Electronic Waste Recycling for Developing Economies

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This article reviews the progress of electronic waste recycling around the world and emphasises the need to give more economic importance to this sector in the developing nations. Two cases are considered for determining a model of recycling under the present constraints. These alternative models can provide a basic foundation for laying out the respective roles of producers and consumers for economic recycling of this waste.

Following the Basel Convention in 1992, measures on the proper disposal and/or recycling of solid waste, particularly those hazardous to the environment, have been one of the prioritised areas of environmental economic activity for the developed nations. A recent development (starting around the early 2000s) has been the search for appropriate strategies for disposal of electronic waste (e-waste), and to put forth plans for implementing economic and environment-friendly recycling of this waste. The importance of the latter has been identified and positive measures undertaken from the perspective of demand and supply in many developed countries as well as in emerging economies like India and China. However, the problem persists in the developing nations: proper disposal of e-waste is still not in practice, let alone accepting an economic and scientific method of recycling it.

The backbone of electronic waste recycling is the Extended Producer Responsibility (EPR) scheme first introduced in Switzerland in 2003. It places the burden of recycling on the producers and hence delineates a recycling market as part of the intermediate goods market of the economy. Most European countries and some south-east Asian nations have followed this model while in California, where recycling has taken on an important role, the consumers have to pay a surcharge. In whatever form the recycling sector is organised, many developed nations have demarcated a sector which functions smoothly if the relevant agents, i.e., the consumers and the producers play their respective roles. For instance, in California, a recycling fee is collected from consumers to fund a programme that in turn redistributes recovery and recycling payments to “qualified entities” to cover the costs of collecting and recycling electronic waste (Wolfington and Maranto 2008). In Maine and in Minnesota, it is the “producers pay” (PP) principle in practice. In Maine which was the first US state to introduce the PP principle, Wagner (2009) found that the three year e-waste recycling programme has resulted in a significant decline in disposal and an increase in environmentally sound recycling.

Pollution Havens

The same is not true for the developing nations. The problem here is deeply rooted in the nexus between the trade environment and the economy of these nations. Like many negative pollution externalities e-waste has been shipped to the developing nations conforming to the pollution haven hypothesis. Less stringent environmental regulations, a lethargic public attitude and relatively poor technical infrastructure have together contributed to the emergence of an informal “market” in the backyard of stores and factories where labourers work under unhygienic and adverse environmental conditions. The main objective of this research is to assess the economic importance of this sector as it exists in the
emerging economies particularly India and China. It will briefly review the structure of this market, identify the key differences with the market in some developed economies, present a concise economic modelling of the working of this sector under the present regulations and conclude with an attempt to tie up this recycling with trade.

**Developed Countries’ Experience**

Switzerland has been the pioneer in the e-waste recycling field ever since it came to the forefront as a hazardous yet economic waste material that needs careful disposal. Switzerland’s adoption of the EPR principle was followed by other developed nations including many in Asia. According to Khetriwal et al (2009), this led to environmentally and economically effective systems for reuse and recycling, and therefore, a structured market for e-waste recycling where only licensed firms (those holding government licences for recycling) can legally carry out recycling against an advanced recycling fee (ARF) payment by the producers and/or consumers. This model has been successful in Switzerland and to some extent in other countries because of consumer cooperation, low cost of compliance, regular audit of licensed recycling firms, and no monopoly creation at all due to an exogenous fee charged to name a few reasons (Khetriwal et al 2009). In the US, California has been active in implementing regulations on the commodity market itself through charging a consumer fee for electronic purchase while the study by Wagner (2009) in Maine documents the success of the extended producer responsibility principle. Maryland and Washington have their e-waste recycling regulations in place too (Thakker 2006). However, this same policy fails to perform in the developing countries due to the differences in the evolution of e-waste recycling market in these economies.

**Developing Countries**

According to Toxic Links, an estimated 0.48 million e-waste is generated annually in India with 95% of the waste being handled by the informal sector. The focus here will be on an economic assessment of the e-waste recycling market and the various aspects of its working in the developing nations. The importance of setting up a formal recycling market stems from the growing problem of e-waste dumping in these pollution havens and the resultant negative health effects on the thousands of workers who engage in removal of essential parts from the waste and selling them off in the secondary market. A formal recycling market with licensed recyclers can mitigate the above problems by (i) setting up a legal route for export of e-waste to the developing nations and leaving it to the governments of both the exporting and importing nations to punish defaulters, (ii) creating a new industry for employment of the vast population

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currently dependent on this informal sector and the meagre income it provides, (iii) developing a formal secondary market for e-waste processing and turning these into usable products which adds to revenues from sale, and finally (iv) reducing or eliminating the various hazardous consequences of handling these waste and the adverse effects on the health of workers involved.

In what follows I attempt to provide an economic model of an e-waste recycling market in India and explore four possibilities from the perspectives of producers and consumers. The conceptual ideas follow to some extent what has been done in Shinkuma and Managi (2010). It is assumed that the collection and separation be done in one stage while the recycling is carried out afterwards.

**Model**

Three scenarios are developed in the context of a developing country with a very informal recycling sector but which is under scrutiny by the government wishing to substitute it with a formal sector.

**Case I**

This approach owes its origin to the concept of the deposit refund system. Wath et al (2010) discuss such a system in the context of e-waste management in India. Suppose the government has certified some licensed recyclers and the manufacturer ties up with them and puts a surcharge on the consumer at the time of purchase. This surcharge may be calculated on a volumetric basis.

Let $P_b$ be the retail price, $P_s$ is the sale price and $\delta$ is the surcharge on the electronic good.

