

**E-waste Recycling in Beijing and the Impact of China's WEEE Directive:
Competition or Collaboration Between Informal Recyclers and Authorized
Recycling Enterprises?**

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ABSTRACT

This thesis traces the afterlives of used electronics after they are discarded by household consumers in Beijing and examines the roles of informal and formal sectors in discarded electronics recycling through following the commodity chain. In contrast to most mainstream narratives about China's e-waste recycling, which almost all conclude with the need to crack down on the current informal e-waste sector and establish a new e-waste collection network controlled by government authorized processing facilities, I argue that the current informal sector has a sophisticated collection and reuse network and has found ways to collaborate with the formal e-waste recycling companies since 2012 when China's WEEE directive and funding mechanism (Administrative Measures on Levy and Use of the Fund for Waste Electrical and Electronic Equipment Treatment) came into enforcement. I establish this argument by showing how specific e-waste flows have changed and are currently managed between informal collectors to formal companies in Beijing. Prior to China's WEEE enforcement, discarded electronics in Beijing had been collected, repaired, reused or dismantled by informal sector entrepreneurs since the 1990s. Following the implementation of the WEEE funding mechanism, certain appliances (in particular CRTs and washing machines) collected by the informal sector have gradually flowed to the formal e-waste disposal companies in Beijing and neighboring provinces. I conclude that the relationship between informal and formal sectors in handling China's domestic discarded electronics is currently more one of collaboration than competition. Other important related findings include:

- 1) Informal e-waste collection and reuse businesses have been a vibrant part of environmental and economic activities in Beijing's urbanization over the last 30 years. That sector's salvaging of appliances for repair and reuse has extended the useful lives of tens of millions of electronic appliances and thereby made major contributions to resource conservation and sustainability.
- 2) The current ad hoc division of tasks, with the informal sector managing used electronics collection and sorting and formal companies managing end-of-life dismantling, has both economic and environmental benefits. By contrast, any attempts by formal e-waste companies to compete with the informal sector over residential collection have failed, and the formal companies remain almost comically ignorant regarding the economics and skills required for collection/sorting.
- 3) The biggest obstacles facing the informal discarded electronics sector are urban planning and policing policies that make their working and living conditions unstable, economically precarious, and at times dangerous. In this way, Beijing municipal policy undermines a sector that contributes greatly to resource conservation and pollution reduction of pollution.
- 4) The discarded electronic trade provides a clear picture of current trends in appliance manufacturing that are accelerating habits of disposal which are counter to environmental sustainability. A key policy suggestion derived from my research is that, if the government's aim is to limit resource waste and maximize environmental

sustainability, it should formulate standards requiring OEMs to design longer lasting appliances paired with policies incentivizing repair and reuse.

- 5) My research reveals that trade in imported used electronics into China is not as massive as many reports have claimed, but it is significant for particular types of devices and products. It is crucial to note that the flow of products is not simply from OECD countries into China; significant flows move out of China and into other countries, including ones in Africa.
- 6) Authorized e-waste recycling companies' supplies mainly rely on the informal sector's work. My research reveals that their relationships are more cooperation than competition. More and more would-be dismantled e-waste is sent to the formal sector after collected by the informal sector.

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Chapter 1. Introduction

1.1 Overview

Since 2013 China Home Appliances Research Institute (CHARI), which is a government affiliated institute dedicated to testing electrical and electronics, has held an annual meeting on WEEE (Waste Electrical and Electronic Equipment) with academics and governmental bodies playing roles in e-waste management. At the 2016 conference in a session I attended called “Internet Plus” almost all speakers from the authorized e-waste disposal companies emphasized the unique characteristics of their programs in applying information technology and software (‘apps’) for collecting e-waste. Only one or two mentioned their exploration in collaborating with informal scrap collectors (shou feipin de ren) in off-line e-waste collection. Most regarded the scrap collectors as their competitors in e-waste recycling. At these same conferences, speakers from the relevant e-waste management governmental bodies including the Ministry of Environmental Protection and National Development and Reform Commission shared the data they collected over several years which show a large scale of diversion of e-waste from scrap collectors to the authorized e-waste recycling companies since 2012 when China’s WEEE directive was enforced and its funding mechanism implemented. However, not one informal e-waste picker or dealer was invited to participate in the meeting and share their experience of e-waste recycling. It became clear that their absence was not a coincidence or mere oversight. Instead, they were deliberately excluded because to both the government and the formal e-waste recycling companies the informal sector represents a competitive threat and should be subject to crack down. One reason for the proposed crack down is that informal scrap collectors are competing with the formal e-waste recycling companies over the collection of e-waste from consumers. Another reason given by the government, is that the e-waste collected by scrap collectors is alleged to flow to places like Guiyu

and Taizhou which are notorious worldwide as e-waste pollution havens for both foreign and domestic e-waste (Tong and Wang 2004, Li 2013). As will be discussed in more detail below, while Guiyu and Taizhou have certainly acted as hubs where highly polluting and health threatening e-waste processing occurs, their role in used electronic repair and recycling has been poorly analyzed and blown out of proportion, not only by Chinese state media but also by the scholarly and policy community working on global e-waste issues (Chen and Kong 2014). These sources focus exclusively on the end-of-pipe, rare earth metals extraction and disposal aspects; however, discarded electronics collection, repair, reuse, and resource recovery by manual dismantling is a broad network of activity in which ‘end-of-pipe’ activities are only one part.

The voice of scrap collectors and e-waste dealers in the informal discarded electronics network is hardly heard in the meetings dominated by formal e-waste recycling companies, governmental bodies and Chinese academics, and scrap collectors are invisible in e-waste recycling policy making as well. Reddy’s work on e-waste reforms in Bangalore, India, analyzes how attempts to assist and formalize informal e-waste recyclers in Bangalore perversely displaced them in favor of large corporate processors, but no similar research has been done on China’s informal e-waste sector (Reddy 2013). The real face of scrap collectors working on e-waste needs to be explored. The comparison of formal and informal e-waste sectors is often over simplified, and the singular image of informal sector workers as polluters, while axiomatic in the current dominant discourses, should be questioned.

This thesis offers a close examination and analysis of the afterlives of electronics after they are discarded by consumers in Beijing. It addresses the current narratives that frame the informal e-waste sector that are articulated by most formal e-waste recycling companies, experts on recycling in Chinese academia, media reports, and governmental bodies which blame the informal

e-waste sector for creating trouble rather than positively contributing to e-waste recycling in the city. For just a few examples from recent Chinese TV media coverage on informal processing include titles like “A small factory illegally burning e-waste; villagers dizzy and vomiting” (2016) and “E-waste is a fatal form of environmental pollution” (2017).

Most research and Chinese government reports about China’s e-waste only mention the informal sector as a source of pollution. The government has a national policy approach framing urban recyclables as above-ground mines which asserts that commodity extraction from e-waste should serve as a crucial resource to avoid more mining and supply important inputs to Chinese industry. To reach the goal of liberating these resources and preventing pollution it is necessary, according to state policy, to eliminate the informal recyclers, the ostensible source of pollution, and replace them with state authorized ones. Conceptualized as tenacious trouble makers in the promising field of circular economics, informal sector entrepreneurs are analyzed as targets requiring elimination so that a formal e-waste recycling system can be built and thrive. China’s current scholarship on e-waste typically follows the government line, argues that the informal e-waste sector is a barrier to what is deemed by researchers and policymakers to be proper e-waste management rather than as possible partners in environmentally sound solutions to manage the problem of rapid e-waste generation. This approach not only ignores or denies the efficiency of the existing informal discarded electronics processing network, it also forecloses exploring the road to learning from the informal sector or crafting policies for planned collaboration between it and formal sector players.

As my thesis will show, informal discarded electronics collectors, repairers, secondhand dealers and recyclers have built a well-organized network that has been managing the vast majority of Beijing’s post-consumer electronics since the late 1980s. While government policy has in no

way intended to foster collaboration between formal and informal sectors, since the roll out of the WEEE directive funding mechanism in 2012, the somewhat ironic result has been a form of ad hoc collaboration between these two sectors. My argument that the relationship between the sectors is characterized more by collaboration than competition will be established through the following three empirical findings:

1) Despite efforts by formal companies and the new policies, the informal sector continues to overwhelmingly dominate in the *collection* of discarded electronics from residential communities as it has since the 1990s;

2) The informal and formal sectors have developed a relationship that is more cooperative than competitive at present, with the informal sector essentially providing the collecting service and then selling certain categories of e-waste to be dismantled by subsidized formal enterprises;

3) Over decades, the informal sector has developed efficient trade mechanisms through which workers can quickly separate goods that can be profitably reused/repaired/resold from those that are not viable for resale, thereby extending the working life of a significant portion of discarded electronics while directing only the least profitably re-used units to be dismantled for recycling. Previously that dismantling was done by informal sector entrepreneurs; but since the advent of the WEEE funding mechanism in 2012, certain categories of end-of-life electronics are now being dispatched to formal e-waste companies; when informal sector businesses find that the profit from dismantling a specific unit is no longer sufficient to cover their labor costs, said units, if on the WEEE directive schedule, will be sold to formal companies for dismantling.

1.2 Aims, objectives, and research questions

Why study e-waste in Beijing? Beijing is one of the world's most populated cities with 21.75 million people in 2015. With its rapid urbanization, its per capita income and consumption are

among the highest in China. According the statistics of Beijing Environmental Protection Bureau, more than 10 million pieces of electrical and electronic equipment (including washing machines, TVs, refrigerators, computers and mobile phones) were purchased in Beijing in 2015 (Wang 2013). In contrast to the above data, statistics estimating the number of workers engaged in the informal e-waste sector do not, to my knowledge, exist in the literature. The closest we get to such statistics are estimates of the number of informal scrap recyclers in Beijing (many of whom are involved in e-waste collection) which Linzer and Salhofer place between 130,000 and 300,000 persons (Linzer and Salhofer 2014) and the amounts of recyclables they collect account for over one third of Beijing's waste (Xie 2008, Song 2015). My informants generally estimated Beijing's informal e-waste sector at about 200,000 people (including collectors, traders, repair workers, etc.) (Interview 4 and 11 2016).

For this study of Beijing's discarded electronics, I have adopted a commodity chain approach. I trace e-wastes from their origin of discard (household consumers) to their final destinations of reuse or dismantling in Beijing. I describe the network of the informal e-waste sector and the people who channel the flow of e-waste; I also examine how the network has changed over time and how e-waste is diverted from the informal sector to formal sector. To analyze the viability of the newly emerging formal sector's e-waste collection network, I also examine an e-waste collection program in Daxing District undertaken by the biggest e-waste recovery and disposal company in Beijing.

I use this approach in order to reveal the real face of informal e-waste network, which up until now has not been studied or described by scholars. Through this approach I can also follow informal actors' relationships with the formal e-waste sector and look at how e-waste flows and processing have changed since the WEEE directive came into force in 2012. I hope to start to fill

in the gap in the previous e-waste research which, with few exceptions (see Steuer et al., 2017, 2018), lacks any close observation to the network of informal scrap collectors in e-waste collection, trade, reuse, physical dismantling.

I undertook my research with the following questions in mind, and I held to these questions throughout my fieldwork, but also, as interviews and discoveries in the field changed my understanding of the sector, I modified my initial questions to suit conditions on the ground. My initial research questions were:

1. How does the ongoing competition between formal and informal e-waste collection shape the historical and geographical patterns of e-waste collection in the city of Beijing?
2. What territories of e-waste collection and processing are being competed over, including on-line and off-line spaces and residential communities?
3. Who are the actors in the competition when the informal and formal e-waste collectors interact with stakeholders in the residential communities?
4. How do the informal and formal e-waste collectors have the knowledge to discern value of e-waste, to decide what e-waste is to be reused, repaired or scraped after collection and how do they apply this knowledge in the collection process?
5. How do the e-waste policies and progress promoting formal collection impact the diversion of the flow of e-waste to the formal collection?
6. To what extent are foreign markets (i.e., those outside China) involved in Beijing's e-waste sector, either as suppliers or buyers of e-waste?

Based on these questions, this study aims to visualize the economy of e-waste flows in Beijing and the interaction between formal and informal sectors using a commodity chain approach. This approach also allows me to follow how discarded electronics travel from households through

chains of different stakeholders. I find that for the most part the informal e-waste network is well organized and effective. With this network, Beijing's e-waste has been collected and handled daily without any support or input from the government. Since 2012, with the advent of the WEEE funding mechanism, authorized e-waste disposal companies have sought channels to work with informal e-waste collectors to get supplies for their operations. E-waste collection is still dominated by informal collectors, but end-of-life e-waste has gradually begun flowing to authorized e-waste companies, particularly in the case of CRTs (Cathode Ray Tubes), of which an estimated 90% now flow to formal dismantling companies (Interview 12 and 13, 2016). Thus, the work of the authorized e-waste recovery and disposal companies depends on supplies provided by informal collectors.

Secondly, I found that the informal e-waste sector has been highly effective at repair and reuse since first emerging in the late 1980s. Their work has well served the used appliance and computer markets which have a high demand in migrant workers' families and small private business operators. Informal sector reuse further avoids the waste of good materials and extends the life of some electrical and electronic equipment. This reuse is not covered in current e-waste policies and formal companies, at the time of my research, were prohibited from reuse and parts recovery. Thirdly, I find that the e-waste collection programs thus far attempted by the formal e-waste companies have not been effective or sustainable.

Through my fieldwork it became clear that in order to understand the present conditions under which the informal sector work, its current geographies and forms of organization, it is necessary to understand the policy background shaping the lives of migrant recyclers in Beijing. The informal e-waste collectors in Beijing are all from rural areas, and they live and work in urban villages on the city's outskirts. Although they have contributed to the environment of urban development, they

have always been legally and socially marginalized from Beijing. Every day they transport e-waste from its place of origin—predominantly residential areas in the city’s urban core—to peri-urban villages where they live for processing. Their work has been crucial for helping manage and remove unwanted e-waste from the city, but their contribution to the city goes unacknowledged, and over the years they have been pushed ever farther away from the city center. Informal collectors left their homes in the countryside to make a living in the city and facilitated Beijing’s development, but they have not shared many of the benefits of that development.

1.3 Literature review

My study references, responds to, and adds to three bodies of literature within current e-waste scholarship: e-waste disposal pollution control literature; e-waste management policy literature; and literature on informal e-waste recovery and disposal. I will first point out the contribution, limitations and differences among these scholarly areas. I will then explain why this study is valuable to current e-waste scholarship.

The first body of e-waste literature focuses on e-waste recycling technology innovation and pollution control. China is facing a big challenge in reuse and recycling of discarded electronics. The country is quickly becoming one of the biggest e-waste producers in the world, with around 7.2 million tons generated domestically annually, and increasing every year (Balde et al 2017, p.68). But China’s disposal capacity is not matched to such a high rate of e-waste generation. At the same time, China is also alleged to be the destination of around 70% of globally traded e-waste, though the empirical basis for these claims is extremely shaky (Basel Action Network 2002, Lepawsky 2015).

In any case, some centers involved in the processing (and unmonitored disposal) of electronics, such as Guiyu in Guangdong and Taizhou in Zhejiang, have been the designated bases

for imported e-waste in the past two decades. The pollution caused by China's unregulated informal e-waste processors has been criticized since 2003 when the international organizations Greenpeace and Basel Action Network (BAN) exposed Guiyu's pollution resultant from e-waste processing and disposal, after which most research on China's e-waste has focused on Guiyu and Taizhou. Since 2003, researches in Guiyu and Taizhou have disclosed the threat of pollution to the environment and local people's health (Li et al 2008, Wong et al 2008, and Xia et al 2007).

These public health findings also lead to research regarding e-waste recycling pollution control technology innovation. The leading research groups are from some environmental science and engineering departments in Tsinghua and Tongji Universities (Liu 2017, Du 2013). Their research focuses on e-waste disposal technology innovation and analyzes the trends in e-waste production with data models; they then advocate designs for formal recycling systems based on the technology innovation. They argue that new technology imported from western world or explored in China is the solution to China's e-waste recycling problems we are facing and building formal e-waste system to replace the informal sector is urgent for the e-waste disposal pollution control. The technology innovation-oriented researchers are generally limited to a strictly end-of-pipe logic that does not consider the larger economic and social context in which their innovative technology would be applied. They over-emphasize the weaknesses of the existing informal recycling sector in regard to not having facilities to safely process and dispose of toxic wastes, but ignore the sector's efficiency of reuse and refurbishment.

The second body of literature focuses on the changes of China's e-waste policies since 2003. The central government has issued several new regulations to promote the extended producer responsibility, support the take back policy, and encouraged the building of a formal e-waste recycling system. This has attracted the attention of social science and humanities scholars in

following the impacts of new policies on different stakeholders and the existing informal e-waste recycling sector. For example, Xin Tong argues that the local government should take more responsibilities and the producers should pay more attention to the take-back system to implement the policy of China WEEE directive (Tong 2013, 2014). However, her research is policy oriented and pays little attention to informal recycling's role in the current e-waste recycling system. Different from Tong's policy research perspective on formal companies, Yvan Schulz's analysis values the informal sector's contribution to current efficient e-waste recycling and concludes that the failure of current government policies to create a formal e-waste processing infrastructure is due to the government's exclusion of the informal sector's role in it (Schulz 2015). But Schulz does not provide a comprehensive picture of how the informal e-waste recycling sector in Chinese cities functions, so my research provides strong evidence reinforces Schulz's claim.

There is also a limited literature on informal recycling in Chinese cities, and in particular Beijing. For instance Tong and Tao (2015) show that the informal recycling sector boomed in Beijing for a decade after 2003 when the government relaxed regulations on recycling markets, arguing that they indeed contributed to urban sustainability and waste management during that decade but that these markets were soon shut down due to local resident NIMBYism. Goldstein (2016), by contrast, confirms some of their findings but disputes their narrative of events, arguing that the informal sector's contributions reach back into the early 1990s and that the market shut downs in 2010s reflects not NIMBYism but the unwillingness of the municipal government to invest in recycling because they see it as a low-value industry. But this debate does not touch directly upon e-waste in the city. Benjamin Steuer examines the electronics repair and refurbishment done by informal sector against the background of new e-waste management policy and argues that the vibrant used e-waste business should be given more room in urban China

(Steuer 2016). In a field that has, for the most part, completely ignored the informal sector as a contributing stakeholder in China's e-waste management, these authors provide by far the most thoughtful studies in a field. Yet their work has focused on scrap materials such as cardboard, plastic, and paper rather than discarded electronics. My thesis is the first to not only map this network but analyze its development in relation to a history of policies, market transformations, and an analysis of the geography of flows, skills and networks of the informal sector.

The third body of literature specifically focuses on the informal sector in Guiyu and Taizhou and explores the possible integration of the informal sector in e-waste policy making. For example, Chi Xinwen argued that the future model of e-waste recycling in China should be shaped by people already active in this field, whether formal or informal – her work was a first step pointing in the direction that my thesis has followed (Chi, 2010). Anna Lora Wainwright claims that recyclers in Guiyu suffer from disconnection from China's flourishing economy and concludes that wiping out the informal workers in e-waste recycling would be misguided if it fails to make use of their significant skills (Wainwright, 2015). However, she does not specify how the new policy might manage to bring the informal sector into the planned regimen.

The second and third bodies literature have recognized the crucial role the informal recycling sector plays in China's e-waste and all assert that informal recyclers should not be ignored and should help shape the future directions of the sector. But none follow, let alone analyze, the processes of informal collection repair, reuse and dismantling nor do they address the current relationship of the informal sector with formal recovery and disposal e-waste companies. These authors make important assertions that the informal sector is important, but cannot speak to which policies, market conditions and manufacturing trends have in the past and are currently affecting the viability of the informal sector; my thesis makes contributions regarding each of these matters.

1.4 Methodology

The major source of information used in this thesis is my field research conducted in Beijing between 2014 and 2016. My field work was conducted in the following periods of time: June in 2014, July in 2015, and mid-May to September in 2016. For most of that time I followed people, with their consent, involved in the informal e-waste network, observing how they collected, repaired, resold, and dismantled air conditioners, washing machines, refrigerators and computers. I also interviewed 38 people involved in the informal e-waste sector. Interviewees included e-waste collectors, e-waste dealers, repairers and refurbishers of computers, washing machines, and air conditioners, secondhand retail and wholesale dealers, and end-of-life e-waste collectors. When following the e-waste collectors in residential communities, I interviewed 13 household consumers selling their e-waste to these collectors. Most interviews lasted one to three hours and occurred in a natural conversation form; some had follow-up interviews. The field work also included several days in used appliance stores and markets, repair stores, computer reassembling markets, and e-waste dismantling sites in three urban villages of Changping District in Beijing.

In this study, the key reason for following the flow of e-waste in the Changping district in northern Beijing is that it is home to several large-scale used e-waste markets and dismantling sites (see maps provided in next chapter). From the perspective of urban expansion and population density, northern Beijing is somewhat more developed than the south. Much of the e-waste generated in the central districts of Dongcheng and Xicheng as well as Haidian and Chaoyang, flows to the places I visited. Beijing is also far too large to cover all of the trading, reuse and dismantling sites, so given time limitations and the need to develop familiarity with the informal recycler community, I limited my fieldwork to North Beijing.

Besides close observation of the informal e-waste network, I followed the e-waste collection program implemented by one authorized e-waste recovery and disposal company in Daxing District of Beijing in August 2016. I interviewed two managers responsible for collection and disposal in this company. I also interviewed the CEO of one state-owned e-waste recycling company based in Beijing.

1.5 Outline of chapters

Chapter one traces the historical development of the informal e-waste recycling economy (starting with the economic reforms of the 1980s) and its counterpart, the formal e-waste recycling system (beginning as pilot projects around 2006), up through the time of my fieldwork in 2016. This chapter shows that informal e-waste recycling has developed into a sophisticated network over a period of three-decades, and has been entirely built by rural migrants. These migrants' market-oriented recycling network gradually replaced the state-owned recycling sector in the 1980s, and when e-waste became a component of Beijing's post-consumer waste stream the informal recyclers began collecting it as well. Driven by market interests, these migrant workers built an effective e-waste collection, repair, refurbishment, reuse and dismantling network. For them, e-waste is a resource not waste. They rely on the e-waste business to make their livings and raise their families. The state affiliated formal e-waste recovery and disposal sector only emerged after the pollution problems in Guiyu and Taizhou were exposed in 2002. The formal sector's development is profoundly dependent on the development of the government's e-waste policies. Until 2009, the formal e-waste recycling sector was still in its infant stage due to lack of policy and financial supports. The Old for New program from 2009 to 2011 marked a turning point for formal e-waste recovery and disposal companies, providing them a supply channel, which was then strengthened by the WEEE funding mechanism in 2012. However, due to the existence of the

informal e-waste collection sector as well as the formal sector's lack of experience in the field, formal companies still have failed to get beyond being heavily dependent on government support. For example, they have so far failed to develop their own collection systems and currently rely on informal e-waste collectors.

Chapters two through five provide a detailed account of the informal e-waste network and its relationship with the formal e-waste sector in Beijing. I generally refer to e-waste in this thesis as discarded electrical appliances (DEAs) rather than 'e-waste' to underline the fact that approximately 50% of these items, according to my fieldwork, were bound for reuse and not just dismantling. The overarching argument in these chapters is that the informal DEA network is effective in DEA collection, reuse and dismantling and migrant workers play a crucial role in Beijing's DEA recycling. Chapter two examines DEA collection at the level of the residential community. Most DEA from households is purchased by informal residential community recyclers/scrap collectors (shou feipin de ren). There are also roaming collectors who specialize in buying used appliances who either buy items directly from residents or buy them from the residential recyclers. Also becoming somewhat common since the Old for New trade in program, residents can take their used appliances to home appliances retailers and get a discount on purchasing a new similar appliance. The chapter looks at all these processes, finding that still by far the most common one is informal residential collection

Chapter three presents how DEAs move from informal residential community-based recyclers on to e-waste middlemen and gets directed either toward reuse or dismantling. The informal residential collectors and roaming used electronics collectors sell their collections either at ad hoc sidewalk DEA trade centers or in yards where used electronic appliance middlemen live and work. In the trade stage, DEAs go to dealers specialized in repair, refurbishing and reuse or

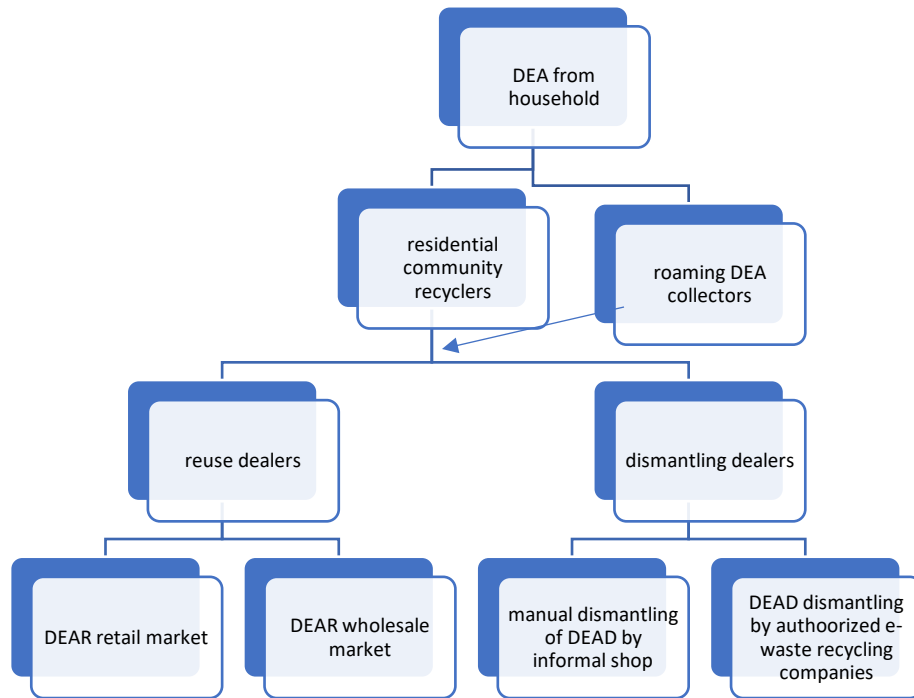
dismantling. All dealers are individuals or family enterprises in this trade network. The division of channeling of items toward reuse or dismantling mainly accords to the market demand for the items collected (with market demand varying according to model, production year, brand, newness of item, etc.) These trade decisions are based on the experience of the dealers and their often very fine-grained understanding of the markets and the items themselves. The spaces, timing and customs of the trading process are profoundly affected by the informal nature of the network and the constant pressure the sector faces from municipal authorities.

Chapter four looks at the market in used appliances, which I refer to as DEAR (Discarded Electrical Appliances for Reuse). In this stage, there are retail and wholesale markets. The categories of items which the retail markets sell are almost the same as the new electrical and electronic equipment retailer malls, but they are usually located in the urban periphery or urban villages. The markets are usually called old goods (jiu huo) markets. DEAR wholesale markets often specialize in a specific type of appliance, such as air conditioners, though some wholesale markets have dealers of more than one appliance type, such as washing machines, refrigerators, and TVs. A third category or market specializes in used computers. Used computer markets differ in several respects from the other markets. For instance, the main markets are in Zhongguancun, which is the busy information technology (IT) area of Haidian District in Beijing. Every store in these markets has its own license. They also reuse removed parts if they still work. However, my research suggests about 90% of secondhand laptops sold in Zhongguancun are not discarded in Beijing nor are they domestic. They are imported from developed countries, mainly from the US. Another finding is that Beijing's used flat screen TV dealers export about half of their collections to South Asian and African countries in recent years. Despite these very important differences, there are also commonalities across the spectrum of DEAR. For instance, DEAR dealers' labor

involves cleaning, repairing and refurbishing the goods which they purchase from collectors. The main consumers of retail DEAR are usually migrant workers coming to Beijing. However, most buyers at the wholesale DEAR markets are from Beijing's neighboring or close-by provinces such as Hebei, Henan, Shandong, Inner Mongolia or the north eastern provinces. They extend the use life of discarded electrical and electronic equipment and provide DEAR to the families or businesses in those regions.

