0.026***						
INC-AREA^				-1492.00					
LAND-AREA^					197.40				
LAND-TAX						0.043			
COST-REC							-0.179		
TARPOP^								-0.001***	
TARMUN^									-0.003***
F test (prob)	0.0000	0.0000	0.00000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Model[§]	FEM	FEM	FEM	FEM	FEM	REM	REM	FEM	FEM
Hausman test (p-value)[ς]	0.000001	0.000001	0.000048	0.00000	0.00000	-	-	0.0227	0.0143

Note: Coefficients and significance are shown (10%*; 5%**; 1%***). Empty cells mean the variable is not included in the regression. Covariates are added separately to the baseline model in order to mitigate collinearity. ^not logarithmic covariates. [ς] p-value < 0.10 favour FEM.

If we include tourist flows per capita, we observe that the significance of VA decreases to below 10%: the only impact factor is population density, related to the aforementioned (see the regional analysis) opportunity costs and environmental impacts, is higher and more critical in densely populated areas. Also confirming the regional analysis, the macro geographic dummies linked to the north, south and centre regions do not seem to explain landfill diversion, which is rather counterintuitive.

On the other hand, the variable related to the strong differences between north and south in terms of performance and share of separated collection, plays a key role in explaining this phenomenon. If we look at regression 3 in Table 6, we can see that VA loses its statistical power completely. The other two are highly significant. If we consider the quite high correlation between VA and share of separated collection, motivated by the different performance in waste management of north and south, the share-related variables, as expected, retain very high significance. If instead we specify a two stage model (not shown) to address 'policy endogeneity',[8] where in the first step we get the predicted values of separated collection regressed over density

[8] Recent studies have focused on analysing the drivers of environmental regulation, by defining endogenous factors (Cole et al., 2006; Alpay et al., 2006). Efforts aimed at establishing environmental policy indexes for climate change, waste and other areas show that developed countries' environmental regulations are more stringent. Consistent with EKC reasoning, policies may be endogenous especially if correlated with income factors at both the supply and demand levels (Cagatay and Mihci, 2006). Regarding (paper) waste, the evidence supports higher demand for waste management and environmental policies in more developed, richer countries (Berglund and Soderholm, 2003). At micro level Callan and

and VA, and in the second step we test density (which must be present in both steps) and predictions such as the drivers of landfill diversion, the significance of separated collection in the preferred FEM, is just 10% (1% in pooled ordinary least squares (OLS) and REM). Overall, separated collection is a very significant driver of landfill diversion. On the other hand, it might signify that waste management strategies are not so effective: if recovery options are not well implemented, part of the separated collection might still be going to landfill,. Even waste management systems that perform well at the collection level may ultimately prove ineffective if disposal options and disposal markets are not sufficiently developed. Landfilling remains the easy last resort and the solution to failures occurring in earlier stages of waste management system.

Thus, we decided to test the effect of: (i) the number of incinerators per capita and per area; (ii) the number of landfill sites per capita and per area. Recall that the former variables are not in log forms given that they present zero values. Also note that although the coefficient linked to incineration is negative, as expected, it is not significant and, similarly, the positive sign for landfill sites per head and per area is positive and not significant. Lock in effects a not relevant here. We offer some alternative insights when we address the unbalanced model.

At the final level of waste management instruments and landfill tax assessment, some new insights emerge. If the non-significance of landfill taxation is confirmed, the tariff-based variables capturing features of the transition to a full cost recovery and privately managed (but not necessarily privately owned) waste managements system, offers some different views.

The coverage of variable cost waste management, not available for all years, is tested for 2004 values. Heterogeneity is high across provinces; the coefficient is negative as expected, but not sufficiently high in terms of significance.[9] Future analyses could exploit full panel data at least for this variable.[10]

On the other hand, and providing some additional relative robustness to the provincial analysis, we find that both share of population and municipalities that have adopted a waste tariff in preference to the tax, impact negatively on landfill diversion. The coefficient is not large, but its significance is at the 1% level. This trend emerges more coherently at the decentralised provincial level and indicates that waste management instruments may have some indirect impact on landfilling, bearing in mind what was discussed above in relation to separated collection.