Then consumer’s retail price $P_R = P_s + \delta$

Thus net value of the good = Use value - $\delta$

However $\delta$ may be returned as “cash back” or refunded at the time when the good is discarded to the recycler and hence is an avenue to encourage more consumers to seriously decide on the commitment to recycle. This surcharge would be a discounted cost subtracted from the consumer’s present valuation of the good. Then net value of the good = Use value - $\delta$

There exist some unlicensed recyclers too but their probability of survival if consumers adhere strictly to the above policy is almost zero. (The government can actually make mandatory the payment of surcharge.) The licensed recyclers thus enjoy a natural monopoly.

**Case II**

If consumers do not pay the surcharge (it is not possible for the government to actually implement it all over thus the payment is not mandatory and recycling by licensed recyclers has not yet been institutionalised) then they dispose off their e-waste in the informal market. They then get a resale price = $P_b$ and Net value = Use value + resale value = $\delta$ If $(b) > (a)$ always, consumers will always follow the second procedure. But even if $(b) > (a)$ mathematically is it always economically intuitive?

First, there is the search cost for recyclers. If informal recyclers are hard to find then disposal is the easy way out. In that case (a) is always a better option but the question remains on how to give incentives to consumers to follow (a). Making legal recycling mandatory by offering consumers cash back without a surcharge is a possibility but recyclers, manufacturers and the government will have to negotiate this.

Second, any awareness of the significantly negative health effects of informal recycling and the fact that it is a parallel market may discourage consumers to sell off their discarded e-waste in this sector.

The price charged in the formal and informal sectors merits further discussion. This price can seldom be the same in the two sectors until the market is very structured with strict penalty on unlicensed recyclers (in the informal sector) if they are detected. Even if the formal sector exists, it may not be able to recover the cost of recycling which will be higher than that of the informal sector. Then the two markets will converge and manufacturers will pay one price. The real issue for the governments in the developing countries then is to

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**Krishna Raj Memorial Scholarships 2011**

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Six scholarships have been awarded in the school where Krishna Raj studied for a few years. The scholarships cover tuition fees, uniforms, books and special coaching. In 2011-12, the scholarships have been awarded to Sreedevi P K, Ajayan V (VIII standard), Arun C, Amal S R (IX standard) and Vipindas P, Induja V (X standard).

**Delhi School of Economics**

Summer fellowships were awarded to 17 students (M.A. Economics & Sociology) working in eight groups, for conducting field surveys and writing reports under the supervision of faculty of the DSE: Ashwini Deshpande, Aditya Bhattacharjea, J V Meenakshi and Anirban Kar.

The students awarded fellowships were Dheeraj Mamadule, Vimmy, Swati Sharma, Arnab Kumar Maulik, Ashutosh Kumar, Debapriya Bhowmik, Yeshvardhan Agarwal, Sandhya Srinivasan, Keshav Maheshwari, Madhulika Khanna, Ravideep Sethi, Resham Nagpal (all Economics); Shagua Kaur Bhangu, Maria Ann Mathew, Ujjaineet Sharma, Trishna Senapati, Aaradhana Dalmia (all Sociology).

The seven projects were (i) Rehabilitation and Resettlement of Slums in Delhi, (ii) Social Networks of Migrant Women Employed at Construction Sites, (iii) Reading Spaces: A Study of Libraries and the Reading Public in India, (iv) Marriage Practices of the Knnaya Community of Kerala, (v) Socio-economic Impact Analysis and Replicability Study of Alternative Energy Programme in the Sunderbans, (vi) Impact of FPS on Slums in Delhi, and (vii) Addressing Poverty through NTFPs: An Analysis of Madhya Pradesh.
decide how the presence of the informal sector can be minimised. An informal sector may exist alongside a formal sector like an informal labour market but there will be limitations to how the wages and the price will be determined.

A related concern is to devise a suitable and economic method to make consumers and manufacturers more aware about the importance of proper recycling. Community level education about the hazards of irresponsible dumping and strict regulations can show results; however there is also a need to relate consumer awareness to manufacturing actions like putting eco labels on electronics which are dismantled in certified recycling areas. On the other hand, recycling technology has to be made public through media and reports. It may be noted here that imported e-waste has to go through the same process too and negotiations with firms from exporting countries on the ground of technology adopted for recycling might encourage the former to ensure the proper development of this sector in the developing economies (for instance, China has this rule in practice).

Recycling with imported goods from abroad:
With tariff:
\[ p = p(1+t) \]
This accrues to licensed recyclers under strict government observation.
Without tariff:
E-waste from abroad goes to unlicensed recyclers. The latter will procure e-waste from the domestic market and from abroad. This can push down the price compared to what licensed recyclers offer. Then an informal sector can develop with probability of detection close to zero.

Conclusion
A new e-waste directive to come into force by 2012 calls for the registration of all firms dealing with e-waste from collection, dismantling, processing and recycling irrespective of their being in the formal and informal sectors. The strategies mentioned above may or may not completely be adhered to depending upon the economic benefits and costs involved in implementation. The benefits from recycling may be overshadowed by the costs of running the sector and expecting every agent to cooperate at least on legal grounds. Yet the long-term solution for the prevention of the hazards now being faced by the developing countries calls for an institutionalisation of the market on the lines of some south-east Asian economies that have already done so. An alternative option as proposed by researchers at Deutsche Gesellschaft für Internationale Zusammenarbeit (gtz) and Adelphi is the integration of the informal and formal sectors in e-waste recycling such that the business can take advantage of the cheap labour intensity of the informal sector and the capital intensity of the formal sector. Whatever the path chosen, present legislation needs
to be transformed to active policies in order for e-waste recycling to make any economic contribution in terms of output and employment and also ensure a conducive work environment.

NOTE

1 Here search cost for informal recyclers may reduce this price difference because the search cost is an opportunity cost of time for the consumer.

REFERENCES