Chapter five explores the other direction where DEAs flow, the end-of-life dismantling, which I refer to as Discarded Electronic Appliances for Dismantling (DEAD). DEAR and DEAD dealers are separated at the trade sites. People who specialize in purchasing DEADs also typically specialize in specific types of items with washing machines, air conditioners, TVs, computers and small items like microwave ovens each collected by different dealers. Some are small dealers, others are big ones, but no matter the scale of their business they decide which items they will send on to authorized e-waste disposal companies and which items they will dismantle themselves. The main determining factors for these decisions are the labor cost of dismantling and the price of materials in commodities markets. Since 2014, more and more DEAD have been sent to the authorized e-waste companies because of the increasing labor cost and declining material price. The diversion to authorized companies has been steadily increasing in the past years. The formal e-waste dismantling companies usually go to large-scale informal DEAD dealers and buy directly from their hands. By doing so, the e-waste disposal companies get enough supplies.

Fig. 1.1: Network Diagram of E-waste (DEA) chain in informal sector



Chapter six presents my research on the authorized e-waste disposal company, Huaxin, and its offshoot e-waste collection pilot program, a company called Banana Peel. With the support of local government and advanced information technology, Banana Peel is attempting to collect DEAs directly from residents so that Huaxin’s supply chain does not have to depend on informal collectors. The company wants to get e-waste directly from the consumers and plans to monopolize the collection rights in the residential community. With those goals, they designed an integrated on-line and off-line collection and management system to collect e-waste and other recyclables directly from consumers by providing door-to-door collection service. After a one month pilot, they found it very difficult to sustain their business, with high administrative costs and very poor collection rates. In contrast to the effective informal scrap collectors network, my fieldwork made it apparent that Hauxin and Banana Peel had no clear strategy for collecting DEAs.

My thesis concludes with a summary of my findings regarding the informal DEA sector, the reasons for its persistence, and a critique of some current market and policy trends in China today that are framed as environmentally sound but, I believe, are in fact moving in a direction detrimental to environmental and social justice within this significant sector.

Chapter 2: A Brief History of the Development of China's DEA Sector

Chapter Summary: This chapter sketches the development of the informal Discarded Electronic Appliance (DEA) recycling sector and its formal counterpart in Beijing over the last few decades. It shows that informal DEA recycling is a sophisticated network that has undergone significant changes over the last three decades and argues that the historical origins and development of these networks are important to understanding their present composition, function and relationship with other social, government and economic actors. Migrant rural workers became the main work force handling Beijing's DEAs beginning in the 1980s, their market-oriented DEA collection and processing sector evolving out of a larger post-consumer recycling network. The chapter demonstrates that from its inception through to today, the informal DEA sector integrated collection, repair, refurbishing, reuse and dismantling, and, moreover, that repair and reuse were by far the dominant aspect of the sector from the 1980s to the early 2000s and today still constitute a major part of the value chain for most forms of DEA. For informal electric and electronic appliance workers, discarded electrical and electronic equipment and appliances are first objects to be repaired for resale and reuse or dismantled for reusable parts, and only when these options are no longer viable are they treated as sources of recyclable raw materials.

By contrast, state-supported formal e-waste disposal companies only emerged in the early 2000s, and have never been engaged in repair, reuse, resale or dismantling for reusable parts. Moreover, these formal e-waste companies have never been economically viable outside of the government e-waste policies and subsidies that enable them to survive. Until 2009, the formal e-waste recycling sector captured almost none of China's DEA flows, but with the implementation of the Old for New Program (2009-2011) followed by the funding mechanism (2012-present)

subsidizing authorized e-waste disposal companies in their purchasing of DEAs on a per unit basis, these companies have begun seeing a flow of end-of-life DEAs, particularly CRTs, but also some other appliance types. Today formal recovery and disposal companies in Beijing rely for supply on informal e-waste collectors and upon the state subsidies for funds to purchase those units.

2.1 Background of China's informal urban DEA sector

2.1.1 Emergence of informal sector in the reform period

China's DEA collection and processing sector is still overwhelmingly dominated by the informal sector. Since the organizational logics and skill sets that make the networks viable cannot be explained or clearly documented without understanding the decades of migrant experiences and histories embedded in that system, this chapter asks readers to start by journeying back to the early years of China's economic reforms in the late 1970s and 1980s. From there, we will travel through a spatial history of Beijing's informal discarded electronics collection, repair, reuse, and recycling networks as they evolved from the 1980s until today, concluding with an initial sketch of how the integration of informal and formal sectors has transpired since 2009.

The term "informal sector" was coined by Keith Hart in his work on Ghana to describe a sector of low income and unskilled migrants who could not find wage employment (Hart, 1973). Hart appraised the informal sector positively and stressed its potential to create employment and reduce poverty. The term "informal" remains an essentially contested category in the literature (Meagher, 2013). By informal for the purposes of this study I mean laborers and entrepreneurs who are almost always rural migrants who have not registered their business with the authorities and who therefore lack any state provided protections and often fall foul of urban policing

mechanisms. China's economic trajectory since the 1978 reforms dismantling agricultural collectives could be interpreted in this light. From the late 1950s through 1978, China had, for all practical purposes, no open free markets and all rural agricultural land was organized under collectives. Farm land was allocated, not to individual households, but collectively to villages which followed state policies regarding what crops to grow and how to allocate the harvest. Under these conditions, rural residents were assigned their work by the collective and could not seek employment in other areas. Beginning in 1978 that system was gradually replaced with one that divided land among households with allotments based on the size of each family, a shift that was completed throughout the country by the early 1980s. Farming households now owned what they produced and had the right to sell it on the open market, so gradually new market spaces were also introduced into China's towns and cities. In highly populated regions such as Henan and Sichuan, per capita plot sizes could be very small, hardly enough to support a household, resulting in household surplus labor which sought other forms of work, either locally or through migration.

Throughout the 1980s and 1990s, China's informal economy was almost entirely comprised of these peasant workers (*nongmingong*, 农民工) who went to cities to look for jobs. While market reforms created opportunities for peasants to sell goods or find jobs in the cities, the reforms did not legalize their freedom of movement to cities—the household registration or *hukou* (户口) system remained firmly in place and was strictly though (due to the vagaries of local police who were often looking to profit from bribes and kickbacks) arbitrarily and unevenly enforced. Under the *hukou* system (dating back to the late 1950s) rural residents were forbidden to travel, let alone live, in the city without government permission, which typically was only given to temporary contract laborers (with much lower wages and fewer benefits than their urban counterparts). The market reforms also encouraged the emergence of private companies that could be more flexible

in choosing their employees. Many preferred hiring peasant workers to save money. According to Philip Huang, well into the early 2000s, 53.2% of peasant workers (about 64 million) worked in manufacturing or construction, while the other tens of millions mostly work in tertiary industry, including as domestic workers, garbage collectors, delivery persons, street cleaners, street vendors etc., almost all informally (Huang, 2009).

China's urban population increased from 170 million in 1978 to 771 million in 2015, and of that urban population about 253 million were rural migrants (National Health and Family Planning Commission of China 2015) who contributed an estimated 21% of national GDP in that period (Wang et al. 2015a). Most of the additional 300 million urban population shifted from rural to urban designation due to the rezoning and the expansion of urban districts (a phenomenon also visible in this thesis in the successive development of Beijing's ring roads). In total, the proportion of population living in cities and towns increased from 18% to 56% (National Bureau of Statistics of China, 2017) over a 37-year period.

Low pay, no job security, and few benefits such as medical insurance—these are typical features of the informal economy in China. Mega-cities, such as Beijing and Shanghai, have the largest number of such peasant workers. Living in these cities on temporary permits, they cannot access welfare in the city nor can their children attend the city's public schools. Lacking legal permanent residence in the city, self-employed peasant workers like recyclers cannot register their business.

2.1.2 Development of Beijing's informal DEA sector since the 1980s

As the capital city of China, Beijing has attracted waves of farmers looking for jobs since the 1980s. Many first came on temporary contracts as construction workers, but after identifying a host of

economic opportunities amidst urban expansion, they improvised ways to find profitable employment in the city, often in defiance of the *hukou* rules. Some construction workers found that the leftovers from construction sites could be profitably sold to municipal recycling shops and began picking from work sites, then from urban dumpsters and dumps, and eventually began buying recyclable scrap from residents and businesses. Within a few years these scrap collectors formed networks that graduated from just collecting scrap to running their own informal recycling markets in the peri-urban periphery and supplying materials to processors and manufactures (Interview 2, 2016). As they prospered, relatives and friends from their home villages followed them to Beijing. In Beijing, and in cities across China, the discarded electrical appliance (DEA) sector evolved as a specialized branch of this informal scrap collecting network. There are no reliable statistics on Beijing's informal scrap and DEA sector, but based on my fieldwork interviews and observations, a vast majority (somewhere between 70 and 85%) of Beijing's informal scrap and DEA workers hale from Gushi County, Henan Province.

By the late 1990s this informal recycling network had not only grown rapidly to encompass the entire city (a 1998 estimate put their numbers in Beijing around 80,000 (Wang W. 1999)), it had also completely replaced the city's state-owned municipal recycling system. Under the Mao era (1949-78) command economy, China's recycling sector had been run by a network of state-owned companies under the management of the Bureau of Commerce. With the economic reforms of the 1980s and accompanying boom in Beijing urbanization and real estate markets in the 80s and 90s, Beijing's municipal recycling companies—facing stiff competition from migrant collectors—steadily sold off their several hundred neighborhood collection depots to invest in more profitable ventures unrelated to recycling. By the late 1990s Beijing's state-owned municipal collection network no longer existed. But it should also be noted that despite having no collection

system and hardly any involvement in recycling Beijing's scrap since the 1990s, these state-owned companies continued to exist (in various forms under a variety of names) and still receive government subsidies and other benefits today. With the exception of a few short-lived and failed government sponsored forays into the sector, informal recyclers have collected, managed and marketed flows of Beijing's post-consumer recycling, including DEAs, since the late 1990s.

The growing household use of consumer electronic appliances and their inevitable need for repair and eventual discard, by and large coincided with the above described growth of the city's informal scrap sector. Just as Beijing's post-consumer waste stream grew prodigiously, more than keeping pace with the city's unprecedented GDP growth, so too did its DEA sector. Since the early 1990s, when Beijing began generating post-consumer DEAs, the informal sector, without any support from the state, has taken on the role of collecting, repairing, reusing and dismantling them (Interview 14, 2016). Over its nearly thirty years of development, the informal sector has built an efficient and well-organized network for DEA collection, repair, reuse, resale and dismantling. This development could be heuristically sketched as passing through three stages: 1) a reuse dominant period from the mid-1980s through the 1990s; 2) a period of rapid growth of DEA flows (late 1990s-2014) during which dismantling became a significant portion of the DEA sector; 3) and the current recession period that started around 2014. It should be noted that until roughly 2005-2010 the majority of Beijing's DEA units went to repair and reuse rather than to dismantling (Interview 14, 2012-2016), and even today repair/reuse channels are roughly equal in economic value to dismantling channels. In other words, only in the last decade has the dismantling/recycling of DEAs begun to outstrip repair and resale. Prior to this, repair and resale overwhelmingly dominated the scene, and, in terms of value and profit derived by the informal sector, still do.

2.1.3 1980s-1990s: Repair and reuse period

The generation of DEAs is closely related to the consumption of home appliances. In China, even in the capital city of Beijing, all but the most elite households had no appliances in the 1970s. But under the market-oriented reforms of the 1980s the government began encouraging China's home appliance manufacturing industry and urban residents were gradually able to afford the luxury of purchasing an appliance. China still practiced purchase quotas in the early 1980s, and by the end of the 1980s, it is estimated that 70% of Beijing households owned a black-and-white CRT TV. China was not yet producing color TVs on a large scale at the time, so most color TVs were imports from developed countries and the price was very high. In the 1980s washing machine and refrigerator ownership was very limited, air conditioners were a rarity, and there was no household consumption of computers. It should be recalled that into the mid-1990s, the average household income in China was under 1,000 US dollars (Beijing Municipal Bureau of Statistics, 2016). At this income level household appliances were extremely expensive, so most families could hardly afford the luxury of replacing old models with newer ones. Given these conditions, households almost always chose to repair their TVs, refrigerators and washing machines (Interview 14, 2016). Mr. He, a community recyclables collector since 1992, recalled only collecting about one TV every two weeks in early 1990s, and, barring the hopelessly broken, every unit he collected went to refurbishment and resale. Neither Mr. He nor any other recycler I interviewed recalled there being any dismantling or end-of-life DEA markets in the early 1990s. Though no one was collecting hard data, my interviewees all claimed that end-of-life DEAs (headed toward dismantling/scraping) only began emerging as a sector in the late 1990s and accounted for at most 20% of DEA generation into the early 2000s (Interview 4, 2016), and that up to around 2005-2010

dismantling focused primarily on removing parts for reuse. My interviewees also universally believed that the quality of appliances—TVs, washing machines and refrigerators—was better in the 80s, 90s and early 2000s compared to those produced over the last decade or so. They assert that appliances were generally designed to last longer and to be more readily repairable, while more recent models are designed to be less sturdy and less conveniently repaired. In sum, these conditions meant that appliance from the 1980s into the early 2000s were less often discarded and were generally more repairable than they are today.

A discarded TV in the 1990s would typically move along the following path: a recycler bought it from a household, sold it to a broker, who then sold it to a DEA dealer who either repaired and refurbished the unit himself (it was almost always a man) or sent it to a repair shop. 1990s buyers of used appliances typically included migrant workers, wholesalers and retailers from less developed regions, and lower-income local Beijing families. In the early 1990s the main item dominating the secondhand appliance market was black-and-white CRT TVs; used color TVs were still fairly scarce. Interviewees indicated that repair was a popular and good job in 1990s; one interviewee, Mr. Ma (see Chapter Three for more on Mr. and Mrs. Ma) took on refrigerator repair as a part-time job to supplement the couple's income as community recyclers.

Mr. Ding came to Beijing from Gushi county in 1988 and soon was collecting recyclables on a bike cart but shifted to specialize in collecting and repairing used TVs in 1992 and has now been a TV trader for 25 years. According to him, the biggest difference in the used TV trade is price: an 18-inch used CRT TV could be sold for 400 Yuan (\$66) to 500 Yuan (\$83) in the 1990s, and if business was good he could collect ten TVs and earn around 1,000 Yuan in one day. Now he buys a 25-inch CRT for 50 Yuan (\$8.2), but it has almost no resale market; consumers only want to buy flat screen TVs now. Others I interviewed shared Mr. Ding's assessment. Mr. Gu,

had worked in the sector since the 1990s and once lived in Wali village, North Beijing's main informal recycling center in the early 1990s. He recalled that the most expensive used TV he sold in 1990s was a Mulan brand at over 1,000 Yuan. He remembered selling used refrigerators then for 600 to 700 Yuan (Interview 34, 2016).

As informal recyclers branched into sectors that specialized in DEA collection, repair, resale and dismantling their status in relation to *hukou* policy did not change; these self-employed entrepreneurs were banned from registering their businesses. While this informal status meant they paid no taxes, it also meant that evading officials and police was a necessary precondition for their existence. In the 1990s the policing agency most commonly involved in enforcing *hukou* rules was the Lianfang (联防) who could stop those they suspected of being rural migrants at any time to demand their residence permits and could detain migrants at their will. Lianfang were civilian self-organized security groups under the direction of the local police station. Their main role was to protect the safety of residents. However, in the 1990s in Beijing, in the name of maintaining neighborhood security, Lianfang often demanded money from waste collectors as bribes and, if they were not forthcoming, would march them off to the police station.

Having followed the development of informal recycling in Beijing since 1990s, Goldstein described what kind of lives informal recyclers had at that time:

In the 1990s these informal recyclers were all “illegal” migrants; none of them had the proper urban household registration (*hukou*) and could be detained and deported at any time. Similarly, the hundreds of recycling markets where they sold their daily haul were fly-by night yards hidden near construction sites and squeezed in alleys, subject to sudden closure and confiscation. City officials compared migrant recyclers to “guerrilla armies”: agile, rag-tag, and impossible to stamp out (Goldstein, 2006, p. 280).

Many of the DEA entrepreneurs I interviewed had experienced harassment and detention in the 1990s. Mr. Liu came from Gushi county to Beijing in the late 1990s and collected recyclables, including DEAs, on a corner of Hongjun Street near where the Fifth ring road is today. He recalled

being detained and deported back home one summer in the 1990s. He was first held in a police station on the outskirts of Beijing. Large numbers of detainees were clustered in one room in the hot summer. It was crowded and sweltering and there was not enough food or water. According to Liu, if you could bribe one of the officers, they might release you, and many of his hometown fellows did this to avoid being deported. Still, most of those deported returned to Beijing anyway, and often went through this cycle again and again. The common belief at the time, according to Liu, was that each local police station in Beijing had a quota of migrants they were supposed to detain, a situation that continued until 2003 when China abolished its Custody and Repatriation law. Many DEA workers I interviewed expressed relief that at least this worrisome system was no longer a problem for them today.

Lacking a great deal of reliable data, one way to chart the growth of Beijing's informal DEA sector is through the development of markets. Today there are several large markets selling used DEAs in the far suburbs of North Beijing, but in the 1990s pretty much all DEA repair and resale in North Beijing was located in one place: Wali (洼里) village near today's Beijing Olympic Park (see Figure 2.1). All Beijing recyclers from the 1990s remember this site where many DEA and other recyclable materials collectors and markets clustered. Among the businesses in Wali was a large used home appliance market called Likang Hongqiao (利康虹桥) selling appliances to consumers, and it is still so well known in Beijing that DEA dealers still mention Likang Hongqiao when advertising their businesses (Interview 16, 2016). Many DEA dealers wax nostalgic for those days when they feel that business was at its most profitable. Wali's recycling businesses were all demolished around 2003 when Beijing began building the facilities for the Olympic Games, but in its place several new large markets for recyclables and DEAs opened out beyond the 5th ring road

in Chaoyang, Tongzhou and especially Changping. These include not just used DEA markets but also dismantling clusters.



Fig. 2.1 Wali, the biggest DEA center in north of Beijing in late 1990s and early 2000, is part of Olympic Park now. Source: map.baidu.com

The average life-span of a CRT TV is about 16 years (Martine & Fu, 2004), so by the late 1990s, black-and-white TVs purchased in the 80s were increasingly being discarded and an end-of-life TV collection network began to emerge. When I talked with the ex-secretary of China Scrap Recycling Association about the development of Beijing's market, he said that by early 2004, there were four TV dismantling centers in Beijing (see Figure 2.2) dispersed in peri-urban villages of Suojia Zhuang (Chaoyang District), Houbajia (Haidian District), Fatou (Chaoyang District) and Hecun (Changping District) (Interview 4, 2016). They physically disassembled the TVs for parts (which were sent out of Beijing to be reused in TV and electronics manufacturing in south China)

and materials (plastic and copper for recycling). Clearly, even if the DEA business was not as profitable (on a per unit basis) in 2004 as it was in the 1990s, the sheer size of the sector had grown considerably.



Fig. 2.2 The TV dismantling centers in early 2000s in Beijing.

2.1.4 Late 1990s-2010: The boom years

Along with rapid GDP growth, increasing family incomes and improved standard of living, the consumption of electrical and electronic products increased dramatically in quantity and diversity at the turn of the millennium in Beijing. Air conditioners and personal computers quickly became common household items, chain stores selling new appliances emerged nationwide, and so did both retail and wholesale used appliances and electronics markets. Clusters of businesses specializing in DEA dismantling also emerged as the generation of DEAs increased. Due to

Beijing's continued urban expansion, rising land rents in the urban core, and the persistent harassment of informal recycling and DEA markets by city police, used DEA and dismantling markets moved frequently from the late 1990s into the 2000s. New waves of farmers from villages in Gushi County came to Beijing seeking opportunities in the ever-growing recycling and DEA sector. The proportion of DEAs flowing to dismantling steadily grew, and by around 2010 outnumbered those going to repair and reuse (with variations depending on the type of appliance), though in terms of economic value the reuse channel remained much more profitable on a per-unit basis.

In 2001, Beijing won the bid to hold the 2008 summer Olympic Games. This sparked an even greater wave of large-scale demolition and construction resulting in an increase of all kinds of waste, not just construction waste but DEAs as well as large numbers of households moved to new housing and, in the process, the selling of old appliances and the acquisition of new ones.

Beijing had a population of 15,278,000 in 2004 and a research article from that year estimated that 20% of household DEAs were heading for dismantling at that time (Martine & Fu, 2004). This included not just TVs, refrigerators, and washing machines (as in the 1990s) but also air conditioners and computers. DEA generation continued to grow dramatically between 2005 and 2008 (Interviews 14 and 11, 2016). Wholesale used air conditioners, washing machines, refrigerators and small appliances markets emerged in urban villages beyond the 5th ring road around 2003. These markets were almost always organized and built by a few highly successful informal recyclers and DEA dealers ("bosses") who had become rich enough to bankroll the startup funds to open a market and cut deals with suburban village governments. They would rent a plot of land from a village (or a work-unit in a village) and build compounds of DEA dealer stalls. Each stall typically included a one or two-room structure where informal dealers (typically a married

migrant couple) could live and store needed tools and equipment and a yard capable of holding several dozen to a few hundred DEAs (see Figure 2.3).



Fig. 2.3 The yard where the dealers live and work.

The “boss” would rent these stalls to DEA dealers. The quality of construction in such markets was always rough and cheap, as they were frequently subject to demolition. Some markets specialized in one form of appliance, but most had stalls with all kinds of DEAs: washing machines, refrigerators, microwave ovens, water heaters, etc. Wholesale markets could have a hundred stalls.

Pretty much all DEAs went to these suburban markets, with the exception of computers. Computers, primarily going for repair, reassembly, resale or dismantling to salvage parts, became a growing stream in the 2000s, but due to a variety of differences between computers and other

DEAs—the skill sets needed to analyze and fix them; the high price of working units and high value and scarcity of certain parts; and (at that time) the relatively elite and educated consumers seeking them—used computers flowed, not to the distant urban villages, but to Beijing’s busy IT area of Zhongguancun, in the Haidian District. Guang’an Zhonghai electronics market (广安中海电子市场) is a one-floor mall with hundreds of stalls run by individuals (see Figure 2.4). They cover a range of computer businesses including repair, reassembly of desktop computers and sale of used computers. New computers were still relatively expensive and hard for many people to afford, so the used business was very popular with college students in Beijing, and the computer markets were located in the university area. The other big repair, reassembly and used computer market is on the underground floor of Silicon Valley Computer Mall, also in Zhongguancun.



Fig. 2.4. Guang’an Zhonghai, the big secondhand computer market is in the area of Zhongguangcun. Source: map.baidu.com.

Over the course of my research I have learned that in Beijing the dismantling/recycling of DEAs began outnumbering the repair and resale of used appliances and electronics around 2008, and this trend toward increased dismantling continues today. However, computers are often an exception to such trends, and for laptops reuse and resale has remained dominant.

2.1.5 2008-present: Falling profitability in informal DEA sector

By the 2000s, children of some first migrants to Beijing began inheriting their parents' DEA and recycling businesses. Those first two decades were a period of almost uninterrupted expansion, and Beijing's DEA sector even continued fairly strongly through the 2008 global financial crisis because of the government's economic stimulus policies, some of which (like the Old for New appliance program) were directed specifically at stimulating the appliance market. But sometime around 2013 the prices for DEAs began falling; the drumbeat of demolitions of used DEA and disassembly markets, particularly in Changping, became relentless, and new markets have not kept pace. The DEA recycling business is increasingly unstable and risky for those who work in it. In the early 2000s, when a market was demolished almost all the dealers would simply follow their "boss" to a new location; but these days, when DEA markets are demolished, around 20% of dealers leave the sector (Interview 11, 2016).



Fig. 2.5. Zhongtan, the biggest secondhand air conditioner market from early 2000s to 2014. Source: map.baidu.com

This decline of Beijing's informal DEA sector is due to many economic and political factors: falling prices for used appliances; falling commodity prices; changes in the appliance quality that have made repair less cost effective; the advent of subsidies for formal companies; and increasingly restrictive and strictly enforced urban land-use regulations. As the remainder of this thesis describes these conditions in detail, they will only be briefly summarized here.

The flow of DEAs has changed dramatically since 2012. Large quantities of DEAs collected by the informal sector are now being diverted or sold to formal e-waste recycling companies. The obvious main reason for this diversion is the implementation of the Directive on Management of

Waste Electrical and Electronic Equipment Recovery and Disposal (废弃电器电子产品回收处理管理条例 or WEEE Directive) which subsidizes formal e-waste recycling companies substantially on a per unit basis so that formal companies can offer DEA collectors a price per unit that is equal or better than what they can make dismantling the units themselves. In sum, formal companies use the government subsidies to purchase DEA units from informal collectors. But there are other factors affecting the sector as well. Labor costs have been rising while the price of recycled commodities has been falling since 2008. Most informal dismantlers find it is no longer profitable to manually dismantle some categories of DEA such as CRT TVs or washing machines and air conditioners (see Figure 2.5) containing less copper. Although the DEA volume is much bigger than in the 1990s, the prices of used DEAs and dismantled materials have declined steadily since the 2008 recession. For instance, the prices of plastic, copper, aluminum, iron and steel which are the main materials derived from DEAs have dropped by one or two thirds (Interview 1, 2016).

This thesis will present evidence that government policies and the exclusion of the informal sector from any discussion or consideration in policy formulation has also negatively affected the informal DEA sector. Others have made similar arguments (Chi, 2013, Wainwright, 2015, Schulz, 2015, 2016) though not in relation to China's extensive informal *domestic* DEA sector. I argue that policies faulting the informal sector for the environmental problems of DEA management, excluding them from policy discussions, and denying their businesses formal legal status, have left these DEA recyclers in a very unstable and vulnerable position today.

Land use instability is a challenge the informal DEA sector has faced since it emerged. Because of its informality, people involved in the informal recycling and DEA sectors can only rent land temporarily in the name of commercial use. This is very different from the legal conditions afforded formal waste management facilities which land use regulations designate as

crucial urban infrastructure with guarantees of use permits lasting thirty to fifty years (Interviews 5 and 23, 2016). Clusters of DEA businesses and markets have been constantly on the move as Beijing has urbanized; the DEA collectors and dealers I interviewed who had been in Beijing since 2003 had moved their businesses from 6-10 times in the last 15 years, most starting from near the 4th ring road and now located around the 6th. Most troubling to them is that, according to land use regulations, such as the Index of Beijing's Banned and Restricted Development Sectors (北京市新增产业的禁止和限制名录) issued in 2014, Beijing districts are now banned from renting land—even for short term use—to labor-intensive sectors such as recycling and DEA markets (Interview 11, 2016).

