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Assessing the functional relationship between the formal and informal waste systems: A case-study in Catalonia (Spain)

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Abstract:

The present study draws from data collected with informal recyclers in the autonomous region of Catalonia in northeastern Spain. The purpose of the investigation is to determine the relationship between the formal and informal recycling sectors in Catalonia and determine how each of their activities impacts the other. From the case study in the city of Granollers, it was determined that from the spring of 2018 to the fall of 2019, the informal recyclers had the potential to collect roughly 44% of the cardboard in their geographical area, helping to meet the environmental goals of the region, but receiving no recognition for their work and not even conceptualized as part of the waste management system. This investigation also analyzed the economic relationship between the formal and informal systems, and the affects that international events, such as China's national sword policy, had on that relationship. It was determined that the embeddedness of waste systems and global waste markets affect not only the formal system, but their relationship with the informal system as well.

Keywords:

Informal recycling sector; Waste management of Catalonia, Waste Pickers, Local Policies, Global flows of materials, Migration

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1. Introduction

The phenomenon of the informal recycling sector is widespread, providing an income to millions of people worldwide (Medina, 2010, Scheinberg et al, 2016; Bonnet et al, 2019). These informal recyclers have created extensive supply and transportation networks that create a significant impact on overall municipal solid waste programming (Hoornweg and Bhada-Tata, 2012). Though not always the case, informal recycling is usually conducted by the most vulnerable and/or marginalized social groups as a means of survival (Medina, 2000; Wilson et al., 2006; Gutberlet, 2010; Scheinberg et al, 2016; Ezeah et al, 2013; Aparcana, 2017). Wilson and co-workers points out that many informal recyclers may not be able to enter formal sector employment due to factors such as lack of education, physical disability, or legal status, and that they are often exploited and underpaid for the materials collected, especially in those markets where only one buyer exists (Wilson et al., 2006). These same factors have also historically contributed to poor inclusion/integration of waste pickers into formal waste management organizations around the world (Velis et al, 2012). However, in the last few decades, additional research has demonstrated the marked impact that the informal recycling sector can have on municipalities and nations reaching their recycling and environmental goals; and therefore, many governments and NGOs have advocated for inclusion of the informal sector into the formal recycling system (Wilson et al, 2006; Gutberlet, 2010; Ezeah et al., 2013; Aparcana, 2017, Davis and Garb, 2015).

Though there has been a substantial amount of documentation of informal recyclers in the global south, a growing amount of informal recycling takes place in the north, which until recently, has not been adequately acknowledged or studied (Scheinberg et al, 2016; Whittmer

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and Parizeau, 2018). According to Scheinberg et al (2016), there are possibly millions of informal workers participating in waste management systems in Europe alone.

The informal recycling sector has existed in Europe for many years, with the Catalan merchants, or "*drapaire*," appearing in the 18th century in Catalonia (Spain), and references of "rag-and-bone" picking in waste management articles materializing during the 19th century (Fernández, 2015; Scheinberg et al, 2016). The implementation of integrated waste management systems by municipalities in the last several decades (following European directives) led to the professionalization of the sector (Wilson et al., 2006; Scheinberg et al, 2016), leaving little room for the informal sector. This transition caused many of the previous informal recyclers to become middle-men who now operate legal private operations, often specializing in one or two materials. However, in the last ten years, the informal recycling sector has re-emerged, offering a way of life to new social groups (Porrás, 2016). Most of today's informal recyclers are immigrants who, either because of their lack of citizenship status or their situation of social exclusion, cannot depend on the formal labor sector and, thus, turn to informal recycling for economic income. The 21st century *drapaire* are now known colloquially as "waste pickers," or in Catalonia as the "*chatarrero*" called such for their collection of "*chatarra*" (or scrap metal).

The objective of this article is to demonstrate that, on a local level, although the formal and informal recycling sectors of Catalonia are separate, and at times in conflict with each other, they are also symbiotic and function through an interdependent relationship, which has consequences for the institutions in charge of waste management. All the while, local waste systems are embedded in global international material flows that affect their functioning and have impacts on the relationship between formal and informal systems at the local level.

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Formal and informal waste sectors often have an uneasy alliance, but they frequently maintain strong relationships of interdependence. Grounded on the proposals of Scheinberg et al. (2016) and Davis and Garb (2015), in our case study we have defined these mutual relationships from the theoretical assumption that formal and informal waste sectors are interdependent, in the sense that the rules that govern one affect the other. However, this relationship is not symmetrical and the capacity of the formal waste institutions to control and manage both is very challenging.

It is possible to design, modify or improve the formal sector through sectoral public policies, and in Spain there are numerous political institutions dedicated to elaborate waste management policies at different territorial levels (European, national, regional), though their execution is left in the hands of the municipalities. In contrast, the informal sector is not designed by political institutions specializing in waste management, but instead is determined by social, economic and political dynamics inserted in international flows (of migrants, materials, prices, etc.) that exceed the formal sector's management capacity (especially from municipalities).

The informal sector is made up of different types of actors. Scheinberg et al. (2016) identify 5 types of informal occupations in Europe related with waste management: waste pickers, itinerant waste buyers/collectors, small dealers/small junk shops, second hand operators, and swill collectors and herders). Informality is not absolute, instead there is a gradation inside the informal sector (Davis and Garb, 2015) between the completely informal activities and businesses outside any formal arrangements, and the businesses that are registered and pay taxes, but obtain inputs from undocumented sources on a cash basis. In our

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case study, there were interactions with the first 2 types identified, however, in this paper we have focused only on the first, without neglecting the importance that the second may have.

