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The social benefits of WEEE re-use schemes. A cost benefit analysis for PCs in Spain

Xose Manuel González [a], Miguel Rodríguez [b,*], Yolanda Pena-Boquete [c]

[a] Universidade de Vigo, Facultade Economicas e Empresariais, Vigo 36310, Spain
[a] Universidade de Vigo, Facultade Empresariais e Turismo, Ourense 32004 Spain
[b] Institute for Studies on the Mediterranean Societies (ISSM), Italian National Council of Research (CNR), Via Guglielmo Sanfelice 8, Naples 80134 Italy

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ABSTRACT

One goal of the new European legislation set out in WEEE Directive 2012/19/UE is the promotion of WEEE re-use schemes. However, some authors are rather sceptical about the contribution of WEEE re-use schemes to improve resource efficiency. In order to evaluate and to design adequate policy instruments, some authors recommend the cost-benefit analysis (CBA) as a compulsory first step. In this context, the main contribution of this paper is to enlarge the empirical literature by providing a CBA of re-use schemes versus recycling processes of PCs. The analysis is made for Spain by quantifying in monetary terms the social damages of environmental impacts such as climate change, human toxicity, particulate matter formation, metal depletion, etc. Our results suggest that promoting re-use against recycling (and consequently the need for manufacturing a new PC from raw materials) may reduce environmental costs by 45.20 € per PC. Those social benefits are mainly generated in the re-use preparation process and distribution activities, whereas the re-use scenario displays a worse performance in energy consumption. The difference in the distribution stage during the second life cycle originates from the fact that the ready to re-use product is produced locally, while the brand new product is manufactured and distributed from abroad, mainly Asia. These results provide valuable information to policymakers and think tanks willing to design support schemes for re-use over recycling operations.

1. Introduction

Waste of electrical and electronic equipment (WEEE) such as computers, televisions, refrigerators, and cell phones globally represent "a complex and fast-growing waste stream that covers a large variety of products" (Baldé et al., 2015). There are environmental, economic, and social benefits that would result from the proper management of WEEE. First, it may abate environmental and health problems associated with hazardous substances. Second, the recycling process may deliver scarce and valuable materials for the economy and reduce the environmental burdens associated with the consumption of primary new materials (Cucchiella et al., 2015). Finally, the recycling process may provide ancillary social benefits such as social inclusion opportunities in different ways: employment for disabled people or the long-term unemployed, helping to bridge the digital divide, etc. (Kissling et al., 2012). Accordingly, "there is a need to move from the linear model *produce, consume, throw* to a circular economy, where *nothing is wasted, everything is transformed*" (Seyring et al., 2015).

In order to address these problems, a new European legislation (the WEEE Directive 2012/19/EU) took effect in 2014. The intention of the European Commission was to tackle the fast increasing WEEE waste stream by passing more stringent legislation than the first WEEE Directive (Directive 2002/96/EC). This legislation should contribute to the circular economy and enhance resource efficiency. This legislation places preparation for re-use at the top of the hierarchy because "it ensures the product recovers its maximum potential, with a minimum use of resources" (Seyring et al., 2015). Despite the European Parliament's goal of a separate 5% re-use target, the new WEEE Directive (2012/19/EU) lacks specific targets for re-use because of the resistance by the European Council of Ministers. More recently, the European Commission adopted an ambitious Circular Economy Package (COM[2015] 614/2), which includes revised legislative proposals on waste that should provide strong incentives and concrete measures to boost re-use activities, but again, without specific targets. Consequently, key stakeholders under the current law (e.g., member states, collective schemes for WEEE) may have weak incentives for prioritizing preparation for

* Corresponding author.
E-mail addresses: xmgonzalez@uvigo.es (X.M. González), miguel.r@uvigo.es (M. Rodríguez), y.penaboquete@issm.cnr.it (Y. Pena-Boquete).

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re-use schemes over recycling operations. Accordingly, "the option of preparing for re-use might be neglected", which may explain why only 2% of WEEE collected in the EU28 was re-used or subject to preparation for re-use processes in 2012 (Seyring et al., 2015). We can expect the same situation in the near future until the approval of specific targets for re-use.

In the particular case of small IT and telecommunications equipment, the progressive shortening of a product's end-of-life for some consumers (i.e., medium-/high-income households, large financial and industrial corporations) represents an increasing pressure on resources and quantities of e-waste that must be dealt with (Ylä-Mella et al., 2015). Re-use activities may support greater economic and ecological efficiency by extending the use phase of products and reducing the manufacturing of new ones. To that end, the re-use sector should operationalize adequate logistical arrangements to accommodate the different lifespans of products among potential users. For instance, the lifespan of personal computers (PCs) is usually shorter for large corporations than for households. Accordingly, households, as well as many other final consumers such as educational and non-profit institutions, could be the recipients of discarded products from large corporations where there is an increasing prevalence of lease-based models (Intlekofer et al., 2010). Following this line of reasoning, Williams et al. (2008) affirm "increases in re-use significantly lower net environmental impacts", but the literature lacks proper empirical analysis to provide evidence for this statement. In the same vein, Truttmann and Rechberger (2006) claim that "measures taken to promote re-use should be evaluated by cost-benefit analysis in comparison to measures that enhance the effectivity of collection and recycling". Our survey of the empirical literature has provided us with several studies performing life cycle analyses (LCAs) for PCs, such as Choi et al. (2006), Duan et al. (2009), Andrae and Andersen (2010) and Yao et al. (2010). We also found papers that included data about recycling processes, such as those by Sepúlveda et al. (2010), Hischier et al. (2005), Cui and Forssberg (2003), Wang and Xu (2014), Kolias et al. (2014) and Menikpura et al. (2014). However, we were unable to find references that compare recycling with re-use processes of PCs by quantifying the environmental impact avoided, in physical and monetary terms.