2.2 Development of the formal “E-waste” sector

In contrast to the informal sector, Beijing's formal DEA handling companies have had a temporally shorter and, until recently, rather minor role in handling the city's DEAs. “Beijing has never had a real formal e-waste collection sector” the CEO of a big state-owned e-waste recycling company told me that (Interview 12, 2016) had worked in government supported formal recycling companies for decades, but by the time Beijing was generating substantial amounts of DEAs in the 1990s, that formal recycling sector had atrophied. Until around 2001, China's cities lacked any formal e-waste recycling sector of any kind, and since then the formal e-waste sector's development has tracked closely with the regulations and policies on e-waste coming from the Beijing and national governments.

2.2.1 2000s: Infant period

The Chinese government started issuing regulations and building e-waste disposal facilities when China joined the WTO (World Trade Organization) in 2001. China's entry into the WTO provided a huge boost to China's home appliances and electronics manufacturing industries, so China looked to OECD (Organization for Economic Cooperation and Development) countries for regulatory models.

In some OECD countries, electronics manufacturers are required to take part of the responsibility for collecting and recycling units when they reach their end of useful life; similarly, China began planning regulations that would make its leading electronics manufacturers partly responsible for the country's e-waste recycling. The revelation of severe pollution from e-waste disposal in Guiyu in Guangdong in 2001 further compelled the government to take responsibility for e-waste domestically. On these grounds, the National Development and Reform Commission (NDRC) in 2003 funded four e-waste pilot project disposal companies across China: Huaxin Environmental Company (the previous name of Huaxing Environment Group) in Beijing; Dadi Environmental Company in Zhejiang; Xintiandi Environmental in Qingdao; and Hechang Environmental Company in Tianjin. These four companies consistently lost money, however, because they were essentially just factories with equipment to shred DEAs, but they were never linked to any mechanism or system for collecting DEAs; in sum, they were factories without any supply chain. They found it impossible to acquire DEAs relying only on market mechanisms. (Interview 13, 2016). Huaxin in Beijing fared slightly better than the other three companies because when Beijing won their bid for the 29th summer Olympic Games, the city's "Green Olympics" slogan was tied to claims the city would institute sound waste management before 2008. Because of this, the Beijing municipal government required that all government departments,

schools, institutes and other tax-backed organizations must send their e-waste to Huaxin for free, otherwise they would not receive funds to buy new appliances or electronics. Even with this help, Huaxin's capacity was under-utilized and failed to make a profit.

2.2.2 2009-2011: Old for New Program

With the global economic recession in 2008, China's exports declined, and the government started promoting domestic consumption. The Old for New Program (OFNP) came out at this time with the purpose of stimulating domestic home appliance and electronics consumption. Under OFNP consumers buying new appliances at retailers could get a 10% discount on their purchase when they traded in their old appliance. Retailers in turn were directed to arrange with formal e-waste disposal companies to collect these used appliances and the local government subsidized these e-waste disposal companies for collection, transportation and disposal fees.

The OFNP was a turning point for China's formal e-waste recycling development. E-waste recycling regulations and over thirty new authorized e-waste disposal companies were launched, both state and privately owned. In Beijing, the two companies legally allowed to collect e-waste were Huaxin and TES-AMM Corporation China Ltd. TES-AMM had built their plant in 2006 in Beijing and received a hazardous waste disposal permit and was listed as an authorized e-waste disposal unit in 2009. Huaxin processed six to seven million pieces of e-waste annually from 2009 to 2011. The items they disposed were mainly e-waste listed in the subsidized scope: TVs, washing machines, refrigerators, air conditioners and desktop computers. They collected e-waste directly from retailers, and, regardless of the condition of the appliance, all units had to be processed into commodities; the regulations left no room for any repair, reuse or salvaging of parts.

The OFNP and subsidy encouraged investors to fund the building of more e-waste disposal companies. The Ministry of Environmental Protection responsible for e-waste management also accelerated their issuance of e-waste recovery and disposal directives the year after the scheme ended. There is no mention of repair and reuse in the policies. These newly established companies are purely dismantling businesses; some can handle the hazardous waste from dismantled e-waste, but none cover repair and reuse.

2.2.3 2011-present: Sustainable subsidy period

The State Council issued the WEEE directive in 2009, and it entered enforcement on January 1, 2011. This was the first directive which required appliance and electronics manufacturers to pay for e-waste disposal; it then shifted these funds to supply subsidies to authorized e-waste disposal companies on a per unit basis. The funding mechanism and subsidy quickly attracted more companies into the e-waste disposal business. There were forty-three authorized companies on the government's list in 2012; by 2016 there were 109. The government has declared their combined capacity sufficient for the country's e-waste flows and has stopped issuing new permits.

With the subsidy, the authorized e-waste recovery and disposal companies have not only grown in number, they also are processing more and more e-waste diverted from the informal DEA sector, because they have money to buy DEAs from informal collectors. To become an authorized company entered into the list requires several permits including an e-waste disposal permit from the prefectural level Environmental Protection Bureau and approving reviews from four national level bodies: the Ministry of Environmental Protection, the National Development and Reform Commission, the Ministry of Industry and Information Technology, and the Ministry of Finance. The process of administering subsidies is quite complex and is detailed in Chapter Seven. In theory,

the companies are supposed to be of the proper scale to handle e-waste flows produced within the province or region where they are located; but there are no rules constraining where companies can source their e-waste, so cross-provincial sourcing is allowed, and, indeed, is commonplace. Beijing's companies primarily source their units from the informal DEA sector in Beijing, but they also purchase some e-waste from Beijing's neighboring provinces. In order to get e-waste directly from consumers, Beijing's formal e-waste companies have been experimenting with designing and implementing e-waste collection programs in residential communities and commercial units since 2011. In Chapter Six I describe my observations of such a pilot project being tried by Huaxin.

The WEEE directive and its funding mechanism has resulted in a form of cooperation between segments of the informal DEA sector and the formal e-waste companies. Since 2012, more and more end-of-life DEAs collected by the informal sector are flowing to authorized e-waste disposal companies in Beijing. As I will describe in the following chapters, this collaboration works rather effectively in the disposition of DEAs headed toward dismantling. However, Beijing's policies in relation to the informal sector—a wide array of land use, migrant household registration, and other policies that create profound difficulties for the informal sector to be described in detail in the chapters that follow—not only endanger the informal sector's well-organized DEA collection, repair and reuse networks, but even threaten to undermine the currently functioning collaborative relationship between the informal and formal sectors. I will argue in the following chapters that the more productive and environmentally sound policy direction regarding the informal DEA sector—which has effectively managed DEA repair, reuse, and recycling over the past two decades—would be to acknowledge the informal sector's crucial contribution to DEA management and include them as stakeholders in planning policy in the future, rather than continuing to crack down on them.

The informal sector's daily collection, cleaning, repair and dismantling work has managed Beijing's DEAs over the past three decades. But in facing a combined onslaught by a myriad of forces—new e-waste policies, the exclusion of informal stakeholders from municipal planning, an intense government push to remove rural migrants from major cities, a protracted recession in China's recycling sector, falling commodity prices, and trends in appliance and computer design and marketing that promote disposal over repair—the informal DEA sector is facing an unprecedented challenge today. Whether the informal sector is given consideration in the new e-waste recycling policies by the government may well decide whether informal DEA workers will continue to survive. Beijing's policy to disregard and eliminate its urban informal recycling sector (a policy that is almost universally followed by Chinese municipal governments) is quite contrary to what we find in the cities of many other developing countries (e.g., India) which have come to realize that informal recyclers are important stakeholders whose livelihoods and expertise are of great social and economic value to urban and environmental management (Chakraberty, 2014; Gutberlet, 2015). As will become clear in the following chapters, the basic understanding of the historical evolution of the Beijing's informal recycling sector is crucial if we are to better understand how the informal recycling system works today as a skilled and resilient networked infrastructure managing the city's DEAs.

Chapter 3: DEA Collection by Community Recyclers

Summary: This chapter examines the collection of discarded electrical appliances (DEAs) in residential communities by scrap collectors (收废品的人). There are four main links through which household DEAs move from residents into channels of reuse or dismantling: 1) community recyclers; 2) roaming DEA collectors(收废家电的小贩); 3) appliance retailers through Old For New Programs; and 4) formally registered “e-waste” collecting and dismantling company pilot programs.

The first two channels are informal sector, the latter two are formal. This chapter describes the first channel, community recyclers, who comprise, by my estimate, the largest channel through which DEAs are collected. The other three channels will all be described in later chapters. Our window onto community recyclers will be the Mas, a husband and wife team of migrant community recyclers whom I met in 2011 and have visited often over the years. I met them through my colleague Mao Da who lived in the residential area where the Mas’ recycling collectors. Since then, I have often visited the couple to follow the changes of Beijing’s community recycler and invite Mr. Ma to meetings about policies affecting recycling. In June 2016, I followed their work for a month, and during less busy periods or when it rained we would sit and have natural conversations about their work and life.

Through the lens of the couple’s collection, I argue that scrap collectors provide efficient door-to-door service, their daily collection not only helping DEA generators get rid of their unwanted objects, but also making reuse and resource recovery possible, passing DEAs to the next handling stage in line with market demand. While the reverse logistics of this first stage of DEA collection might at first seem quite simple, the Mas’ story reveals its complexity. Their long tenure as community recycling collectors has involved building their business through trust and

perseverance, handling many social, business and local regulatory obstacles, managing the logistical challenges of DEA removal and sorting, and keeping up with the markets for constantly changing appliance models.

3.1 Becoming Community Recyclers in Downtown Beijing

Mr. and Mrs. Ma have worked at the corner of the Huayuanli residential community, between the North Third and Fourth Ring Road, collecting recyclables since 1991. Their truck is usually parked on the sidewalk of Minyu Road. The truck symbolizes that this collection site belongs to them and, except for a few hours every evening when they drive to the suburban recycling markets to sell their daily collection of materials, is always parked there. The Mas leave the truck at their collection site overnight, and each morning arrive with their basic collection tools: an electric-tricycle cart, ropes, string, scale, bags for sorted materials, a calculator, and notebooks. Mrs. Ma is responsible for taking care of the site, collecting all recyclables (paper, plastic, etc.) which people bring to their site, weighing and sorting them. Mr. Ma, often using his electric cart, provides home collection of DEAs and bulky quantities of materials generated by residents, restaurants and work units. Their collection scope covers around two blocks to the south and one block to the west and north of their site (see Figure 3.1 and Figure 3.2).



Fig. 3.1 The Mas' collection site and collection scope, covering at least four blocks with both residential and business sectors. That spans one station of the subway with length and width around 1.3 km. Source: map.baidu.com



Fig. 3.2 Mr. Ma removing an air conditioner from a building after purchasing the appliance.

The government officially often uses the term e-waste (电子垃圾) to describe this sector, but the Mas never do. In their eyes, the used electronics and appliances are not waste, but items to be either cleaned up and reused or dismantled for parts and materials. Mr. Ma calls them “discarded refrigerators,” “discarded TVs,” “discarded computers” etc. (废冰箱， 废电视， 废电脑).” When daily collection is done, the couple upload all recyclables collected to their truck, placing the large DEAs on the top because they will need to unload those items first, selling them at a trading site (Lincuiqiao, see Chapter Four) on their way to the recycling market.

The Mas are both from Gushi county, the most highly populated rural county in all of China. They married in 1988, but found it impossible to survive on their family’s allotment of just one mu (0.06 ha) of farmland. Mr. Ma had tried working odd-jobs such as building houses in the village to make extra money, but it was not enough after they had their first child in 1990. Seeing that relatives and neighbors were earning money in Beijing, the couple decided to seek opportunities in the city as well. In 1991 Mr. Ma left for the city, following his cousin. When he arrived in Beijing, he temporarily lived in the house of Mrs. Ma’s classmate’s cousin for a week. Originally, he planned to get a stall in a wet market selling vegetables, but he switched to recycling when he learned about it from other relatives who had come to Beijing earlier. Mr. Ma bought a three-wheel bike-cart. He lived in Wali village in North Beijing, the biggest center of informal recycling markets at the time and a dense enclave of Gushi migrants living in close packed temporary housing.

Every day Mr. Ma pedaled about a dozen kilometers to Ciqikou (磁器口) in South Beijing, where he plied the streets buying and picking recyclables and then biked back to Wali each evening to sell his haul at the recycling markets there. After a year as an itinerant collector, Mr. Ma was

joined by his wife and, realizing they could collect more materials at a fixed location in a residential community, they undertook a concerted effort to establish themselves at Huayuanli in 1992.

Back in the early 1990s, migrant recyclers competed fiercely (and sometimes even violently) for stable collection sites proximate to residential communities, often paying property management companies to work at a site; those without such arrangements were forced to roam streets and alleys to buy or pick recyclables. Hearing that the Huayuanli site was quite productive, the Mas decided to compete for it. The area lies between the Third and Fourth North Ring Road and in the mid 1990s was home to residential communities as well as some lively commercial sections with restaurants and offices. Their strategy was to come to the site earlier than others, so the couple would ride their bike-cart to Huayuanli around mid-night and stay until day break. Mrs. Ma would then stay at the site collecting recyclables while Mr. Ma roamed the area buying recyclables. After about four months of this exhausting routine the couple finally succeeded in establishing Huayuanli as a stable collection site. Mrs. Ma told me repeatedly that to save money they had breakfast at home, skipped lunch, then went back home to have a quick dinner before biking back to the site at midnight. There was a noodle shop next to their collection site, and the soup smelled so good, and even though a bowl cost only two Yuan (0.33 cents) she never bought any, even though she would go from before dawn to dusk without eating.

3.2 Relationships with local officials, Chengguan and residents

Having won the four-month-long battle with other informal collectors for this stable site did not mean that everything went easily for the Mas, and indeed their struggle to keep their site has never stopped over the past twenty-five years. Over those years the couple has needed to manage relationships with property management working groups (物业管理小组), the Residential

Community Office (居民委员会), the Chengguan (short for Chengshi guanli xingzheng zhifa ju 城市管理行政执法局, City Urban Administrative and Law Enforcement Bureau) and community residents. Over my month of field work with the Mas, I found that they had built good relationships with residents and other stakeholders in the community. The mutual trust between the Mas and residents is based on the Mas' hard work (they work without breaks for weekends or holidays) and good quality of service.

The Mas' collection site is just to the left of a residential community's gate. This residential community was built in the early 1980s by the government and allocated to the Second Porcelain Factory in the planned economy era, so there is no property management company for this community, but there is a property management working group. In the early 1990s, this working group repeatedly roused the couple from their collection site, stating that their work made the neighborhood dirty and disordered. But the couple persisted in returning before dawn every morning, and the management group gradually realized the couple cleaned their work area very well every day and provided convenience for the residents, and so stopped harassing them. Unlike in many other communities that charge informal collectors a fee to stay at a collection site, this working group has never tried to extract a fee from the couple.

The Mas' collection site is under the administration of the Xiaoguan Residential Community Office. Although they don't have to pay to the property management working group, they were required to pay the Street Community Office 100 Yuan monthly throughout the 1990s. In the 2000s the Mas paid a recycling company affiliated to the Street Community Office 300 Yuan monthly, even though this recycling company was only a shell entity that did no actual recycling. Several years ago, this recycling company went bankrupt, and the Mas have not paid the Street Community Office since then. Mr. Ma helps the office by picking up large items like sofas and

beds residents dump on the neighborhood streets at night. This is a service he provides at no cost as part of the Ma's strategy for maintaining good relations with the Street Community Office.

Most challenging is the couple's relationship with the Chengguan. A group of officers from this bureau oversees the proper appearance of the city's streets and prior to 2003 were entitled to arrest any migrant worker (under the provision that they lacked permanent Beijing housing permits) under the Custody and Repatriation procedure. The Chengguan would often come to the Mas' collection site and confiscate their three-wheel bike cart and tools. For years the couple had to pay a supervising official's 200 Yuan monthly phone bill as a bribe until in 2000 they established a good relationship with someone within the Residential Community Office who got them out of that arrangement.

Throughout the 1990s collections rates rose, while at the same time recycling markets moved farther and farther from downtown, so in 2005 the Mas scaled-up and bought a truck (which they still used in 2016) to transport their materials each day. After purchasing their truck in 2005, the Mas registered with the Chaoyang District Office of Commerce, buying a 4,000 Yuan license so as to curtail Chengguan harassment. Though Chengguan officers occasionally accost them for creating an environmental nuisance, such harassment is now infrequent. Still, during events such as the Beijing Olympic Games, national holidays and Communist Party Conferences they are informed by the government to stop operating their site.

After over twenty years, Mr. Ma knows many of the personalities and households in the community. There seem to be very few complaints from residents, and many called Mr. Ma "little Ma" to show their affection. In particular, older residents have seen the Mas age from their early twenties into their late forties; two old women residents often volunteer to help them sort paper and plastics. In 2006 the Mas moved into a small house in a yard in the southeast corner of the

residential compound. The room belonged to a private company whose boss used to sell all his recyclables to Ma when his company had a project there. When the project ended, that boss decided to let the Mas live in the two-room house for free when he learned how hard it was for the Mas to find affordable housing in Beijing's suburbs. These examples offer some indication of how the Mas and the work they do are woven into the fabric of the neighborhood and of the city. The couple productively contributes to the urban economy with their labor, but also to the affective geographies of daily life in Huayuanli.

Summer is the busy season for e-waste collection. In summer, the consumption of large electrical equipment such as air conditioners, washers and refrigerators rise. The Mas collect at least one large DEA daily, and average around four large DEA units daily as well as many small items like cell phones, water heaters, electrical fans etc. According to the Mas, there are not so many DEAs in winter and spring. DEAs are the highest value items the Mas collect, especially those that can be reused; they can earn at least 50 Yuan (8.0 US Dollar) from each reusable DEA. However, the couple repeatedly mentioned that since the 2008 recession, both scrap and DEA recycling have been steadily declining in profitability.

3.3 Up to the Door Collection of large DEAs

In the 1990s and early 2000s, the Mas generally provided up to the door collection service for all recyclables to any customer who asked. But since 2008 the prices of recyclables have fallen steadily, so that in the last few years they have stopped doing residential household collection except in cases of high value or large volume materials. DEAs, unlike other reusable items or recyclables such as paper or plastics, are still in the scope of up to the door collection without any conditions.

Since they have been at this site for over twenty years, most residents in the area know them well, and many keep Mr. Mas' cell phone number, which is also posted on the window of their truck which is always parked at their site except for the few hours during which they transport their recyclables to the market. Residents who want to sell their DEAs either call Mr. Ma or come to their collection site to make an appointment for a pick-up. No matter whether these customers are old or new residents, Mr. Ma asks them a few questions about their DEAs and then gives a ballpark price for each item; he uses this exchange to gauge whether the resident is serious about selling or just wants to consult about price. Mr. Ma's questions include: for color TVs: What size? CRT or flat screen? For a washer: Single cylinder or twin-tub? For refrigerator and air conditioner: Does it have an energy-saving label? The resident might bargain. If they cannot make an agreement on the general price, Mr. Ma will not pick up their DEA; if the customer agrees with the general price Ma proposes, Ma will schedule a collection. With new residents Mr. Ma asks for an address and phone number, but in many cases, he is already familiar with the customer and does not have to do so. Most collections are scheduled and completed on the same day. The Mas only provide pick-ups for large DEAs such as washers, refrigerators, or TVs. Smaller items such as cell phones, landlines, electrical fans, and other small items are usually brought by customers to the Mas truck (see Figure 3.3) as are other recyclable materials such as plastics and paper where prices are paid based on weight.



Fig. 3.3 DEAs at the Ma's collection site. The items will be loaded onto the Ma's truck in late afternoon.

Residential DEA collection not only requires intensive labor, but also several skills including customer service to DEA generators, DEA evaluation and pricing, the mechanics of DEA removal and loading, and knowledge of the materials from which various types of DEA are made. Following Mr. Ma on his DEA collection, I observed his professionalism and skill set.

When going to collect large DEAs from residents, Mr. Ma rides his electric cart for transport. For air conditioners, he also takes specific tools to help him take the unit down and remove it from the apartment. After looking at a DEA's appearance and checking its functioning for possible reuse, Mr. Ma then offers a price.

Ma's knowledge of DEAs generally derives from two sources. One is from the downstream dealers to whom he sells. These dealers tell him the factors which decide the prices of various DEAs and sometimes explain how to evaluate specific functions and components of various models. The second route is through his own years of experience dismantling DEAs, making him highly familiar with what kind of materials can be extracted from various appliances and hence able to gauge the market values of DEAs for both reuse and dismantling. Because the Mas sell DEAs every day, they are constantly updated about their markets, and they adjust their collection prices accordingly.

Items	Price for Dismantling	Price for Reuse
CRT TVs	30-50 Yuan	30-50 Yuan
Flat screen panels	30-50 Yuan	80-200 Yuan
Washers	20-30 Yuan	30-50 Yuan
Refrigerators	40-50 Yuan	50-60 Yuan
Air conditioners	100 Yuan	150-200 Yuan
Computers	30-50 Yuan	50-200 Yuan

Table 3.1 Prices of large home appliances at the collection level in June 2016

For CRT TVs, because there is very little reuse demand in the market, whether black-and-white or color, the only factor that affects its price is size (not the model, physical condition, functionality). The prices range from 30 Yuan (\$4.20 US) to 50 Yuan (\$7.20 US). The prices for flat screen TVs, especially liquid crystal TVs, are much higher because the demand for used flat screens is still high. Ma has learned to discern between plasma, LED, and LCD flat screen TVs, otherwise he would lose money. LCD TVs are of highest value on the market while plasma and LED screens fetch lower prices. First, Ma checks whether the screen is broken. If so, the TV's

value drops dramatically. If not, he plugs it in, and checks if it still works well. The broken screens are almost the same price as the CRTs, but one needing only minor repairs or fully working ranges from 80 to 200 Yuan depending on size. For each CRT, Ma makes about 10 Yuan, but he can make around 50 Yuan on flat screens. Having collected CRTs for over 20 years, Ma is very familiar with the value of their components and their changing markets. Up to around 2008, if Ma could not sell a CRT for reuse, he would sell it to a few small family firms that specialized in CRT dismantling because he found he made more money selling to these dealers than dismantling them himself. Those family dealers no longer exist; almost all CRTs now flow to authorized e-waste recycling companies (see later chapters). During the period of my observation, Ma collected more CRTs than flat screens. He collected at least one set each day and did not store them, but always sold them to a dealer the same day. Most of his flat screens went to used DEA markets if the screen was not broken.

Collecting washers requires different skills. The main element is determining whether the electrical motor is made of copper or aluminum, which Ma can determine from the machine's make and year. Ma's price for washers with copper motors is 10 Yuan higher. Washers manufactured before 2008 have mostly copper motors, more recent makes are often aluminum. Ma also opens the washer's bottom cover to check, but this can be misleading as sometimes the aluminum is copper plated, a distinction that Ma learned about when selling downstream; if Ma fails to tell the difference, he will likely lose money on that washer. The other very important skill is judging whether a washer can be sold to used DEA dealers. Several factors come into play, including the functionality of the machine, its age, and its efficiency rating according to the China Energy Label. The rating scale is divided into five levels, with the first being the most efficient. More recent and fashionable models with first and second ratings for energy efficiency usually go

to the used appliance market. Ma estimates that in recent years only around one third of those he collected went to these reuse markets; the majority are now going to dismantling (which suggests how technical changes in manufacturing are negatively affecting the useful lives of appliances). The average price of washers going to dismantling is 30 Yuan. Washers that can be reused usually fetch 10 to 20 Yuan more. Ma does not dismantle washers himself because (when figuring in the time spent dismantling as a labor cost) he does not make any more money selling dismantled materials than he does selling to traders who specialize in dismantling washer. In general, the Mas do not dismantle large DEAs because they can more profitably use their time on other work.

Considerations regarding refrigerators are almost the same as for washers. The collection price for refrigerators is 40 to 50 Yuan on average, and the evaluation regarding reuse or dismantling is almost the same as with washers. One big difference is that, while all washers collected are sold within a day or two, the Mas store some secondhand refrigerators that they collect in the winter for sale in the early summer when they have noticed used refrigerator demand and prices are higher.

Compared to washers and refrigerators, air conditioners are more valuable because they have more copper and aluminum. They are typically comprised of two pieces of equipment, indoor and outdoor. When Mr. Ma collects air conditioners he is responsible for taking these two pieces down. Removing the outdoor piece requires tools to cut the cable connecting it to the indoor unit and to cut the iron brace supporting the outdoor unit, a chore that is rather dangerous on the high floors. When talking about the risks of taking down air conditioners, Ma said that he has become more courageous as he has gained experience but recalls often trembling with fear in his early years. One potential environmental problem in Ma's air conditioner collection is that, for units destined for dismantling, he releases the coolant straight into the air, though he generally manages to save

the coolant if the unit can be reused. Fortunately, few of the units are so old as to have chlorofluorocarbons as coolant.

Ma estimates that around eighty percent of the air conditioners he collects go to the used DEA market. The first step in evaluating an air conditioner is plugging it in to check if it works well, and then looking at the model, size, and year. Top brands such as Haier, Gree and Midea sell well if they still work and are less than ten years old. Based on this information, Ma gives a price to the resident. For broken units Ma offers around 100 Yuan, ones for resale range from 150 to 200 Yuan. Because there is a great deal of copper in air conditioners, Ma will dismantle the big ones if time allows as he can make more money than by selling it to a downstream dismantler. Ma also stores some air conditioners waiting for a better price. During my fieldwork, a secondhand air conditioner dealer came to Mr. Ma's home to buy all the units he had in storage, twelve in all. Ma explained he was storing so many because he expected their prices would rise as the summer advanced. Prices of units for dismantling had dropped a lot since last year due to the drop of secondary metal and plastics prices and had not recovered during my fieldwork period. Still, Ma makes a greater profit from air conditioners than from the other large items discussed above, anywhere from 10 to 50 Yuan per unit.

I did not see Ma collect many laptops in June, but he did collect several desk-top computers with both CRT and flat screen monitors at prices ranging from 50 to 80 Yuan. CRT monitor computers have no resale market, so Ma did not bother to check whether they worked or not. He did plug in flat screen monitors to check how they worked, setting his price based on the wear, production date, and memory capacity. More recent computers with Intel i5 and i7 generally flowed to reuse while older models usually went to the dismantling market.

According to Ma, there were several reasons why there were not as many desk-top computers being discarded now as a few years ago. Many families bought new computers during the Old for New Program from 2009 to 2011, but since 2011 laptops, tablets and smart phones have replaced desk-tops in many households. Young people tend to use on-line platforms to sell their used laptops, tablet and smart phones, or they just store them because they do not take as much room as large home appliances (more on this in chapters Six and Seven).

Ma also provides up to the door collection service for other large DEAs such as water heaters, electrical water purification machines, and stove ventilation hoods, all of which have demand in the used appliance market. When Ma collects them, he checks if they work well and the brand. Because only top brands will be reused, he does not care so much about low-price models. Both Ma and the resident may make concessions about a price, and when they agree then the deal is done. Ma pays cash to the resident, and he carries the item on his back or with his hands downstairs to his tricycle. The baseline for each deal for Ma is that he can earn at least ten Yuan on each item. If he meets with something new for him and cannot decide the price, he will usually check the materials which an item is made of and offer a price based on the weight of those materials.

According to Ma, when it comes to DEAs going to dismantling, older models are almost always worth more than newer ones because older models almost always have higher metal (especially copper) content than new ones. Given the range of appliance types and over two decades of changing models and makes, making the right pricing decisions on Beijing DEAs is complex and requires both years of experience as well as keeping updated on the ever-changing DEA re-use and commodities market trends.