Thomas (1999), who studied the drivers of unit price adoption at municipal level, provide evidence of policy (economic instrument) endogeneity with regard to demographics, fiscal capacity and socio-economic determinants.

[9] Also, the interaction term between cost coverage and landfill tax, a variable that captures economic instrument impacts for different levels of waste management, is not significant.

[10] If we run the analysis just for 2002-2004, the period for which panel data related to the coverage of variable cost of waste management are available, the variable is still not significant even in the FEM. We note that the signs and significance of the coefficients for VA and density change, highlighting the VA of having a fairly long time series compared to the more usual short term panel. This proves the value and robustness of our dataset, which exploits a sufficiently long time series and in-depth regional heterogeneity.

3.2.2 Unbalanced panel analyses

Unbalanced panel estimations related to model (4) show the following results (Table 7). The first difference is the significance in the log models at regional level, of the quadratic term. The related TP is estimated at €19,440, which is a similar value to that for regions. This logarithmic specification originates the U shape, that would suggest, based on the TP, that richer areas could (re)experience a positive relationship between economic growth and landfilled waste.

Population density is confirmed as a main driver of landfill diversion: the sign of the coefficient even in the quadratic specification is negative and highly significant.

Tourist flows in this case are a significant factor: the negative sign indicates that landfill activities are mitigated by the presence of high numbers of tourists. The opportunity costs of land exploitation, and negative externalities are elements that may undermine the profitability of tourism. Venice and Rimini are examples of two highly tourist-dense provinces, which have waste management strategies biased towards recycling and incineration, and away from landfilling. The business of tourism crowds out the 'business' of landfill. This is a new and interesting result based on our unbalanced panel estimations.

Table 7. Specifications for landfilled waste per capita (log-log model, unbalanced panel) provincial analysis (N=658, 98 provinces, 1999-2005)

Variables	Specificaton										
	1	2	3	4	5	6	7	8	9	10	11
Constant							145.83	144.81			
VA	-51.09**	-52.97**	-24.947	-49.65**	-63.75***	-45.076*	-29.04	-28.46	-60.81**	-66.00***	-78.89***
VA²	2.587**	2.713**	1.282	2.511**	3.263***	2.284*	1.448	1.439	3.101**	3.374***	4.080***
DENS	-6.28***	-6.96***	-5.20***	-6.53***	-6.321***	-6.03***	-0.036	-0.072	-4.152**	-3.789**	-4.341**
TOURIST		-0.88***									-0.607***
COLLEC			-0.128**								
INC-AREA^				-18696.2							
INC-WASTE					-5.777***						-5.409***
LAND-AREA						0.058					
LAND-TAX							0.393				
COST-REC								-1.157			
TARPOP^									-0.005**		
TARMUN^										-0.011***	-0.011***
F test (prob)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Model§	FEM	FEM	FEM	FEM	FEM	FEM	REM	REM	FEM	FEM	FEM
Hausman test (p- value)ᵍ	0.0007	0.0000	0.0478	0.0015	0.0001	0.0052	…	…	0.0652	0.0739	0.0000

Note: Coefficients and significance are shown (10%*; 5%**; 1%***). Empty cells mean the variable is not included in the regression. Covariate are separately added to the baseline model in order to mitigate collinearity. ^not logarithmic covariates. ᵍ p-value < 0.10 favour FEM.

For separated collection, we see that, as above, the variable is significant. It should be noted that the fitted values have increased (5%) significance, which is more evident in the unbalanced specification.

Incinerator sites per capita and per area, are significant, which is different from the above results: the latter is significant only in the non-quadratic model, at 5%, while the former is significant at 1% in both the linear and non-linear specifications Also, the variable incinerated waste per capita, is strongly significant at 1%.

This result gives robustness to our comments on the relevance of lock-in effects in local waste management strategies. The (increasing) weight of incineration drives down landfilling. Methodologically speaking, it imposes the necessity of further investigating selection models that accommodate 'zero' values in the data.

