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Discriminations in the Market for “Lemons”: A multicriteria correspondence test in France

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Summary

The existence of discrimination by the sellers of second-hand cars is a little studied subject, whereas the possibility of acquiring a car conditions multiple aspects of economic and social life. In this article, we apply the correspondence test method to the purchase of a used car in order to measure the extent of discrimination in this market according to the ethnic origin, gender, place of residence and age of the applicant. We constructed six profiles of fictitious individuals, perfectly similar except for their age, gender, origin indicated by the consonance of their surname and first name or place of residence. Between January and May 2015, we used these fictitious profiles to respond to 489 used car sales ads located in Ile-de- France. Statistical analysis of the responses to these tests reveals the existence of discrimination according to gender and place of residence. The analysis shows that information based discrimination prevails on the second-hand car market rather than taste based discriminations.

Keywords: Discrimination, testing, mobility, used cars

Codes JEL : C93, J14, M53

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Introduction

Access to a car conditions access to employment and, more generally, the economic and social integration of people. Recruiters value having a driver's licence or having an individual means of transport. Therefore, the ability to commute daily into space play a major role in the school-to-work transition. It can affect access to training as well as access to employment. This effect is underlined by the job search literature where low mobility complicates the job search process and decreases the chances of leaving unemployment. Low mobility lengthens the distance between the place of residence and the workplace and is equivalent to a strengthening of the 'spatial mismatch' in the labour market (Kain, 1968). From the perspective of the worker, low mobility leads to longer and costly job search (Rogers, 1997; Immergluk 1998; Wasmer and Zenou, 2002). From the firm perspective, employers tend to prefer a mobile employee because he/she will be able to exert a level of greater effort at his work (Zenou, 2002). A low mobile worker in his travels runs the risk of tardiness or absenteeism and might generally be less flexible in his/her scheduling (van Ommeren et al., 2011).

These theoretical mechanisms have been confirmed by several empirical studies, which emphasized that the most vulnerable groups are the most penalized by the high cost of public and private transports. Having the use of a car can increase both the chances of being employed and the quality of the job measured by the number of hours worked or the pay level (Raphael and Rice, 2002) and salaries (Gurley and Bruce, 2005). This effect seems to be particularly marked for the people furthest from employment, especially young people furthest from employment and training as well as minimum income recipients (Ong 2002; Blumenberg and Hess, 2003, Le Gallo et al., 2018). Conversely, lack of access to public transport and to private vehicles deteriorates the situation on the labour market, especially for those living in the most deprived neighbourhoods (Kawabata, 2003; Ong and Miller, 2005).

However, access to effective mobility presupposes that holders of a driving licence are able to acquire a new or second-hand vehicle. This possibility does not exist for all socio-demographic groups. The most vulnerable groups who are usually discriminated against in the labour market may encounter barriers related to their individual characteristics (age, gender, ethnic origin or place of residence) when seeking to acquire a new or used vehicle. If we consider, for example, the residents of deprived neighbourhoods in France, the proportion of households without a car varies from 29 to 41 per cent depending on the size of the urban unit, compared with 12 to 21 per cent in the rest of the urban area. For these particular groups, discrimination in access to individual means of transport can constitute a powerful barrier to mobility which may limit their economic and social integration more strongly than for other groups.

Experimental evidence of discrimination has already been given for access to individual means of transport. Discrimination based on gender and skin colour has been highlighted in the process of negotiating the purchase of a new car in the United States in Chicago (Ayres and Siegelman, 1995). Discrimination on the basis of nationality and religion has also been highlighted through an approach combining a correspondence test and a post-phone survey in Israel (Zussman, 2013). Another correspondence test in Germany reveals substantial discrimination by ethnicity and gender in the carpooling market (Carol and al., 2019).

In this article, we look at discrimination in the used car market. The market for "Lemons" is one of the most quoted articles in economics² where George Akerloff presents the concept of

information asymmetry that plays a central role in contemporary microeconomics. In the case of used cars, the asymmetry of information relates both to the quality of the offer (quality of the car for sale, for which an advertisement gives little verifiable information at low cost) and on the quality of the demand (ability of the buyer to negotiate the price, to identify technical malfunctions of the car if there are any and solvency, characteristics not observable when making contact).

In the absence of information on the buyer who contacts him, the seller may be encouraged to use the few information available to him, for example the demographic group of the buyer, to attribute to this individual what he knows or what he thinks he knows about the average characteristics and their dispersion in this demographic group. So the seller hopes to be able to make the best possible transaction. Vendors are thus exposed to information-based discrimination, as initially theorized by Arrow (1973) and Phelps (1972). They may also be exposed to discrimination through preferences, theorized by Becker (1957). This market is therefore a very interesting area to study supplier discrimination in the marketplace.

We want to measure and identify these sources of discrimination. To achieve this, we have adopted a multi-criteria protocol. Our goal is to measure discrimination on the basis of age, and among young people, discrimination on the basis of gender, origin and reputation of place of residence (living in a deprived neighborhood) in the used car market with a correspondence test method. We therefore constructed six profiles of fictitious individuals, perfectly similar except for their age, their gender, their origin indicated by the consonance of their surname and first name or their place of residence. Between January and May 2015, these six profiles of fictitious individuals responded almost simultaneously to 489 used car sales ads located in Paris region. The study consists of statistically evaluating the responses to these tests.