3.4 Small items, second round trade and transportation

The Mas' truck collection site is like a hub. Every day, there are several groups of people specializing in buying DEAs, used clothes, and furniture who come to their site seeking what they want to buy. In the afternoon, a few large DEA traders seeking washers, refrigerators, air conditioners, TVs, water dispensers, microwaves ovens etc. come by. Some come with a Pingbanche (平板车), a kind of home-built motorized tricycle cart developed by DEA traders with around a one-ton load capacity. Others use vans or seven-seat private cars because trucks are not allowed to run during daytime within Fifth Ring Road in Beijing.

The Mas also collect all kinds of small appliances such as electrical cookers, land line phones, cell phones, cameras, keyboards, CVD and DVD players etc., but residents need to bring these items to their collection site. Mrs. Ma weighs them and buy them at the price of plastic or iron depending on her judgement of the materials which the items contain and sets them aside. Among the smart phones and tablets, top brands such as Apple and Samsung are never seen, and most cell phones collected are old and have no market for reuse. Several traders specializing in used phones, laptops, cameras, etc. visit their site daily to buy these small items. When the Ma's sell these items, it is not by weight but by piece. Each cell phone goes for 5 to 10 Yuan depending the value of its materials; the specialized buyers report that some old units contain more valuable precious metals than the newer models. These collectors roam downtown, buying from dozens of collection sites like the Mas; most do not dismantle the collected items, but rather sell them downstream to other dealers who dismantle them for their material value.

3.5 Multiple pathways of informal trade

While for narrative purposes I have chosen to focus each chapter on the primary activities occurring at each site, it should be remembered that every site of DEA collection and trade is a space where multiple transactions are possible, and this is also true of the Mas' collection site. Here are a few examples of different trade paths: 1) Some residents, particularly rural migrant tenants, go directly to the Mas hoping to buy used home appliances for their own apartments, though he typically does not have what they are looking for on any given day and so these residents often return daily to inquire; 2) Some roaming DEA traders, rather than buy DEAs directly from residents, buy them from community recycling collectors like the Mas; 3) Some dealers who specialize in particular appliance types (only TVs, or only washers, etc.) do the rounds of downtown residential recycling collection sites buying items from collectors.

The above three paths of trade are fairly common, but each involves a trade-off. Path 1, for example, cuts out links in the typical chain of DEA trade, but while this might shave down the price for the consumer seeking a used appliance, it is a hit and miss process that can involve several unproductive trips to the community collector (as compared to shopping at a large used DEA appliance market where a large selection of used appliances is always for sale). Path 2 may also collect materials directly from the residents if they often come to the same area. Path 3 can sometimes involve a specialty dealer doing rounds of collectors and finding several collectors have no items to sell them, or it can entail arranging meetings when the community recycler has a large stock of DEAs (as in the case described previously where the Mas sold a dozen air conditioners to a dealer). What is important to note here is that this kind of flexibility and range of activities at every site in the informal system is distinctive when compared to formal channels of trade where

the forms of processing and transaction are usually much more narrowly defined (see subsequent chapters for further detail).

3.6 Competition for DEA collection from Appliance Retailers and On-line Platforms

When following the Mas, I talked with residents who have DEAs and come to Mas collection site to talk prices. Most said that they considered two other possible channels for selling their units: appliance retailers that offer old for new trades, and on-line exchange platforms, some affiliated with formal “e-waste” companies.

During the Old for New Program (OFNP) from 2011-2013, appliance retailers became designated agents to collect DEAs from consumers, passing DEAs on to government authorized e-waste dismantlers. Although the central government’s OFNP has ended, several appliance manufacturers still support such exchange events to promote sales, and appliance retailers continue to collect and channel DEAs. One resident near the Mas’ collection site knew the couple but, after consulting Mr. Ma about a price for his used air conditioner decided instead to sell it to the retailer because they could offer him 40 yuan more. With the proviso that my sample selection is biased as I was located at a residential collector’s site (and not at a retail outlet), most residents I interviewed said they choose to sell their large DEAs to community based collectors like the Mas because it was convenient and saved time. Many also said they trusted the Mas since they have been in the community for such a long time. But the most important factor seemed to be that collectors like Ma provide up to the door collection, scheduling a pick up is very easy and much less hassle than transporting an appliance by car or taxi to a retail store.

The other channel for residents to sell their used electronics, especially top brand smart phones, laptops, digital cameras, and tablets, are on-line platforms such as Taobao (淘宝), Xianyu

(咸鱼), and some on-line based used electronics collection companies such as Loving Recycling (爱回收) which collaborates with Jingdong (京东), one of the biggest daily use on-line retailers in China that collects used smart phones and laptops. People who have used electronics will post information in Taobao and Xianyu, which is an information sharing platform also utilized by some used electronics dealers. Jingdong, Taobao and Xianyu all provide apps through which consumers (typically under 40 years of age) can order up to the door collection services. These on-line platforms attempt to ride the wave of China's recent on-line shopping boom. However, for large DEAs, especially ones that are likely destined for dismantling and therefore fetch relatively low prices, community based informal collectors remain the dominant network.

3.7 Current Policy Pressures and Economic Trends

Over thirty years of rapid urbanization, Beijing's policies have never acknowledged migrant workers' contributions, but rather, conversely, the government tends to blame them for social problems and through various policies has sought to expel them from the city. In recent years, pointing to problems of air pollution and a new planning model, the city has refocused on controlling population flows, banning the development of labor intensive sectors, and adjusting its daily use supply chain. For example, street breakfast stalls and recyclables collection are done by the unregistered entities; the city wants to attract big companies to invest in these fields and exclude the unregistered vendors from the street.

In 2014, the Beijing municipal government issued the document List of Restricted and Banned Sectors in Beijing's New Industries (北京市新增产业的限制和禁止名录) within the city. Among the activities to be banned are the city's informal recycling businesses and markets. Since then several of the city's largest DEA dismantling yards, used appliance markets, and

recycling markets have been closed. Migrants in the dismantling, repair and reuse sectors have had to move, and these closures have had immediate effects upstream, causing collection prices to drop and destabilize. Such policies are not just targeting recyclers; a broad range of migrant businesses are being targeted. For example, since 2014, all farmers' wet markets, where most residents bought their produce, have been closed, forcing tens of thousands of rural produce sellers from the city. Seeing this, the Mas feel very uneasy and pessimistic about their future. They predict they might be the next to lose access to their collection site. And of course, as I write in late 2017, an unprecedented wave of migrant enclave demolitions and evictions is underway in Beijing. For informal recyclers, there is nothing unique in this, though the scale of the rapidity of the evictions has drawn international attention.

3.8 Conclusion

In general, there are several factors currently impacting DEA collection in Beijing: the drop in commodity prices, the demolition of reuse markets, policies on DEA collection and processing, the rapid pace of Beijing's urbanization, and the city's anti-migrant population control policies are all major factors. Of course, changing consumption patterns are also central to DEA collection and reuse flows. In China today, on-line shopping has become an extremely powerful trend reshaping consumption habits. Many on-line DEA platforms have emerged in recent years trying to attract younger consumers to use them to sell or donate their DEAs.

Mr. Ma believes that quantities of DEA generation in the city are closely related to policies related to the floating population and Beijing's urbanization, because whenever there is residential demolition, households tend to discard their appliances whether they still function or not. In general, people moving out, moving in, or refurbishing their homes tend to sell and/or buy

appliances, so demolition, construction and flows of migrant tenants are all linked to DEA sector activity. At least half of the cases of DEA collection I saw during my fieldwork fit into one of these situations. For example, a young couple selling a washer, refrigerator, TV and air conditioner had just bought a house in another neighborhood and so were discarding all their appliances. The husband came to their collection site to ask Ma to collect all their DEAs. With the floating population declining, more used appliances are being sent to neighboring provinces and, in the case of flat screen TVs, are even being exported to Southeast Asian or African countries. Such long-distance transport increases the cost of circulation, which leads to collectors having to sell DEAs at lower prices than before. Also, declining demand of re-usable DEAs means more DEAs are now heading to dismantling, also cutting the profits for collectors. Market trends for new electronics and appliances also are not helping, as many such products are becoming inexpensive enough that populations that used to buy used DEAs are now opting instead for new ones.

In terms of specific government policies, three have had strong direct effects on informal DEA collection. One is the OFNP. In Mr. Ma's estimation, DEA generation dropped by around 70% immediately after the program ended in 2011 because large numbers of residents replaced their old home appliances with new ones under the program. He says that DEA flows have never recovered their pre-2009 rates since then. The 2012 roll out of WEEE directive subsidizing formal e-waste companies on a per unit basis has also had a strong effect on the informal sector, leading many informal DEA traders to stop dismantling scheduled units, especially lower value units. The third policy powerfully affecting the informal sector is the List of Restricted and Banned Sectors in Beijing's New Industries, a Beijing regulation banning the recycling sector as a low-value form of land use. This policy is leading to the permanent shut down and demolition of DEA reuse and dismantling markets, forcing many migrants involved in repair, reuse and dismantling to leave

Beijing's DEA sector. Others are shifting to more hidden locations. In addition to destabilizing the DEA processing network, it is pushing DEA transport higher as reuse and recycling markets must move further and further from Beijing districts (more on all this in Chapters Four-Six).

The commodity prices for the main materials derived from DEA dismantling (plastic, iron, copper, aluminum) have all generally been declining in China since 2008. Mr. Ma has a very clear picture of these price shifts. According to his observations, the price decline was not so bad in 2009 and 2010 (the years of China's massive stimulus plan). 2010 was a turning point for recycling markets, and since then, almost all prices for recyclables have dropped again and again. Mixed plastic priced at 3.5 Yuan in 2010 had dropped to 0.8 – 0.9 Yuan in 2016; iron's price decline matched plastic; aluminum had fallen from 17 to 7 Yuan and copper from over 70 to about 25 Yuan. These changes have led to declining profits all along the informal DEA processing chain. For example, in 2010 Ma could sell models of air conditioner with high material yields for dismantling for 350 to 400 Yuan, but today he sells them for around 200 Yuan. In general, the DEA prices have dropped by around 50% since 2008. These broad changes to Beijing's DEA economy are explored in more detail in the upcoming chapters.

Chapter 4: Trading Sites

Summary: This chapter presents the two dominant kinds of DEA trading sites: roadside and urban village yard trading sites. Among the various processes that occur at these sites, one of the most crucial is the differentiation of DEAs into those going to repair/refurb/resale/reuse (Discarded Electronic Appliances for Reuse: DEAR) and those headed to dismantling (DEAD: DEAs for dismantling). I visited roadside and yard trading sites throughout August 2016, observed the trade and talked with both buyers and sellers. Through these visits and conversations, three major empirical findings emerged: 1) Informal DEA trade channels goods to reuse as well as dismantling—it is much more than simply a path to waste disposal. At these sites DEAs are divided between DEAR and DEAD dealers. Few of the DEAs traded at these sites directly enter a waste stream that carries the items directly to landfills, incinerators, or open dumps. 2) Over the last decade the proportion of DEADs in the DEA stream has been rising for several kinds of appliance, though the quantities vary for different appliances. 3) Beijing’s DEA trade sites are currently under increasing threat of demolition and crack down.

4.1 Roadside DEA trade

Beijing’s roadside DEA trade sites evolved out of the transportation flows of the DEA and recyclables trade. After a day collecting recyclables and DEAs in the dense and affluent city center, late afternoon sees collectors heading out to the distant, low-rent urban villages to sell their materials at the scrap recycling markets there.

Back in the 1990s, when Beijing was smaller, less developed, and the quantity of DEAs was relatively small, DEA resale and dismantling stalls often collocated with scrap recyclers in the same market clusters. As mentioned previously, Wali village, between the Third and Fourth Ring Roads, was the main scrap recycling and DEA market cluster in North Beijing in the 1990s, and the gamut of recycling, repair, dismantling and used DEA sales could be found there. With expanding urban development, rising land rents, and other urban development pressures, scrap markets located between the Third and Fourth Ring Roads were all demolished by the early 2000s, and shifted to more distant urban villages (Interviews 11 and 20, 2016). But by this time the DEA resale sector was much larger, and while DEA markets still tended to locate in the far suburbs (reasons will be discussed in more detail below) they began to no longer collocate in scrap recycling markets, as scrap markets were ill-suited for selling DEAR to consumers—they were

too dirty, lacked any facilities to display products, lacked access to proper materials, and other necessities of the trade.

This multiplication and specialization of market sites posed a logistical challenge to recycling and DEA collectors, who, in addition to having to make trips to scrap recycling markets, now also needed to make runs to various DEA trading sites and markets. Collectors, who already had extremely long work days, had to add even more hours in order to visit multiple markets every day. Moreover, DEA entrepreneurs began to specialize in a particular kind of appliance and therefore needed access to a large enough flow of collectors to have a continuous supply of units. In sum, the new market arrangements in the 2000s posed problems for both collectors and DEA entrepreneurs and both groups sought trading sites that could facilitate exchange of DEAs. The solution arose in ad hoc markets that emerged on streets *en route* between the city center and the suburban recycling markets. Over the years (and in an endless scrimmage with city police) these trading practices gradually evolved into a handful of regular informal roadside trading sites—daily temporary markets if you will—where DEA trade occurs.

Trade at the roadside sites starts in the late afternoon when roaming DEA collectors and community recyclers finish their collection downtown and head back to their yards and scrap recycling market in the far suburbs. Every day at around 5 pm in the summer (a bit earlier in winter), heading north out of the city from Deshengmen on the way to Lincuiqiao, between the Third and Fifth Ring Roads, you will see scores of e-tricycles or trucks full of recyclables including all types of DEAs rushing to the north (see Figure 4.1). It is easy to pick out which e-tricycle (Banche 板车) drivers are DEA traders because of their loads, but van drivers are harder to determine until they stop at the DEA trade site. E-tricycle riders have more flexibility; when there is a traffic jam, they can squeeze through spaces where vans and trucks cannot pass. Some e-tricycle riders even own vans but prefer to carry DEAs from downtown by e-tricycle because those use less gas (200 yuan a month for fuel vs. around 2000 for a van), have the same loading capacity as a van, skirt traffic, and park easily.

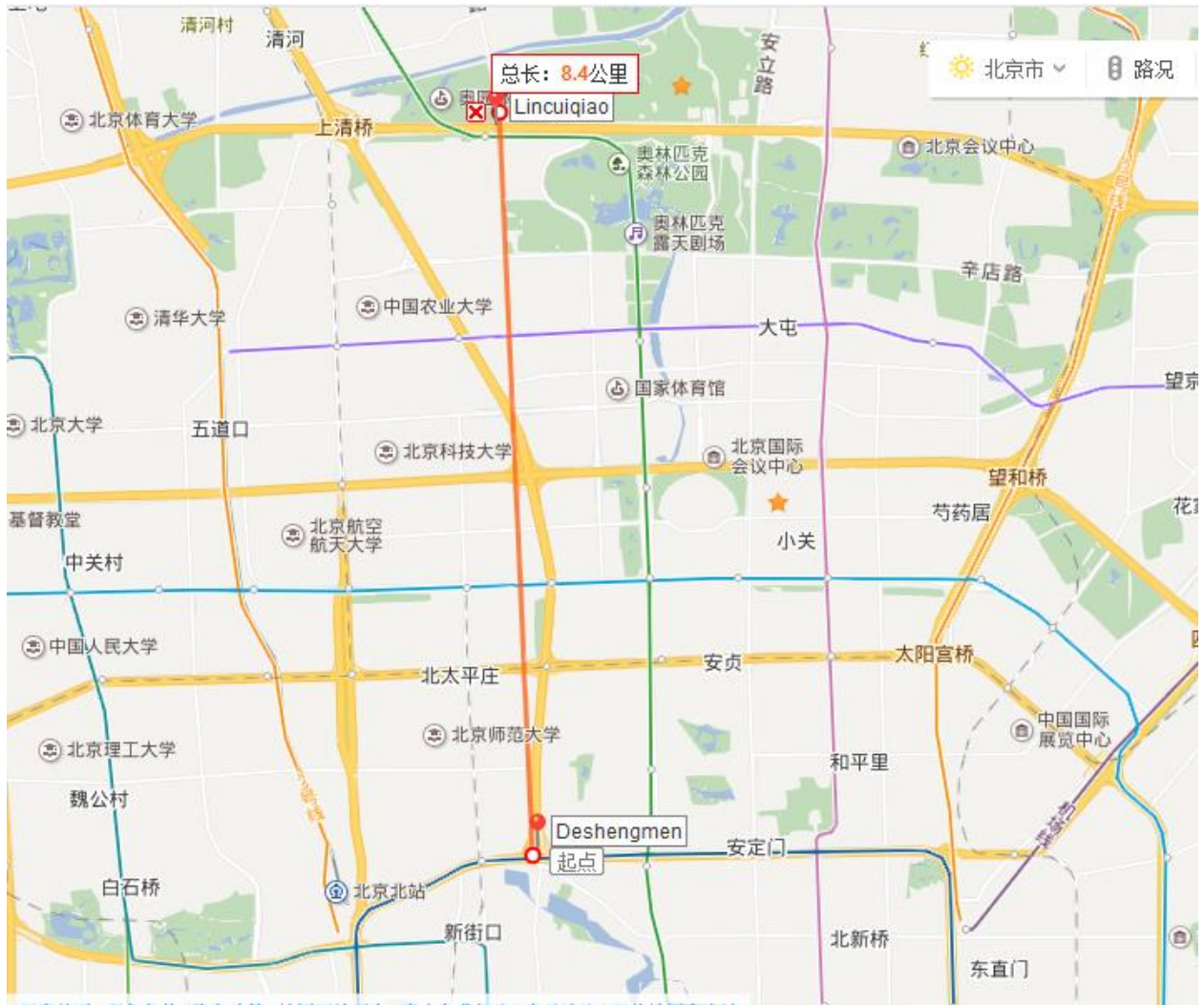


Fig. 4.1 Map with location of Lincui Bridge trading site. Distance from Deshengmen is 8.4 km. Source: map.baidu.com.

By the time the DEA collectors and community recyclers arrive, the specialized DEA dealers are already waiting on the eastern side walk of Lincui Road and Heiquan Road on both the northern and southern sides of the intersection. They always face to the south so they can see the collectors coming from downtown. Lincui Bridge crosses the Fifth Ring Road, which is a crucial borderline for Beijing planning and policing; roads inside the Fifth Ring Road are more closely policed and trucks are carefully restricted by hour of day and permits; the area outside the Fifth Ring Road is generally treated as the suburbs and special truck permits are not required. Markets for scrap recyclables and DEA repair, resale, and dismantling yards are all located several kilometers beyond the Fifth Ring Road, and sometimes even beyond the Sixth.

When trade starts, it is easy to tell that dealers are divided into two main groups: DEA reuse (DEAR) and DEA dismantling (DEAD). DEAD dealers use trucks of various sizes and park just inside the side walk, while DEAR dealers drive vans and much smaller trucks that are much more mobile and their collection of units much smaller compared to DEAD dealers. Dealers at this stage are called dahuoderen (打货的人), something like cargo loaders, shippers). DEAR and DEAD dealers are also roughly divided into several types of dealer specializing in washers, air conditioners, refrigerators, or TVs, and other appliances. In addition, there are a few smaller groups: computer dealers, for example, tend to buy units for both reuse and dismantling, and there are also a few dealers who specialize in smaller electronics.

The Lincui Bridge trade center averaged about one hundred dealers a day during my fieldwork. I never witnessed any fights over goods. When collectors with loads of DEAs arrive, the dealers crowd toward them and usually with a brief glance identify what they plan to buy. The dealers and collectors then negotiate on an agreed price, and when they reach one the dealer almost always pays immediately in cash. Occasionally, as will be described in more detail below, the dealer will first check an appliance's functionality by plugging it into a power supply before paying.

DEAs collected in central and north Beijing (Dongcheng, Xicheng, Haidian and Chaoyang districts) are traded here, accounting for at least one fourth of Beijing's DEA generation (Interview 5, 2016). Lincui Bridge trade center has a backstory, evolving from the Longwangtang recycling and DEA center from the 1990s until about 2003. When the Fifth Ring Road was built and Longwangtang demolished, Lincuiqiao became the trade center.

Trade at Lincui Bridge in the summer starts around 5 pm and lasts for around four hours until 9 pm (see Figure 4.2—Figure 4.5). The main sellers are community recyclers and roaming DEA collectors (收废家电的); buyers include a range of dealers specializing in dismantling and repair and reuse. When the trade is over, there's nothing left except some water bottles on the street. It seems like nothing has happened. Most dealers in Lincui Bridge are also from Gushi County, Henan province; a handful are from Hebei and Anhui provinces.



Fig. 4.2 DEA trade along the Fifth Ring Road side road at Lincui Bridge



Fig. 4.3 CRT trader at Linqi Bridge



Fig. 4.4 Roaming DEA collectors arriving at Lincui Bridge trading site



Fig. 4.5 A community recycler (large sealed truck), a roaming DEA collector (three wheeled bicycle cart) and used refrigerator dealer transferring items at Lincui Bridge trade site.

4.2 Dismantling Dealers

Dealers in DEADs generally use either small four-wheel or large six-wheel trucks. They are generally divided into four groups: TVs, air conditioners, washer and refrigerators, and microwave ovens and water dispensers.

DEAD dealers specializing in TVs, washer and refrigerators usually stay closest to the Fifth Ring Road on the northeast side of Lincui Bridge and station their trucks between the sidewalk and the vehicle lane, an extremely convenient location from which to catch collectors coming from the city center. Notice that they do not congregate on the south side of Lincui Bridge, because the south side is within the Fifth Ring Road boundary where police enforcement is much more rigorous, permits are required for entry, and the Chengguan regularly raid and confiscate vehicles (see Figure 4.6 and Figure 4.7).



Fig. 4.6 Detailed map of the Lincai Bridge area. The main trading area is along the red part of road. Source: map.baidu.com



Fig 4.7 Picture taken facing south while standing in Lincui Bridge's main trading area.

The CRT TVs trade is simple: the price is decided by their size. Every day at least one CRT TV business (a couple that has been dealing CRTs for years) comes to Lincui Bridge with their four-wheel truck modified with high steel fences going up on both sides to increase its loading capacity. The couple got involved in dealing CRTs following the wife's younger brother, Chen Hongxi, who dismantles washers and refrigerators. North Beijing DEA collectors all know this couple and there is almost no bargaining with them. Their prices are clear and the collectors know them: 85 Yuan for 28 inch, 60 Yuan for 25 inch, 50 Yuan for 21 inch, 30 yuan for anything smaller. When the deal is done, the husband pays the collector in cash, and lifts the unit onto the truck bed. The wife is then responsible for getting each TV, all of various sizes, stacked in the right place. Both sweat profusely doing this loading. The couple can buy around one hundred TVs every day, earning around 10 Yuan from each unit. They usually sell them directly to an authorized e-waste dismantling company (they call these "environmentally friendly companies" 环保公司) on the next day. The couple do business with a number of authorized e-waste companies in Beijing and Hebei, generally selling to whichever company gives the best price.

Often another CRT TV dealer with a four-wheel truck also works the south side of Lincui Bridge. He can repair CRT TVs and tries to sell some very good quality ones on the used market. In his experience, almost every broken CRT TV can be repaired and reused, the challenge is the lack of market demand. Consumers simply do not want used CRT TVs any more (see Figure 4.8). Not only are few CRTs going to used appliance markets, very few are getting manually dismantled; since 2012 almost all are being sent to authorized e-waste companies because, under the e-waste funding mechanism, these companies offer a price that is more profitable for dealers than manual dismantling.



Fig. 4.8 DEA collectors transfer items along the side of the road.

In contrast to the very few CRT TVs dealers, there are several washer and refrigerator dealers at Lincui Bridge. One dealer, Chen Xi, comes daily with a large truck and two workers who help upload his purchases. He is from Fangshan District, to the south of Beijing and is one of the biggest washer/refrigerator dealers at Lincui. His truck is usually parked in the third or fourth position of trucks collecting dismantled washers and refrigerators, but he stays with the other dealers by the sidewalk and when middlemen and collectors approach, he walks quickly to them, finds what he wants to buy, gives cash to the collectors, and tells them where his truck is. Because it is only several meters away, the collectors will unload what he buys and take it to his truck and his two employees upload it. You can see that Chen Xi and the collectors and middlemen are very familiar with each other and trust each other. Although he first pays for the goods, he does not worry about collectors leaving without uploading to his truck. As with CRTs, Chen makes about 10 Yuan on each unit. Each day, he can collect 170 to 180 items. There are usually other trucks parked in the

same row as Chen Xi's, also buying washers and refrigerators, but their trucks are almost always smaller than Chen's and they have no employees, uploading everything by themselves. Positions in the line are not fixed, it depends on who comes first. Chen not only buys washers and refrigerators but also air conditions, all for dismantling.

The fridge and washer dismantling trade requires a set of distinct skills. The ability to differentiate between copper and aluminum electrical motors is crucial, as the metals prices are very different and mistakes can add up quickly and be very expensive. During my fieldwork, washers with copper motors traded for 60 Yuan, aluminum ones for 40, and refrigerators averaged about 20 Yuan more than washers. Truck loading is also an arduous art; traders need to upload all their goods often three, four, even five layers high (see Figure 4.9), and make sure they don't topple. During the four-hour trading period, their work is intense and they sweat continuously.

One young man in his early twenties bought washers and refrigerators every day at Lincui Bridge. With no helper, he did everything by himself, including hoisting heavy washers or refrigerators up to a fourth or fifth layer. He recalled his feelings when he first started working in the sector some years ago: "When it got up to the third layer, I dared not look down. I just stared at the appliances, and my legs quivered. My parents helped me in the first days. Now, I'm used to doing this and know how to lift all goods safely into my truck." (Interview 5, 2016).



Fig. 4.9 A young man buys and uploads all his collection to the truck.

The dismantling traders I met send most of what they collect to authorized e-waste recycling companies, only keeping a relatively small fraction to dismantle themselves, these usually being appliances with materials that can fetch more money, like old copper-motor refrigerators. For example, Chen Xi is a supplier to Beijing's authorized e-waste recycling companies and interacts with them frequently enough that he has had meetings with their managers.

Some fridge and washer dealers also buy air conditioners, but some dealers specialize in air conditioners for dismantling, piling up to four or five tiers of units on their trucks. At least two dealers specializing in air conditioners for dismantling come regularly to Lincui Bridge. These two dealers live in the same yard in Langezhuang village where they dismantle the bigger units manually and sell the smaller ones to bigger dealers or directly to authorized e-waste recycling companies. Unit prices at which they purchase from collectors are based on the size and amount of copper and range from 150 to 200 Yuan. Both dealers complained about the drop in prices over

the years (strongly influenced by the fall in the price of copper on commodity markets) shrinking their profit. One dealer's son is in high school but comes to help his father during the summer holiday. The father wants the son to experience how hard this job is so he works harder to go to college. He does not want his son to follow in his line of work because it is dirty, grueling, business is getting worse, and it is not respected. Most of the DEAD dealers that I encountered are in their late thirties or forties and have been in this business for over ten years. Very few are new entries to the sector, probably because it has been declining in profitability; those I met in their twenties were usually helping their parents. There are few dealers in their 50s or older (I met none) because the work, especially uploading units, is so strenuous.

4.3 Reuse Dealers

You can immediately distinguish the refurbishment and resale dealers from the dismantlers by the vehicles they use. Used washer and refrigerator dealers usually drive small four-wheel trucks whereas flat screen panel and air conditioner dealers drive vans (see Figure 4.10). Because their vehicles are smaller they do not require permits like large trucks and so they are free to travel either north or south of Lincui Bridge depending on where the collectors end up stopping on their way north. There are many more used DEAR dealers than DEAD dealers, and their collection scale is smaller. While dismantlers often work in groups of 2 or 3 (to handle the high volume of heavy units), DEAR dealers are almost all solo. Like the dismantlers, when the collectors come from the south, they rush to them and look at whether there are goods they want to buy. Their trade with the collectors will be introduced respectively based on the type of appliance.