In this case study we intend to highlight these two interdependent and contradictory sectors within the context of global geopolitical dynamics that include immigration laws, international trade agreements, and economic restructuring policies, and their unique challenges for waste management at the local level. All of this greatly complicates relations between the two sectors, which is often seen as a threat by local waste management institutions. This is one of the reasons why, in our case study, the policies that have been applied to cope with the waste picker phenomenon mainly involve police, and in parallel, social services, without any attempt to do so through environmental policies nor through integration of the informal sector.

Davis and Garb (2015), identify a continuum of the degree of integration of the informal sector, ranging from i) those advocating a prohibition of informal recycling, ii) those ignoring their existence, iii) those where the sector is recognized but pressed to conform to and compete with the formal sector, and iv) and those attempting to integrate the strengths of the informal sector with those of the formal. The authors advocate for the last one as the preferred situation, even though this has not been the case for policies in most European countries, and not for our case study.

In short, although both sectors are interdependent, the informal sector is subject to numerous unpredictable factors and embedded in international flows, which limits the ability of formal waste management institutions to control them. Therefore, the informal sector influences the formal sector in a more unpredictable way, which forces those institutions to improvise, or under conditions of great uncertainty, seriously compromise the efficiency of

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the service. In line with our theoretical referents (Scheinberg et al. 2016), Davis and Garb (2015), we argue that better knowledge of the logistics to which the informal sector is subjected, recognition of its potentialities, and strategies of collaboration and/or progressive integration of both sectors, would contribute to building a fairer, more efficient and sustainable waste management system.

2. Methods

The investigation discussed in this article took place from April of 2018 to September of 2019. Data was collected through a combination of techniques by means of a mixed method approach.

First, 12 interviews with waste experts in Catalonia were carried out (April-September 2018). These interviews, though essentially open and exploratory, were organized into three sections: (1) the past – including the historic participation of informal recyclers in Catalonia, (2) the present – including how many informal recyclers currently participate, perceived impacts to the formal system, and municipal and public perceptions, and (3) the future – expectancies regarding the informal recycling sector, and how their activities may affect the formal sector; however, the process was flexible enough to explore specific areas more deeply if new information arose. The sample of 12 experts included: 1 expert on the Catalan informal economy, 2 municipal employees related with waste management, 1 member of a waste picker cooperative in Barcelona, 3 social workers working with waste pickers, 1 member of a private waste recovery company, 1 business owner in the city of Granollers and 3 experts in local waste management.

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Second, a 2-month long questionnaire to determine both quantitative and qualitative data was administered with a sample of 8 waste pickers in a Catalan city (Granollers) (Oct. 16, 2018 – December 11, 2018). The participants were all men between the ages of 22 and 60, originating from Senegal, Gambia, and Morocco. Each participant was asked to complete the questionnaire (face-to-face) once a week for 8 weeks (64 questionnaires in total). The content of the questionnaires focused on: hours worked, distance travelled (in km), method of travel (by foot or vehicle), route of travel, kilos of materials collected, prices of each material, place of sale of the collected materials, price of sale of each material, perceived health effects and how they were handled, and some brief questions about living conditions (accommodation, having sufficient funds to cover daily needs, isolation, etc.).

Third, 8 in-depth interviews were conducted with the same 8 waste pickers who answered the questionnaire during the previous two months (December 11-15, 2018). The thematic guide of these interviews focused on: brief biographical information (country of origin, how he got here, for what reasons, with whom he lives, marital status/number of children and if they are with him or in his country of origin, etc.); work activity and sources of income (how he started doing this activity, how they perceive the number of total waste-pickers in the community, what he likes and dislikes about his job, etc.); practical organization rules (how he organizes himself, with what criteria he chooses his activities, what relationships he establishes with other actors, etc.); public policies (do the city council policies help or hinder him?); and expectations (what future expectations does he have about his life and his activities in the future, expectations from the city council, etc.).

Fourth, 12 municipal staff working in the field of waste management of 12 different Catalan cities were interviewed (May 2019 – June 2019). The content of the interviews

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focused on: a description of the city's waste management system; a description of local waste pickers; perceptions of their evolution over time; an assessment of their positive and negative aspects; the role of intermediary (recovery) companies in the system; public policies regarding waste pickers; and future expectations.

Fifth, ten months after the original interviews, 8 follow-up interviews were conducted with participating waste pickers (October 4-11, 2019) utilizing the same thematic guide. It should be noted that in the follow-up interviews, two of the original interviewees were replaced by two new participants due to an inability to contact them.

The in-depth interviews with the waste pickers and with the municipal staff were fully transcribed and a thematic analysis (Braun and Clarke, 2006) was carried out to identify key words and arguments on perceptions, experiences and expectations on waste picking. In both the interviews with waste pickers and with municipal staff members, anonymity and confidentiality of personal opinions were guaranteed in writing. The interviews were coded for analysis, ensuring that no one could be identified.