The density of landfill sites in provincial areas, on the other hand, is not significant, though with a positive coefficient: lock-in effects related to landfill site investments are weak at the provincial level (recall the significant effect at regional level), while incinerators investments can be seen to be drivers of landfill diversion, at least in the unbalanced version of the model.

If we focus on the waste management-policy covariates, landfill taxes and cost coverage are shown to be their meaninglessness for explaining landfill diversion.[11] Finally, in terms of the evolution towards a waste tariff system, both factors (population coverage and municipality coverage) present a 1% and 5% statistical significance respectively, in the quadratic specification.

Overall, the fully logarithmic unbalanced model confirms the previous outcomes.[12] Statistical significance varies widely, depending on the log form of the quadratic specifications, which perhaps should be taken as a warning that there may be links between income and landfilling above a certain threshold. Evidence related to the role of tourist flows, shows that there is a negative impact on landfill diversion trends, and incineration investments. This variable increases the robustness of the model. The significance of policy and waste management factors is the same as in the semi log specifications.

To sum up, landfill diversion is stronger when the economic costs deriving from high population density, which is a structural factor, are higher, and when waste management collection systems and economic instruments are associated with higher performances. The main economic driver of landfill diversion has only a weak impact, but this is plausible because of the distance between landfill and waste generation.[13]

The decoupling is driven by a mix of structural factors, density - linked to economic issues, and management actions. We can confirm that just relying on the endogenous path characterized by landfilling and economic growth (the baseline EKC scenario) will not assure delinking. Some policy action is needed to shape this delinking. Future analyses might provide more insights on the effectiveness of landfill tax, which has been the subject of debate even in countries with high taxes, such as the UK.

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[11] Quadratic models show how these time invariant variables reduce model performances. Note that if we estimate a linear model the above 10% VA significance appears.

[12] In terms of model robustness, the higher R^2 (within) performance is the quadratic form with density, tourist flows, population tariff coverage and incinerated waste per capita (column 11 in Table 6).

[13] If we include the amount of waste generation per capita as an explanatory variable, the variable is not significant in a simple model, and significant at 10% when using a two stage procedure with VA as the driver of waste generation in the first step. Counter intuitively, the sign is also negative, but this may be due to the correlation between VA and waste generated. The insignificance of waste generation is plausible if we reason that there is a direct link between economic drivers and waste generation, which indirectly induces effects downstream, at landfill level. Given that separated collection and other waste recovery options drive a wedge between waste generation and landfill, this results is coherent with a waste system associated with fairly good performances, although heterogeneous across regions.

3.2.3 Verifying the relevance of sample bias in landfill siting and diversion

As already noted, there is a methodological issue that needs to be addressed given the nature of our data, and the zero values for some provinces in some or all of the observed years, and that is the possibility of sample bias. In the foregoing, we dealt with it either by specifying a semi log model that allowed the inclusion of all observations, or by specifying an unbalanced logarithmic model that drops zero values (68 cells out of 721). We also employ a two stage Heckman-like estimator that explicitly takes into account this 'sample bias' as an additional robustness check. Table 8 presents the results, which show no striking differences, thus confirming that the previous evidence is robust to sample bias based on some provinces having no landfill sites or on provinces that closed down their sites at a certain point.

The preliminary probit regression shows that the three covariates – VA, DENS, TOURIST – are significant in explaining the dichotomous decision to have/or not a landfill site in the province. We note only the positive sign of the tourist related variable: while tourist flows negatively impact on the amount of landfilled waste, presumably to reduce disamenities, landfill siting is necessary where tourist flows are high, with some exceptions to this regularity (e.g. Rimini). Fit measures (Estrella and Mc Fadden fit measures show good performance and, more important, correct prediction performance is high, with 90.7% of actual 1s and 0s correctly predicted.

The basic unbalanced specification, which now includes the inverse Mills ratio (IMR), confirms the results for the unbalanced model, and the IMR is significant at 10%, highlighting the relevance of introducing the two stage procedure.

