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Crime and Conspicuous Consumption.*

Daniel Mejía† Pascual Restrepo‡

Abstract

This paper develops an incomplete information model wherein individuals face a trade-off between status and security when deciding the optimal amount of conspicuous consumption. On the one hand, we assume that individuals derive utility from status, which is obtained by signaling wealth through the consumption of an observable good. On the other hand, the increased consumption of observable goods also signals wealth to a criminal audience, thus increasing the chance of becoming target for criminal activities. The paper proposes an information channel through which crime distorts consumption decisions; this channel is different in nature from the channel whereby crime acts as a direct tax on observable and stealable consumption goods. More precisely, we argue that, in the presence of crime, individuals reduce their consumption of observable goods, not only because criminals may steal these goods, but also because it reveals information that could be used by criminals to target individuals' wealth. We test our model's predictions using U.S. data, and find that crime has a negative and significant impact on conspicuous consumption; also that this effect cannot be explained by the fact that some of these goods tend to be stolen by criminals. Finally, we show that this result is robust to different specifications and alternative measures of conspicuous consumption and crime.

Keywords: Crime, Conspicuous Consumption, Concerns for Status.

JEL Classification Numbers: K42, D11, D12.

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Crimen y Consumo Conspicuo*

Daniel Mejía†　　Pascual Restrepo‡

Abstract

Este artículo desarrolla un modelo de información incompleta en el cual los individuos enfrentan un *trade-off* entre status y seguridad al momento de escoger la cantidad óptima de consumo conspicuo. Por un lado, asumimos que los individuos derivan utilidad del status, el cual obtienen señalando riqueza a una audiencia de pares a través del consumo de bienes observables. Por el otro, el aumento en el consumo de bienes observables también es observado por los criminales y, con esto, aumenta el riesgo de caer víctima de las actividades criminales. El artículo propone un nuevo canal (canal de información) a través del cual el crimen afecta las decisiones de consumo de los individuos. Este canal es diferente en su naturaleza de aquel en el cual el crimen actúa como un impuesto al consumo de bienes observables. Más precisamente, el canal que proponemos en este artículo indica que, en presencia de mayor crimen, los individuos no sólo disminuyen el consumo de bienes observables porque estos pueden ser potencialmente robados, sino también porque el consumo de bienes observables revela información a los criminales que puede ser usada por éstos para seleccionar a sus víctimas. Finalmente, usamos datos a nivel individual de EE.UU. para testear la principal implicación del modelo, encontrando que el nivel de crimen a la propiedad tiene un efecto negativo y significativo sobre el consumo de bienes observables. Al corregir los posibles problemas de endogeneidad, el efecto negativo del crimen sobre el consumo de bienes observables se vuelve aún más negativo y significativo. Por último, mostramos que este resultado es robusto a diferentes especificaciones del modelo econométrico, y al uso de medidas alternativas de consumo observable y tasas de crimen a la propiedad.

Palabras clave: Crimen, Consumo Conspicuo, Preocupaciones por Status.

Códigos JEL: K42, D11, D12.

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"[whether or not I decide to rob a particular person] depends on what they got; like if they are wearing nice clothes, jewelry, and you know, that's basically it. You can look at a person and just tell if they've got money...." [quoted by Wright and Decker (1997)].

"Neither inflation nor unemployment. The most important concern for consumers in Rio de Janeiro... is violence." [Journal O Globo, Aug. 10, 2004. Cited by De Mello and Zillberman, 2008].

1 Introduction

As the quote above suggests, armed robbers rely on outward signs of wealth, such as clothing, jewelry and demeanor in order to judge how much cash people are likely to have. Anticipating this behavior, potential victims take into account the cost of those types of consumption that signal wealth to criminals.[1] They thus face a trade-off between security and status when deciding on the optimal amount of visible (conspicuous) consumption. More precisely, whereas higher levels of conspicuous consumption will likely lead to higher social status by signaling a higher level of wealth to peers, it will also make an individual a more attractive target for criminals.