3. Main Results

3.1 The informal recycling sector of Catalonia

According to the data gathered in our research, the informal recycling sector of Catalonia is comprised of mostly men whose ethnicities most often include Roma, Maghreb (northwestern Africa), and most recently, sub-Saharan African (mostly Senegalese and Gambian). Informal recyclers from Roma communities tend to consist of established Catalan residents or immigrants from Romania and Bulgaria who have been active in the collection of

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recyclables in Catalonia for 10 or more years. They most often use vans for collection, have organized collection strategies (particularly in smaller cities and rural areas) and, in general, have more economic and social resources. Maghreb and sub-Saharan African waste pickers, the latter of which were the focus of this study, most often use bicycles and shopping carts to gather and transport materials. They often work alone and have very limited social and economic resources. They are known locally as “chatarreros,” derived from the word “chatarra” or “scrap;” and while “chatarreros” exist in all regions of Catalonia, their presence is most prevalent in large cities and metropolitan areas where shopping carts and bicycles can more easily be pushed from place to place and the points of sale are accessible on foot.

The case study for this investigation was conducted in the city of Granollers, 35 km north of Barcelona, with a population of approximately 60,000 inhabitants. During the last 10-12 years, waste picking activities in Granollers and similar sized cities in Catalonia have increased in conjunction with an increase in migration to the area of sub-Saharan African men. The choice to migrate is highly correlated with the income opportunities of the destination country (Ramlov and Laudati, 2016). These immigration decisions, especially for irregular migrants in Spain, are based on a host of additional factors, including: the presence of migrant networks, socio-cultural expectations and obligations, and migration costs (Ramlov and Laudati, 2016). Of the migrants interviewed, all had a prior connection with the migrant networks in Catalonia, and the majority were not legally recognized citizens of Spain. Due to their citizenship status, they cannot obtain formal employment, and therefore integration and formalization strategies that work in other parts of the world (notably China, Brazil, India, and others), are not an option for irregular migrants. In Catalonia, the presence of waste with economic value represents an opportunity and a source of livelihood for

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informal workers (Wilson et al., 2009), and in this case study, migrant workers from sub-Saharan Africa have capitalized on the value of recyclable materials in Granollers.

An unexpected finding of this investigation, though not the main focus of the study, establishes a connection between the type of work that sub-Saharan immigrants undertake and their individual ethnic identity and social class from within their country of origin, as seen in this dialogue:

IR#3: I don't know them. Most of the people who are *manteros*, they speak Wolof. I speak Mandinka. You see them but you don't know what to say to them. We have no relationship.
Q: But there are people who live here in the Granollers area and go to Barcelona to work as *manteros*?
IR#3: Yes. But they're Wolof. Mendinks don't do it.
Q: Who makes the most money, *manteros* or those who collect cardboard and metal?
IR#3: The *manteros*. They earn a lot more. (Interviewee #3, September 4, 2019)

While other forms of informal work (mostly agriculture and household projects) do also employ many irregular migrants, the two main groups of informal workers most visible to the public—*manteros* (those who sell new items on a *manta* or blanket) and *chatarreros* (informal recyclers)—tend to be distinct not only in the type of work they do, but also in their ethnicity (this is compatible with previous findings of Contijoch and Espinosa, 2019; and Jabardo, 2006). Whereas Wolof, who in our case study tend to be more educated and wealthier immigrants from cities in Senegal and surrounding countries, are generally *manteros*, Mendinks, who more often have received less formal education (at least those of our case study), come from rural areas and generally have farm/ranch work experience, are most likely to work as *chatarreros*.

Another important finding in this investigation is that very few informal recyclers depend solely on the collection and sale of material resources as a means of making money. Since the work of informal recycling is a form of survival and not generally considered socially

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respectable (Gutberlet and de Oliveira, 2010), if other job opportunities arise, especially ones with more economic possibilities, they will often capitalize on that prospect first, and then fall back on material collection when no alternative options exist. Therefore, it is not uncommon for an informal recycler to collect recyclables for a few hours in the morning, help a resident move furniture for a few hours mid-day, and then return to collection in the afternoon.

3.2 Material collections of the informal recycling sector

The majority of waste pickers in Catalonia collect cardboard and/or various types of metals. However, they will gather anything (most often out of the waste containers) that they can sell for profit, including clothes, electronics, kitchen equipment and anything that can be sold in a second-hand store. For our case study, we focused on cardboard collection since during the period of observation it represents the highest volume material collected by *chatarreros* in the area of study.

The informal recyclers of Catalonia mainly gather cardboard from either surface containers spread through-out the cities, where residents place it either in or next to the waste containers, or directly from shop-owners and construction sites with whom the recyclers have created a relationship. Shop owners often store the cardboard for informal recyclers and then call them when they need it removed. This activity benefits the shop owners since, prior to the informal recyclers removing it for free, they were required to pay the municipalities to haul it away. To collect and transport the cardboard, *chatarreros* use shopping carts (while Roma more often use vans), sometimes piling several meters of material, and pushing it by hand to middlemen buyers who, in turn, then sell it on the global market.