Our results highlight the existence of discrimination in the second-hand car market. A young man of French origin mentioning a neutral place of residence is significantly more likely to obtain a non-negative response than his counterfactual residing in a deprived neighbourhood, and to a lesser extent than the young woman of French origin. We show that these results are sensitive to compositional effects. More than the price of the vehicle, it seems that it is the type of vehicle and the characteristics of the seller that influence the chances of obtaining a non-negative answer. This type of discrimination is consistent with the predictions of the statistical discrimination model (Aigner and Cain, 1977; Ewens et al, 2014).

In the first section, we present an overview of the theoretical and empirical literature on discrimination in the market place. In the second section, we present the data collection protocol and in the last section, we present the results.

1. Discriminations in the market place: theories and evidences

1.1. Economic theories of discriminations

The economic theories of discrimination formalise a rational behaviour of the supplier and highlight two main families of explanations. The first involves the preferences and was introduced by Gary Becker (1957) who was the first to propose an economic analysis of discrimination. The central assumption is that employers, workers and consumers have preferences about the characteristics of the people with whom they interact. Some prefer

the majority profile, the self, and instead feel uncomfortable exchanging with people with the minority profile, who are potentially discriminated against. For Becker, this taste based discrimination is not likely to persist in the long term in a competitive environment, unless it arises from the preferences of customers or those of the company's employees. Compliance with competition rules in the markets for goods and services, as well as in the labour market, leads to the long-term elimination of discriminatory agents, which end up being sanctioned by the market.

The second approach has been developed by Arrow (1973) and Phelps (1972) to report on the persistence of discrimination in the long term. The central assumption here is that suppliers are asymmetric in their information on the qualities of demanders. This is indeed the hypothesis put forward by Akerloff to describe the second-hand car market. Salespeople will then rely on what they believe are the average abilities in the same population category. This phenomenon is referred to as statistical discrimination or information based discrimination. More generally, discrimination through information consists in applying to individuals aggregate information about the categories of population to which they belong, whether real or perceived, about their ability to complete the transaction.

Economic theories of discrimination insist on conscious decisions by suppliers at an individual level. For psychologists and sociologists, on the other hand, the decision is not necessarily conscious and is based on collective determinants. The recruiter is unknowingly victimized by his stereotypes, which are preconceived and shared ideas that make it possible to characterize a social group in a schematic way. In a recent experimental study on how stereotypes are produced and modified, Bordalo et al (2016), draw a parallel with the theory of subjective probabilities and unrepresentativeness proposed by Kahneman and Tversky (1972, 1973). This type of cognitive shortcut makes it easier to make decisions but it also introduces errors of judgment. The existence of implicit discriminatory biases is now widely accepted by the international community of psychologists and is also considered in the body of analysis of economists as implicit discrimination, thus expressing the fact that they are actually carried out without the knowledge of agents (Bertrand et al. 2005).

1.2 Measuring and interpreting discrimination

A vast empirical literature has developed to measure the extent of discrimination in different markets and to try to determine its causes, based on economic theories of discrimination. To achieve this, the method considered most convincing today is the correspondence test, which consists in sending, in response to real offers, a pair of requests from two fictitious applicants, similar in all respects except on the characteristic whose effect is to be tested. This approach makes it possible to control all unobservable variables on the demand side and thus establish differences in treatment *ceteris paribus*. It has been widely used in the labour market (see Neumark, 2018 for a recent overview) as well as in the housing market (see Flage, 2018 for another overview). It still covers very little of the other goods and services markets.

To identify the discrimination sources, several approaches exist in the literature. For instance, Zschirnt and Ruedin (2016) suggest that evidence of stronger measured discrimination against “more distant and visible minority groups” (p. 5) would be indicative of taste discrimination. But the most common approach is to add a quality signal to one of the agents and compare the performance of this signal between the reference agent and the potentially discriminated agent. For example, this approach has been applied by Drydakis (2014) in the Cypriot labour market to identify the causes of sexual orientation

discrimination. He sent applications to advertised vacancies and experimented with two information sets the 'sexual orientation' and 'information' of the potential applicants. Both heterosexual and gay/lesbian applicants gain by providing more job-related information. However, the informational premium for sexual orientation minorities could not reduce the discriminatory patterns. This result indicate that discrimination against sexual orientation minorities is a matter of preference, not the result of limited information.

Another example has been given by the work of Ewens et al. (2014) about discriminations in the U.S. rental apartment market. Responses from over 14,000 rental inquiries with varying applicant quality show that landlords treat identical information from applicants with African American and white-sounding names differently. This differential treatment varies by neighborhood racial composition and signal type in a manner consistent with statistical discrimination and in contrast to patterns predicted by a model of taste-based discrimination.

1.3. Discriminations in the sale of new or used cars: what do we know?

Few studies have addressed discrimination in the used car market. Some used a non-experimental approach and used sufficiently detailed vehicle purchase micro- data bases to cover the characteristics of the seller, the buyer, the car sold and the amount of the transaction (Godberg, 1995; Chen et al. 2018).