Fig. 4.10 Washing machine dealer's truck.

Given the nearly non-existent market demand for used CRT TVs, reuse TV dealers at Lincui Bridge hardly ever buy CRTs. The used TV buyers travel in vans which also provide electricity which they use to plug in sets to test if they work. Whether and how well they work influences their decision to buy or not and at what price. They first check if the screen is good; if it is broken they usually do not buy it. Then they plug it in to test its functionality. Prices vary from 400 to 600 Yuan depending on size, brand, function, year and condition. Broken screens, if purchased, go for around 100 Yuan.

There is much bargaining over flat screens because the range for profit and prices varies widely. I was told that generally agreements get struck if both collector and dealer can make about 100 Yuan. In terms of the quantity of units, far more CRT TVs are traded at Lincui Bridge (almost all for dismantling) while the number of panel TVs going for reuse is much smaller; but there are always several used flat panel TV dealers, and only a couple of CRT TV dismantling dealers.

Almost all used TV dealers at Lincui Bridge have their own stalls in retail used DEA markets located between the north Fifth and Sixth Ring Roads.

The standards applied by used washer and refrigerator dealers are similar to those applied by used flat screen TV dealers: functionality, age, energy efficiency (only models in the top 3 ratings are wanted) and condition (units that look close to new sell better). DEAR dealers will first quickly ascertain whether the unit satisfies these basic conditions; next they usually open it to check if all the parts are still in place; then they negotiate a price based on each unit's condition, brand, size, age and energy efficiency ranking. Most deals settle if buyer and seller can each earn at least 50 Yuan; prices usually range from 150 to 500 Yuan. Refurbishment and resale dealers do not care about whether a unit's motor is copper or aluminum, and they do not bother with plug-in tests because they know the structure of the various brands and models and a plug-in test is not determinative of how difficult a unit will be to fix. They also use vans or small four-wheel trucks and park them on the sidewalk. Each dealer collects from a few to up to 10 units daily. Fridge and washer dealers generally estimated that on an average day at Lincui bridge, more units trade for dismantling than for repair, but no one felt certain about the rates.

The refurbishment and resale air conditioner trade is almost the same as for washers and refrigerators, but prices are higher, ranging from 200 to 800 Yuan per unit, depending on size, age, brand etc. Most dealers are very skilled at differentiating models and quality and differences in the prices they offer are usually no more than 10 to 50 Yuan. For example, late one evening, well after dark, I watched as one highly astute dealer, Mr. Wang, saw a collector passing by with one air conditioner on his e-tricycle. Before the collector even stopped, Mr. Wang told me he knew precisely what model it was, its age, and quality and would offer 650 Yuan for it (Interview 11, 2016). Within minutes the deal was struck at 700 Yuan. This is a deal which I witnessed. Top brands such as Gree, Haier, and Midea can be used at least twenty years, but are often discarded after just ten. Dealers observe that in recent years about half of discarded air conditioners go to resale and half to dismantling.

DEAR dealing is closely related with market demand; even if an appliance is still functioning fine, if there is no demand, resale dealers will not buy it. Prices for re-sellable DEAs are higher than for units headed for dismantling. Of course, resale traders occasionally accidentally buy units that cannot be resold, but if that happens more frequently than about one in ten units they will not be able to turn a sufficient profit and will go out of business.

Several factors effect demand in the used appliance market. All the dealers I talked with mentioned that the price and quality of new home appliances have dropped dramatically since 2008, leading many young tenants and landlords (the primary consumers of used appliances in Beijing) to shift to buying new units rather than used ones. At the same time, the declining quality of appliances also leads many consumers to choose to discard them rather than take them when moving or repairing them as was the habit in the 1980s and 1990s. Dealers find that washers and TVs often are used for only three to five years, and even refrigerators are being discarded more quickly, so that the number of DEAs has risen dramatically since 2008. So, while the quantity of DEAs has been rising, their quality and the market for them has narrowed, with only specific types of DEAs (for examples ones with good energy ratings) having consistent demand in reuse markets.

4.4 Computers and small IT items, microwaves and water dispensers

Unlike large DEAs that are sorted into two different streams (DEAR and DEAD), for small computers, small electrical and electronic equipment and some other items, reuse and dismantling remain comingled at the Lincui Bridge. There are two groups of small unit dealers. One group specializes in microwave ovens and water dispensers, and generally drive vans to carry what they buy at the site. The other group focuses on PCs, DVD and CVD players, monitors, key boards etc. I saw typically around five of these dealers on average each day. They park their e-tricycle carts on the sidewalk and are rather mobile, parking north and south of the bridge. Parking to the south puts you ahead of other dealers to meet collectors coming from the city, but it is also riskier, particularly before dusk during which time the Chengguan is more active about enforcement inside the 5th Ring Road.

Both groups deal in units for both reuse and dismantling, typically selling the reusable units to used appliance dealers and personally dismantling those items which cannot be resold. The main reason that they dismantle all items themselves is that these small home appliances are not currently on the list of goods that authorized e-waste recycling companies are subsidized to dismantle. In other words, unlike the dealers in big DEAs who are a link a trading chain, consolidating goods most of which they sell on to dismantlers, small appliance dealers are themselves dismantlers. The logic behind how computers flow is rather distinctive. Although desktop computers are on the scheduled list for e-waste company subsidies, informal dealers

typically choose to dismantle them rather than sell them to e-waste companies because they contain several valuable potentially re-useable parts such as memory cards and CPUs.

Most small DEA dealers are young people in their twenties or thirties, especially the computer dealers. They must be able to differentiate clearly what can be reused and what will go to dismantling, the various models and their market values. Trade in used computers, especially laptops, can involve intensive bargaining because they are fairly scarce in this trading circle and tend to be high value goods that can also vary greatly in value—both buyers and sellers are eager to maximize their profitability. For the small items, the prices can range from 10 to 100 Yuan. DVD players are cheap and water dispensers are usually no more than 50 Yuan. By the end of the trading day, almost all dealers have a full load.

4.5 Chengguan at roadside trading sites

While this roadside trade site is free (charging no fees for use or land rent) and open to all comers, it is also constantly under the threat of disruption by the Chengguan, which restricts any on-street business and comes irregularly to either force them to leave or fine them. That is one reason why dealers with larger trucks stay north of Lincui Bridge, where trucks are permitted. Additionally, if the Chengguan comes, collectors coming from the south inform dealers at the bridge, the information passing from south to north, giving dealers on the north side time to escape while the Chengguan is still in the south. When I was present one day in June for such a raid everyone immediately stopped trading and drove north. Most dealers are experienced at evading the Chengguan; dealers with big trucks usually drive out to streets near the main scrap recycling markets to the north and some trade resumes there.

When discussing the Chengguan, everyone expresses anger. Dealers and collectors hate them, not only because the Chengguan interrupts their trade, but because they have to bribe or make covert deals with them. Everyone I met who had been fined by the Chengguan had different anecdotes, but one aspect was common to every story. When the Chengguan impounds a recycler's truck, the recyclers must pay a fine to recover the vehicle. The fines are steep and vary for different kinds of vehicles: a large truck is fined 5,000 Yuan, smaller trucks range from 2-3000, and e-tricycles are 1000. Regulations require that the Chengguan issue a receipt upon the payment of these fines. The receipt is basically useless to the recycler, but it is proof that the fine has been registered with the government and paid and that the money is therefore going to the government

revenue not the Chengguan officers' pockets. In every case described to me, the Chengguan refused to provide a receipt, and if the recycler being fined requested one the fine immediately went up by one or two thousand yuan (In China, if the government bureaucracy fines people, they need to give receipts to people. That is part of governmental revenue. If the officials refuse to provide receipts, fines will become their grey income).

4.6 Suburban yard trading sites

The other kind of sites where the dominant activity is trade are locations I will call DEA trading yards (see Figure 4.11). These yards are enclaves in urban villages on the outskirts of the city where roaming DEA collectors reside and work. In north Beijing between the Fifth and Sixth Ring Roads are several urban villages with such clusters including Banjieta, Hetan and Langezhuang, all in Changping District. The oldest and biggest cluster was in Banjieta village, a village in which rural migrant tenants outnumber native villagers. It hosts not only DEA traders but also computer and other small electronics traders. A description of it will serve well as a basic sketch of how such enclaves cum trading sites are organized.

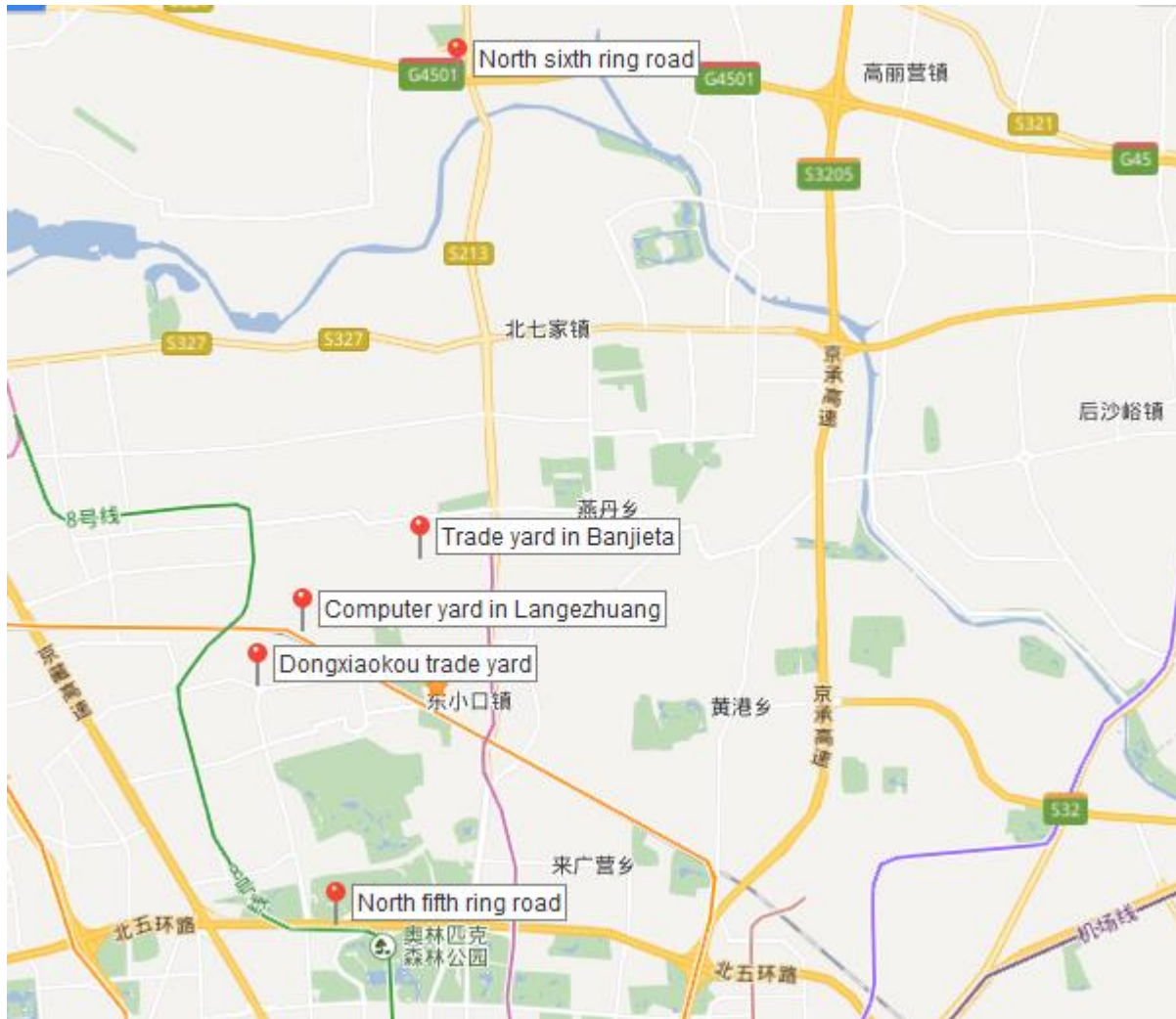


Fig. 4.11 Locations of trade yards between North Fifth and Sixth Ring Road.
Source: map.baidu.com

The yard accommodates about 40 DEA collecting households. There are four rows of houses in the yard. Each household has a temporary two-room house and they share water taps and restrooms with other households. The front room of each house is usually piled with collected appliances, dismantled parts, and plastic and metal scrap. The yard was built around 2006 by a DEA collector who became successful enough to become a market boss. He rented a plot of land from the village, built these temporary houses, and then sublet them to a few dozen DEA collectors who live and work in their yards (Interview 18, 2016; see Figure 4.12).

One household in the community specializes in collecting and selling scrap metal from dismantled DEAs, but all the other households are roaming DEA collector. These roaming collectors typically spend each morning dismantling any units that they have failed to sell to

dealers on the previous evening; then, typically the men of the household, spend most of the day covering routes through downtown Beijing collecting DEAs, either purchasing them directly from residents or through community recycling collectors. While the roaming collector is out getting DEAs, someone (typically the wife) stays at the yard, selling units to buyers who might come by and organizing, cleaning and otherwise tending to DEA units and scrap on site. In the early evening the roaming collectors head home, sometimes stopping at a roadside trading site to sell what they collected, but often returning to their yards in the evening with several units. Typically, by the time they return, buyers have begun to gather at the yard to check over and purchase units from the collectors. The DEA units for sale can be both DEAD and DEAR, though of course the trading yard businesses would prefer to sell a unit as DEAR rather than DEAD. Roaming collectors often have some repair skills. Turnover is rapid. Typically, a trading yard business's stock of DEAs turns over completely almost daily; they do not store items because they have very little storage space and because prices have generally been dropping in recent years. If a unit does not sell a day or so, it usually gets dismantled—from my conversations and observations households end up dismantling about 10% of what they collect.



Fig. 4.12 A trading yard in the village of Banjieta.

Trading yards almost always have some open space near the entrance where buyers can park their vans or trucks. There are generally three kinds of buyers who come to these yards, similar to the groups at Lincui Bridge: DEAR dealers, DEAD dealers, and IT and small item dealers. Trade in the yards can happen any time day or night, but the bulk of trade is during and after evening rush hour, from about 5pm until 9pm or so, often involving buyers who have also visited Lincui Bridge that evening. The yard residents often cluster at the gate where buyers park, accompany buyers back to check out the units in their stalls/homes and then help carry out units on hand

trolleys and upload them. Many buyers and collector/traders have known each other for years and use cash for the daily trade (Interview 11, 2016).

One big difference from the roadside trading site is that there is not the constant threat of being raided by the Chengguan, so people are more relaxed during trading. Buyers who come to village yards generally are ones that prefer the relative safety of the yards to the risks and interruptions of roadside trading. Another big difference is that, while roadside trade happens exclusively during rush hour, trade at yard sites can occur at any time of day. Though yard trade is certainly busiest during rush hour as well, appointments can be arranged for any time convenient to buyer and seller.

Although yard site traders need not worry about Chengguan harassment, they have other worries. One big challenge facing DEA village yard traders is that yards move frequently because of urbanization. Many roaming DEA collectors in Banjieta village who have worked in the trade for over twenty years have had to change residence about ten times over their careers because of urban development. Instability is one of their concerns. Whenever they are forced to move, it takes a time to settle down and business to recover (Interview 15, 2016). With the increasing policy restrictions on urban land use it seems possible that there may soon no longer be any spaces where such yards can be opened in the Beijing area. Most traders at Banjieta are from Gushi County, Henan Province, some are relatives to one another, and most have been in this business for over ten years. Most say that nowadays if possible they would choose another profession because business is becoming so difficult with labor and transportation costs rising, prices for DEA keep falling, and their yard is also slated for demolition soon.

4.7 Conclusion

Both roadside and yard DEA trade centers have evolved and adjusted to the changing policy and economic environment over the last three decades. These trade centers make DEA reuse and dismantling possible, sorting a wide variety of appliances rapidly and with great economic and spatial efficiency.

During the whole process of trade, DEAD and DEAR exchange uses a variety of acquired skills. The main factor guiding the decisions of everyone in the trade network is to make a profit from the units they collect, trade and process. DEA trade also requires intensive labor to remove, transport and upload units. One point of great significance: despite the great instability of the

context in which trade takes place—the constant threat of Chengguan raids, the demolition of yards, the lack of banks and credit institutions so that all transactions are done in cash etc.—trade is extremely smooth. The key reason for this that a majority of the parties in the informal trading network have years of experience both in the trade and with one another; those years of accumulated work experience, familiarity and trust in the trading community make this kind of efficient trade in the midst of so many obstacles possible.

There is also much evidence of specialization and division of labor when work conditions and markets enable (for example, the dealers specializing in specific types of appliances) or demand it (for example, how jobs demanding a great deal of DEA uploading onto trucks focuses the work force in 20-40-year-old range). At the same time, the informal sector yet again allows for a kind of flexibility of tasks that is not possible in the formal sector; roaming DEA collectors essentially perform a bit of all the following kinds of work: collecting DEAs (meaning also advertising and offering services to residents); trading DEAs to both reuse and dismantling dealers; and variously repairing, refurbishing, and dismantling the DEAs they collect.

On the other hand, almost every aspect of this highly effective trading system reflects how the informal network has reacted to the municipal government's incessant harassment and legal exclusion of migrant recyclers and DEA dealers. These conditions shape informal DEA workers decisions about the vehicles they use, where they park, the locations they choose for their markets, etc. Almost every specific aspect of the informal network described in this chapter (and indeed in most of this thesis) is in some manner shaped by these conditions. This is a point I expand on in the conclusion of the thesis.

Chapter 5: DEA Dismantling in the Informal Sector

Summary: This chapter describes DEA dismantling in the informal sector. At every step in the informal network, beginning with neighborhood collectors, a portion of collected DEAs are dismantled, but as we move along the informal chain of trade, we find businesses that specialize in dismantling of consolidated DEAD for sale to formal e-waste companies. Following DEAD dealers and visiting their yards, I found that the portion of the DEA stream being manually dismantled by informal entrepreneurs varies by the kind of appliance and materials, with computers generally being the most likely item manually dismantled due to the many valuable reusable components. The other major trend found in my fieldwork is that more and more DEAD are being sent to the authorized e-waste recycling companies due to the WEEE directive subsidies, rising labor costs, and falling commodity prices. The relationship I found between informal DEAD dealers and authorized e-waste recycling companies was more one of collaboration than competition, with the formal companies relying on the informal sector's collection for their sourcing.

5.1 Multiple sites of dismantling

While this chapter focuses on business sites where the primary activity is dismantling, we should begin by noting that some dismantling takes place at every stage in the informal DEA sector. At every node in the trade network—community recyclers, roaming discarded appliance collectors (shou feijiadian de) used appliance retailers—some dismantling occurs. Precisely what kinds of units and how many is quite variable.

The community collectors in this study, Mr. and Mrs. Ma, who, when they have time do so, dismantle larger copper bearing air conditioners which cannot be sold as DEAR. They also often dismantle small or medium sized appliances that no brokers buy, like hotplates. In most cases though, they find dismantling DEAs is too time intensive and not worth the opportunity cost. As we saw in Chapter 4, roaming DEA collector/traders (shou fei jiadian de) also dismantle units they either are unable to sell or can make more money by dismantling themselves. In the trade yard of Banjieta village, for example, several families dismantle all the units they cannot sell, and they usually have large piles of DEA scrap in the front of their houses and stalls. The wives, who typically stay at home managing the stall all day, spend some of their time each day dismantling

DEAs. In the used wholesale appliances markets (see Chapter 6), roughly 5% of the units cannot be affordably repaired for reuse, and these typically end up being dismantled on site.

But the bulk of dismantling is undertaken by small-scale dismantlers who specialize in that task. There are also larger scale dealers who consolidate DEADs and then send most of them to authorized e-waste recycling companies. Which items go to which site for dismantling varies depending on several factors, to be discussed below.

5.2 Dismantling clusters

Most informal dismantling is done by specialized DEAD businesses. In 2008 a large DEA dismantling market of about 100 stalls in Houbajia was demolished, and since then no similarly large DEAD markets have emerged. Today, Beijing's DEA dismantlers are found scattered in the far suburbs in relatively small clusters living and working in yards of about five to six businesses, mainly in Changping District. This is also in clear contrast with DEAR sellers who tend to cluster together into larger markets. Dismantlers tend to be more spread out and locate in less trafficked corners of urban villages; they have no need to attract customers and so seek locations where rents are low and visibility to authorities is minimized. Four urban villages, north of the fifth ring road in Changping district, with clusters of dismantling businesses are in the scope this study: Langezhuang, Banjieta, Dongsanqi, and Zhongtan villages (see Figure 5.1).

Across different kinds of DEAD, we find there are different rates at which units are either dismantled by the informal sector or diverted to authorized e-waste recycling companies. The only kind of DEAD no longer being dismantled by informal businesses and almost always being diverted/sold to formal e-waste companies are CRT TVs and monitors.



Fig. 5.1 Locations of four DEAD dismantling yards between North Fifth and Sixth Ring Roads. Source: map.baidu.com

The first-round list of subsidized e-waste dismantling covered four large home appliances: washers, refrigerators, air conditioners, and TVs, and one kind of electronic equipment: computers (State Administration of Taxation of the People’s Republic of China, 2012). Other home appliances and electronics are not yet part of the government’s subsidy program. They are collected and dismantled by informal dismantlers and formal e-waste companies do not process these goods.

I visited four dismantling clusters: two sites (one in Langezhuang Village the other on the east side of Banjieta Village) hosted businesses primarily involved in dismantling computers, IT

electronics and other, typically smaller, discarded appliances not on the government's list of scheduled items; a third cluster of DEAD yards in Dongsanqi Village; and a DEAD consolidator in Zhongtan Village. For the purpose of the readers clarity, one of the main trading yards described in Chapter 3 was also located in Banjieta village, but that site is separate and distinct from the DEAD processing cluster described in this chapter, which I will call East Banjieta for the purpose of clarity.

When following the computers and IT machines flowing toward dismantling in the informal sector, I found that all IT electronics that are not on the subsidized list are dismantled by informal enterprises. These enterprises also dismantle most desktops they receive because their components can be reused and are valuable for resale, bringing in more money than the subsidized formal companies are able to pay. In other words, component reuse, rather than material recovery, is the more lucrative trade. Removed parts which can be reused are mainly sent to the Shenzhen area in Guangdong province for reuse—one of the most important locations for electronics manufacturing in China and, indeed, the world. Computer dealers do not handle the monitors because there is no market for used CRT monitors or their parts in China today.

5.2.1 Langezhuang cluster

Langezhuang Village, a suburban village in the northwest corner of Changping District, is host to a compound of informal DEA businesses. The compound is separated from the residential neighborhood of the native villages, divided into few rows of houses-stalls. The market boss, who rented this plot of land and built these rows of small house-stalls, sub-rents them to his hometown fellows who work in electronics dismantling. These dismantlers collect used computers and other DEA at trading sites and bring them to their stalls where they remove reusable parts for resale to specialized dealers and sell the remaining materials to be recycled. Typically, the husband of the household has some technical skills in dismantling and evaluating computer hardware. Dismantled parts are piled by the front doors, making it easy to see that the majority of businesses handle computers (see Figure 4.2), the rest mainly specialize in either printers or photocopy machines.



Fig 5.2: The working and living place of computer dismantlers in Banjieta Village.

Most Langezhuang computer dealers buy discarded computers from roaming DEA collectors and then sort them into two categories: DEAR and DEAD. Repairable units go to used markets in Zhongguancun (see figure 4.3). However, about 90% of what they collect cannot be sold as a complete unit for reuse. The remaining DEAs are further divided into two groups: those with valuable reusable parts and those lacking such parts that will go almost entirely to recycling commodity streams. Removed parts which can be reused are sent to Shenzhen, and the metals,

plastics and removed parts that cannot be reused go to Beijing's recycling markets. I did not see any CRT dismantling in this yard which suggests there is no market for CRTs and the formal e-waste companies pay more for a CRT than the entrepreneurs could make by dismantling them.



Fig. 5.3 Map showing the large distance between Langezhuang, the computer dismantling cluster which lies 6.5 kilometers north of the Fifth Ring Road, and 16 km from the IT reuse markets in Zhongguangcun which are all in nicely maintained indoor retail shopping centers near the Northwest corner of the Fourth Ring Road. Source: map.baidu.com

Mr. Qin, in his thirties, is a computer dismantler who came to Beijing in 2008. When I visit his home, there are several shelves on which removed parts are piled: hard drives, mother boards, CPUs, memory cards, batteries, and monitors. These can be sold for reuse; those that cannot be reused are piled outside. In the middle of the floor, there is a computer running to test whether the hard drive can be reused. Mr. Qin tests all potentially reusable parts for functionality, and if they pass he places them on the shelves. His hard drives range from 20 to 300 Yuan depending on

capacity and model. He says that most removed parts can be reused unless they are too old and out of date.

Around 10% of the desktops and laptops that Qin buys from collectors can be repaired/refurbished for resale and reuse without extensive dismantling, but the vast majority are dismantled for parts and scrap. Qin also sells used computers on-line, but very few. He emphasizes that the dismantling occurring in Beijing does not involve any precious metal extraction. All his removed parts are sold to Huaqiangbei electronics market for reuse in Shenzhen. When the testing goes on, Qin sometimes goes out for a breath of fresh air, checking on the progress from time to time.

While large appliance dismantling requires a lot of physical labor, computer dismantling relies more on skills to judge the capacities of various parts, their viability for reuse, and their value on the market. IT markets change quickly, and it is not an easy business. Many find it hard to profit, but Qin learned the basics from his relatives and has since become more skilled and updated in his knowledge. Still, he too complains the used computer business has been getting worse and worse since around 2013:

Overall, the secondhand (ershou, 二手) and dismantling computer business is shrinking. In 2008 and years after that until 2013, I could earn around 500 Yuan for each unit of computer, but the price of secondhand computers and removed parts has declined again and again, and the profits are less and less. Even the prices for metals and plastics from desktops are only half of what they were before. I used to make 10 Yuan on iron from one desktop, but now it's only 5. And our frequent moving makes business worse. What we are doing is extending computers' lives and I can't understand why the government does not support us. Since Houbajia was demolished, the computer dismantling business is scattered among urban villages and there is no big market any more. Usually, five or six computer business families rent one yard between the Fifth and Sixth Ring Road or even further outside. It is impacting the circulation of reuse (Interview 25, 2016).

Qin is not the only one to complain about these conditions. Most businesses in Langezhuang have moved frequently due to market demolition. They generally just follow the market boss who helps them find a new location. But with each demolition many consider leaving the business; many are also concerned about their "left behind children" (liushou ertong, 留守儿童) and would like to go home to be closer to them (Interview 25, 2016).

Dismantlers collect all DEA not in the subsidized list such as copy machines. A relatively big house by the yard's gate is home to a printer and photocopy machine dismantling business. Mr. Wan spends much time dismantling and sorting parts, and his house is crammed with machines for reuse, repair, dismantling and various reusable parts. There are about 20 parts that can be removed and reused from dismantled photocopy machines. Wan sells functioning photocopiers to less prosperous regional markets while removed parts go to repair or reassembly markets. Printers and photocopiers are just two kinds of very common IT related electronics that were not included in the government's subsidized list of e-waste types, but for which the informal sector has already developed a repair, reuse and resale network that spans the entire country and integrates economically disparate areas.