In order to formally develop this idea, we construct an incomplete information model where individuals have concerns for status, defined here as others' beliefs about their wealth. The model is a two audience signaling model with a criminal audience and a status audience. Since wealth is private information, individuals signal their wealth by consuming more of an observable (conspicuous) good[2] (Ireland, 1994; Glazer and Konrad, 1996; Bagwell and Bernheim, 1996)[3]. However, signals are not only observed by peers (on the basis of which individuals obtain status), but also by criminals seeking potential victims. Since devoting time to criminal activities is costly, criminals prefer to target individuals with more wealth, who "offer" a higher rate of return on criminal activities.[4] Thus, the introduction of a criminal audience generates an incentive to hide wealth from peers, one that acts in the opposite direction from the motivation to "show off," present in models with concerns for

[1]Taking advantage of significant crime wave in Argentina during the late nineties, Di Tella et al. (2010) document that individuals indeed respond to higher property crime rates by trying to mimic the poor (for instance, by using less jewerly when going out).

[2]Conspicuous consumption (or "Veblen effects") exists when consumers are willing to pay a higher price for a functionally equivalent good (Bagwell and Bernheim, 1996).

[3]Other papers that incorporate concerns for status in economic models assume that status is determined by and individual's position in the distribution of conspicuous consumption across a particular reference group (Hopkins and Kornienko, 2004).

[4]See the extensive evidence for this cited in Wright and Decker (1997).

status. Thus, when deciding the optimal consumption of observable goods, individuals trade off the benefits derived from obtaining higher status with the expected cost of becoming the target of criminal activities. To the best of our knowledge, this channel - through which crime affects consumption decisions - is new in the economic literature.

The main problem we face when attempting to test our proposed channel empirically is that its predictions are difficult to separate from those generated by a standard consumption model, in which crime acts as a direct tax on visible and stealable goods, hence generating incentives to reduce their consumption. We will refer to this channel as the *direct substitution effect*. For example, individuals living in places experiencing greater larceny theft perceive a higher probability of their jewelry being robbed. This is equivalent to an increase in the relative price of jewelry, and leads individuals to consume less of it. Therefore, if places with higher property crime also exhibit lower amounts of conspicuous consumption, it could well be due to the fact that some of these visible goods are targeted by crime; hence, we observe a substitution towards safer types of goods. Whereas the direct substitution effect predicts that the consumption of observable and stealable goods will decrease with crime, our proposed channel predicts a drop in consumption, even for goods which are not (or cannot be) stolen, such as clothing, memberships in country clubs, beauty expenses, etc. More precisely, under our proposed channel, individuals do not reduce their consumption of conspicuous goods because criminals may steal them, as in the direct substitution effect. Rather they do so because it reveals information to criminals that could be used to target individuals' wealth.

Using available data on consumption patterns for U.S. households from 1987 to 1999, and data on crime at the state level, we find strong empirical support for the mechanism proposed by the model. More precisely, we find a negative and significant effect of crime on the consumption of observable goods that are not (or cannot) directly be targeted by criminals. Furthermore, after solving for potential endogeneity problem of criminal activities, the relationship becomes even stronger. We also show that the negative effect of criminal activities on the consumption of observable non-stealable goods is robust to different specifications and alternative measures of conspicuous consumption and crime; likewise, crime reduces the consumption of goods which can be targeted or stolen by criminals, suggesting that the substitution effect of crime on consumption decisions might be at work as well.

The contribution of this paper is twofold. First, it proposes and tests a channel, yet unexplored in the economic literature, through which crime distorts individuals' consumption decisions. Although the economic literature on the determinants of crime is quite large,[5]

[5]Since the seminal contribution of Becker (1968) there are several papers, both theoretical and empirical, that analyze the determinants of crime. In particular, see Ehrlich (1996), Freeman (1983, 1996), Levitt