To our knowledge, there are only two studies that have evaluated discrimination in access to the new or used car market using a controlled experience methodology. The first is by Ayres and Siegelman (1995), which focuses on the city of Chicago. The study examines whether dealers discriminate by gender and skin colour when negotiating the price of a new car with a potential buyer. 153 dealers were tested: each was successively visited by two fictitious buyers who distinguished themselves from each other by their gender or skin colour. Both buyers expressed interest in the same car model and negotiated its price with the seller. The results reveal significant discrimination: dealers more often offered the same vehicle at a lower price to a white male than to a female or black buyer.

Using a 2013 correspondence test, Zussman investigated the extent of ethnic discrimination against Arab buyers by Jewish sellers in the Israeli used car market. This study is done in 2 stages. The first consisted first of sending in response to 8,000 used car sales advertisements published on the Internet by Jewish sellers, pairs of fictitious buyers' e-mails in which each pair consists of an Arab buyer's e-mail and another Jewish buyer's e-mail distinguished by the sound of their first and last names. Second, to facilitate direct monetization of the measure of discrimination, randomly selected buyers suggested prices to sellers.

The author showed the existence of strong discrimination against the Arab buyer who has 22% less chance of acquiring a used car than his Jewish counterpart. Also, for an Arab buyer to have the same probability of receiving a positive response as a Jewish buyer, he must offer the seller a price 5 to 10% higher than that offered by his Jewish counterpart to the same seller. The second step consisted in contacting randomly selected Jewish sellers by telephone in order to obtain socio-demographic information and the attitudes of these sellers towards Arab buyers. The results of this telephone survey show that most Jewish sellers have negative assumptions about Arabs.

We are examining a similar problem here. However, there are several differences between our testing and that of Ayres and Siegelman, 1995 and Zusmann, 2013. First, we are interested in the used car market, not the new car market. In this market, two types of vendors coexist: professionals and individuals. Secondly, it is not an audit study by couples: no natural person will meet the vendors. The development of the Internet today allows contact with sellers without incurring biases related to the personality or physical appearance of fictitious buyers. Finally, we are simultaneously examining a greater number of discrimination criteria and not just one or two. We measure discrimination on grounds of age, and among young people discrimination on grounds of gender, assumed origin and reputation of place of residence.

2. Data collection

To measure discrimination in the used car market, we conducted a correspondence test with six profiles of fictitious individuals, distinguished only by their age, gender, origin indicated by the sound of their first name and surname and the reputation of their place of residence. In France the most deprived neighborhood are classified as “Quartier de la Politique de la Ville” (City Priority District) and we use this classification. We present the distinctive characteristics of these six individuals in Table 1.

Table 1: Distinctive characteristics of the 6 fictitious individuals

Individual	Age	Gender	Consonance first and last name	Reputation of place of residence (in Paris Region)
A	42	man	French	Neutral
B	22	man	French	Neutral
C	22	Woman	French	Neutral
D	22	man	African (non-Muslim)	Neutral
E	22	man	French	Disadvantaged (Location in a "City Priority District")
F	22	Woman	African (non-Muslim)	Neutral

Note: Several studies have shown the existence of specific discrimination linked to the supposed religion of job applicants (Adida et al. (2010), Pierné (2013)). Here we choose to examine discrimination based on origin in the strict sense.

In similar short messages in response to a used car ad, the six fictional individuals show an interest in the vehicle and request an appointment to try it. In these messages, the distinctive characteristic of the candidate (age, gender, ethnic origin, reputation of the place of residence) appears.

In response to each of the advertisements, on the same day they went online, we sent the six messages from each of our six fictitious candidates, a few hours apart. The order in which the six individuals send their requests to the same supplier is determined by drawing lots. On the whole sample, each person's message was sent first the same number of times.

In order to be able to identify whether discrimination is more associated with uncertainty or preferences, we have adopted the most common strategy of varying quality signals in the formulation of applications. We have taken as a signal the mastery of the French language.

We built two sets of messages. One contains no French errors in its drafting, the other contains French in a comparable manner for the six individuals. To respond to a given ad, we mobilize one or the other of the two sets of messages. Thus, either the messages of the six fictitious individuals contain errors, or they do not. The order in which the six messages are sent is random and varies from one ad to another. For illustration purposes, we report in Table 2 the messages with or without fault addressed by the fictitious 42-year-old individual, by the 22-year-old woman of French origin and by the 22-year-old young person of French origin residing in "city priority district". The original text of the buyer messages is available in Table A in the Appendix.

Table 2: Examples of messages with or without errors sent by 3 fictitious individuals on ads in Paris intramuros

Fictitious individuals	No Fault Message Game	Message game with errors
Christophe LEROY (42 years old, French origin, neutral place of residence)	Good morning, I contact you because I am interested by your car, is it possible to see it and to make a test myself? And if so: where and when? I'm in the 14th. I'll tell you, I've had my license for over 20 years. In thanking you in advance, Christophe Leroy	Hello I contact you because I am interest by your car, it is possibe to see it for me to make a test myself. or when I am in the 14th. I'll tell you, I've had my lisens for over 20 years. thank you Christophe Leroy
Laura DURAND (22 years old, French origin, neutral place of residence)	Hi, I saw your ad for your car and it interests me. Is it still on sale? Can I see it and try it on? Can we see each other on the side of Nation where I live but otherwise I am mobile. I'm 22 and I've been driving for four years. Thank you in advance. Laura Durand	Hello I sawe your ad for the car that interests me. It's stil for sale? I can see it and try it? you can see it from the nation side where I live but otherwise I can come. I'm 22, I've been driving for four years. Thank you in advance. Laura Durand
Florian ROUX (22 years old, French origin, place of residence in a "city priority district")	Good morning, I'm looking for a car like the one you sell. Can we make an appointment so I can see it for a test drive (I have a 3 year license)? As I live at La Goutte d'Or in the 18th century, we are not very far away. Thank you in advance, Florian Roux.	Good morning, I'm jut looking for a car like this. We can have an appointment for me to see it and try it I have 3 years lisens we are not far I live the golden drop in the 18th. thanks florian roux