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Table 1: Hours, Distance, Kilograms and Euros per waste picker per week

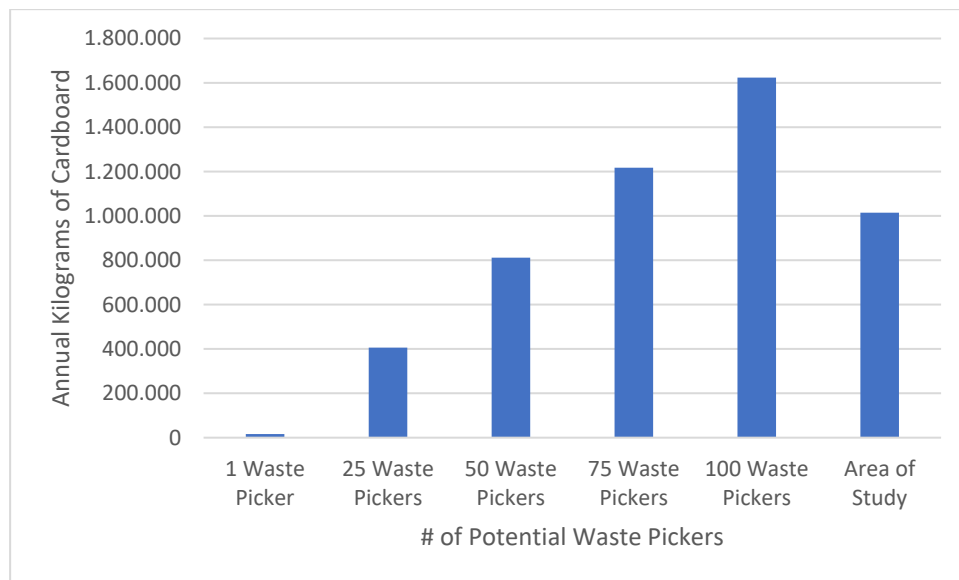
	Average of total	Standard deviation	Range
Hours worked	30.9	3.8	24.3 – 37.7
Kilometers travelled	28.4	8.0	14.0 – 40.1
Kilograms of paper	317.4	141.2	92.5 – 547.3
Euros made	45.3	14.3	25.0 – 71.7

Source: (Authors' own elaboration based on data obtained)

From the data collected during our 2-month questionnaire (Table 1), the average number of kilograms of cardboard collected per person per week in 2018 was 317.4 kilograms. This number calculates to 1,375 kilograms per month and 16,505 kilograms per year based on the weekly average. This does not mean that they collect that amount each day, but rather it is an average of their collection potential based on the measurements that were done. To understand what impact this number has on the total volume of cardboard collected in the area of study, it is necessary to know how many informal recyclers were collecting during this time period. However, it is not easy to offer a definitive count of informal recyclers in Catalonia, as that number constantly shifts due to a variety of factors such as: parallel jobs that temporarily draw them away from material collection, fluctuating prices of materials that encourage or discourage material collection, and migratory flows impacting arrival and departure of people within Catalonia and between Spain and countries of origin. The estimates made by the municipal employees, social workers, and the chatarreros themselves were disparate and based on personal intuitions. Therefore, the estimates in Figure 1 show the annual kilograms of cardboard collected based on the different numbers of informal recyclers compared with actual figures (official collected by the formal waste system) from the area of study in 2018.

Figure1: Annual waste picker potential collection compared with 2018 total formal collection in area of study

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Source: (Authors' own elaboration based on data obtained)

As mentioned above, the average annual collection of cardboard from each informal recycler was 16,505 kilograms per year. Based on conversations with social workers, municipal employees and the author's observations, it was concluded that during the period of study, most likely there were around 50 informal recyclers operating in the area of study, so the informal recyclers were collecting roughly 825,250 kilograms of cardboard per year. At the same time, official government figures state that, during this time period in the area of study, the formal recycling sector collected 1,014,780 kg of cardboard. Therefore, it was concluded that the 'chatarreros' collected roughly 44% of the total paper/cardboard recycled in the targeted area.

If this is the case, then 44% is a significant percentage (almost half) of the total paper/cardboard collected, and therefore represents a significant impact to the recycling numbers. Regardless of the exact number of informal recyclers, it is apparent that the chatarreros have a significant impact on the volume of paper/cardboard recycled, and therefore a significant impact on the environmental goals and objectives of the municipalities

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listed. However, this environmental contribution is carried out without the informal recyclers receiving any recognition for their involvement. Instead of the stigmatization that usually takes place, the informal recycling sector could be recognized as an important part of achieving environmental goals of the region (Ezeah et al, 2013). This could be as simple as a municipality or state publicly stating that their work has positive benefits, which not only provides a sense of pride in their work, but could lead to participation in policy design, or changing the public narrative.

As part of the case study, each week during the questionnaire, the chatarreros were asked how much money they made. The average amount per week during the observation period was 45.3 euros. If extrapolated, this averages to 2,355.6 € per year or 196.3 € per month (the official Minimum Wage in Spain at this stage was around 850€). However, this number varied depending on the person. From the eight people participating in the questionnaire, the average maximum reported income per week was 71.67€ and the minimum was 25€. The principal reason for this disparity is that chatarreros perform this job as a last resort. As mentioned previously, if other informal job opportunities were available, they took that work first and resorted to waste picking when no other options arose. Therefore, the amount of money chatarreros make constantly varies depending on what type of work they are able to find. Another area of interest of the case study examined the distances that waste pickers travel for gathering and selling materials. The chatarreros were asked how many kilometers a week they walked, and the average was 28.4 kilometers per week.