to the best of our knowledge there have been few contributions examining the effects of criminal activities on the behavior of individuals. An important exception is De Mello and Zilberman (2008), who find a robust positive impact of property crime on saving decisions using data for the state of Sao Paulo in Brazil. Additionally, using data for Colombia, Pshiva and Suarez (2006) find that kidnappings affect firms' investment decisions, while Camacho and Rodriguez (2009) find that in those municipalities with a higher number of attacks by guerrilla and/or paramilitary groups, firms exit at a higher rate. Cullen and Levitt (1999) find that crime has led to the depopulation of American cities. Finally, Di Tella et al. (2010) take advantage of a significant increase in crime rates in Argentina during the late nineties in order to document different types of crime avoidance activities by individuals. They find, for instance, that rich individuals tend to hire more private security; tend to use less jewelry when going out; and both the poor and the rich tend to avoid dark places. This paper contributes to that branch of the literature dealing with the effects of crime on individual decisions, by developing and testing a model wherein property crime affects individuals' consumption decisions through an information channel. More precisely, according to our proposed mechanism, individuals react to crime by reducing the consumption of observable goods not only because these goods are subject to illegal appropriation, but, also, because the consumption of these goods reveals information about individuals' wealth that is used by criminals to select their targets. Second, the paper contributes to the growing literature incorporating concerns for status into economic models.[6] One of the most salient conclusions in the literature is that the incorporation of concerns for status into economic models leads to over-investment in conspicuous (positional) goods (Frank, 1999; Hopkins and Kornienko, 2004; Glazer and Konrad, 1996; Ireland, 1994)[7]. In this respect, this paper argues that criminal activities counteract this channel and, if crime is high enough, may completely reverse it. That is, sufficiently high levels of crime may lead to *under-investment* in conspicuous goods.

(1997), Glaeser and Sacerdote (1999), and Di Tella and Schargrodsky (2004).

[6] See, among others, Cole et al. (1992); Frank (1999); Bagwell and Bernheim (1996); Rege (2008); Hopkins and Kornienko (2004). See Bastani (2007) for a thorough review of the literature on concerns for relative ranking in the economics literature.

[7] However, if complementary interactions exist between individuals, conspicuous consumption might be welfare enhancing, even when the costs of conspicuous consumption are taken into account, as they allow for a better (i.e. more efficient) matching between individuals in the marriage market or between firms and workers in the labor market (see, among others, Cole et al. (1992); Bagwell and Bernheim (1996); Rege (2008)).

The paper is divided in four sections, wherein this introduction is the first one. Section two describes the model and its predictions in detail. Section three presents the empirical evidence, and section four concludes.

2 The model

In order to formally develop the ideas described in the previous section, we develop an incomplete information signalling model wherein individual have concerns for status. Since wealth is unobservable, individuals signal it by consuming observable (conspicuous) goods. We also introduce a *criminal audience*, modeled here as a unitary agent that decides how much time to allocate to expropriating individuals' wealth based on all information at its disposal. Finally, we have a peer group, called the *status audience*, which "grants status" to individuals through the formation of beliefs about their wealth.

We assume that both the criminal and status audiences have exactly the same information, so that all information concealed by individuals to one of the audiences is also learned by the other. This assumption implies that individuals cannot direct their public observable signals in order to show wealth to the status audience while hiding it from the criminal audience. This assumption creates a direct trade-off between status and security when deciding the optimal amount of conspicuous consumption.[8]

The timing of the model is as follows. Nature plays first, giving each individual a type consisting of a wealth level, w, which is private information. Individuals observe their type and consume two goods, one observable good, z (called the conspicuous good), and one unobservable, y (called the numeraire good). Afterwards, the status audience observes the conspicuous consumption of all individuals and forms beliefs about their respective wealth. Finally, in each case, and based on the consumption of the observable good, the criminal audience decides the amount of effort to allocate to expropriating both consumption goods based on their expected value, which must be equal to the individual's expected wealth. Notice that the criminal audience is indifferent with respect to the goods it expropriates. Hence, we assume that both goods are equally stealable by criminals; consequently, the presence of crime does not change their relative prices. We make this assumption explicit in order to show that our mechanism is independent and different in nature from the substitution effect described in the introduction.

We now introduce the agents involved in the game in more detail. We do this in the same order in which they appear when solving the model by backward induction.

[8]As long as individuals cannot perfectly discriminate their signals, the trade-off between status and security would still prevail.

2.1 The criminal and status audiences

The criminal audience's strategies are fully characterized by a function $t(\widehat{w})$, which describes the level of effort allocated to expropriating the wealth of an individual sending the signal z, and whose expected wealth is $\widehat{w} = E(w|z)$. We assume that $t_{\widehat{w}} > 0$, so that the criminal audience allocates more effort on individuals expected to have higher levels of wealth. The fact that t only depends on $\widehat{w}$ implies that the criminal audience is totally indifferent as to whether expropriating the conspicuous or the numeraire good. In particular, the criminal audience only cares about the expected market value of the stolen goods, which is exactly equal to $\widehat{w}$.[9]