The statistical significance of the IMR increases to 1% in all other regressions, which present significant effects for COLLEC, TAR-MUN, TAR-POP, and COST-REC. Landfill tax is nevertheless not significant. Overall, the two stage Heckman procedure does not alter our evidence, but demonstrates the relevance of investigating the 1/0 binary decision, which seems to depend on socio-economic and structural factors, with some signs that are possibly reversed (TOURIST) compared to the analysis of landfill diversion strategies.

Table 8. Heckman two stage regressions (probit + unbalanced panel)

Variables	1	2	3	4	5	6	7
Constant	13.98***			184.097*	190.049**		
VA	-1.039***	-2.607**	-2.847**	-38.609**	-38.969**	-4.406***	-4.282***
VA^2				1.981**	2.023**		
DENS	-0.495***	-7.641***	-7.322***	0.424*	0.421*	-6.565***	-6.199***
TOURIST	0.125*	-0.658**					
COLLEC			-0.116**				
LAND-TAX				0.335			
COST-REC					-1.238*		
TARPOP^						-0.004**	
TARMUN^							-0.010***
IMR	/	8.642§	12.894***	-3.177***	-3.397***	16.777***	16.349***
N	721	653	653	653	653	653	653
F test (prob)	0.0000	0.0000	0.00000	0.0000	0.0000	0.0000	0.0000
Model	Probit	FEM	FEM	REM	REM	REM	REM

Note: Coefficients and significance are shown (10%*; 5%**; 1%***). Empty cells mean the variable is not included in the regression. Covariate are separately added to the baseline model in order to mitigate collinearity. ^not logarithmic covariates. IMR (§20% significance); regression 1 specifies as dependent variable the dummy equal to 1 if the province has a positive amount of land-filled waste. Results are not affected by the linear or quadratic specifications on VA;, the quadratic specifications on average provide more robust outcomes in the REM, and the linear ones in the FEM.

4. Conclusions

This paper has analysed the process of delinking in relation to landfill trends by embedding the dynamics in a framework that simultaneously includes economic, institutional, and geographical and policy variables. On the basis of the recently observed decreasing trend in landfilling which is occurring at EU level, the aim was to investigating in depth what main drivers may be responsible for such a phenomenon, and whether differences may be observed focusing the lens on a very decentralised provincial based setting.

We exploit a rich panel dataset stemming from Official sources (Italian environmental agency) merged with other provincial and regional based information, covering all 103 Italian provinces over 1999-2005. Such an extended, decentralised and recent source of data is of major interest for investigations dealing with waste processes and policy valuation, where evidence is typically scattered and rare given paucity of high quality data.

The case study on Italy is worth being considered provided that Italy is a main country in the EU, thus it offers important pieces on information on the evaluation of policies like the 1999 landfill Directive. Then, its problematic economic, institutional and environmental performance heterogeneity allows an interesting analysis of how economic and policy levers impact on the dynamics of landfilling in such settings. Finally, being waste management and landfill policies implemented at a much decentralised level, it provides food for thought for policy making processes that have operated or will operate along similar directions.

Econometric investigations have focused on both regional and provincial disaggregation. The two set of results are consistent to each other, with some minor differences.

Overall, we observe a significant delinking between economic growth and landfilling of waste. Nevertheless, the case study shows how the baseline EKC relationship between income and environmental pressure may be not sufficient to explain landfill diversion. Other factors impact on environmental performances. We cannot rely merely on economic growth to reverse the income-environment relationship. In fact, if it is confirmed that the sign of the income-landfill diversion trend is negative, since we already observe a descending path in terms of waste landfilling, this link turns out to be not the key one. Structural factors, like population density, highly matter[14]. This means that other things being equal the geographical embedding and the economic (market and non market) costs of landfill investments are drivers of landfill diversion. Then, some specifications also highlight the role of tourism: local systems relying on tourism tend to avoid landfilling as a waste management strategy, as additional opportunity costs may arise and negative externalities could affect the business.