3.3 Viewing the IRS as a social problem

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According to the international literature on the subject, informal recyclers are some of the most excluded, impoverished and disempowered citizens within the community (Gutberlet, 2010), and often local governments and society do not recognize their work as part of the resource recovery system (Ojeda-Benitez et al, 2002; Gutberlet, 2010; Ezeah et al, 2013). They are often exploited by middlemen, and political leaders do not appreciate their work, nor defend their interests (Aparcana, 2017). This same perspective is witnessed in our case study in Catalonia. Though some municipal employees interviewed for this investigation did recognize the environmental benefits that the informal recyclers provide, as well as the precarious nature of their livelihood, most of the comments about the informal workers were based on negative perceptions of their activities, specifically that they are taking materials out of the trash containers, and it is illegal.

As a society, where there are people doing that [waste-picking], that should not be accepted. We will not institutionalize it. People collecting, first, it shouldn't be done. No one can take anything from the trash. Everyone that is doing these actions, surely it is being done to stay alive, because he/she doesn't have another way, [but] they shouldn't do it. (Municipal staff #3, City of Terrassa, May 13, 2018)

Those who steal the material are other kinds of people who have no kind of diminishment. They jump the fences loaded with things. With illegal activities like these, what kind of policy can you do more than notify the police? (Municipal staff #6, City of Besalú, May 23, 2018)

Aside from the formal recycling sector viewing their activities as illegal, there were four activities that tended to drive political engagement with the informal recycling sector; 1) waste scattered on the ground after a container was rummaged through or a manufactured good was disassembled 2) shopping carts left out in public, in the right of way, or in a location that was perceived as dangerous, 3) recovered material stored in residential houses, and 4) public discomfort near the "green points" (collection points for materials that don't fit into the main collection bins). In the interviews conducted with municipal staff and officials,

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multiple jurisdictions complained that in an attempt to collect material of value, informal recyclers were scattering trash around the containers and on to the street without picking it up. They stated that, while this continues to be a problem, but it has decreased due to more active law enforcement and intervention. In regard to the second activity, it was learned through interviews that the city of Granollers had conducted three prior campaigns in response to carts being left in problematic locations. These campaigns targeted the mostly sub-Saharan African waste-pickers, advising them on where their shopping carts could safely be stored. Municipal employees of Granollers confirmed that, as long as the informal recyclers follow these guidelines, they are not harassed by the police. The investigation revealed that the third activity was very short-lived. Only in a few instances were recovered materials stored in residential houses, and in those cases, local authorities let the residents know that it was not allowed. During the interviews with the municipal employees, none mentioned that this situation was still occurring. The final activity involved waste pickers waiting outside the green points, asking residents directly to give them their materials of value (such as metals) in lieu of dropping them off inside. In most cases when this occurred, police were summoned, and waste pickers are now prohibited from this activity.

3.4 Local waste systems embedded in global flows of material

The timeframe that the investigation took place (early 2018 to late 2019) offered a unique perspective into how global trends, as international market prices, affect local waste pickers. By the time the follow-up interviews were conducted (October 2019), the price of paper/cardboard had dropped so low that almost all of the chatarreros had entirely stopped. Those that continued to operate claimed that, in the absence of other sources of income, they

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still had no choice but to continue collecting cardboard, despite it offering extremely low returns. The timing of this investigation allowed a first-hand look at the global connection of the waste trade, and the impact that it can have on local populations.

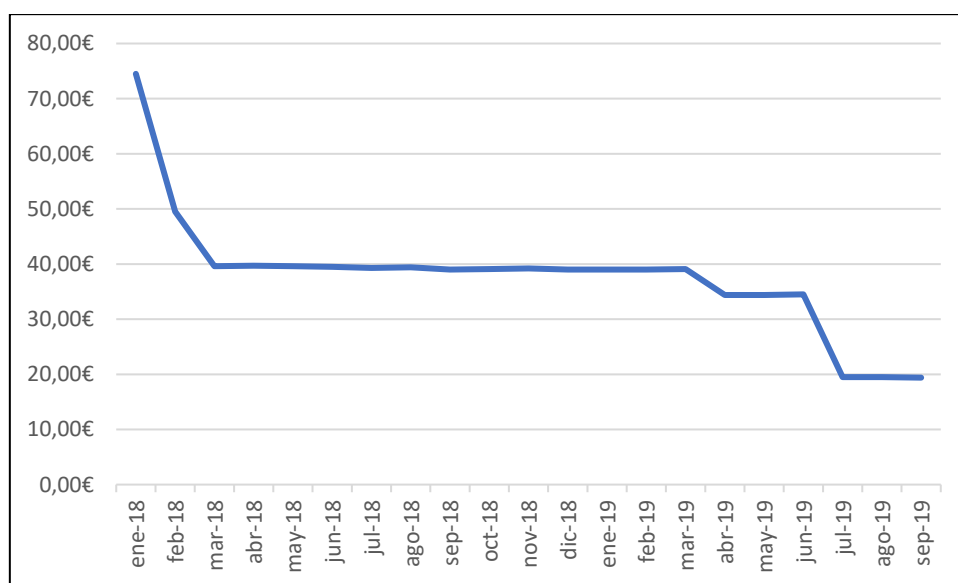
In February of 2017, China announced a new policy called "National Sword." National Sword originally had a specific aim to halt smuggling operations, but additional elaborations on the ban ensued, and in July of 2017, a larger mandate was issued to stop the import of post-consumer materials (Resource Recycling, 2019). Due to the National Sword policy, many materials were banned from import, including all materials with a contamination rate of greater than 5%. Since global waste management systems normally contain a much higher percentage of contaminants, the 5% threshold is incredibly difficult for most countries to meet, and the policy virtually ended imports of recycled materials, including the majority of the world's fiber (paper/cardboard). One of our informants from the Catalan Waste Agency (ARC), whom we did an exploratory interview in 2018 (on July 9th), clearly told us that China's decision to limit the import of paper would lower prices. By then prices had dropped significantly, and would continue to do so over the next year. As a result of the National Sword policy, the price of fiber steadily declined, and waste pickers both in Catalonia, as in other countries (Eminton 2019), and around the world experienced a significant decline in revenue, and in some cases, the loss of (informal) employment.