We assume that the criminal audience has an expropriation technology represented by a concave and smooth function, $0 \leq a(t) \leq 1$, where t is the amount of time invested in criminal activities. If the criminal audience expropriates both goods, z and $y = w - pz$, from a given individual at rates, η_z, η_y respectively, and if the criminal audience has an opportunity cost of time normalized to 1, then the problem is given by

$$\max_t E[(pz\eta_z + y\eta_y)a(t) - t] = \max(pz(\eta_z - \eta_y) + \widehat{w}\eta_y)a(t) - t. \tag{1}$$

Since this function is concave, it has a unique maximum at $t(z, \widehat{w})$ satisfying

$$a'(t) = \frac{1}{pz(\eta_z - \eta_y) + \widehat{w}\eta_y}. \tag{2}$$

If both goods are equally stealable, then $\eta_z = \eta_y = \eta > 0$. In this case, t only depends on $\widehat{w}$, allowing us to uniquely define the function $t(\widehat{w})$, which is increasing in $\widehat{w}$ by the concavity of $a(t)$. We define $\gamma(\widehat{w})$ as the fraction of wealth not expropriated from an individual who is believed to have wealth $\widehat{w}$. Explicitly we have

$$\gamma(\widehat{w}) = 1 - \eta a(t(\widehat{w})). \tag{3}$$

Based on the previous remarks, γ is a smooth function decreasing in $\widehat{w}$, so that individuals who are expected to be wealthier are expropriated a higher fraction of their wealth, as a simple version of Becker (1968) model would predict. If expectations are rational, this assumption implies that richer individuals bear most of the burden of property crime. This implication has been documented for Latin American cities by Gaviria and Vélez (2001),

[9] A more general version including substitution effects would allow t to depend on z and $\widehat{w}$ (i.e. $t(z, \widehat{w})$). Thus, the assumption about the extent to which the criminal targets both goods becomes an assumption about the derivatives of this function. It could also be the case that the market value for stolen goods is less than its original value. Our model gives the same predictions so long as this value is proportional to the original one.

and Gaviria and Pages (1999). However, Levitt (1999) finds that, between 1970 and 1994, property crime victimization became increasingly concentrated among the poor, and that by 1994, poor households in the U.S. were more likely to be victimized by property crime than rich households. As noted by Levitt, this result seems to arise because individuals invest in private protection, and wealthier individuals invest in it to a greater extent. This last point is important since we do not include private protection decisions in our model; moreover, the fact that γ is a smooth function that decreases in $\widehat{w}$, rests upon this assumption. If individuals could invest in protection, their expenditures in this front could not be ignored when computing the crime burden they face, as noted by Levitt (1999). Therefore, the fact that rich individuals face lower levels of victimization does not mean they bear a lower crime burden, since they have to invest resources in order to lower their chances of becoming targets of crime. The crucial point for our model is that if criminals believe that an individual is wealthier, then she is going to loose utility, either because a larger fraction of her goods are expropriated (as we are modeling it), or because she has to spend a larger fraction of her wealth to protect her property from being stolen. In the latter case, the extra expenditures needed to avoid expropriation should be qualified as a cost of signaling wealth to criminals. A more general version of our model that incorporates private protection would yield the same results as long as criminals' expectations of higher wealth would increase the burden of crime on the individual (holding constant her expenditures on private protection).

As it is usually the case in the literature, we assume that status is given by $S = \widehat{w}$ - that is, status is based on others' beliefs about an individual's wealth. Here, $\widehat{w}$ is the individual's expected wealth given her conspicuous consumption - that is, $\widehat{w} = E(w|z)$. This assumption could be replaced by one where status is given by any smooth (increasing) function of $\widehat{w}$, and all our results would still hold. We assume that the criminal and status audiences' beliefs are identical. This mutual consistency assumption implies that both audiences have the same information set. In other words, we assume that individuals cannot induce different beliefs on the two audiences by selectively concealing different information to each of them. Of course, this assumption may be relaxed if individuals are able to discriminate between the receivers of their signals (for example, individuals might wear luxury jewelry at a private party but leave it at home when going out to downtown). As long as individuals are unable to perfectly discriminate between the receivers of their signals, a trade-off exists between security and status when deciding on the optimal amount of conspicuous consumption.