5.2.2 East Banjieta Cluster

The computer and IT dismantling cluster in East Banjieta is bigger than the one in Langezhuang. It houses about 30 houses that double as stalls. The layout of these structures is divided into five rows, each row fronted by an iron gate. Each family has one or two rooms for living and storing dismantled materials (hard drives, CPUs, memory cards) and an open space in front of each house for dismantling and piling dismantled metals and plastic.

The outdoor yards at East Banjieta are larger than the ones found in Langezhuang, and that points to one of the main differences between the kinds of work done in these two sites, as Langezhuang's businesses focus much more on salvaging reusable parts, while the businesses in Banjieta that are more fully dedicated to dismantling for scrap. Banjieta stalls dismantle almost everything they collect, with the exception of CRT monitors, and the kinds of electronics they handle are more diverse, with computers as the majority but also many big and small electronics such as DVD, CVD players, and all types of routers. After dismantling, they do not test the quality of the removed parts from computers, they simply sort them into two categories: reuse and scrap. They do not test parts such as hard drives; they categorize hard drives as either reuse or scrap based solely upon their model and capacity, using this as the indicator of reuse demand. They do not dismantle CRT monitors but do often dismantle flat panel monitors which cannot be reused; re-useable flat screens are usually sold to the used computer markets in Zhongguancun (see Figure 5.4).



Fig. 5.4 A box of hand-tools used by an electronics dismantler at Banjieta.

Dismantlers at Zhongguancun typically source from roadside or yard e-waste trade centers, typically using an e-tricycle cart, and dismantle what they collect within a day or so. Their typical manner of handling a desktop is to take down the whole machine, sell the casing as scrap and remove each part: CPU, memory card, hard drive, CD Rom, printed circuit board, fan. Removed parts from the latest generations of computers can usually be reused and are sold within Zhongguancun (some buyers also come to the yard to buy parts) while printed circuit boards are sold to Guangdong. However, more and more removed parts are outdated and the market demand

for many parts can be slim to none. For instance, there is no longer any market for working CD ROMs, and each CPU can only be sold at 1 or 2 Yuan. More and more removed parts are phasing out from reuse markets and being shredded because of the rapid development of computer technology (Interview 15, 2016). In recent years, the price of dismantled desktops has dropped from 100 to 50 Yuan, and dismantlers' profits have also declined.

Mr. Sun is from Chengde, Hebei Province. He and his wife stayed in Beijing in the first years after their marriage running a street food stall, but she went back to their hometown when their children turned school age. Mr. Sun got involved in electronics dismantling around 2011—he had lived in this yard for many years prior to it becoming a DEAD recycling enclave and decided to get involved in the sector himself. When I visit the yard in the late morning, everyone is dismantling their collections. The businesses in the market all follow the same rhythm: buying electronics in either the early morning or the late afternoon at roadside or yard DEA trading sites; dismantling units upon returning to the yard; and selling dismantled parts when buyers come by. The typical turnover time for a unit is about 24 hours and businesses rarely stockpile units or parts. Desktops, laptops and removed parts from desktops going to reuse can sell for much higher prices and profit than parts heading for recycling which are sold by weight.

When talking about the business, Mr. Sun is not optimistic:

There's no doubt that the electronics business has shrunk in recent years. Not only the price, but it's not easy to sell out all dismantled materials as before. I am considering going back home or looking for other opportunities in Beijing. (Interview 15, 2016)

As I write this thesis, Mr. Sun has been forced to leave this business because their cluster was closed during an eviction by authorities in November of 2017.

Mr. Wang has been working for this business since 2000 and has seen many changes in discarded computer processing in Beijing. According to Mr Wang, by 2008, the first generation of desktops with CRT monitors (mostly imports from developed countries) were almost all heading for dismantling rather than resale. Currently, what they are dismantling are mainly flat panel desktops, however, more and more have been flowing to authorized e-waste recycling companies since 2012 (Interview 11, 2016). Since 2008, not only has the price dropped, but the time in which new generations of computers become out of date is getting shorter and shorter, and so fewer and fewer are marketable for reuse. For example, most laptops with Intel i3 CPUs (first released in 2010) or lower are headed for shredding.

As the used computer market is shrinking, people are considering leaving this field because they can no longer make enough money to raise a family. Also, as we have seen for other sites and markets in the informal sector, dismantlers find themselves moving incessantly. Wang has moved four times since 2000 as a consequence of broader urban development forces that have forced his relocation from Longwangtang to Chenying Village, to Hecun Village, and now here to East Banjieta.

5.2.3 Dongsanqi cluster: large, scheduled DEADs

The above described clusters mainly processed computers and other IT related electronics; the following two clusters focus more on the large DEA included in the WEEE directives scheduled list (fridges, washers, air conditioners, and TVs). A considerable portion of DEA dismantling occurs in the hands of specialized informal dismantlers. Similar to the yards where dealers specialize in computer and IT equipment dismantling, people working at dismantling large and small home appliances are spread out in corners of urban villages in northern Beijing.

Typically, either several families share a big yard, or one large scale dealer has his own yard. By following the DEAD buyers from the trade sites, I found several yards where informal businesses specialized in DEADs, dismantling some units and selling others to authorized e-waste recycling companies. In general, if the copper content of a scheduled DEA is large enough to raise the commodity price higher than the price offered by the formal e-waste companies, DEAD dealers will dismantle the unit themselves; otherwise they will sell it to an e-waste company. Their dismantling is typically done by hand, involves very little electricity consumption and generally breaks units into easily sorted pieces (in contrast to formal factories that put units into large, high-powered shredders). Over the last several years as the business environment for informal dismantlers has become increasingly challenging, the quantity of DEADs listed in the subsidy scope getting sold to authorized e-waste companies has been climbing.

In northeast of Dongsanqi Village, there are several yards where a few family businesses engage in DEA dismantling are clustered in the typical 2-room home-stalls with small yards (see Figure 5.5). Most days I would find dealers either dismantling units or sorting materials. Some families only collect one kind of appliance (such as washers or air conditioners); others handle a variety of scheduled appliances, and some tend to focus on water dispensers and microwave ovens. In general, the yards are more spacious than the ones focused on computer dismantling.



Fig. 5.5 A dismantling yard in Dongsanqi. Behind the TVs and air conditioners, is the house where the dismantler families live.

Typically, a dealer selling a DEAD unit to an authorized e-waste company makes about 10 Yuan profits per unit sold, so DEAD dealers basically approach every appliance by calculating whether, after accounting for the costs of their time and labor, dismantling will render a profit higher than the 10 yuan they would make by selling the unit to a formal company. Several factors effect that calculation. Copper content is perhaps the most important; copper is the most expensive metal in large appliances, so the copper content of a unit often determines whether or not a DEAD dealer will dismantle or sell it. Labor costs also matters; some large families with a lot of labor choose to dismantle almost all the DEAD they collect because their labor is essentially free. Small home appliances are not on the subsidized list, so any that cannot be sold for reuse are dismantled. No one dismantles CRT TVs and monitors; by contrast non-CRT screen computers are almost all manually dismantled despite the fact that formal companies will pay for them with subsidies, because the reusable parts can fetch much more on the market than the subsidy price.

After 2006, the copper motors of washers and refrigerators were gradually replaced by aluminum ones. In addition, the price of copper has dropped considerably over the years, so more and more copper motor driven washers and refrigerators are flowing to authorized e-waste recycling companies (Interview 18, 2016). Washers with aluminum motors are hardly ever dismantled informally any more, almost all are sold to authorized e-waste recycling companies at around 50 Yuan each. Copper motor washers fetch 20 or 30 Yuan more than their counterpart and so are often still manually dismantled by the collectors.

From a quick look at a unit's size and model, experienced dismantlers can quickly estimate the total value of scrapping a unit into copper, iron, plastic, and salvageable parts. Mr. Luo, in the DEAD business since the late 1990s, explained his calculation while looking over an air conditioner: compressor, 10 Yuan; motor, 4 to 5 Yuan; iron, 0.8 Yuan per kilogram; plastic, a little over 1 Yuan per kilogram; mixed aluminum and copper, 10 Yuan per kilogram; copper, 17 Yuan per kilogram; and circuit board, 2 Yuan per kilogram—for a total of approximately 200 yuan. Most sell materials promptly these days because of the high risk of instability and downward jolts in commodity prices. Manual dismantling is labor intensive and requires understanding machine design and the most efficient way to take down a unit. Small appliances are not necessarily faster to dismantle as some have complicated structures. Equipped with an arsenal of shears, screw drivers and electric cutters, Mr. Luo dismantles around 10 air conditioners in the morning and over 20 units of various kind every day. Unlike the computer dismantlers who work with bare hands, most large DEA dismantlers wear safety gloves, even in the sweltering summer heat.

During my fields visits to these three electronics and home appliances dismantling sites I only saw businesses undertaking physical dismantling and witnessed no burning or chemical treating to extract metals. The only chemical pollutant problem that arose to my knowledge involved the collection of coolant from air conditioners and refrigerant from refrigerators. Due to the lack of market demand for reusing these chemicals, Freon is often released into the air when air conditioners and refrigerators are dismantled. A great deal of research emphasizes the negative effects of manually dismantling by the informal sector because of its uncontrolled pollution during dismantling process (Li and Zeng, 2013, 2015). However, my observations are in striking contrast, for I found generally that the entire chain of informal collection and dismantling was in many respects more energy conserving, more resource conserving, and less polluting than the present formal company processes. As to the specific problem of refrigerant, my observations of Mr. Ma

made it clear that informal DEA collectors like him are very skilled at handling refrigerant, and when they think a unit can be resold they make sure to preserve it in the unit. Ma and others only release it to the air when they know a unit is heading for dismantling. If infrastructure existed, either government or market based, where Ma could sell and dispose of refrigerant he captured from defunct units, he already has the skills to perform this task; but no such infrastructure exists in China for informal DEA handlers. I discussed this issue with informal dealers of air conditioners and refrigerators as well and all know how to collect the refrigerant. The challenge is that there's no market where they can sell the collected refrigerant (Interviews 14 and 18, 2016). A sensible alternative to simply blaming these dealers for releasing such chemicals would be to create a program that connects informal dealers with companies that manage these chemicals properly.

5.3 Zhongtan yard: DEAD consolidators

In 2016, 70% of units processed by the 109 authorized e-waste recycling companies across China reportedly were sourced from informal sector collection (Interview 33, 2016). Following Beijing's DEADs through the informal discard trading chain, I found them routed to formal e-waste companies through two groups of people: 1) small-scale DEAD dealers selling directly to formal companies, and 2) larger DEAD consolidators who act as intermediaries between small DEAD dealers and formal companies. These consolidators are few in number, but their collections are very large; they have emerged only recently, mainly to meet the needs of formal e-waste companies that demand large shipments.

Interviewees explained that diversion of DEADs to authorized e-waste recycling companies became common once these companies, using their subsidies, could buy units at the going market price (comparable to what dismantlers could get by doing the labor and selling materials themselves). However, the financial flow of the subsidy can be constrained by time (when subsidies are released) and type (what items are subsidized) greatly affecting sales from the informal sector and dictating when deals and payments can be made. Informal businesses often expressed a sense of relative powerlessness in relation to the formal companies in this respect.

The DEAD consolidating yard I visited in Zhongtan Village received between 300 to 400 items daily, include scheduled large home appliances and some computers, almost all of which were desktops. The village is located in the north corner of a used goods market. The

large yard space is divided into specific areas: a yard for storing DEADs; a yard for dismantling a portion of the collection; and a small house with sign “Cashier” where the yard owner pays sellers after they have unloaded their DEAD units.

The business is operated by a family surnamed Li (see Figure 5.6). The Lis do not buy DEADs at trade centers. Their supplies all come from roaming collector/traders and dismantlers. Formal e-waste companies would find it too expensive and inefficient to buy small lots of DEAD units from dozens of small DEAD dealers scattered in the suburbs, so the Li’s and other large-scale DEAD consolidators provide the needed service of aggregating DEAD units for formal company collection. Mr. Li employs four to five people to do the uploading, dismantling and logistics. His wife is responsible for the cashier work, his son and he manage the business and relations with the formal e-waste recycling companies. Like the small-scale dealers, the Lis dismantle refrigerators and air conditioners with high copper content when they think doing so is profitable. The Li’s profit per unit sold to authorized e-waste recycling companies is only 2 or 3 yuan, and Li complained about the shrinking profit margin, saying that despite the large scale of his business, it is less and less lucrative (Interview 24, 1016).



Fig. 5.6 The compound where Li does his collection and a portion of dismantling.

Li has been in the DEA business since the late 1990s and is one of the largest DEAD dealers in Beijing. In early 2016, a formal e-waste recycling company from Hebei Province

started working regularly with him as a supplier. Despite this close relationship with a formal company, Li faces problems due to his lacking any business license which he regards as the symbol of legitimation. He would like to register his business and has approached various government bureaus, but the reality is that there is no bureaucracy to accept his registration application. DEAs are not in the legal business scope for a recyclables collection business, but he also clearly cannot register as a disposal business. Although he has become a supplier for several formal e-waste recycling companies, he cannot get a business license which he feels might protect him from facing harassment and threats of demolition from the local government and Chengguan.

In addition to large consolidators like the Lis, some small-scale dealers, after a period of weeks, accumulate large collections of units that they do not dismantle. Instead, when they have around 300 items they contact an authorized e-waste recycling company to deliver these large loads. There are only three family businesses with the Li's scale in northern Beijing, and, according to Li, about 30 such businesses across the whole of Beijing. Li estimates there are around 300 smaller-scale dealers in Beijing. From his experiences, 40% of DEADs collected by the informal sector are sent to authorized e-waste recycling companies, the remainder is dismantled by the informal sector. Li summarized the proportion of DEAD units sold to the formal companies as follows: desktops are still mostly manually dismantled informally; air conditioners are the second, with about 50% being diverted to the formal sector; refrigerators are the next, with aluminum motors fridges almost always exchanged for the subsidy; washers are only occasionally dismantled and are often sold to formal companies regardless of the kind of motor; finally, CRT TVs are essentially never dismantled and are always sold to formal companies for material recovery.

In describing their interaction with authorized e-waste recycling companies, Luo, Li, Lu and He all basically agree, the formal companies are very poorly managed (Interview 26, 2016). The prices they offer for DEADs are not stable and they are always very late in paying their bills. Overall, informal sector suppliers feel ill-treated by authorized companies in the formal sector companies. Authorized e-waste recycling companies hold the power to decide prices as well as when and which items are collected. This even shows up in minor details: whenever informal suppliers bring deliveries to formal companies they are kept waiting at the gates for a long period of time. And it seems that often this is intentional—all interviewees

mentioned that they have had to bribe managers to avoid long waiting times for unloading and to hasten delayed payments. In general, authorized e-waste recycling companies tend to treat small-scale dealers quite poorly but are friendlier toward large scale consolidators whose supply streams are large and stable.

5.4 Conclusion

Informal DEAD traders have long played an important role in handling China's DEADs, hand dismantling appliances that could not be repaired or sold at used appliance markets, salvaging parts to be re-used by repair shops, and tearing down items into their constituent materials for recycling. The 109 government-supported formal e-waste processors that emerged with great rapidity since 2012 represent a huge new capacity in the area of e-waste recycling, and when I began my research I imagined that this formal sector would be in fierce competition with the informal dismantlers over the supply of DEADs. But, as described in this chapter, what I found instead was that the formal e-waste recyclers have come to depend on informal DEAD traders for 70% of their processing input, and that rather than a relationship based mainly on competition, theirs is a relationship characterized by collaboration (Interview 26).

But this collaboration is not between equals, and it is not without tension. Informal DEAD traders, even the large-scale consolidators who have fairly stable relationships with formal recyclers, feel that the formal companies do not treat them well and are paying them barely enough to keep the trade profitable. Of course, if informal DEAD traders feel that trading with formal companies is not worth their while, they could, in theory, dismantle the appliances themselves and sell the materials for recycling. But in fact, dismantlers are finding that the more recent generation of DEADs are generally not profitable to hand dismantle either. The light-weighting of appliances by manufacturers (i.e., the use of less amounts of materials in newer appliances), the low prices in commodities markets, and the higher costs of living are all conspiring to make hand dismantling less profitable as well. For now, informal dismantlers seem to be choosing to collaborate with the formal companies, even though the profitability is limited; if at some point this collaboration ceases to be attractive to informal DEAD traders, it is hard to predict what will happen to the DEAD market. Conceivably, if neither selling to formal e-waste companies nor hand dismantling are

profitable, informal DEAD traders will be forced to leave the sector, but it is hard to imagine that formal companies will be able to fill that vacuum. DEAD traders occupy a vital link in the logistics of collection for formal companies, a link that would be extremely costly for formal companies to fill on their own.

Another important finding regarding informal DEAD dismantlers, and one similar to what many other researchers of informal dismantling in other countries have found as well, is that hand dismantling performed by informal enterprises preserves more component parts for reuse than mechanical shredding allows (Wang et al. 2012). In this regard, informal dismantling is almost always at least as sustainable than shredding. To the extent that the informal sector focuses on reuse and resale it conserves more energy and materials embodied in devices than does the formal sector focusing on shredding. But it should be noted too that salvaging components is only worth doing, from both an environmental and a profitability angle, if there is a healthy sector of reuse and repair into which these components can be sold for effective reuse. As reuse, repair and resale become increasingly uncommon and disposal increasingly normalized, component salvaging becomes less profitable or viable, and informal sector DEAD processing becomes increasingly difficult to sustain economically.

Chapter 6: DEA Reuse Markets

Summary: Chapter Six looks at DEAR markets, both retail and wholesale. Businesses specializing in the retail sale of used appliances are often parts of “old goods markets” (旧货市场), typically located in the urban periphery, where many kinds of used goods (furniture, luggage, etc.) are also sold. One of the main consumers of retail used appliances being sold in Beijing are newly arriving migrant workers. On the other hand, wholesale used appliance markets are more specialized; there are, for instance, wholesale used air conditioner markets; there are also wholesale markets divided into sections selling used washing machines, refrigerators, TVs and some small items. Most wholesale buyers are from nearby provinces such as Hebei, Henan, Shandong, Inner Mongolia. The third category of used DEA market is used computer markets where often retail and wholesale businesses co-locate.

Used computer markets are distinctly different from appliance markets. For instance, they are located near the city center, in Zhongguancun, the busy IT area of Haidian District in Beijing. Every store (stall) in these markets has its own license. They also reuse parts of computers if they still work. However, it should be noted that over 90% of used laptops sold in Zhongguancun are not sourced in Beijing or domestically but are imported from developed countries, mostly from the US (Interviews 26 and 27, 2016). One can distinguish domestics from imports by the models and labels on the laptops. Used flat screen TVs also circulate abroad, in this case more as exports than imports, with some dealers sending over half of their collections to South Asian and African countries in recent years. All three kinds of reuse markets described in this chapter extend the use life of discarded DEAs and provide the used items at more affordable prices to families and businesses that would not be able to afford new appliances and computers.

6.1 DEAR retail markets

Retail used appliance markets target individual consumers, especially the city’s migrant population and landlords. Five old goods markets in the north of Beijing between the Fifth and Sixth Ring Road are in the scope of this study: Jiutai, Baifang, Xierqi, Dongsanqi and Aobei old goods markets (see Figure 6.1). The information here is based on field visits and interviews with used appliances stall owners in these markets. These markets are open from Monday to Friday, with a posted opening and closing time. The market space is strictly for business and dealers do not live

in them. Stall owners do not hold licenses, only the old goods market owner needs a license which covers all the stall tenants.

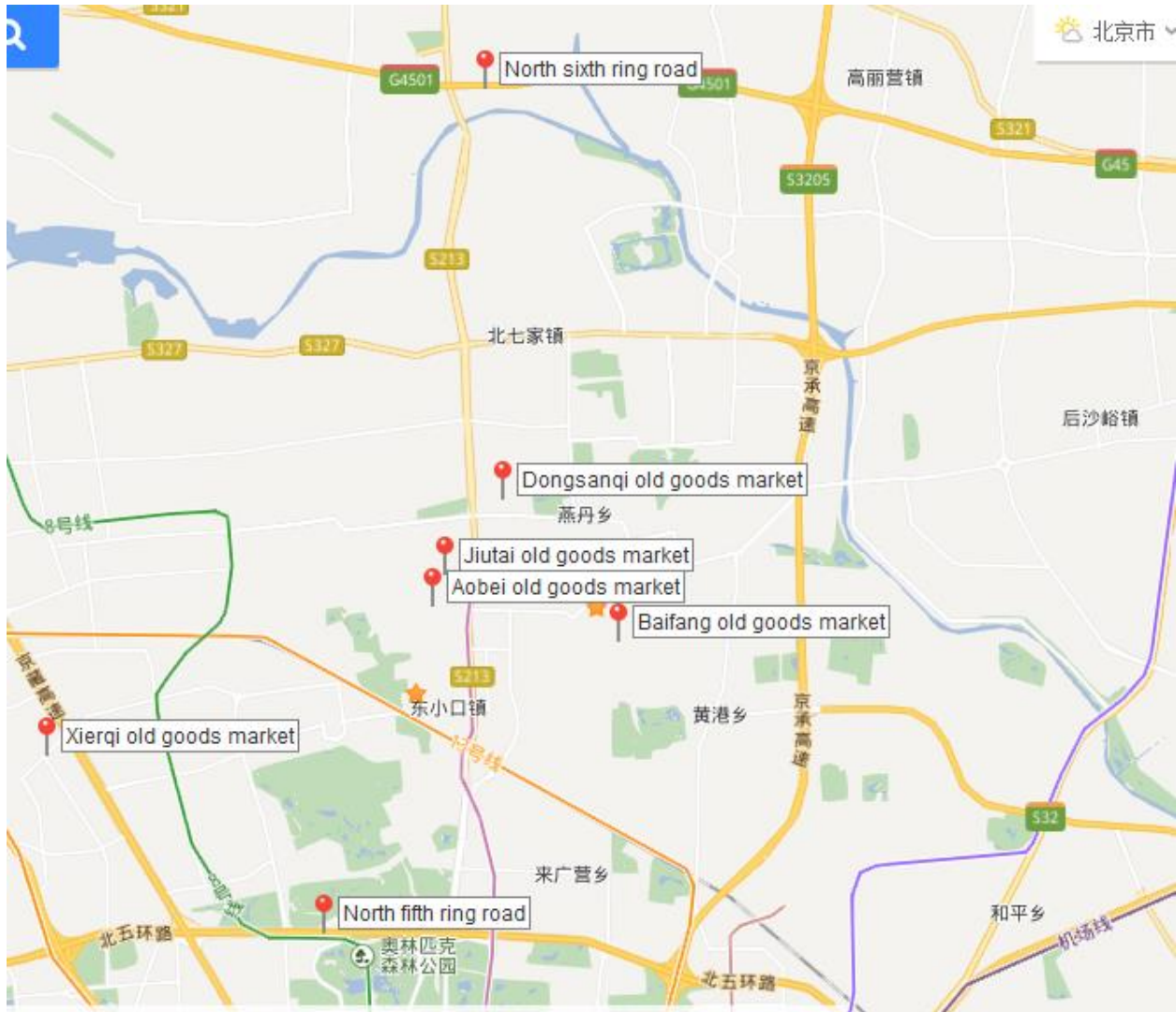


Fig. 6.1 Map of North Beijing showing the locations of five old goods markets with secondhand DEA business between North Fifth and Sixth Ring Road. Source: map.baidu.com

Retail used appliance markets are usually located either near densely populated suburban residential communities (neighborhoods where rents are low and migrant workers numerous) or near recycling markets in urban villages. Three markets I visited are located near Tiantongyuan, a community of around 300,000 residents. These old goods markets, where used furniture and home appliances are the main products, are structured like shopping malls divided into sections or stalls. There are no walls or hard borders between stalls and each stall tenant can determine what kinds of appliances she wants to sell. For DEAR, there are generally five types of stalls: TVs, air

conditioners, water heaters, computers, and washers and refrigerators (usually combined in one stall; see Figure 6.2). Small items such as microwave ovens and water dispensers are also typically sold at washer/fridge stalls. There are no TV and computer business in small scale markets such as Dongsanqi and Aobei because there is little demand in recent years, and the stalls selling TVs and computers have closed.



Fig. 6.2 Used washers for sale in the old goods market.

Most stalls are run by a couple. The husband is typically responsible for purchasing goods at DEA trade sites or from community collectors and repairing them in their yard/residence as needed, while the wife takes care of the retail stall and the cleaning of refurbished units. I saw several familiar faces in the old goods markets I recognized from Lincui Bridge and the trading yards.

No matter which type of used appliances they sell, the first thing they do is to clean and repair units as needed. Cleaning takes much of the wives' time and may require several rounds. For example, air conditioners need both the inside and outside cleaned, each using different

brushes and different detergent. Some entrepreneurs with bigger and successful stalls clean and repair units in a separate warehouse, typically in a nearby village. Most owners of air conditioner stalls clean the units on site at their store. Most husbands I talked to said they learned how to repair, dismantle and reassemble appliances on their own. Though many units do not require much repair, many reported that it is difficult to fix the latest generations of home appliances because key parts have become relatively too expensive to fix. In such cases, the retailers dismantle the units and sell the scrap, but they cannot afford to have this happen too frequently if they want to make a profit.

The main customers of DEAR at retail old goods markets are neighborhood landlords, tenants and local small business owners like those with small restaurants who do not know how long their business will last and so buy used air conditioners, refrigerators etc. Dealers from neighboring provinces have also begun frequenting retail DEAR markets and many DEAR dealers told me that Beijing residents now account for less than half their customers. Some DEAR retailers of TVs also do business with some companies which export flat screen panel TVs to less developed countries in Southeast Asia and Africa. The clients for export prefer foreign brands such as Panasonic, Sharp, Samsung etc.

If the buyers are locally within 20 km of the market in Beijing, they can also get three-month warranties on the units similar to those that stores give on new home appliances. Many air conditioner store stall owners also provide installation services for clients, but most other appliance retailers provide no transport service, so most old goods markets also have several delivery businesses that solicit customers who have purchased large units. Deliverers typically charge between 100 and 200 Yuan depending on the number of items, their size and weight, whether the destination has an elevator, etc.

Most used appliances at these markets have been cleaned and refurbished to look brand new, but their prices are much lower than new units. Over 90% of used TVs being sold are flat screens with prices ranging from 80 to 4000 Yuan. Washers are from 300 to 600 Yuan, and refrigerators from 400 to 600 Yuan with different sizes and functions. Air conditioners run from 500 to 1000 Yuan with different sizes of electrical engines (see Table 6.1). Generally, a retail DEAR business can earn around 100 Yuan for each unit, and they need to sell about one unit per day to cover stall rent. The low-end rental fee for a sales area in an old goods market is around 3,000 Yuan each month, though rents vary based on size. On average, most stalls are under 100 square meters. Stalls

are usually staffed by family members, a couple and sometimes other relatives. Most DEAR retailers seem to regard 2003 to 2013 as the golden time in their business. Since 2014, with the economy slowing, business has been declining.

	Used appliances (Yuan)	New appliances (Yuan)
Flat screen TVs	80-4000	999-279999
Washers	300-600	1000-91800
Refrigerators	400-600	1000-96800
Air conditioners	500-1000	1000-89000

Table 6.1 Price comparisons between used and new DEAs.

Talking with the secondhand home appliances stall owners, you can tell that most of them speak with the same accent. As with other segments of the DEA sector, probably 80% are from Gushi County, Henan province, with the rest hailing from Hebei or Anhui province. Retailers typically get along well with each other and may help their neighboring retailer by taking care of their business during lunch breaks etc.

