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Assessing the intention-behavior gap in electronic waste recycling: the case of Brazil

Fabian Echegaray [a, *], Francesca Valeria Hansstein [b, 1]

[a] Market Analysis, Rua Felix Kleis, 23, Florianópolis, SC 88035330, Brazil
[b] School of Public Economics and Administration, Shanghai University of Finance and Economics, 111 Wuchuan Road, Yangpu District, 200433 Shanghai, China

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ABSTRACT

Recycling electronic waste (e-waste) is a major concern due to the risks associated with waste management, namely environmental pollution and negative consequences on individual health. Besides the need for appropriate policies and legislation for e-waste management, consumer awareness about recycling is an important factor. This paper discusses determinants of consumer intentions and behavior towards e-waste recycling in the major metropolitan areas of Brazil, where the consumption of electronic devices and appliances has significantly increased in the past decade. Modeling measures obtained from a general population survey sample after the Theory of Planned Behavior (TPB), we find that the majority of respondents hold a positive intention towards recycling electronic appliances - particularly, female, middle-aged individuals from lower income groups, and residents of the South-east region. Favorable views of recycling and the perceived social acceptance of recycling significantly explain the intention to recycle. In contrast, only a minority of respondents actually adopts adequate recycling practices connected to e-waste, a behavior which is socially skewed among the higher income echelons of Brazilian society. Differences and forces underlying this intention-behavior gap are discussed.

1. Introduction

Waste from Electrical and Electronic Equipment (WEEE), or e-waste, indicates any electronic goods that have reached its end-of-life (OECD, 2001). These include computers, televisions, cellphones and also traditional home appliances, such as refrigerators or ovens. The use of electronic devices and appliances has drastically increased in the last decades, both in developed and developing economies, spurred by an ever-expanding electronics market and the rising obsolescence rate of electronics equipment; as a result, e-waste is the fastest growing component of solid waste stream (Widmer et al., 2005). E-waste is chemically different from other forms of municipal or industrial waste, and it contains several hazardous materials as lead, mercury, polybrominated biphenyl and diphenyl, dangerous for individual and environmental health if not properly treated (Araújo et al., 2012). Responsible solid waste management and reduction is thus at the core of strategies to advance sustainability (UNEP, 2011). Treatment of electronic waste involves reuse, remanufacturing, recycling and, in some cases, incineration or landfilling. E-waste recycling refers to the disassembling of electronic devices and appliances, followed by the recovering of materials. In a key strategic document from UNEP (M. Schluep, C. et al.), efficient practices of e-waste recycling are described as follows: *"More collection of electric and electronic appliances (…) keeps valuable e-waste components (e.g. metals) in the economy and safely disposes of its harmful components in order to prevent risks to human health and the environment"*. Recycling has been identified as a key strategy for reducing pollution and depletion of natural resources, as well as for increasing energy savings (Cui and Zhang, 2008; Debnath et al., 2015; King et al., 2006; Zeng et al., 2015). Recycling is also relevant from a social and economic perspective when it encourages the adoption and development of green technologies and enables the expansion of economic activity and jobs generation by fostering a recycling industry (UNEP, 2008).[2]

* Corresponding author. Tel.: +55 48 3364 0000.
E-mail addresses: fabian@marketanalysis.com.br (F. Echegaray), f.v.hansstein@mail.shufe.edu.cn (F.V. Hansstein).
[1] Tel.: +86 2135120847; fax: +86 2165104294.

[2] Nevertheless, e-waste recycling in Latin America is, for now, limited to disassembling because is a relatively new activity (Ongondo et al., 2011).

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Motivating and furthering recycling behaviors is pivotal to the success of responsible e-waste management, and it seems particularly relevant for developing societies, like Brazil, given the fast-paced increase in goods disposal and waste volume resulting from a consumption-avid middle-class (World Bank, 2012). Accordingly, in addition to facilitating conditions and long-term incentives, successful large-scale adoption of recycling practices strongly relies on public's attitudes and behaviors (Do Valle et al., 2005).

This article aims at elucidating the characteristics favoring individual pro-recycling behaviors and the forces that leverage and downplay the adoption of these practices among metropolitan residents of Brazil, using the Theory of Planned Behavior (TPB) (Ajzen, 1991). We contend that engagement with responsible waste management like recycling does not solely rely on environmental awareness, positive views of environmental goals, or sympathetic attitudes towards recycling technologies. Rather, it requires a sense of personal efficacy and a sense of social legitimacy for adopting those actions in order to effectively engage individuals. Proper understanding of influences molding pro-recycling behaviors offers valuable insights for policy-making and helps to identify the key touch-points that government, corporations and grassroots initiatives can explore to address environmental pressures more effectively.