Each of the six fictitious individuals is provided with an e-mail box and a mobile phone line to collect the suppliers' returns, to which no follow-up is given. We examine whether the same supplier has replied to all six fictitious individuals and, if so, we compare the content of his replies.

We tested ads from professional and private sellers throughout the Paris region. The six fictitious individuals report a place of residence in the same department as the supplier. The main sites used are Le Bon Coin, La Centrale and Vivastreet. The vehicles offered for sale are very varied. They are distinguished by their type (city car, sedan, minivan, 4x4, convertible, etc.), make, engine and number of doors, as well as their price (from a few hundred euros to over 10,000 euros).

Between January and May 2015, we tested 489 used car ads posted on the Internet, which corresponds to 2934 messages (489 x 6) sent. A negative response is considered to be when the supplier does not respond to the fictitious individual's message or explicitly indicates that the transaction will not be possible, for example because the vehicle is already sold. Conversely, when the supplier responds positively to the fictitious individual's request, by inviting him or her to an appointment to see the car and take it for a test drive, the response is considered to be non-negative.

3. Results

Of the 489 ads tested, 99 were the subject of at least one non-negative response to one of our fictitious individuals. The distribution of the number of responses per ad tested is given in Table 3. One fifth of the ads tested received at least one non-negative response. This low proportion is certainly due to the large number of contacts received by suppliers following the publication of their advertisement.

Table 3: Distribution of the number of responses per ad tested

	No negative answer	
	Number	%
None	390	79,8%
1 and more	99	20,3%
Total	489	100%
Number of non-negative responses per ad:		
1	39	39,4%
2	17	17,2%
3	11	11,1%
4	15	15,2%
5	7	6,1%
6	10	11,1%
Total	99	100%

Source : Testing TEPP-CNRS, DIAMANT, used car market.

Reading: Of the 489 ads tested, 390 did not receive a non-negative response and 99 resulted in a non-negative response to at least one of our 6 fictitious individuals. Of these, 39 ads were answered by only one of the six individuals, 17 resulted in a response by two fictitious individuals.

3.1. Discriminations in the used car market

If, faced with a multitude of messages received, the supplier is not in a position to respond positively to everyone, notably by offering to present his vehicle, it nevertheless seems that he does not make his selection randomly. Indeed, the chances of obtaining a non-negative answer differ according to individuals (Table 4). Thus, when the supplier chooses to send a non-negative answer to only one of our six fictitious individuals, it is in 31% of the cases of the young man of French origin mentioning a neutral place of residence and in only 5% of the cases of his female counterfactual.

Table 4: Breakdown of non-negative responses obtained by each of the six individuals, according to the number of non-negative responses sent by the supplier

	Non-negative response rate		Non-negative response rate conditional on total number of non-negative responses											
			1		2		3		4		5		At least 1	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Female 22 years old French origin	41	8,4%	2	5,1%	8	47,1%	8	72,7%	7	46,7%	6	83,3%	41	41,4%
Female 22 years old African origin	47	9,6%	5	12,8%	8	47,1%	10	90,9%	8	53,3%	6	83,3%	47	47,5%
Male 42 years old French origin	42	8,6%	6	15,4%	5	29,4%	3	27,3%	12	80,0%	6	83,3%	42	42,4%
Male 22 years old French origin	52	10,6%	12	30,8%	7	41,2%	4	36,4%	13	86,7%	6	83,3%	52	52,5%
Male 22 years old French origin, residing in "City Priority District"	38	7,8%	8	20,5%	4	23,5%	4	36,4%	7	46,7%	5	66,7%	38	38,4%
Male 22 years African Origin	42	8,6%	6	15,4%	2	11,8%	4	36,4%	13	86,7%	7	100,0%	42	42,4%
Number of ads tested	489		39		17		11		15		7		99	

Source : Testing TEPP-CNRS, DIAMANT, used car market.

Reading: Of the 489 ads tested, the young woman of French origin received a non-negative response in 41 cases (8.4% of the cases). It was the only one to receive this type of response in 2 cases (5.1% of cases). When the supplier sent a non-negative response to only two fictitious individuals, the young woman of French origin was included in 8 cases (47.1% of cases). Of the 99 cases where the supplier sent a non-negative response to at least one of the 6 fictitious individuals, the young woman of French origin was among the fictitious individuals contacted in 41 cases (representing 41.4% of the cases).

Table 5 compares the non-negative response rates of the six fictitious individuals given in the first column of Table 4. In this respect, this table identifies the existence of discrimination on the second-hand car market. Overall, the young man of French origin mentioning a neutral place of residence is significantly more likely to obtain a non-negative response than his counterfactual residing in the city priority district, and to a lesser extent than the young woman of French origin and the young man of African origin¹. Thus, three of our fictitious applicants among five seems to be discriminated in the used car market. While the reference candidate, a young man of French origin mentioning a neutral place of residence, has a success rate of 10.6 %, the discriminated profiles have success rates more than 2 points lower, which corresponds to a relative difference of more than 20%.