Retailers I interviewed do not have a positive outlook regarding the future of the retail DEAR business. Its development is constrained by a complex of factors including policy at multiple levels of government (e.g., national, municipal), prevailing economic conditions, and ongoing urban expansion of Beijing. Everyone noted the dramatic drop in market demand for DEAR in Beijing. This slump is related to the government's concerted roll out of policies discouraging migration to Beijing leading to a decline in that key customer base.

Markets have also seen prices drop for many new products. The prevalence of wireless internet and smart phones is also leading many young people to regard TVs and even computers as less necessary. Another big challenge is increasingly restrictive land use policies which puts pressure on every kind of site in the Beijing DEA sector. The most threatening aspect is from Beijing municipal government policy to ban labor-intensive sectors. The policy was issued in 2014

and retail markets like old goods market is in the list. As urban villages are encompassed in Beijing's expanding urban plan, DEAR retail markets are invariably slated for demolition. DEAR retailers who have been in the sector for over twenty years have typically moved about ten times over that period, and many feel they have reached the geographic limit in that moving further from residential communities, facing a shrinking clientele, and increased shipping costs, they find their profit margins are becoming too thin to be viable.

6.2 DEAR wholesale markets

I visited two wholesale DEAR markets closely linked to the Lincui Bridge trade site, one exclusively for air conditioners, the other for all other appliances. Unlike retail used appliances markets where all types of large home appliances are available and collocated with furniture etc., wholesale DEAR markets typically only sell DEAR. Wholesale DEAR markets are less dependent on household and small business clients, but they need more space than retail markets to handle the quantity of units they manage. The major clients for wholesale markets are wholesale dealers from neighboring provinces such as Hebei, Shandong, Henan, Inner Mongolia, and the northeastern provinces. Some wholesale markets sell all kinds of appliances, from washers and refrigerators to TVs and other items like water dispensers and microwaves. Other wholesale markets focus more exclusively on specific appliances with, for example, wholesale used air conditioner markets being fairly common.

6.2.1 Baixianzhang Air-conditioner Market

About half the air conditioners traded at Lincui Bridge were diverted to dismantling, the other half to resale and many of these wound up in a big market in Baxianzhuang village, Changping District to the north of Beijing. This yard was originally the warehouse of a state-owned company, and that company's signboard still hangs on the gate. The yard is very spacious, with several rows of houses higher than houses in typical trade yards and dismantling clusters, divided by roads big enough to accommodate two truck widths. Outside the buildings, dealers clean air conditioner units while the interior spaces are full of cleaned units for sale (see Figure 6.3).



Fig 6.3 Wholesale used air conditioner market in Baxianzhuang village

As with other recycling markets, the boss who rents this warehouse compound divides it into plots and sub-leases them to dealers. There are around ten dealers in each warehouse and each rent their plot at 2,000 Yuan monthly. Altogether, there are over 90 stalls. Each stall is run by a couple or family with a familiar division of labor (husband going out to purchase goods, managing repairs; wife responsible for cleaning units and managing the stall). In every stall, one side holds cleaned air conditioners ready for sale and the other side uncleaned and not yet for sale. They also have their own repair closet with all kinds of tools for repairing air conditioners.

They use water and dishwasher soap to clean the units. To remove yellow stains in the plastic from years of use and exposure to cigarette smoke they spray on some bleach, cover the unit in newspaper, and place it outdoors in the sun for two days, after which the unit is nearly as white as new. Barring problems with the motor, most units are quickly repaired, so less than 5% of units

end up going to dismantling, much more than that and the shop's profitability will be at risk (Interview 20, 2016).

Two stalls in the market collect scrap metal and plastic from the small portion of dismantling done in the compound, and two collect motors. The Wangs are in the motor business, mainly selling motors to stalls that use them to repair broken units, but the Wang's business is in decline because resale businesses are choosing not to take on difficult repairs such as changing motors if needed nor are they manually dismantling units (slump in supplies) as often as they used to, given the low price of copper and the increased ability to sell units to buyers (especially formal e-waste companies) in the dismantling chain. The demand for secondhand motors is continually declining, and the Wangs increasingly have to sell the motors as scrap which is a much less profitable business than the reuse of motors under previous economic conditions.

Very few household consumers come to this market. Buyers are mainly used air conditioner retailers from Beijing or neighboring provinces, mainly from the county or township level, where they sell the units to small business stall owners or farmers. May to October is the busiest time in the market while it is fairly quiet from October to April.

Stall tenant families often know also each other or are even relatives from villages in Gushi County. Mr. Gu has been in the DEA business for twenty years and has specialized in air conditioners since the early 2000s. He has witnessed the changes in the used air conditioners market from being small in scale to the current large and sophisticated network for repair, reuse and dismantling. According to him, this kind of wholesale used air conditioner market first emerged around 2006 when generation and demand reached a certain scale in Beijing. Since then they have moved several times because of rapid urban expansion and the instability of land-use contracts for such markets, moving from Shuangquanpu to Wali to Zhongtan village over the past ten years (see Figure 6.4). They came to this yard in late 2014 but will be forced out by the end of 2016. Gu has followed the current boss who rents the yards since 2006 and he hopes that his boss can find a new location. During market relocations over the last few years several families have abandoned the DEAR business.



Fig. 6.4 Map showing locations of a DEAR wholesale market that has repeatedly moved further north as Beijing’s urbanization has expanded. Source: map.baidu.com

Gu and his family love this job which has provided them a decent living, though it is dirty and hard work. What frustrates him and others in the market is the frequent uprooting. He questions why land use is such a constant problem:

We are willing to pay for the land use, but it seems there’s no place for us to go any more. We are already approaching the North Sixth Ring Road. We have extended the life of air conditioners and contributed to environmental protection in this way without any support from the government and can’t understand why there is no stable place for us to stay (Interview 21, 2016).

As market demand slows and land use becomes more problematic with Beijing’s ban on labor-intensive businesses, the hope for a stable place to do business seems more and more out of reach.

6.2.2 Yuxingzhang market

Following washer and fridge traders from Lincui Bridge, I learned that one of the biggest used appliance wholesale markets for these items was in Yuxinzhuan in Changping, an urban village with many migrants. It is a big yard surrounded by a temporary fence, with a sign on the gate reading “Beijing Shengshihongda Home Appliances Wholesale Limited company.” The company rented this land from the village, built a large two-story tent structure and sub-rents spaces in it to used washer, refrigerator, TV and small home appliances dealers. Rental fees vary based on size and location, from 600 Yuan for 20 square meters to well over 1000 Yuan. The interior organization on the ground floor resembles that at retail markets: clean and tidy, divided into plots. The second floor is for repair. On the right side of the yard is a residential area where the families renting the stalls reside. Housing rent ranges from 700 to 1000 Yuan depending on size. There are over 200 stalls in this market with various business scopes, but the three main types are: 1) used washers; 2) used refrigerators; and 3) a mix of both along with other goods like microwaves and water dispensers. There are also a several (less than ten) secondhand flat screen TV and air conditioner stalls. There are also several stalls selling new but slightly defective washers. Buyers are largely from less developed areas in neighboring provinces, though there are also clients from Guangdong with big trucks and come to purchase microwave ovens and water dispensers monthly.

The vast majority of units one finds here are in the top three energy efficiency rating categories and look almost new; one might say these are the fairly consistent current market standards for used DEA resale. Appliances are tested, cleaned, and those needing repairs sent upstairs where each business has a space to work. Spaces are chaotic with parts and tools, but there is also a good deal of communication and help between dealers teaching one other how to repair various problems.

For specific major or difficult fixes many washer dealers send their units to the washer repair store near the market gate. This repair store is run by the Zhuang family, a father and two sons. Their small room is so crammed with all types of washer parts from small cables to the bigger parts like the clutch (which is the most frequently broken and trickiest fix) that there is hardly enough room for the three of them sit at one time. When I visited, the two brothers in their twenties were taking care of the store while their father had returned to the village. The boys had been working and training with their father for over seven years. Their repair fee ranged from 50 to 150

Yuan. They often got calls from other markets in Beijing for help, and they have even fashioned some repair tools themselves.

The Zhuang brothers love their job, but also confess that the repair business is becoming harder. One big challenge for them is that it is not as easy to buy new components to replace broken parts. They claim that the washer manufacturers have limited the sale of components and have not been allowed to sell their parts to other buyers since 2008, because the manufactures usually have agreements with the component suppliers who state specifically that they cannot sell them in the retail market (Interview 22, 2016). To a large extent, this limits the development of repair stores like the Zhuang brothers, though presently they can still buy what they need online.

The height of the Beijing's used washer and refrigerator market was in late 2008 as the migrant population surged back into the city following the Beijing summer Olympic Games (Interview 6, 2016). Since 2013 sales have been lackluster and profits declined. Each unit sold yields between 60-100 Yuan, with top foreign-made brands like Panasonic and LG going for slightly more. The availability of price information via the internet also puts some pressure on used appliance retailers profit margins (Interview 10, 2016). Those I interviewed believe that the decline in both demand and profitability for used appliances is resulting in a greater proportion of DEA heading to dismantling rather than reuse (Interview 11, 2016).

The Yes, a couple in their early 30s, first came from Gushi county to Beijing after graduating from high school. They started a used washer business in 2003 and have followed the same boss from market to market since then, moving from Wali village for half a year, to Chenying for a year, then to Hecun for several months, settling in Zhongtan village until 2007 and then to Xiejia until 2013, and landing came to Yuxinhuang village in late 2013. By 2017 Ye informed me they would need to move to yet another urban village.

Moves are particularly disruptive to business during times of economic slowdown. Typically, market tenants are informed about demolition only about one month in advance, leaving them little time and very few options. Resistance is not one of them. When the Zhongtan market was to be demolished in 2013, the Yes, together with other market tenants, banded together and refused to vacate. The local police physically dragged people from their homes (which double as stalls), threw all their belongings into the street, and demolished the market (Interview 24, 2016).

These days, Mr Ye predicts, their DEAR business will not be a viable way to make a living much longer; the land use problem is too disabling, and the solution is not in the hands of migrants

like him. With falling profits and no support forthcoming from the government, he predicts entrepreneurs like himself will have to leave this field. According to Ye's observations, very few new people are entering the DEA sector. From 1980s to 2013, the situation was the opposite he says, but now young people are looking for jobs in the emerging service sector like driving for Didi (the Chinese version of "Uber"). Ye is not alone in his negative prognosis for the sector, and many tenants at the Yuxingzhuang market are planning to leave the sector when the market is shut down. All those I interviewed are aware of Beijing's ongoing population control policy and know they are one of the groups the municipal government is targeting for removal from the city.

Even worse is that informal DEA businesses are often harassed the by local government, especially township level bodies like the Land Resources Bureau (Guotuju, 国土局) and Environmental Protection Bureau (Huanbaoju, 环保局). They come to the market in the name of inspection, but their purpose is to exact bribes from the market boss. This is common at both the air conditioner and washer/ refrigerator wholesale markets, and often, following a visit, the markets are forced to close for several days. The money paid to these officials typically comes from rental fees, so in the end it is the stall tenants that pay much of the cost for these bribes.

In sum, entrepreneurs in the informal DEA sector have little power in the face of officials and policies. As Mr. Ye noted, it is not that he (or others in the sector) have chosen to intentionally go into the DEA business without a business license. Ye would be delighted to register his business, there simply is no government bureau that accepts registrations for used appliance businesses (Interview 6, 2016). So Ye, and everyone else at these markets, can be expelled at the whim of local government officials.

6.3 Computer repair and reuse

Beijing is home to the biggest used computer center in northern China. As soon as personal computers entered the consumer market in the 1990s, demand for used computers was intense, as incomes in the city were very low and new computers were few and expensive. Even as incomes rose, and the computer market rapidly grew through the first decade of 2000, the demand for used computers among lower income and rural consumers was such that most units were repaired and reused rather than dismantled for parts or recycled for materials. There are also imported used computers in Beijing's used computer market. However, since around 2010 there has been a notable decline in computer repair and reuse, which is also true for the cell phone market as well:

as the repair price goes up, and the price of new phones go down, most people tend to buy new ones rather than put the money into an expensive repair.

Computer repair and reuse is different from large home appliances in many aspects. For one, used computer markets are situated in downtown Beijing in the busy IT area of Zhongguancun, Haidian District. Since the late 1980s, Zhongguancun has been designated by the state as a center for IT development, and it is the biggest center in northern China. The streets of Zhongguancun are lined with both software and hardware business as well as several skyscraper office-buildings that house IT business. Among these high buildings, there is rather old, block-long, one-floor building called Beijing Guangan Zhonghai Electronics limited company (hereafter called Zhonghai). In the 1990s it was a market with hundreds of stalls selling all kinds of electronic parts and gadgets, but by the early 2000s the market was mostly dedicated to IT products and accessories.

The market is somewhat like a shopping mall. It is also divided into stall sized stores, and each stall is rather small. Unlike in the used appliance retails markets, store stall owners stay in their stalls and rarely cover for one another. The owners and workers are fairly constantly busy, if not providing service to clients, then cleaning, repairing and reassembling computers. There are more than 200 stores in Zhonghai (see Figure 6.5), three aisles dedicated to repair stalls, four aisles for used desktop computers, repair and reassembling, and another four aisles for laptop repair and sale, mixed with few stores for used printers and photocopy machines, and communications equipment. Outside of the mall, there are several people standing or sitting at the south and east gates with signs collecting computers or printers which cannot be repaired and reused. On the same street, a few blocks west, is the Silicon Valley Computer Mall. In its underground floor is a mall with almost the same of business layout as Zhonghai, but on a smaller scale and with fewer dedicated repair businesses than Zhonghai. Both markets are multifunctional sites of repair, reassembly and retail and wholesale sales of computers as well as computer parts and accessories. Since completing my fieldwork, Zhonghai market was shut down in late 2017.



Fig 6.5 Zhongguancun area and Guangan Zhonghao, the secondhand and repair market. Source: map.baidu.com

6.3.1 Computer Repair

The most fabulous thing in these markets is to observe how computer repair is done from building and installing systems to complicated physical repairs like repairing laptop batteries. Desktop and laptop repair businesses are generally done by different stores. Most desktop repair stores are versatile and handle all aspects of desktop repair, but some stalls focus on specific components, like monitors, CPUs, mother boards, or hardware repair. Laptop repair ranges similarly, from generalized repair to stalls repairing all kinds of laptop batteries.

Most repair people are male and young, in their early twenties to thirties, with a few in their forties (see Figure 6.6). Some are graduates from vocational schools. They regard themselves as professionals, and their jobs do require a great deal of skill. They usually train for years before running their own business. First, they need to test the broken parts or the whole computer and diagnose the problem, then propose repair solutions.

Customers at the market are either individuals wanting to repair their personal computers or repair professionals from community-based electronics repair stores who need help with a technical problem they cannot fix themselves. These community repair people usually will split the profits from a job, with 50 to 100 Yuan going to the Zhonghai repairer. Despite the constant turnover of new technology, the technicians at Zhonghai are familiar with both the newest products as well as older ones. Currently, most of the desktop computers that move through the repair shops are second generation machines with flat screens produced after 2000; the first-generation desktops (with CRT monitors) are already out of repair scope and go to dismantling. One big challenge currently for computer repair is the tendency in technology design practices that actually prevent repair. For example, motherboards have fewer chips, and solid-state hard disk repair is essentially impossible (Interview 26, 2016). Also, as the quality and price of these more recent models drop, repair has become less appealing to consumers; desktops in particular are often discarded even when only a minor part is broken requiring little money to repair (Interview 25, 2016).



Fig 6.6 A young man testing a laptop in need of repair.

Following the flows of used desktops in Beijing's market, I found that, rather than being dismantled or shredded, many flow out of Beijing to other regions of north China. Many reusable parts flow to markets in southern China. Desktops tend to go to neighboring countries such as Mongolia and North Korea as part of a transboundary used computer trade. The source and flow of laptops are even more complicated, as some used units come from other countries (US, Japan, etc.) and transit through China to less developed countries. In the following two sections, I will provide some anecdotal information, based on interviews and observations, about these flows or

computers. Unfortunately, I can do little more than report what interviewees were willing to share with me about transboundary computer trade as, unlike the other aspects of these networks I traced in Beijing, I could not follow these onward journeys. Mapping and observing the complex flows of these devices would require a very different research approach and would be further complicated by the highly sensitive nature of transboundary trade under current conventions governing such trade (e.g., to North Korea).

6.3.2 Used desktop computers and removed parts

In a building called Guang'an Zhonghai and on the basement level of a building called Silicon Valley, there are large used computer and IT repair markets, and desktop computers are a big part of their business. They not only repair, but also sell sets of used computers, removed parts, and reassembled computers. The used desktop business is more diverse than the laptops because people can more easily remove and replace parts in desktops, facilitating their relatively easy reuse. The used desktops in Zhonghai and Silicon Valley are not only from residential community scrap collectors, but also from big companies, government offices, universities and internet cafes which often discard units in large batches.

Interviewees claimed that currently all used desktops being bought and sold in Beijing are produced in China, but according to a stall owner with many years of experience, for many years the bulk of used desktops were imported from abroad until that practice was banned by the government in 2011. Prior to 2011 many companies imported used desktop brands such as Gateway, Sony, Mitsubishi, Fujitsu etc. mainly from US and Japan, shipped them through the Tianjin port and then on to Beijing. Now that such imported used desktops are not available, the foreign brands so traded are ones produced domestically, like Dell.

Stall technicians buy the used units, clean them, test their capacity, remove broken parts, and reassemble them into workable desktops; this assembly work is often done in warehouses located a few kilometers from the market where the rent is cheaper. Some samples are displayed in their stores, and they will bring the customers to their warehouse if they need more than what is on display in the store. The shops also sell reusable removed parts, and of course such parts are far more valuable than parts that cannot be reused. For example, a reusable CPU, depending on make and generation, can be sold at over 100 Yuan, but the unsalvageable ones are worth less than 10 Yuan when sold for scrap.

For Beijing's market, demand for used desktops has changed dramatically. Today, there is very low household demand, and the major buyers are newly established small-scale firms who buy used equipment to reduce start-up and operational costs. Currently, customers for secondhand desktops are mostly electronics retailers from other provinces out of Beijing, but also include customers from foreign countries (see Figure 6.7). Typically, these latter customer relationships (those with foreign buyers) developed after the supplier and customer first met in person in Beijing, built trust and a good business relationship with time, and then traded online or via telephone calls. Used desktop stall owners can reassemble the computers tailoring them to customer preferences. There are several logistics companies close to Zhonghai and these companies deliver goods by truck to the customers or may help make arrangements for both domestic and international shipping.

For used desktops, there are also foreign markets to several importing countries include Mongolia, North Korea, Tajikistan and other central Asian countries bordering Xinjiang Autonomous Region. Generally, there are two routes for Beijing's used desktops to those countries. One is that the electronics business men come to Zhonghai or Silicon Valley to buy what they need and bring back to their home country for sale. This approach is used mostly by businessmen from Mongolia and North Korea (where there is still a market for used CRTs) (Interview 25, 2016). The other route is going through China's secondhand electronics business men in small counties of Inner Mongolia, Xinjiang Autonomous Region and the three northeast provinces neighboring the above importing countries. However, overall demand for secondhand desktops from these importing countries is not very high and does not represent a large business segment for the repair technicians at Zhonghai or Silicon Valley. In terms of secondhand removed parts, most are sent to Guangdong province which is the biggest center in China for electronics manufacturing where these parts are reused.



Fig 6.7 Used desktops stalls in Guanganzhonghai

6.3.3 Used laptops

In used laptop stores, most of the items are top brands such as Lenovo Series, Dell, Apple, Sony etc., and some look brand new. In Silicon Valley, there is also one big store selling only used Apple and Lenovo Thinkpad series. When looking closely at these laptops, you will find a small “old goods” label stuck to it. This label is provided by the market and given to stall owners to show that the laptop is legally bought. There are also other labels such as price, and CPU. Prices range

from 500 to 3000 Yuan. Roughly half the used laptops in these two markets are middle capacity, but some are high capacity with an i7 core Intel chipsets (which were first manufactured in 2012).

Used laptop entrepreneurs say that over 90% their supplies of are from developed countries, mainly the US, with only a few sourced domestically. The imported used laptops firstly arrive in Hong Kong and then cross into mainland China to be sold in markets in Shenzhen, which is where most Beijing stall owners buy most of the used laptops they sell. A few large-scale used laptops businessmen in Beijing also have a registered company in Hong Kong. They purchase goods through their Hong Kong company, then deliver some to mainland China, and others they route to African and other Asian countries.

The imported used laptops arriving in Beijing for sale are not only consumed by China's market, but also by overseas students and businesses from less developed countries. Like used desktops, laptops go to neighboring provinces and countries (e.g., Vietnam). The other international route for used laptops sold in Beijing is through overseas students from Africa and Asian countries who often purchase up to 10 used laptops to sell back home each time they return to their home country.

One clear difference between used computer stall owners in Zhonghai and Silicon Valley and retailers of other kinds of DEAR is that in the computer markets each stall holds its own license which it hangs in front of their stall. Each stall owner is a registered small business and subject to tax regulations. Prior to 2012, each retailer needed to pay a 300 to 400 yuan tax monthly; after 2012 they were made exempt from these taxes.

Although they do not have to pay taxes, most of repair men and used computers stall owners are pessimistic about their future. They feel several factors are contributing to a decline in the used electronics business. Since on-line electronics shopping has taken off in China, business in Zhongguancun has dropped dramatically. Young peoples' turn to on-line shopping includes shopping for used electronics. The on-line secondhand electronics platforms are either between individual exchanges or retail sales. Another factor is the rapid change of Chinese consumers disposal behavior. The price and quality drop and acceleration of new computer technology drives young people to discard directly after about three years use rather than repair or choose used electronics as in early 2000s. The lifespans of computers are shorter and repairing has become more expensive. Even compared to their business in 2011, the repair sector at Zhongguancun and Silicon Valley is experiencing a noticeable decline in consumers. A third big challenge, as in other

parts of the network I have traced, is land use. Like the scrap yards and used good markets elsewhere in the city, Zhongguancun is also facing new plans from the government, several buildings selling electronics have already closed, and there are rumors that Zhonghai market might be demolished soon.

Computer repair and reuse is different from other appliances in some aspects, and even used desktops and laptops differ in their sourcing and markets. Reuse, particularly of removable components from desktops, is still common and supports a market for reassembling, but most used desktops are sold outside to buyers for export to provinces outside Beijing and even to less developed countries in Asia and Africa. As for used laptops, over 90% of units are imported from developed countries, and there are both domestic and overseas markets. Overall, the flow of used laptops is dominated by import into China while flows for used desktops are dominated by export to developing countries.

Overall, the computer repair and reuse business is declining. There are several reasons for this: 1) Laptops and other devices are increasingly designed in ways that prevent part replacement and create obstacles to repair and reuse; 2) The IT environment continually demands the acceleration of processing and this limits the useful lifespan of devices and encourages habits of disposal and purchase of new models rather than repair and purchase of used units; 3) Locally, Beijing residents now have higher incomes enabling them to purchase units and keep up with that acceleration, so the local consumer market for reuse and repair has shrunk; and 4) Online platforms allowing peer-to-peer trade have become a common alternative for used computer sales.

The location of computer reuse and repair markets closer to the city center and in the heart of Beijing's "Silicon Valley" manifests some basic ways in which used computer repair is treated very differently from the repair of other used appliances. Computers and IT equipment are, generally speaking, more prestigious than home appliances, and being viewed as "hi-tech" receive more positive attention from the government than other sectors. And, of course, the income computer repair and reuse can generate and thus the rent used computer shops can pay (and the fact that computers are relatively small compared to other appliances is not insignificant in this regard) is significantly higher than for other appliances. All these factors contribute to the quite obvious difference in geographic location and condition of used computer markets (they have not, for example, had to constantly relocate due to demolition). However, with the used computer

market clearly in decline, it is unclear whether the large used computer markets of Zhongguancun described in this chapter, will continue to exist in the coming years.

6.4 Conclusion

There is still a large portion of discarded large home appliances and electronics flowing to the informal repair and reuse sector in Beijing. The rate of reuse and dismantling varies for different items, and while the overall picture is one where repair/reuse is declining somewhat relative to dismantling and recycling, repair and reuse is still substantial, both in the quantity of units being repaired/reused and in the overall economics of the discarded appliance and electronics sector.

Still, the sector is facing a variety of major challenges: 1) appliance and electronics designs are increasingly less suited to, if not intentionally discouraging of, repair and reuse; 2) this factor, combined with pricing and other economic factors encourage consumers to choose to buy new units rather than repair old ones or buy used ones; 3) regulations discouraging migrants from residing in Beijing have led to a softening of demand for used appliances and electronics as migrants tenants and their landlords are a major market for these goods; 4) those same anti-migrant regulations also make the lives of the workers in the sector increasingly precarious; 5) the city continues to undergo urbanization, but there are no plans to support the informal DEA sector or consider its contribution to extending the life of electronic equipment. Instead, recent urban land use regulations ban DEA markets from Beijing. Yet despite all these pressures, as of the writing of this thesis, the well-organized system for discarded appliance repair and reuse built by the informal sector is still working in the city.

As has been argued in each chapter of this thesis, every stage in the reverse logistics network of DEA collection, sorting, dismantling and repair involve business methods and technical skill sets in order to function effectively. The importance of highly developed technical skills is nowhere more clearly displayed than in the DEAR workshops described in this chapter. These technicians are a lynchpin of the sector, without whom it would fail to function. These networks of skilled entrepreneurs and technicians have been an important part of Beijing's vibrant economy and rapid urbanization over the last three decades, enabling the megacity to manage at least two crucial issues: 1) supplying millions of residents and businesses with affordable appliances and IT devices; 2) managing the millions of discarded electrical and electronic units in a manner that significantly extends their working lifespans while directing the resources embodied in DEAD to

channels for recycling and reuse. Moreover, this informal sector has by and large managed the entirety of Beijing's DEA flows without any financial or logistical support from the government in Beijing.

Chapter 7: DEA Collection by Authorized E-waste Companies

Summary: This chapter presents how authorized e-waste disposal companies, Huaxin and its “child” company Banana Peel, have piloted an e-waste collection program with the support of the local government. The company on the one hand wants to get e-waste supplies directly from consumers and plans eventually to monopolize collection rights over all recyclables and DEAs in residential communities where it contracts.

Company management has designed an on-line and off-line information technology collection and management system, and they collect e-waste and other recyclables directly from consumers by providing up to the door collection service. After launching a pilot in April 2016, they found it is difficult to sustain their program, which yielded few DEAs and had very high administrative costs. Banana Peel found it was unable to effectively collect either DEAs or other recyclables (paper, plastic etc.) in a cost-effective manner and were ineffective at accessing and managing the processing of the pilot community’s DEAs or recyclables despite attempts to revise their approach.

7.1 The Banana Peel pilot project

For decades now the government has made it clear that it hopes at some point to drive the informal sector out of residential recycling and DEA collection and processing and there have been repeated attempts at pilot projects to accomplish this. Most recently, since confirming the status of the 109 formal e-waste companies, there has been a trend of developing e-waste collection pilot programs in residential communities to supply these authorized companies. In my fieldwork, I looked at one such recent pilot project launched by Huxin Lvyuan Environmental Protection Co. Ltd (hereafter as Huaxin), the biggest authorized e-waste recycling company in Beijing.