To the authors' knowledge, this is the first study on consumer intention to recycle electronic waste conducted in Brazil. We therefore begin by outlining the context of e-waste in Brazil, illustrating both aggregate figures as well as the state of public opinion with regards to relevant solid waste-related issues, to characterize this society. Then, we review the literature in order to assess the underlying forces conducive to pro-recycling behaviors, and to acknowledge the limitations and alternative readings brought forth by cumulative evidence. Given the paucity of research covering developing societies like Brazil, whenever possible, we use lessons learned from studies based on similar emerging contexts. Elements of the theory of planned behavior (TPB) are then discussed given its adequacy to properly model individual choices. Next, we detail the methodological procedures, measurement model and data characteristics used for testing the adequacy of the TPB model. In the last section, data findings and implications for policy are discussed.

2. Background

2.1. E-waste in Brazil

Following economic boom that paved social mobility and higher consumption rates throughout the 2000's, Brazilians per capita solid waste generation amounted to 1.06 kg per day (Abrelpe, 2014). Between 2008 and 2014, total urban solid waste generation jumped from 52.9 million of tons to nearly 78.6 tons (Abrelpe, 2014), a 48.6% increase which far exceeded GDP and population growth over that period of time. According to official sources (BRASIL, 2014), only 20% of municipalities rely on regular solid waste management services and despite improvements in broadening the number of townships with selective recollection of garbage, government statistics recorded a decrease from an average properly managed waste of 15 kg/per person per year to 11.3 kg per person per year from 2011 to 2012. When extrapolating coverage to the entire country and considering all waste mass generated, estimates reckon that only 3.1% of total household public waste is adequately managed and treated (BRASIL, 2014).

Estimating e-waste generation per capita is far more complicated and several methods have been proposed. Market estimates point Brazil's e-waste in excess of 1 m ton annually and it is expected to hit the 1.25 m ton in 2016 (SDP/MDIC-ABDI, 2012) – a prognosis deemed conservative once the segments of electronic household devices, mobile handsets, and computer equipment have exhibited double-digit growth rates per year (ABINEE, 2013). Currently, the e-waste volume increases three times faster than regular waste and, among developing nations, Brazil stands out with the highest per capita e-waste rate (annual increase of 0.8 kg/per capita), currently totaling 7.1 kg/per person, as projected for 2015 (World Bank, 2012). Given that less than 60% of total solid waste is adequately disposed in authorized landfills and only 4% of total waste is actually recycled, the implications of waste generation in Brazil are enormous.[3]

Regulation that directly tackles e-waste issues in Brazil has largely been related to mandatory extended producer responsibility, enacted in 2010. However, these legal arrangements remain largely unfamiliar to consumers and poorly enforced among both manufacturers and local authorities. In addition to these limitations, scholars point to the lack of formal and continuous feedback instruments to provide all stakeholders with information about their respective roles and possible sanctions, and the ineffective implementation of collection, recycling, and reverse logistics mechanisms, particularly with regards to electronic appliances (de Oliveira et al., 2012). This situation further heightens the salience of individual awareness and engagement of consumers for successfully addressing the environmental and social problems of e-waste.

Key stakeholders' approaches in promoting pro-recycling behavioral change have traditionally put emphasis on awareness rising campaigning. Government has taken for granted that extended producer responsibility will be conducive to improved disposal practices by consumers while social movements presupposed that guilt-oriented communications and available information on e-waste point of disposal would guide individuals towards responsible recycling. Yet, public opinion surveys reveal serious limitations both in awareness and favorable attitudes towards recycling, which suggest that conditions for green behavior adoption exceed legal, cognitive, or infrastructure opportunities. Large-scale surveys conducted with representative samples of urban Brazilians report that garbage segregation at home ranges reaches between ¼ and ½ of households, at best, a practice geographically biased towards South and South-East regions.[4] Self-reported recycling rates largely trail the increasing willingness to engage in garbage segregation (from 68% in 2001, to 78% in 2006, to 86% in 2012).[5] Improper waste management practices by consumers, like mixing-up of batteries with organic waste, are the rule for a majority of the population (58%),[6] a fact that sends a warning signal concerning the limited effectiveness of current approaches that overemphasize awareness rising campaigns, default upon producers campaigns to educate and guide consumers, or bet exclusively on broader waste collection coverage. Furthermore, opinion data suggest self-guided recycling involvement as

[3] UN/Step E-Waste World Map Initiative 2015. See: http://www.step-initiative.org/Overview_Brazil.html.

[4] Incidences obtained by the two largest, continuous polls on the subject were 23% (by NGO Akatu, see Instituto Akatu, 2012. See: http://www.akatu.org.br/pesquisa/2012/PESQUISAAKATU.pdf) and 48% (according to Ministry of the Environment survey, MMA, 2012. See: http://mma.gov.br/publicacoes/responsabilidade-socioambiental/category/90-producao-e-consumo-sustentaveis?download=989:o-que-o-brasileiro-pensa-do-meio-ambiente-e-do-consumo-sustentavel).

[5] See: http://mma.gov.br/publicacoes/responsabilidade-socioambiental/category/90-producao-e-consumo-sustentaveis?download=989:o-que-o-brasileiro-pensa-do-meio-ambiente-e-do-consumo-sustentavel).

[6] Other irresponsible disposal practices of solid waste mix up with organic waste includes mobile phones (18%), household appliances (16%), and notebooks or PC accessories (9%) (MMA, 2012).

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