¹ Unlike gender and African origin, which are visible characteristics of the applicant, the applicant may choose not to mention his/her address when making contact. But he will have to do so later, when signing the contract, which implies mentioning his address. He will then be exposed himself to the risk of discrimination that he wanted to avoid.

Table 5: Differences in non-negative response rates on the same ads (discrimination)*(Reference: young man of French origin mentioning a neutral place of residence)*

	Non-negative response rate gap (in pts of %)	Critical probability
Female 22 years old French origin	-2,24*	0,089
Female 22 years old African origin	-1,06	0,446
Male 42 years old French origin	-2,03	0,123
Male 22 years old French origin, residing in CPD	-2,85**	0,044
Male 22 years African origin	-2,04*	0,097

*Source : Testing TEPP-CNRS, DIAMANT, used car market.**Reading: Of the 489 ads tested, the young woman of French origin received a non-negative response in 8.4% of cases. His chances of success are 2.24 percentage points lower than those of the young man of French origin mentioning a neutral place of residence. However, this difference is only significant at 10%.**Student statistics and confidence intervals were calculated using the bootstrap method over 10,000 runs significant at 1% level, ** significant at 5% level, *significant at 10% level.*

3.2. Distastes or uncertainty?

We have built one indicator that make it possible to identify the nature of discrimination in the second-hand vehicle market. It is given by the errors introduced in the messages. Remember that we have introduced syntax errors randomly in the messages to indicate the quality of the buyer. We notice that the chances of receiving a non-negative answer are lower for the six fictitious individuals when their message contains errors (Table 6). For five individuals among six, the penalty is significant and uniform, in the order of 5 percentage points. The absence of differentials in penalties rather indicates the absence of discrimination by preferences.

The penalty differs in the case of young men of French origin living in a city priority district. For him, the penalty is not significant and his chances of receiving a non-negative answer are essentially the same whether his message contains mistakes or not. A lower social level, indicated by the presence of syntax errors in the contact message sent to the supplier, therefore has a relatively identical effect for all candidates except for the one who reports a low social level through his address, i.e. a signal equivalent to that of syntax errors. This suggests that the message with errors is not of great importance to sellers as soon as the candidate residing in a city priority district, whereas this is not the case for other candidates. In the absence of information on the quality of the buyer contacting him, the seller seems to use the type of message (with or without error) to attribute to these individuals what he knows or what he thinks he knows about the average characteristics and their dispersion in their demographic group. In this way, the seller hopes to be able to make the best possible transaction. So, this result suggests information-based discrimination, rather than taste-based discrimination.

Table 6: Effects of errors in messages on the chances of success

	Non-negative response rate with messages with errors (1)	Non-negative response rate with messages without errors (2)	Difference in pts of % (1)-(2)
Female 22 years old French origin	6,1%	11,1%	-5,0**
Female 22 years old African origin	7,2%	12,4%	-5,2**
Male 42 years old French origin	6,5%	11,1%	-4,6*
Male 22 years old French origin	8,0%	13,7%	-5,7**
Male 22 years old French origin, residing in CPD	7,2%	8,4%	-1,2
Male 22 years African origin	6,1%	11,5%	-5,4**

Source : Testing TEPP-CNRS, DIAMANT, used car market. Chi 2 Test

Reading: On the ads to which we sent six messages containing errors, the young woman of French origin received a non-negative response in 6.1% of cases. Its chances of success are 11.1% on ads where we have sent clear messages. This 5 percentage point difference is significantly different from zero at the 5% level.

significant at 1% level, ** significant at 5% level, *significant at 10% level.

3.3. Econometric estimates

The non-negative response rates reported in table 4 concern all the ads tested. Given the heterogeneity of the ads tested, these rates may *a priori* be sensitive to composition effects. Indeed, it is possible that certain characteristics of the advertisement, the supplier or the testing itself influence differently the chances of success of the six fictitious individuals. It is therefore important to check whether these discriminations are maintain in an econometric estimation of all other things being equal.

Table 7 presents the results of linear probability model to receive a non-negative answer. The dependent variable is equal to one if the candidate receives a non-negative response and zero if he receives a null or negative response. We use a regression with random effects to account for clustering of our data, insofar we sent 6 applications for each offer. In Appendix table B, we present the results obtain by using a simple OLS model. The two specifications give the same value for the estimated coefficients but may differ for standard errors.

Models (1) and (2) only take into account the characteristics of the fictitious applicants. The only difference between the two models is that the latter contains an interaction term: In latter we introduce the cross effects of the presence of syntax errors in the contact initiation message and the characteristics of the candidate (Errors x CPD). Models (3) to (5) ad various covariates regarding the ad. The control variable relate to the supplier characteristics: name consonance, gender and status (professional or not). They relate also to the characteristic of the vehicle: price class, size of the car.

Globally, neither the age, nor the presumed origin for male has a significant effect on the probability of receiving a non-negative response. The discrimination against the man of African origin that appeared in the raw data in Table 5 does not stand up to an analysis all other things being equal.