But not only structural factors are relevant. If on the one hand landfill taxation is not arising as a significant driver of the phenomenon, even at the more coherent regional level, where the tax is implemented, waste management instruments, when we exploit the provincial dataset, are associated to high significant negative effect on Landfilled waste. A good performance on managing waste according to economic rationales helps reducing the amount that is landfilled. In association to the features of the tariff system, we also underline the key role played by the share of separated collection: where it is higher

Both the evolution of collection and tariff system are joint factors that may drive a wedge between the comparative waste performances of northern and southern regions.

We note the importance of having panel data for management variables, that captures both the time evolution and the cross section heterogeneity of the waste management evolution towards market based management systems, based on tariffs rather than taxes, and full cost recovery principles.

We finally note that lock in effects linked to the intensity of incinerator sites in the area are relevant for landfilling: though quite obvious, past investments in incineration lock in the region in this technological path, which may be associated to less opportunity cost and lower external effects. The lock in effect driven by the number of landfill sites in the areas is instead significant, a bit counterintuitive perhaps, only when analysing regional data.

Summing up, landfill diversion is stronger where the economic costs deriving from high population density, a structural factor, are higher, and waste management collection systems and economic instruments are associated to higher performances. The main economic driver is just weakly impacting, but this is plausible since is more distant to landfilling with respect to waste generation, and landfilling.

The decoupling is then driven by a mix of structural factors, density, but linked to economic issues, and management actions. We may affirm that just relying on the endogenous path characterised by landfilling and economic growth (the baseline EKC scenario) is not assuring delinking. Some policy actions are needed to affect the shape of delinking. Future analyses may provide more insights on landfill tax effectiveness, which nevertheless has been debated even in countries with high landfill taxes.

[14] A logarithmic model that estimates the impact of population on landfill diversion also shows a negative and significant effect. Both higher density and higher population drive down landfilling.

References

Alpay S., Caliskan A., Mahmud S. (2006), Environmental policy performance, economic growth and trade liberalization: a cross country empirical analysis, Department of Economics, Bilkent University, mimeo.

Andersen F., Larsen H., Skovgaard M., Moll S., Isoard S. (2007), A European model for waste and material flows, *Resources, Conservation and Recycling*, vol.49, n.4, pp.421-35.

Andre F., Cerda E. (2004), Landfill construction and capacity expansion, *Environmental & resource economics*, vol.28, pp.409-34.

APAT (2006), Rapporto Rifiuti (waste report) 2002, Ministry of the Environment, Rome.

- (2005), Rapporto Rifiuti 2005, Ministry of the Environment, Rome.

- (2004), Rapporto Rifiuti 2004, Ministry of the Environment, Rome.

- (2003), Rapporto Rifiuti 2003, Ministry of the Environment, Rome.

- (2002), Rapporto Rifiuti 2002, Ministry of the Environment, Rome.

- (2001), Rapporto Rifiuti 2002, Ministry of the Environment, Rome.

Berglund C., Soderholm P., (2003), An econometric analysis of global waste paper recovery and utilization, *Environmental & Resource Economics*, vol. 26, pp.429-56. *Environmental & Resource Economics,* vol.14, pp.503-18.

Brisson I., Pearce D., (1995), Benefit transfer for disamenity from waste disposal, CSERGE working paper n.6, UCL, London.

Brock W., Taylor S. (2004), The Green Solow Model, NBER working paper n.10557, Cambridge, Massachusetts, National Bureau of Economic Research

Burnley S., (2001), The impact of the European landfill directive on waste management in the United Kingdom, Resources, Conservation and Recycling, vol. 31, pp.349-58.

Cagatay S., Mihci H. (2006), Degree of environmental stringency and the impact on trade patterns, *Journal of economic studies,* vol. 33, n.1, pp.30-51.

-(2003), Industrial pollution, environmental suffering and policy measures: an index of environmental sensitivity performance, Journal of environmental assessment Policy and management, vol.5, pp.205-45

Callan S., Thomas J. (1999), Adopting a Unit pricing system for MSW: policy and socio-economic determinants,

Caplan A., Grijalva T., Jackson-Smith D. (2006, Using choice question formats to determine compensable values: The case of a landfill-siting process, Ecological Economics, vol.60, pp.834-46

Cole M., Elliott R., Fredrikkson P. (2006), Endogenous pollution haves: does FDI influence environmental regulations?, *Scandinavian Journal of Economics*, vol.108, n.1, pp.157-178.