When the idea for this project first began in January of 2018, the price of paper was roughly 74.50€ per ton, and had consistently held at this price point throughout the prior year. However, soon after the investigation began, as can be seen in Figure 2, the price of paper/cardboard started to drop, and in two months was roughly half of its previous worth.

Figure 2: Global commodity prices of paper/cardboard during investigation (€/ton)

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Source: (CGRVO 2019)

The empirical data used for this investigation was collected at three different times: at the time of the questionnaire and preliminary interviews (October – December of 2018) when the price of paper was 39.20€ per ton; during the interviews with municipal employees (May – June of 2019) when the price of paper was 34.45€ per ton; and during the follow up interviews (September of 2019) when the price of paper was 19.40€ per ton.

It became apparent during this investigation that the decrease of ‘chatarreros’ participating in the informal recycling sector is directly related to the decrease in the price of paper on the global market. Though an exact number is not known, it was estimated that around 50 chatarreros were operating during the preliminary interviews, and around 15 during the follow-up interviews. This reality was expressed by municipal employees, shop owners, and informal recyclers themselves. Below are two examples from municipal employees:

At the time of the crisis there was a small drop in cardboard material that we attributed to the economic crisis of activities, and perhaps a small presence of some cardboard theft,

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but not today. Today, I would say that it does not exist. And we don't see people in the containers who are taking cardboard. No, we haven't seen anything. (Municipal staff #12, City of Olot, June 18, 2018)

Chatarreros, no. They have stopped appearing, the price of cardboard dropped a lot about a year ago. (Municipal staff #7, City of Igualada, May 30, 2018)

Another example from a shop owner in October of 2018:

People would come by and pick up the cardboard, and now we (the business owners) have to call someone to pick it up. The price has come down, so shop-owners are realizing what a service they (the informal recyclers) provided...The boys (informal recyclers) used to say thank you to the shopkeeper, but now the shopkeeper says thank you to the boys (Shopkeeper, October 2, 2018).

Finally, an example from a waste picker in September of 2019.

IR#5: Now it's very difficult, because you can pick up a lot of cardboard but then they almost don't give you anything. You fill up the cart to the top and then it's worthless. It's demotivating. (Interviewee #5, September 11, 2019)

At the time of the follow-up interviews (September of 2019), some informal recyclers claimed that in the absence of other sources of income, they had no choice but to continue collecting cardboard and metal, supplementing income by collecting additional items they could sell to second-hand stores.

3.5 The influence of global flows on local systems: How global market fluctuations determine the rise and fall of the informal local recycling system and its relationship with the formal waste system

Informal recyclers base their activity on market value, focusing their collection efforts on objects and materials that draw higher prices, as opposed to city councils, who organize their collection systems on the costs of the collection process itself. City councils have limited flexibility since they are obliged by municipal, regional, state, and national objectives and requirements, while the informal recycling sector operates outside of those laws, allowing more flexibility to collect (or not) based on other factors, such as the availability of alternative employment opportunities, the price of materials, and personal preference.

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The global crash of paper/cardboard commodity prices exposed a unique economic relationship between the formal and informal systems. Since some of the income generated by the municipality is based on the market value of specific products, and in particular the sale of paper, there is concern over the economic impact that chatarreros have on the formal recycling sector. When informal recyclers take paper out of the municipal containers and sell them on the open market, one can argue, results in a direct loss of income to the municipality. As well, as materials are removed from bins, it creates additional stress on the formal system to reach their recycling goals, which, if they do not meet, will receive less money from the state for ongoing management of local waste. An additional revenue source for municipalities is income received from Ecoembes, a non-profit public agency that finances the collection and selection of waste deposited in containers, the amount being determined by quantities of recycled cardboard and packaging collected. When waste pickers are active, municipalities receive less money from Ecoembes, since less cardboard arrives at recycling centers via municipal containers.

Since the price of paper has declined, and there are now fewer waste pickers, the municipalities recover a higher quantity of cardboard, and, theoretically should receive more money from Ecoembes. However, since the value of cardboard is so low, but still has to be collected, the formal system is devoting more time and resources to collecting a material which has little value. This reality is explained by a municipal employee from the city of Granollers:

The city has to pay more every time they go to pick up something extra. After the crisis, community members put something out on the street, and the chatarreros would take care of it. So, the community members got used to this, and now when there are not people [chatarreros] picking it up, the city has to make extra stops. (Municipal staff, city of Granollers, July 13, 2018).