The discrimination according to the place of residence is confirm in a robust way (first line). It is consistently present in all estimates, with or without control and with or without interaction terms. To a lesser extent, at the 10% level, we highlight also discrimination against women. This gender discrimination is difficult to highlight. It only appears significantly when the control variables are present.

Another interesting result is the situation of women of presumed African origin. Note the global impact of this profile is not directly given by the coefficient associated to AO× Female. The marginal effect of such profile is obtained by the addition of the coefficients associated to AO× Female, Female and AO. The p-value associated with the hypothesis that this sum is null is 0.458. The global impact of women of presumed African origin profile is not statistically different from zero. The presumed origin for female has not a significant effect on the probability of receiving a non-negative response.

As Table 4 already outlined, econometric results indicate this candidate profile has higher non-negative response rates than those of French women and higher than those of men of African origin. At the intersection of these two characteristics, women of African origin are a profile that is not negatively discriminated against on the second-hand car market.

The presence of syntax errors in the contact initiation message (model 1) reduces the probability of receiving a non-negative response. The decline is uniform for all claimant profiles, with the exception of those residing in a disadvantaged neighbourhood (model 2). The coefficient of the interaction term is of the same order of magnitude as that of the syntax error. This confirms that for this particular profile, a syntax error has no effect on the probability of receiving a non-negative response, as suggested in Table 5. However, this effect is linked to ad characteristics. When we controlled for seller's attributes (model 4) this effect is no longer significant.

Model 3 introduced covariates associated to the ad of the seller. Note according to Freedman (2008) all these covariates are centred. Our results indicate that when the ad is published either by an individual, or for a small car, or when the price of the vehicle is above 5,000 €², or when the seller has a name with French origin, the chances of getting a response are generally higher. Conversely when the seller is a man this probability is lower.

In the latter model (model 4), these covariates are interacted with all the profiles. In table 7, we keep in our regression only the significant variables. The full model is available in the Table A in the appendix. The cross terms CPD x small cars is significant and negative. This means that discrimination against applicants living in disadvantaged areas is stronger for small and medium-sized urban cars.

According our results, if we focus on active ads, defined as an ad with at least one positive answer, globally it is necessary for a young man (or an older man) with French origin to send 9.5 responses in order to obtain 5 appointment with the seller and to have the possibility to buy a used car³. This figure is 8.1 for small and medium-sized urban cars (model 4). For a young woman with French origin these figures are respectively 12.1 and 9.5. For man with an African origin, they are 11.8 and 9.7. For a candidate living in deprived areas, they are respectively 13.0 and 20.4⁴. In relative terms, these applicants must, on average, provide an additional 37% search effort $(13.0/9.5-1)$ to have the same chance of concluding a transaction. For small and medium-sized urban cars, this gap reaches 150% $(20.4/8.1-1)$.

Note the two coefficients associated with the interaction variables CPD x "seller is a man" and older x "seller is a man" are significant, negative and quite high. The interpretation is the following. A man in his forties has to send 35 messages to obtain 5 appointments if the seller is a man⁵, when a candidate living in disadvantaged areas has to send 290 messages.

² We also test the logarithm of the price see Table A in the appendix.

³ To obtain this ratio we use the Intercept of model1-4 $9.5 = 5 / 0.525$

⁴ $5 / (0.525 (\text{Intercept}) - 0.141(\text{CPD}) + 0.095(\text{small car}) - 0.234 (\text{small car} \times \text{CPD}))$

⁵ The coefficient associated to Female x seller is a man is almost significant (p-value = 0.107).

Table 7: Regression results taking into account clustering
(The standard errors are clustered on seller ID)

	Model 1	Model 2	Model 3	Model 4
CPD	-0.141** (0.069)	-0.141** (0.068)	-0.141** (0.069)	-0.141** (0.065)
Older (42 years old)	-0.101 (0.065)	-0.101 (0.065)	-0.101 (0.066)	-0.101 (0.064)
Female	-0.111* (0.064)	-0.111* (0.064)	-0.111* (0.065)	-0.111* (0.064)
AO	-0.101* (0.060)	-0.101* (0.060)	-0.101* (0.061)	-0.101* (0.061)
AO × Female	0.162** (0.081)	0.162** (0.081)	0.162** (0.082)	0.162** (0.082)
Message with errors (Errors)	-0.237*** (0.054)	-0.270*** (0.058)	-0.269*** (0.055)	-0.262*** (0.055)
Errors × CPD		0.200* (0.102)	0.200* (0.103)	0.156 (0.095)
Price higher than 5,000 euros			0.154*** (0.050)	0.154*** (0.050)
Suppliers's French consonance name			0.063 (0.062)	0.063 (0.063)
Non-professional			0.091* (0.050)	0.091* (0.050)
Small car			0.056 (0.050)	0.095* (0.053)
Small car × CPD				-0.234** (0.098)
Seller is a man			-0.121** (0.057)	0.041 (0.076)
Seller is a man × CPD				-0.367*** (0.101)
Seller is a man × Older				-0.281*** (0.103)
Seller is a man × Female				-0.164 (0.102)
Intercept	0.525*** (0.048)	0.525*** (0.048)	0.525*** (0.048)	0.525*** (0.047)
Obs.	594	594	594	594
Nb of clusters	99	99	99	99

Note :

CPD : City Priority District (deprived neighborhood)

AO : African Origin

The variable Non-professional indicates that the ad is published by an individual, Small-car indicate that the car is a city car or a medium sized sedans. High price indicates if the price of the car is higher than 5,000 euros. We also introduce the consonance name and gender of the supplier.