Berrens R., Bohara A., Gawande K., Wang P. (1998), Testing the inverted U hypotehsis for US hazardous waste. An application of the generalized gamma model, *Economic Letters*, vol.55, n.3, pp.435-40

Bringezu S., Schütz H., Moll. S. (2003), Rationale for and Interpretation of Economy-Wide Material Flow Analysis and Derived Indicators. *Journal of Industrial Ecology* vol.7, n.2, pp.43-64

Brisson I. Pearce D., (1995), Benefit transfer for dis-amenity from waste disposal, CSERGE working paper n.6, UCL, London.

Burnley S. (2001), The impact of the European landfill directive on waste management in the United Kingdom, *Resources, Conservation and Recycling*, vol. 31, pp.349-58.

Calcott P., Walls M., (2005), Waste, recycling and "design for the environment": roles for market and policy instruments, *Resource and energy economics*, vol.27, pp.287-305.

Cole M., Rayner A., Bates J. (1997), The EKC: an empirical analysis. *Environment and Development Economics* vol.2, pp.401-16.

Daskalopoulos E., Badr O., Probert D. (1998), An integrated approach to municipal solid waste management, *Resources, recycling and conservation*, vol.24, pp.33-50

Davies B., Doble M. (2004), 'The Development and Implementation of a Landfill Tax in the UK', in Addressing the Economics of Waste, Paris, France: OECD, 63-80.

DEFRA (2005), A study to estimate the disamenity costs of landfill in Great Britain, DEFRA, London.

DEFRA/DTI (2003), *Sustainable Consumption and Production Indicators*, DEFRA, London.

Dijkgraaf E., Gradus P. (2004), Cost savings in unit based pricing of household waste: the case of The Netherlands, *Resource and energy economics*, vol.26, pp.353-71.

Dijkgraaf E., Vollebergh H. (2004), Burn or Bury? A social cost comparison of final waste disposal methods, *Ecological Economics*, vol.50, pp.233-47.

Dinda S. (2004), Environmental Kuznets curve hypothesis: a survey. *Ecological Economics* vol.49, pp.431-55.

EEA (2007), The road from landfilling to recycling: common destination, different routes, Copenhagen: European Environment Agency.