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Inferred from this quotation, if the chatarreros are not picking up materials (in this case paper/cardboard), then the city has to make extra trips to collect it. Based on interviews with municipal employees and industry experts, even when profits are high, the profit on materials still isn't enough to justify a large collection budget. This creates a somewhat interdependent relationship between the formal and informal recycling sector in Catalonia with regards to paper/cardboard. If the informal recycling sector is removing a key product from one of the containers (such as cardboard), then less employees are needed to collect the resource, thus saving the city collection costs, even though they are losing profit sales. Of course, the reverse of this is also true. If there is less cardboard being removed from the containers by the informal recycling sector, than this creates more work for the formal recycling sector, and costs the city more money. Although it is correct to assume that when the price for paper is high, municipalities lose money due to waste picker activities (because they have less material to sell and are not reaching their recycling goals), it is also true that when the price of paper is low and the waste pickers are no longer collecting cardboard, municipalities lose money. Thus, an interdependent relationship ensues where the informal system is reliant on the formal system for clear and organized locations to collect materials, while the formal system benefits from the informal system to keep labor costs down. The main concern for city employees at the conclusion of this investigation was that, since they moved part of the workforce responsible for collecting paper and commercial cardboard to other areas when paper/cardboard prices were high, now that prices have gone down, they will have to relocate those positions, thus costing the city more money for collection.

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The formal municipal system in Catalonia is based on a daily service that collects cardboard deposited in specific containers and operates on a fixed schedule. Some cities, such as our case study in Granollers, have an additional waste collection service aimed at businesses and industries, which operates on demand. Additionally, quite a few cities also deploy a vehicle that randomly drives the streets to identify and collect waste left by citizens on the sidewalks as a way of maintaining a clean public space. Although this should be a solution only for exceptional cases, it has become a daily practice and many citizens dispose of their waste in this manner. Waste pickers take advantage of this waste left on the streets and collect it before it is identified by the municipal service.

Based on observations collected from interviews with municipal employees, the price of paper/cardboard influences both the volume of activity of the informal recycling sector and the staffing needs of the formal recycling sector. Next, we look at three different scenarios regarding paper prices, deducted from our interviews with municipal staff and observations: when the price is high (more than 70-80€/ton), when prices fall to an intermediate level (around 40-50€/ton), and when prices fall to very low levels (20€/ton and below). Each scenario has a different impact on both the formal and informal sectors.

3.5.1 When the price is high

There is more collection by the informal recycling sector when materials become more valuable. As prices increase, more participants are drawn to the informal sector, including waste-pickers who operate individually via foot, bicycle and shopping cart, as well as those that operate with a greater degree of organization and infrastructure, using vans and working in groups, to collect cardboard/paper. Consequently, conflict is generated between the two types of informal recyclers, who attempt to exert their influence on various urban spaces,

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such as local markets, shops, containers, green points, etc. In this context, recyclers using shopping carts/bicycles and whom tend to be working alone have a greater disadvantage, as they cannot compete with others who are more organized, more mobile and have great capacity for collection. These types of motorized recyclers have more resources, and therefore collect more cardboard, so the municipality has less to collect and sell.

For its part, the municipality is obliged to act and penalize all informal recyclers for conflicts in the public sphere (including specific legal infractions and more general neighborhood complaints). Since collection is achieved through the informal sector, there is not enough collection work for formal employees, and, for a brief moment, the city is allocating resources to tasks that do not exist, leading the city to reduce the quantity of workers and means to adjust to their actual needs. In addition, the municipal waste system collects less materials (paper-cardboard), which is economically penalized by the Waste Agency of Catalonia (ARC) and Ecoembes for not achieving their recycling objectives, even though the material is recycled by 'informal' channels. As mentioned prior, the decrease in economic resources received from Ecoembes-ARC does not compensate for the reduction of resources dedicated to waste management, thus the municipalities lose money.

3.5.2 When prices fall to an intermediate value

In this scenario, motorized informal recyclers disappear from cities similar in size to the case study, leaving the field free to informal recyclers operating by non-motorized means. This is the ideal scenario for this group of informal workers, who, under these circumstances, do not face conflicts with competing groups, can count on a certain complicity of public services (social services, police, waste collection companies, etc.), and have greater access to materials. Additionally, conflicts between informal recyclers are significantly reduced and the

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impact of the informal sector on public roads can be managed positively (with goodwill on the part of the city council).

The municipal waste management service continues to collect less paper/cardboard than it should collect, so material recovery ratios remain low, and the city council continues to be penalized by Ecoembes and ARC, resulting in reduced revenue. In addition, the city council has to decrease the resources it devotes to the collection of waste, as a large proportion is collected through the informal channels. Similar to the first scenario, reduction in resources is not comparable to the reduced economic revenue from Ecoembes/ARC, so the city council again loses money. However, from an economic perspective of the municipality, this is the most optimal of the three scenarios since the local, non-motorized waste pickers collect only a portion of the materials that are reused or recycled, while the municipality still collects a substantial share that can be sold in the global materials market.

3.5.3 When the price falls to very low levels

In this scenario, informal recyclers withdraw and the city council must deal with managing the entire collection of paper-cardboard, for which it must allocate considerable additional or unplanned resources. (In the case of Granollers it is roughly 150,000 euros/year, according to our interviews to municipal staff). In addition, since the price of paper in the global market is very low, the municipality receives a minimal economic return from its sales, but collection costs greatly increase.

Local informal recyclers engage in other activities (also informal, as most of them do not have the documentation to be able to do so in the formal market), although some still collect and sell materials (mainly metal and household goods with resale value), but to a much lesser extent.