Source: Testing TEPP-CNRS, DIAMANT, used car market.

significant at 1% level, ** significant at 5% level, *significant at 10% level.

3.4. Discussion

Our results highlight the existence of discrimination in the second-hand car market. The place of residence leads to the strongest effect. We also show that this effect is the same when the demander reports a low social level through the presence of syntax and spelling errors in his initial message. While this type of error penalizes all other candidates symmetrically, it has no effect on the fictitious claimant who lives in a deprived neighborhood. This type of candidate is associated with a low social level because of his or her address. This is statistical discrimination.

The place of residence seems to appear to the seller as a marker of the buyer's reservation price: since CPD residents have on average lower purchasing power than residents of non-disadvantaged neighborhoods, sellers identify that the latter have a lower reservation price. From a theoretical point of view, this discrimination may be linked to the supposed risk of the buyer's non-solvency.

In 2012, 42% of CPD residents lived below the poverty line (compared to 12% for residents in non-disadvantaged neighborhoods). The probability that a buyer is poor is therefore higher if he is CPD resident, and our results suggest that sellers perceive it as such. However, here we are unable to examine whether the sellers correctly assess this risk. Using a controlled laboratory experiment, Bordalo et al. (2016) show that decision maker assesses a target group by over-weighting its representative types, defined as the types that occur more frequently in that group than in a baseline reference group. It is therefore possible here that sellers overestimate the risk of buyers' insolvency.

In addition to information-based discrimination, there may be a presumption of taste-based discrimination, even though our data do not allow us to highlight the latter: living in a disadvantaged neighborhood suggests that the buyer is likely to be poor, and sellers are reluctant to contact buyers they believe to be poorer because they are less willing or able to pay. Either they are reluctant to contact buyers because living in a disadvantaged neighborhood suggests that the buyer is probably poor with a lower purchasing power (information-based discrimination) or they are sending the messages with errors suggesting a low education or low social level and therefore lower purchasing power (information-based discrimination). Or they may not refuse to contact purchasers living in disadvantaged neighborhoods or people who send messages with errors, but may refuse to contact people with a low education or low social level, because they do not like to deal with them. This would suggest the presence of information-based discrimination.

Discrimination against women is more difficult to identify and is only significant at the 10% level. They are also more difficult to interpret. It is likely that gender stereotypes are at work in the used car market, but it is not within the scope of this study to determine which ones and how they operate. We can only note that women are penalized in terms of access to a used vehicle.

A common stereotype is that women are less interested in mechanics and cars. If sellers believe it, they may prefer a male claimant to simplify the transaction. But with the same stereotypes, they may also prefer a transaction with a woman because she will be less able to identify the defects of the vehicle in this lemon market. Maybe that's what happens to women of African origin who appears to have an advantage in our results. Since the seller receives almost all the requests at the same time, he is able to arbitrate between the woman and man presumed to be of French origin and the woman presumed to be of African origin. If his used car is of good quality, his interest is to enter into negotiations with a man, who will be able to enhance this quality. If this is a bad opportunity, it is preferable to negotiate with a woman of African origin, who probably knows herself as well as a French woman in mechanics, he thinks, but who is perhaps in a more fragile situation and who will be easier to fool. These are mere conjecture and we cannot confirm them any further. The important point from our point of view is that such gender discrimination may also be purely statistical discrimination.

Conclusion

We propose an evaluation of discriminatory behaviour on the second-hand car market, linked to age, and among young people, gender, origin and reputation of the place of residence. For this purpose, we use the correspondence test method. We have constructed six profiles of fictitious individuals distinguished only by their age, gender, the sound of their first and last names and their place of residence. We selected 489 used car sales ads posted online between January and May 2015 in Paris region. On each of these ads, the same day it went online, we sent six similar messages, showing a certain interest for the vehicle. These six messages come from each of our six fictional candidates.

We examine whether, overall, the six fictitious individuals receive similar responses from the same providers or whether, on average, they discriminate. One fifth of the vendors tested sent a non-negative response to at least one of our six fictitious candidates. This low proportion is certainly due to the large number of contacts received by suppliers following the publication of their advertisement.

Overall, the young man of French origin mentioning a neutral place of residence is significantly more likely to obtain a non-negative response than his counterfactual residing in a deprived neighborhood, and to a lesser extent than the young woman of French origin. We show that these results are not sensitive to compositional effects. When we take into account the price of the vehicle, the type of vehicle and the characteristics of the seller that influence the chances of obtaining a non-negative answer, there are no discriminations according to origin but there is an effect of place of residence and of gender. These discriminations can be explained by the prejudices of the sellers on the ability to pay of the applicants and on their mastery of automotive mechanics, which corresponds to informational discrimination. The penalty suffered by residents of deprived neighbourhoods leads them to have to make a search effort that is 37% to 150% higher, depending on the type of vehicle, than the effort made by other applicants to equalise their chances of completing a transaction. This is a strong penalty that can reduce their chances of acquiring a vehicle, being mobile and gaining access to a job to the same extent if they do not make this extra effort.