Accordingly, the main objective of this paper is to enlarge the empirical literature by providing a cost-benefit analysis (CBA) of re-use schemes versus recycling processes of PCs in Spain.[1] The main contribution of the paper is to identify re-use schemes delivering greater resources and economic efficiency, hence improving welfare. To that end, the paper develops a CBA beyond a technical analysis based on LCA, which is a compulsory first step to designing adequate policy instruments. The results may provide valuable information to policymakers and think tanks to aid in designing support schemes for re-use over recycling operations.

The paper includes the following sections. Section 2 will provide the necessary background and the scope of the paper. This section will summarise the environmental impact of preparation for re-use versus recycling for the demonstration processes covered by the project. In Section 3, we present the methodology and database. Section 4 presents the results and discussion of empirical findings. Finally, Section 5 summarises conclusions and the main policy implications.

2. Background

According to Kissling et al. (2012), preparing for re-use may "optimize the use phase of a product in order to achieve greater resource efficiency". In doing so, these authors argue that re-use activities do not "compete with recycling as an end of life solution" but only postpone the definite end of life by extending the use phase of products. Hence, preparation for re-use is usually before recycling in the waste management hierarchy[2] in national legislations because it reduces the consumption of resources (materials and energy) during the manufacturing of new appliances. That may not be the case for the use phase as long as the higher energy efficiency levels attained by new products may reduce the convenience of re-use versus recycling (Truttmann and Rechberger, 2006). However, it is also true that improvements in energy efficiency are lower in the present than at the time of the Truttmann and Rechberger report in 2005 (particularly after replacement of CTR monitors by new ones; e.g., LCD).[3] These authors are rather sceptical about the contribution of WEEE re-use schemes to improve resource efficiency. They argue that policymakers should focus their efforts on improving collection and recycling processes because that will deliver better outcomes.

The conclusions reached by Truttmann and Rechberger (2006) may be one of the reasons for the resistance by the European Council of Ministers to set up any specific re-use target in the 2012 EU legislation. Furthermore, Kissling et al. (2012) maintain that the opposition to setting up specific re-use targets by the European Council of Ministers may be related to the difficulty to "identify policy instruments that can be used to do so [promote greater levels of re-use] without the risk of creating expensive systems with the potential for inefficient outcomes". In addition, a recent study conducted by Seyring et al. (2015), on behalf of the European Commission, assessed the implementation of separate re-use targets within the new Circular Economy Package. That study recommended against the inclusion of re-use targets because of limitations on databases "for assessing the feasibility of such targets accompanied by only limited benefits compared to a further enforcement of selective treatment and increasing collection rates".

For the particular case of personal computers, Kissling et al. (2012) provide the more interesting analysis to our knowledge. The aim of their study was to identify re-use operating models exhibiting positive *potential for re-use*. As a result, they provide a useful generic typology of the re-use industry for desktop and notebook computers: (1) the IT Asset Management Model, (2) the Close the Digital Divide Model, and (3) the Social Enterprise Model. The first business model supplies re-use computers "for miscellaneous large corporate users". The other two represent non-profit operating models that differ in terms of their customer segments. Close the Digital Divide organisations supply re-use computers "at low prices to eligible institutional recipients in developing countries", whereas Social Enterprises resell them "through charity outlets directly to individual users or to eligible institutional users such as schools or health organisations" (the main objective of Social Enterprises is to create employment and education opportunities). Unfortunately, the *potential for re-use* analysis of the operating models in Kissling et al. (2012) lacks a complete analysis of the environmental, social, and economic impacts.

[1] The CBA is part of a broader research agenda: the ecoRaee Project. It is a LIFE+ project funded by the EU that aims to characterize the industrial processes of preparation for PCs reuse. Thus, results from the LCA analysis published by ecoRaee represent the background for this CBA.

[2] For instance, the European Union waste legislation (Directive 2008/98/EC) states: "The following waste hierarchy shall apply as a priority order in waste prevention and management legislation and policy: prevention, preparing for reuse, recycling, other recovery (e.g. energy recovery) and disposal".

[3] The ecoRaee project estimate the differences in power consumption in 2014 as 97.93 kw/h in 2 years as showed in Section 4.2 of this paper.

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