In 2011, Huaxin founded a child company called Banana Peel Environmental Technology Co. Lit (hereafter, Banana Peel) aimed at collecting e-waste directly from consumers and building their own collection networks in residential communities (Interview 13, 2015 and 2016). In the beginning of 2014, Banana Peel’s collection business opened Beijing-wide with their website providing a hotline for consumers seeking e-waste pick-up. After a year, there was no breakthrough in collection quantity with this strategy.

In 2016, the company started developing another strategy focused on a cluster of residential communities with the support of the Development and Reform Committee of the Yizhuang Economic-Technology Development Zone, Yinghai township and Jiugong township (see Figure 7.1). By May, 2016, Banana Peel had their own app and a team maintaining both on-line and off-line tasks and began accessing 34 residential communities in the administrative scope of the Yizhuang Zone. Turning their collection scope to focus on specific communities rather than all of Beijing, they also changed the scope of their materials collection from specializing in e-waste to collecting all forms of recyclables, very much like informal community scrap collectors.



Fig. 7.1 Banana Peel's collection area Yizhuang, Yinghai and Jiugong. Source: map.baidu.com

In August 2016, I visited Huaxin three times and followed Banana Peel's collection work for one week. I followed their collectors as they provided door-to-door services in residential communities to observe how their collection work happens. I also talked with company managers in charge of collection in communities and e-waste processing and their collectors in the communities.

Through observation and interviews with staff and managers of Banana Peel and Huaxin, I arrived at four empirical findings. First, no one in Banana Peel understands how the current informal scrap collection works in the residential communities. They tend to ignore current scrap collectors and exclude them as they intend to build a totally new collection system. Second, the costs of on-line administration and off-line collection are extremely high. The money they earn from collected materials cannot even cover the basic salary of their collectors, not to mention all the other costs. Banana Peel has been steadily losing money since the pilot began, despite subsidies from the local government and its parent company, Huaxin. They admitted that they were failing in the near term, but I would also predict that there is no potential opportunity for them to turn a profit even in the long term in the collection business. Third, though e-waste collection was meant to be their main task, it currently makes up a minority of their collection material now that they have expanded their scope. Moreover, the recyclable scrap they collect ends up being sent to the same markets that informal collectors frequent. Fourth, according to Huaxin's own management, the company's main competition and greatest challenges come from China's formal e-waste sector—the other formal companies in nearby Hebei and Tianjin that are competing over e-waste supplies with them—and from matters directly related to government policies and the funding mechanism, not from the informal sector.

In 2016, Banana Peel received over 2 million Yuan in the name of source separation and sustainable recycling from the Yizhuang Development and Reform Committee. With this fund and money from their parent company Huaxin, Banana Peel built a new team to practice source separation in 34 residential communities with the Yizhuang government providing them authorized access to those communities in early 2016.

With the local government's funding, Banana Peel planned to build their own scrap collection system and collect e-waste directly from consumers. To do this, they hired new staff, built their own smart phone based app, advertised their "internet plus recycling" online platform to order pick-ups, and claimed that they differed from informal scrap collectors in collecting low-

value materials like glass bottles (which informal recyclers often do not collect) and processing their recyclables with sound environmental technology and good pollution control. The use of on-line technology and the app were strategies to attract young people to choose Banana Peel instead of informal scrap collectors. They also thought on-line technology might save labor costs.

The community recycling team staff was divided into three groups: four managers and administrators, four on-line and hotline operators, and fourteen community collectors. There was also a driver for transporting the recyclables to the Huaxin warehouse.

In May and June 2016, they entered the 34 residential communities designated by the Yizhuang government on weekends to promote their collection business by giving away free recycling bins to households. Residents who took a bin needed to register as Banana Peel users and download their app. With this app in the user's smart phone, they can order recyclables pick-up service whenever they want. By August 2016 there were 80,000 registered users, but the number of active users was quite low. Daily orders average around 200 for all 34 residential communities with a total of over 100,000 household. Of those 200 orders, only about 10 each day include DEAs.

The collection process works as follows: users either call or order pick-up through the app. Operators input user information (address, phone number and materials awaiting pick up) into an order form, and then send a message with the users' information to the on-site collectors' smart phone. On receiving the order information, the collector calls the customer to make an appointment to pick their recyclables. The collectors arrive with an order form, scale, tape to tie the card board and a bag for plastic and other small recyclables. Unlike informal scrap collectors, they do not pay residents with cash but credit called 'Banana Coin' (which can be used to buy a small number of items such as hand soap and detergent). Collectors enter information on everything they collected and its weight in the order form, and then check it with the user and get their signature. At the end of day, collectors send all their order forms back to the on-line service staff, who process the information and endorse each users' credit ('Banana Coin'). Service staff also calculate the pay for each collector. Weekends are busier than workdays, with staff working overtime.

14 collectors serve the 34 residential communities. Weekdays they work 8:30 am to 6 pm, working longer hours on weekends. But on typical days collectors often work late to finish unloading recyclables and manage paperwork. Banana Peel rents a one-bedroom apartment in one of the residential communities where collectors can take breaks, charge their e-tricycle, and await scheduling calls. Their e-tricycles are emblazoned with Banana Peel's app code and other

information in green. Unlike informal scrap collector's e-tricycle, theirs are enclosed (see Figure 7.2 and Figure 7.3). This means they have limited room for their collection. When it is full, the collectors carry them to the truck or van on the side walk of the street close to the communities. There are two vans and one four-wheel truck for transporting the daily collection. All of them are enclosed with one ton capacity, so they collect roughly three tons maximum of recyclables including cardboard, plastics, cans and large and small home appliances. Compared to Mr. and Mrs. Ma's daily collection (see Chapter Three) I found that the Ma's on average collected more DEAs and about 1/3 of the recyclables that all 14 collectors amassed per day. The 14 collectors' daily haul sold at recycling markets for around 3,000 Yuan, not nearly enough to cover their salaries, let alone the other costs of the system.



Fig. 7.2 E-tricycle used for collection in residential communities.



Fig. 7.3 A van Huaxin used for collecting large amount of materials generated by companies.

On-site collectors' income is based on the basic monthly salary of 2500 Yuan, plus the bonus of 7 Yuan for each order, so the collectors don't care how much they can collect in each order, but only how many orders they transact. Each collector takes from 10 to 35 orders every day, and the operator managing off-line transactions also makes 2 Yuan from each order. Based on these figures I collected, each month Banana Peel's system covering 34 residential communities is losing 400,000 to 500,000 Yuan. In fact, the more they collect, the more money they lose because the average value of a pick-up is too small to cover its cost. The management seems to see no potential for making the current situation profitable (Interview 29, 2016) leading the parent company, Huaxin, to lose confidence in continuing the project.

Apart from being economically infeasible, Banana Peel's collection process is out of control. Banana Peel does not have any experience in dealing with e-waste collection or other recyclables. They cannot meet some of the promises advertised to users and their recyclables are

becoming a mounting problem. For instance, in the beginning they claimed they could collect all recyclables, even the low-value materials such as glass bottles which even informal collectors no longer collect. However, they soon stopped doing so because they have no downstream for those materials. While I was doing my fieldwork, they had resorted to just piling all the recycling materials they collected in a yard without further sorting, and then occasionally employing two old men to separate cardboard from plastics and e-waste when they ran out of storage space.

Banana Peel's main collection target is DEAs, but collectors do not seem to emphasize DEA collection and their jobs extend to collecting all recyclables. On the other hand, few residents choose to give DEAs to them. DEAs are still more valuable than other recyclables and when residents compare the price Banana Peel offers to those of informal scrap collectors, they tend to choose the latter. Banana Peel ends up mainly with low-end discarded appliances like CRTs, microwave ovens and water dispensers, but very few washers and refrigerators and even fewer computers. When collecting DEAs, in addition to filling out order forms, collectors need to take a picture of the item and send it to a Wechat group in which all collectors and managers are enrolled in order to prevent collectors from replacing high value DEAs with lower value items.

When I followed the collectors, I saw that some residents set their DEAs aside and did not give them to Banana Peel. There are many possible reasons for this. Banana Peel's app actually provides very little information about their e-waste pick-up. Indeed, from the perspective of Banana Peel's users, the one obvious advantage Banana Peel offers over informal community collectors is doorstep collection of recyclables (plastic, paper, etc.). When it comes to DEAs, informal collectors are happy to arrange very convenient pick-up and pay better prices than Banana Peel. And most residents prefer real money to Banana Credit, which can only be exchanged for a small number of goods like detergent and hand-soap. The company had plans to make gifts available for Banana Credit as well, but as of August 2016, when I ended my fieldwork, that had still not happened.

Banana Peel's collection workers are also ineffective at promoting DEA collection. Management provides no clear incentive for collectors to promote DEA pick-up over recyclables; indeed picking-up DEAs does not pay any better and is much more complicated as used appliances are often heavy and hard to move. The collectors themselves have little training and no previous experience in recycling. And they have no training at public relations nor are they given any

autonomy to bargain and make deals with residents for their DEAs, so they are unable to compete with informal collectors (Interview 12, 2016).

One way Banana Peel has tried to set themselves apart from informal recyclers is by promising to collect all kinds of recyclables, even low-value materials that informal community collectors typically do not collect (plastic bags, glass bottles) and guaranteeing that all collected materials will be processed with sound environmental technology. However, the company has found that they cannot deliver on these promises. Several days into the pilot program, Li Qiang, Banana Peel's manager in charge of on-site collection, decided to stop collecting low-value materials because there was no market demand. Over the following weeks their collection scope continued to shrink, as they gave up on bulky items like beds. Apart from DEAs, their collection list narrowed to paper, cardboard, plastic bottles, cans, and clothes. When facing the users' questions about the narrowed collection list, collectors were embarrassed and would simply reply that it was a decision from the company.

While e-waste went to the Huaxin plant, other recyclables were sent to Huaxin's open-air warehouse nearby. But Huaxin had no processing facilities for these materials and Banana Peel had no idea how to deal with these mixed materials; they were so cheap they hardly seemed worth selling and so they just piled them in the yard for over a month. Summer is Beijing's rainy season. In June, after several storms, all the materials were wet. Management realize that they needed to clear the warehouse and hired two old men to sort all the mixed, wet, smelly materials. They sold the sorted recyclables to informal sector markets as well. Clearly, Banana Peel not only lacked experience in community collection, but was also ignorant of how to handle what they collected.

In previous chapters I have described the relationship between the informal and formal sectors as more collaboration than competition with the former becoming the crucial supplier of the latter since the 2012 WEEE subsidies kicked in. But Banana Peel's move into community collection marks an important exception, for in doing so the company, on behalf of its parent company Huaxin, aims to source directly from consumers, essentially in an attempt to usurp the informal sector's collecting function. Predictably, conflicts arose.

About a month into the pilot, one of the 34 communities, Boke Yayuan, blocked Banana Peel from collecting there. The property management company kept Banana Peel's collectors out because the informal scrap collector working in the community complained that his collection had dropped since Banana Peel came in. The property management company sided with the informal

collector because he paid an annual fee to the management company for rights to collect recyclables in the community. Banana Peel is not willing to pay property management companies for the rights to collect. Instead Banana Peel uses its formal status as a government supported company to get community access. But there is no regulation stating that the government can force property management companies to favor Banana Peel over other collectors.

In response to being shut out, Banana Peel told Boke Yayuan clients to bring their things outside of the community gate on weekend afternoons to Banana Peel collectors waiting on the side walk, but they discovered that their orders and quantity dropped dramatically when they could no longer offer doorstep collection. The situation speaks volumes about the economic value of the space between the street, the community gate, and residents' front doors. While in absolute terms that space amounts to no more than a few square meters in area, access to (and control of) this little patch of the city (and all those like it) is terrain in which the economic stakes of the competition between informal and formal organizations are enormously high.

By September 2016, Banana Peel again changed their collection strategy to save costs, by shifting to collecting only at fixed times on weekends. Orders dropped off further. To save labor costs, large numbers of collectors and other staff were laid off, but even with staff reduced to only 5 workers (a manager, two collectors, one on-line staff, and one person sorting the collected recyclables) the company was still in the red. As of March 2017, when I interviewed Banana Peel's manager for an update they were still losing money. It appears that unless and until Banana Peel can secure monopoly control over community collection, whether of general recyclables or more specifically of DEAs, they will be unable to compete against the informal sector.

7.2 Conclusion

Banana Peel's foray into community collection clearly put them in direct competition with the segment of the informal DEA sector engaged in collection. But aside from such pilots, my research supports the proposition that the relationship between formal e-waste processing companies and the informal DEA sector has generally reached a kind of mutual accommodation to one another, and, particularly in handling the portion of the DEA stream headed toward dismantling, a kind of cooperation, with informal collectors diverting an increasing portion of DEAD to formal company processing. Huaxin, for example, uses the government subsidy to purchase most of its e-waste from informal collectors. However, Huaxin still faces many development challenges. In 2015 and

2016, I interviewed two managers in different positions, one in charge of the company's overall operation, the other of e-waste collection. Both forthrightly admitted that Huaxin was only able to become profitable due to the government funding mechanism initiated in 2012. But even under these subsidies, the company faces problems; one is the inconsistencies in the subsidy payment schedule; the other is competition due to overcapacity in formal e-waste processing in the Jin-Jing-Ji (京津冀) region (which includes Beijing, Tianjin and Hebei Province). In other words, too many authorized e-waste processing companies have been permitted and granted access to the e-waste subsidy in their region so that none of them operate at full capacity and the competition between them over e-waste is intense and counter-productive.

Authorized e-waste recycling companies like Huaxin depend almost entirely on the government WEEE subsidy for their financial survival and operating funds, so the specific processes through which that mechanism is implemented—how precisely data is reported, how subsidy levels are set, when funding is dispersed, etc.—are determinative of the company's daily operation. Release of subsidies from the central government's fund involves a complicated administrative process and typically takes months between when a unit is processed and when the subsidy is received (Interview 7, 2016). Companies must keep records on each unit processed; these are checked by the prefectural level Environmental Protection Bureau and then sent for a second review to the national level Ministry of Environmental Protection. If there are no problems, the checked information is sent to the Ministry of Finance which, after a third review, sends the subsidy to the company. The whole process takes at least three months, and in 2015 subsidies were delayed for over six months, driving several smaller companies into bankruptcy. At that time, Sound Recycling, one of the biggest waste management corporations in China, purchased 11 authorized e-waste disposal companies in nine different provinces due to their financial distress.

According to Yuan Jie, the ex-manager of Huaxin, to receive the subsidy the company needs to provide paper work and video evidence verifying their dismantling of each unit, and only after such verification is the subsidy received. Part of the reason that a delay in receiving the subsidy is so threatening is that the companies hardly have any other revenue stream and so are dependent on the subsidies to survive. In many cases the subsidy is almost entirely expended simply on purchasing units of e-waste. For example, the 80 Yuan subsidy for a CRT is almost entirely used up in purchasing CRTs from informal suppliers. Aside from that subsidy, Huaxin's only other revenue stream is from selling recyclable materials from their e-waste shredding (copper, plastic,

etc.) all of which have been dropping in price. But daily operating expenses for the company of course also entail salaries and wages, transport, warehousing, factory processing etc. Thus, delays in receiving subsidy payments put enormous pressures on companies that have almost no other revenue stream.

Huaxin managers also made it clear that from their perspective their most immediate competitors are not informal collectors but other formal e-waste processing companies like themselves, particularly their neighborhood rivals. It is generally believed by state planners that the current formal sector e-waste dismantling capacity of the 109 authorized companies is more than sufficient for handling the DEA currently produced in the country (Interview 3, 2016).

The government's plan is modeled on the idea that each e-waste handling plant has the proper capacity to handle the amount of e-waste being produced in its region. So, for example, Beijing's e-waste plants are supposed to be suited to handle the e-waste produced in the Beijing region. But the match of capacity and supply is far from this ideal. The population in Jing-Jin-Ji accounts for 8% of the entire country, but the e-waste dismantling capacity is estimated to be about 15% of national needs (Tong, 2017). Looking at the authorized e-waste recycling company list, there are three in Beijing, four in Tianjin, and seven in Hebei Province. A direct result of this local overcapacity is that e-waste recycling companies in the region compete with each other for e-waste, pushing the price of e-waste in the region to abnormally high levels.

Beijing is by far the most populous and wealthy area in the Jing-Jin-Ji region and generates more e-waste than Tianjin or Hebei. However, Qian Wan, a Huaxin manager, reported that aside from CRTs, only 8% of Beijing's large home appliances flowing to formal dismantling are going to Huaxin because the other e-waste companies in Tianjin and Hebei offer higher prices to e-waste collectors. On the other hand, Qian explained that some e-waste generated in Inner Mongolia and the three northeast provinces (Jilin, Liaoning, Heilongjiang) flows to Huaxin. Truckers who frequently haul goods out from Beijing to these provinces do not want to return to Beijing empty, so they contract to haul loads of e-waste to Beijing. In many ways, this domestic transportation practice mirrors the organization of the international trade of e-waste that sees cheap shipping available on the 'backhaul' journeys of container ships leaving wealthy markets like the US and Europe after arriving to deliver manufactured goods and then return to China (see Minter 2013 and, for comparison, Issenberg, 2007). Although there are total of ten authorized e-waste recycling companies (including one "child" company of Huaxin) in Inner Mongolia and the northeast

provinces, a certain proportion of e-waste from those areas still flows to Beijing's companies. In other words, because Tianjin and Hebei take some of Beijing's market, Huaxin is forced to seek materials from other regions when transportation costs from those areas make it feasible. E-waste is flowing across distances upwards of 500 km driven by demand fed by the government subsidy (Interview 13, 2015 and 2016) The environmental effects of the transportation geographies arising from the situation are important to understand: a European study found that after 500 km of road transport, the environmental benefits of recycling e-waste were outweighed by the environmental costs of the road transport (Barba-Gutiérrez et al, 2008).

Since August 2016, one on-line platform, Yizaisheng (易再生), a child company of the Sound Group which owns many e-waste authorized recycling companies across China, has coordinated with over 60 e-waste recycling companies to publish a monthly e-waste price index. The company claims this is to make prices more transparent and help stop unreasonable competition between regional authorized companies, but informal sector entrepreneurs believe the real purpose is to help set prices that authorized companies pay to informal sector dealers (Interviews 11 and 16, 2016). This concern among the informal sector dealers is reflective of their general feeling of relative powerlessness vis-a-vis these formal companies. As described in Chapter 5, many informal DEAD traders are finding it increasingly difficult to survive economically; whether they dismantle appliances by hand or sell them to formal companies, their profit margins are shrinking. Informal DEAD traders fear that they are becoming increasingly dependent on formal companies as buyers and therefore increasingly vulnerable to their pricing and trade practices. Moreover, as has been illustrated throughout this thesis, state related bureaus and companies have never recognized informal sector traders as stakeholders; it is no wonder, then that informal DEA traders are wary and that the current "cooperation" between themselves and the formal companies might turn in a less auspicious direction.

CHAPTER 8. CONCLUSION

This study set out to interrogate the role of the informal sector and the relationship between the formal and informal sectors in Beijing's e-waste collection, reuse and dismantling economy since 2012 when the WEEE directive (Administrative Measures on Levy and Use of the Fund for Waste Electrical and Electronic Equipment Treatment) went into force. Using a commodity chain approach, I have traced the flow of e-waste (or what I have termed in this thesis DEAs (Discarded Electronic Appliances)) from its point of origin—the household consumers of electrical and electronics equipment—to their disposition either in reuse and resale markets, informal dismantling shops, or authorized e-waste processing companies in Beijing. I described the network of informal sector work in DEA collection, trade, reuse and dismantling, as well as their interaction with the formal sector authorized e-waste recycling companies. I have also examined how the WEEE directive, Beijing's rapid urbanization and its economic and population control policies have affected e-waste processing and diversion to the informal and formal sectors since 2012.

A survey of all the policies, rules, and regulations on e-waste issued by the Chinese government finds only one directive that even mentions the informal sector: the Regulations on Old Electrical and Electronics Equipment issued by Ministry of Commerce in 2013. This document describes rules which the old electrical and electronics equipment sector should follow, but mentions nothing about the many ways in which meeting these rules is essentially impossible for any informal sector business, ignoring realities such as land use restrictions or the status of repair and reuse.

Over the past few years, integrating of administration of waste and recycling into one bureaucracy has been debated in Beijing (Beijing Youth Daily, 2017), but it is obvious that the informal sector for reuse and recycling is not included in the scope of this broader policy discussion. Government plans involve having big state-owned or state-affiliated companies and large investors take over all of Beijing's waste management, including post-consumer recycling and handling of DEAs. The informal sector is otherwise ignored.

The findings presented in the preceding chapters can be summarized as follows:

- 1) The informal e-waste, or DEA, sector is a well-organized and efficient network that has been handling Beijing's DEA collection, repair and reuse since the late 1980s when China's market economy opened new possibilities for the development of an informal

economy, including an informal DEA sector in Beijing. As quantities of DEAs increased in the 1990s, the informal sector also increasingly processed some DEAs for dismantling. Over these decades migrant workers have accumulated rich experiences trading DEAs and channeling goods to reuse or dismantling without any support from the government. This profit driven network also provides up-to-the-door DEA collection for residents, extends the life cycle of discarded electrical and electronic equipment through repair and reuse, and maximizes the recovery of resources by manually dismantling. Apart from their expertise in DEAs, many workers in the informal sector are familiar with one another and with their up- and down-stream clients, which has helped forge a reasonably trusting and reliable business environment for DEA trade to proceed smoothly. Their economic activity is part of Beijing's vibrant economy, connecting consumers to used goods markets and resource recycling over the past decades. However, their activity is more and more constrained due to Beijing's policies aimed at banning the informal and labor-intensive sectors in recent years. Land use policy, an issue that has long been beyond informal actors' ability to address, has become an urgent problem.

- 2) The informal DEA sector in China's cities intersects with but is largely distinct from the DEA and WEEE processing that has been the focus of most of the scholarship on China's e-waste thus far. That scholarship has been centered on hubs of transboundary e-waste trade such as Guiyu and Taizhou. This thesis demonstrates that, with the notable exception of computers, the kinds of DEA that circulate, the markets for repair and reuse, and the networks that have developed for scrapping units that no longer have viable reuse markets are largely distinct from the informal networks feeding into Guiyu and Taizhou. In this respect this thesis provides a crucial context for understanding the much broader and quantitatively larger picture of informal DEA and WEEE collection, trade and processing to which Guiyu, Taizhou and transboundary WEEE is connected.
- 3) Repair and reuse is prevalent in the informal sector's EEE commodity chain, extending the life cycle of discarded EEE which still functions well and has a viable consumer market. Beijing's DEEE retail and wholesale markets not only meet local demand, but also supply affordable used EEE to neighboring provinces, and, in the case of some items like desktops, laptops and flat screen TVs, also to developing countries elsewhere in Asia and Africa. Moreover, trade in removed parts is also a crucial part of the informal discarded EEE trade.

Meanwhile, reuse is completely neglected by the current WEEE directive, and formally registered e-waste companies do not engage in any refurbishing or reuse activities and there is no subsidy supporting such activities. The policies and practices of the formal sector conform with what Schulz has termed a “shredder ideology” (Schulz 2015) that assumes without any comprehensive research or quantitative data, that processes of mechanized shredding are the environmentally and economically optimal solutions for DEA. This “shredder ideology” is disturbingly compatible with trends in appliance design toward making items increasingly uneconomical to repair. Informal sector practices of repair and reuse are threatened by several interconnected EEE design and consumption trends that contribute to shortening the useful life of many appliances, including the degraded quality of EEE, manufacturers limiting the availability of parts to repair businesses, and the increasingly rapid emergence of new and less expensive models of EEE. Since 2008, as mass consumption of electronics has spread throughout China, more recent designs have tended to make repair and the salvaging of components more and more difficult and less cost effective. As the quality and price of new EEE declines, the portion of discarded EEE flowing to reuse has dropped. Lack of policy support for reuse and restricting land use so that used goods businesses are obstructed from functioning only exacerbates these trends, facilitating even more rapid consumption and turnover of EEE, exhausting resources and disposing of them at a steadily increasing pace; while this uptick in consumption might create numbers that are appealing to analysts of China’s economy and GDP, these trends are very troubling from an environmental perspective.

- 4) Since 2012, when the WEEE directive and its funding mechanism was enforced, DEAD collected by the informal sector has increasingly been diverted to authorized e-waste recycling companies who are reimbursed for processing these units by government subsidies. This diversion has been crucial to keep supplies flowing to authorized e-waste companies, and could be characterized as a form of cooperation between the two sectors. Informal workers who specialize in dismantling DEAD still dismantle a portion of their collection, that proportion varying for different kinds of DEAD. The manual dismantling done by the informal sector has generally been found to be preferable to the mechanical shredding done by formal factories in terms of resource recovery (Wang et al, 2012; Manhart, 2011), and especially in terms of reuse of removed parts.

- 5) Compared to the informal sector's DEA collection, pilots of collection by authorized e-waste recycling companies have proven extremely inefficient, the failure of Huaxin's child company, Banana Peel, being a case in point. The financial viability of Huaxin, Beijing's biggest authorized e-waste recycling company, is overwhelmingly dependent on the WEEE directive's funding mechanism, creating the rather ironic situation that Huaxin's management perceives its main competitors to be, not informal enterprises, but rather other authorized e-waste recycling companies that compete with them for subsidies in a context of overcapacity.

My findings counter the mainstream understanding about China's e-waste problem. Chinese government policies and the majority of journalistic and scholarly accounts describing e-waste in China render people engaging in the informal e-waste sector as trouble makers and environmental destroyers. Officials and policy consultants like CHARI support models of e-waste management that exclude the informal sector completely from e-waste management, and the policies they promote either enforce that exclusion or actively work towards the elimination of informal sector businesses. The present study shows that their conceptualization of the informal sector is flawed, at least as it concerns the thousands of entrepreneurs engaged in the sector in the city of Beijing. The misrepresentation of the informal sector conceals not only the contribution of the informal sector to daily e-waste collection, reuse and resource recovery, but also the diverse forms of e-waste related business and their services to citizens. It is worth noting that this misrepresentation of the informal community's involvement in discarded electronics is of a piece with how China's informal recycling sector has been misrepresented in both China's domestic policy and even in much of the scholarly literature on that sector. As long ago as 2006 *Habitat International* published a special issue titled "Solid Waste Management as if People Matter" that assembled ten articles, including cases studies from both developed and developing countries, arguing in every instance that community involvement and partnerships between the state and informal recycling sectors was necessary to achieve environmental and social benefits. It is a striking symbol of how the approach to China's informal sector has been out of step with international scholarship that this special issue had no articles on recycling in China, which by 2006 was by every measure the biggest recycler in the world. The findings of this thesis are very much in line with the assertions of *Habitat International's* collection of studies.

Urbanization is not only a political-economic process. It consumes resources and energy, and it also produces waste. The production of wastes, including so-called e-waste, is an unavoidable aspect of urban metabolism. This study attends to those people engaging with this aspect of the urban metabolism. As we have seen, migrants from the countryside who make a living managing the dispositions of Beijing's e-waste have been marginalized in the city's social-ecological processes for decades. Few scholars give a voice to these socially marginalized groups, but this study argues that these socially marginalized migrant workers play a critical role in managing Beijing's urban metabolism in two ways. On the one hand, their labor removes unwanted materials from the city and helps urban Beijing open up new room for accumulation; on the other hand, they help turn these unwanted materials into goods that can either continue to be used by other consumers or into parts and recovered resources for use in other industries. The important contributions of the informal migrant e-waste sector have been generally ignored by scholars and received no support at all from the Chinese state. Recognizing their contribution is a starting point for us to imagine labor activism in the waste sector.

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