We produce experimental measures of discrimination. However, precautions must be taken to generalize the results. Indeed, according to Heckman, 1998, the results of a discrimination test provide a one-off, localized and partial measure of discrimination, and as such are not representative of the entire used car market. We only tested the active part of the market at the time of data collection in the Paris region alone. However, it is the only method that can provide a robust quantitative measure of discrimination in access to a particular market, free of selection bias and unobserved heterogeneity.

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Appendix

Table A: Examples of original messages with or without errors sent by 3 fictitious individuals on ads in Paris *intramuros*

Fictitious individuals	No Fault Message Game	Message game with errors
Christophe LEROY (42 ans, origine française, lieu de résidence neutre)	Bonjour, Je vous contacte car je suis intéressé par votre voiture, est-il possible de la voir et de faire un essai moi-même? Et si oui : où et quand ? Moi, je suis dans le 14ème. Je vous précise que j'ai mon permis depuis plus de 20 ans. En vous remerciant par avance, Christophe Leroy	Bonjour Je vous contact car je suis intéresser par votre voiture, il est possible de la voir pour je fasse un essai moi-même. ou et quand ? moi je suis dans le 14e. Je vous précise que j'ai mon permis depuis +de 20 ans. merci Christophe Leroy
Laura DURAND (22 ans, origine française, lieu de résidence neutre)	Bonjour, j'ai vu votre annonce pour votre voiture et elle m'intéresse. Est-elle toujours en vente ? Est-ce que je peux la voir et l'essayer? Peut-on se voir du côté de Nation où j'habite mais sinon je suis mobile. J'ai 22 ans et je conduis depuis 4 ans. Merci d'avance. Laura Durand	Bonjour j'ai vue votre annonce pour la voiture qui m'intéresse. Elle est toujours en vente ? je peux la voir et l'essayer? on peut ce voir coté nation ou j'habite mais sinon je peux venir. J'ai 22 ans je conduis depuis 4ans. Merci d'avance. Laura Durand
Florian ROUX (22 ans, origine française, lieu de résidence en « quartier politique de la ville »)	Bonjour, Je cherche une voiture comme celle que vous vendez. Pouvons-nous prendre un rendez-vous pour que je puisse la voir pour faire un essai (j'ai 3 ans de permis) ? Comme j'habite à la Goutte d'Or dans le 18ème, nous ne sommes pas très loin. Merci par avance, Florian ROUX.	bonjour, je cherche justemment une voiture comme celle là. Nous pouvons avoir un rdv pour que je la voit et que je l'essai ; j'ai 3 ans de permis ; on est pas loin j'habite la goutte d'or dans le 18ème. merci florian roux

Table B: (Complement of table 7) Regressions with all the covariates and the cross-effects

OLS taking into account clustering (The standard errors clustered on seller ID)			
	Coef (std)		Coef (std)
CPD	-0.141** (0.065)	-Non-professional	0.205** (0.100)
Older (42 years old)	-0.101 (0.064)	Non-professional × CPD	-0.071 (0.135)
Female	-0.111* (0.064)	Non-professional × Older	-0.116 (0.129)
AO	-0.101* (0.061)	Non-professional × Female	-0.197 (0.141)
AO × Female	0.162** (0.082)	Non-professional × AO	-0.177 (0.139)
Message with errors (Errors)	-0.280*** (0.096)	Non-professional × AO × Female	0.248 (0.189)
Errors × CPD	0.181 (0.135)	Small car	0.119 (0.095)
Errors × Older	0.042 (0.134)	Small car × CPD	-0.261* (0.134)
Errors × Female	0.029 (0.133)	Small car × Older	-0.062 (0.140)
Errors × AO	-0.008 (0.127)	Small car × Female	0.041 (0.133)
Errors × AO × Female	-0.001 (0.174)	Small car × AO	-0.105 (0.134)
Suppliers's French consonance name (Sel. French)	0.137 (0.114)	Small car × AO × Female	0.071 (0.170)
Sel. French × CPD	-0.229 (0.149)	Seller is a man	0.097 (0.108)
Sel. French × Older	-0.070 (0.151)	Seller is a man × CPD	-0.363** (0.141)
Sel. French × Female	0.023 (0.155)	Seller is a man × Older	-0.332** (0.147)
Sel. French × AO	-0.037 (0.136)	Seller is a man × Female	-0.274* (0.142)
Sel. French × AO × Female	-0.113 (0.184)	Seller is a man × AO	-0.154 (0.149)
Price higher than 5,000 euros (Price)	0.136 (0.097)	Seller is a man × AO × Female	0.238 (0.183)
Price × CPD	0.070 (0.131)	Intercept	0.525*** (0.047)
Price × Older	-0.138 (0.135)		
Price × Female	0.046 (0.133)		
Price × AO	0.005 (0.127)		
Price × AO × Female	0.073 (0.169)		
Obs	594		
Nb of clusters	99		

Note : CPD : City priority District (deprived neighborhood)

AO : African Origin

The variable Non-professional indicates that the ad is published by an individual, Small-car indicate that the car is a city car or a medium sized sedans. High price indicates if the price of the car is higher than 5,000 euros. We also introduce the consonance name and gender of the supplier.

Source: Testing TEPP-CNRS, DIAMANT, used car market.

significant at 1% threshold, ** significant at 5% threshold, *significant at 10% threshold.