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In this context, conflicts are usually due to the collection of these other materials (mainly metals), often at green points or in the form of thefts of wiring or metal parts in secluded locations (industrial polygons, etc.). However, the investigations indicate that this type of incident is most often carried out by motorized informal recyclers.

4. Conclusions

In the case study analyzed, the formal waste management sector is designed to collect all municipal waste selectively, in accordance with the laws and objectives established by European, national and regional regulations, in order to achieve certain goals of collection, recycling and re-use. The formal sector consists of a series of infrastructures and technical and human resources, adapted to the estimated volume of population and waste, in accordance with the legal requirements. The institutions in charge of management are the municipalities, with financial support from other public entities (ARC and Ecoembes, in this case), with amounts that vary depending on the degree of success of the waste separation objectives. It is a public policy based on the assumption that everyone in the city will cooperate to throw away waste through the established formal system. But in practice, there is a fluctuant portion of waste that escapes through the informal system. This portion of waste depends on different factors that condition and shape the informal system at each historical moment.

The informal sector in Catalonia depends on different factors, such as i) the existence of a contingent of people with needs and conditions (abilities, knowledge, etc.) to do this activity; ii) the existence of local middlemen, who often have a status that is a mixture of

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formality/informality; iii) prices that make it viable; and, of course, iv) a formal system in place (which can leave more or less space for the success of informal activities).

Despite being a local phenomenon operating on a micro scale, the informal system is integrated into international flows. On the one hand, because of the migratory flows that lead people to live without recognized legal citizenship, they are precisely the ones who have the most needs and find in the collection of paper, cardboard and scrap metal, a resource to support themselves. In our case study they were mainly sub-Saharan migrants, living in the city for many years in a precarious situation. On the other hand, the phenomenon is influenced by the international flow of raw materials, and the global market in which they move, which is conditioned by the prices of each historical moment. This point was clear in our case study by looking at the changes that occurred after the drastic reduction in imports of paper and cardboard by China, and the consequent collapse of the price of these materials. Despite this international dimension, the responsibility for urban waste management rests in the hands of the local institutions (municipalities), which have the least capacity to influence those flows.

The waste pickers in Catalonia are mainly a mix of Roma, Maghreb (northwestern Africa), and sub-Saharan African men. Roma informal recyclers have historically been the most active participants in this activity and have, over time, developed the most organized systems, which often includes motorized vehicles. Sub-Saharan African male migrants are the newest collectors in Catalonia, and they mostly operate individually and on foot, using shopping carts for collection and transport. This study did not focus on Maghreb recyclers because they only represent a small percentage of the informal recyclers. The sub-Saharan African men operating in this sector are unique when compared with global informal

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recyclers since they are often immigrants that are not legally recognized citizens, and, therefore academic literature on waste picker strategies, which often assume that local waste pickers are legal residents and can be incorporated into formal sectors more easily, do not apply. As well, the ethnicity of some of the African migrants influences the work that they will do in their host country, often further limiting their options. Since the formal waste management system is embedded within the government at the national and local level, the informal recyclers focus their activity on cardboard, metals, and second-hand products.

The global price of paper supports different informal actors, but when the price of cardboard is at an intermediate or high value and informal recyclers are fully active, they can collect close to 50% of the cardboard in Catalan communities, and have a significant impact on the volume of materials recycled, and the environmental goals and objectives of the municipalities. For instance, in 2018, cardboard represented 14.7% of recyclables collected (Generalitat, 2020), showing that the informal recycling sector could collect roughly 7% of all recycling collected just in cardboard. Therefore, instead of viewing informal recyclers as a social problem, formal recyclers should be recognizing them as environmental stewards that are a part of the solution. The interdependence between the formal and informal waste systems is built upon asymmetrical interrelationships. On the one hand, it helps to increase the efficiency in the separation and recycling of certain types of materials, resulting in environmental improvements for the municipality and better reuse of materials. While on the other hand, the employment and working conditions of the people engaged in these activities are very deficient, dangerous and without any legal protection, and people engaged in these activities suffer from social stigma due to their informal work and are vulnerable to possible abuse. Solving these imbalances would require public policies addressed to dignify these

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works and activities, through integrating the informal system within the formal norms (for instance, giving documentation, recognition, uniforms, adequate tools, capacity development, educational opportunities, etc.). Additionally, the inclusion of informal waste pickers in the waste management equation would generate income for some of the poorest sectors of Catalan society, provide a supply of secondary raw materials, and enhance environmental protection.

Though, from the outside, it appears that the formal recycling system in Granollers operates independently from the informal system, a closer look reveals that both sides share a symbiotic relationship that is tied to global commodity prices and to international migratory flows. The presence of informal recyclers, which is a direct result of global prices, affects the economics of the formal system as well as their staffing decisions. Whereas the formal system provides an opportunity for the informal system to operate, the informal system can lower staffing costs of municipalities and help them achieve environmental objectives.

The problem is that local governments cannot react properly to the international fluctuations of prices and migrant flows since they do not have the authority to determine these global factors. However, local governments can anticipate the arrival and impact of informal recyclers and have adaptable staffing and collection systems in place to adjust.

Finally, although the policies applied from the municipalities have been based mainly on police and social service purposes, these results suggest that their policies should also include environmental objectives, something still far from the expectations of current municipal waste managers. This represents an obstacle to progress towards a greater integration of

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formal and informal systems, which would result in a more just, efficient and sustainable waste management system.

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