- (2003a), *Evaluation analysis of the implementation of the packaging Directive*. Copenhagen: European Environment Agency.
- (2003b), *Assessment of information related to waste and material flows*. Copenhagen: European Environment Agency.
- (2003c), *Europe's environment: The third assessment*. Copenhagen: European Environment Agency.
Eshet T., Ayalon O., Shechter M. (2004), A meta analysis of waste management externalities: a comparative study of economic and non economic valuation methods, Haifa, Israel, mimeo.
European Commission (2003a), *Towards a thematic strategy for waste prevention and recycling*. COM (2003) 301, Brussels: European Commission.
- (2003b), *Towards a thematic strategy on sustainable use of natural resources*, COM(2003)572.
Eurostat (2003), *Waste generated and treated in Europe. Data 1990-2001*. Luxembourg: Office for Official Publications of the European Communities.
Fischer Kowalski M., Amann C. (2001), Beyond IPAT and Kuznets Curves: globalization as a vital factor in analyzing the environmental impact of socio economic metabolism. *Population and the environment* vol.23.
Jacobsen H., Mazzanti M., Moll S., Simeone M.G., Pontoglio S., Zoboli R. (2004), Methodology and indicators to measure decoupling, resource efficiency, and waste prevention. ETC/WMF, European Topic Centre on Waste and Material Flows, European Environment Agency, P6.2-2004, Copenhagen, October.
Jenkins R., Maguire K., Morgan C. (2004), Host Community Compensation and Municipal Solid Waste Landfills, *Land Economics*, vol.80, pp.513-28
Kaurosakis K. (2006), MSW generation, disposal and recycling: a note on OECD intercountry differences, paper presented at ENVECON 2006: Applied Environmental Economics Conference, 24th March 2006, the Royal Society, London.
IVM (2005), Effectiveness of landfill taxation, IVM Institute for Environmental Studies, Vrije Universiteit, Amsterdam
Lang J.C. (2005), Zero landfill zero waste: the greening of industry in Singapore*, International journal of environment and sustainable development*, vol.4, pp.331-51
Martin A., Scott i. (2003), The Effectiveness of the UK Landfill Tax, *Journal of Environmental Planning and Management*, vol.46, n.5, pp.673-689
Mazzanti M., Zoboli R. (2007), Waste Generation, Waste Disposal and environmental Policy Effectiveness, Paper presented at the EAEPE annual conference, Oporto, November
- (2005), Delinking and Environmental Kuznets Curves for waste indicators in Europe, *Environmental Sciences*, vol.2, n.4, pp.409-425.
Mazzanti M. (2008), Is waste generation delinking from economic growth?, *Applied Economics Letters*, vol.15, n.4, pp.287-91.
Mazzanti M., Montini A., Zoboli R. (2008a), Waste generation, economic drivers, and the EKC hypothesis, *Applied economics letters*, forthcoming.
Mazzanti M., Montini A., Zoboli R. (2008b), Municipal waste generation, socio-economic drivers and waste management instruments, *The Journal of Environment & Development*, vol.17, pp.51-69.
Miranda M.L., Miller J., Jacobs T. (2000), Talking trash about landfills: using quantitative scoring schemes in landfill siting processes, *Journal of policy analysis and management*, vol.19, n.1, pp.3-22.
Morris J., Read A. (2001), The UK landfill tax and the landfill tax credit scheme: operational weaknesses, *Resources, Conservation and Recycling*, vol.32, pp.375-87.
Morris J., Phillips P., Read A. (1998), The Uk landfill tax: an analysis of its contribution to sustainable waste management, *Resources, Conservation and Recycling*, vol.23, pp.259-70.
OECD (2003), *Response indicators for waste prevention within the OECD area*. ENV/EPOC/WGWPR/SE(2003)2. Paris: OECD.
- (2002), *Indicators to measure decoupling of environmental pressure from economic growth*. Paris: OECD.
Ozawa T. (2005), Hotelling rule and the landfill exhaustion problem : case of Tokyo city, *Studies in Regional science*, vol.35, pp.215-30.
Pearce D.W. (2004), Does European Union waste policy pass a cost benefit test?, *World Economics,* vol.5, n.3, pp.115-37.
Phillips P.S., Adams K.T., Read A.D., Green A.E. (2007), Regional variations in waste minimizations in England: challenges and issues for policy development, *Regional studies*, vol.34, pp.297-302.
Powell J., Brisson I. (1995), Benefit transfer for disamenity from waste disposal, CSERGE working paper, UCL, London.
Quah E. Yong J. (2007), An assessment of four popular auction mechanisms in the siting of NIMBY facilities: some experimental evidence, *Applied Economics*, vol.40, n.7, pp.841-52.

Seok Lim J., Missios P. (2007), Does size really matter? Landfill scale impacts on property values, *Applied Economics letters*, vol.14, pp.719-23.
Seppala T., Haukioja T., Kaivooja J. (2001), The EKC Hypothesis Does Not Hold for Direct Material Flows: Environmental Kuznets Curve Hypothesis Tests for Direct Material Flows in Five Industrial Countries, *Population & Environment,* vol.23, n.2, pp. 217-238.
Stern D. (2004), The rise and fall of the Environmental Kuznets curve. *World Development* vol.32, n.8, pp.1419-38.
- (1998), Progress on the environmental Kuznets curve? *Environment and Development Economics* vol.3, pp.173–196.
Taseli B. (2007), The impact of the European landfill Directive on waste management strategy and current legislation in Turkey's specially protected areas, *Resources, Conservation and Recycling*, vol.52, pp.119-35.
Turner K., Salmons R., Powell J., Craighill A. (1998), Green taxes, waste management and political economy, *Journal of environmental management*, vol.53, pp.121-36.
World Bank (1992), *Development and the environment*, World bank Report, Oxford University Press.

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