2.2 The Individual's problem

Every individual has an exogenously determined wealth level, w, which is distributed across individuals according to the CDF $F(w)$ along the support $[w_{min}, w_{max}]$, and the corresponding density function $f(w)$. Since individuals decide first, they anticipate the subsequent reactions of the status and criminal audiences and incorporate them into their reduced form problem. When an individual with wealth w signals z, and both audiences expect her to have wealth $\widehat{w} = E(w|z)$, her reduced form utility function is given by:

$$V(w, \widehat{w}, z) = U(z\gamma(\widehat{w}), (w - pz)\gamma(\widehat{w})) + \lambda\widehat{w}. \tag{4}$$

Function U captures the private utility of consumption, which depends on the non-expropriated goods. We allow U to be a smooth concave function with U_z, $U_y > 0$, and U_{zz}, $U_{yy} < 0$. Additionally, we assume that z is a normal good so that $U_{zy} - pU_{yy} > 0$. We denote by V_1, V_2 and V_3 the derivatives of V with respect to its arguments.

We make two assumptions regarding preferences and explicitly explain their consequences:

A1: The marginal rate of substitution U_z/U_y depends only on the ratio z/y, and not on γ, so that preferences are homothetic. We define $U_z/U_y = m\left(\frac{z}{w}\right)$.

We make this assumption in order to introduce crime in such a way that it does not affect consumption decisions by changing the marginal rate of substitution between the two goods. Since our objective is to propose a mechanism different in nature from the simple substitution effect, we impose this assumption in order to isolate our effect and show that it is totally independent of a substitution effect towards safer types of goods. This assumption regarding the homotheticity of preferences is not necessary for our model to work; in its absence, however, we would have to note that changes in conspicuous consumption induced by crime arise from both, the substitution effect and our proposed mechanism.

A2: We assume $U_y + zU_{zy} + yU_{yy} \leq 0$. This assumption about individual preferences implies that if two individuals with wealth w_1 and w_2, with the same level of conspicuous consumption, z, have a fraction $1-\gamma$ of their goods expropriated, then they both lose utility, but the poorer individual suffers the most.

Although not strictly necessary, this assumption is used in the proof of proposition 2; it is also a condition that could be useful in proving the existence of a separating equilibrium. Unlike assumption 1 then, this assumption plays a key role in proving our results. In practice, if $U = f(S(z, y))$ with S being homogeneous of degree 1, then U satisfies assumption A2 if $f''(x)x + f'(x) \leq 0$ - that is, if f is "as concave" as the logarithmic function. In words, assumption A2 says that a poorer individual suffers more from the expropriation of a given fraction of income than a rich individual. Equivalently, this assumption implies that individuals are risk averse, and that individuals have a relative risk-aversion coefficient that is greater than or equal to one, which is in line with the empirical evidence in Kihlstrom and Mirman (1981).

2.3 The complete information case

Assuming complete information, $\widehat{w} = w$ and expectations are not affected by the consumption of z. Therefore, the optimal level of consumption, $z(w)$, for an individual with wealth w is defined implicitly by the following tangency condition:

$$\frac{U_z(z(w)\gamma(w),(w - pz(w))\gamma(w))}{U_y(z(w)\gamma(w),(w - pz(w))\gamma(w))} = m\left(\frac{z(w)}{w}\right) = p, \qquad (5)$$

Since preferences are homothetic, $z(w) = \alpha w$ with $0 < \alpha < 1$, and z is a normal good with income elasticity equal to 1.

In this case, consumption decisions are not affected by the extent of crime, since $z(w)$ does not depend on γ. This shows that under complete information, crime introduces no distortions on individuals' consumption decisions, just as we desired when introducing assumption A1[10].

2.4 The incomplete information case: separating equilibrium

Here, an individual's wealth constitutes private information. In order to construct a separating equilibrium, we must find a 1-1 function $\sigma : [w_{min}, w_{max}] \to \mathbb{R}$, describing the conspicuous consumption, $\sigma(w)$, of an individual with privately known wealth w. The function must be 1-1 because for every consumption level z, the audiences must be able to deduce the wealth of the individual sending that signal, a task that would be impossible if $\sigma^{-1}(z)$ contained several elements. Since the function is 1-1, equilibrium path beliefs must satisfy $\widehat{w} = E(w|\sigma(w) = z) = \sigma^{-1}(z)$ - that is, both audiences should be able to determine, without any uncertainty, the wealth of an individual sending signal z by applying the inverse function σ^{-1} to her signal. Notice that beliefs are only defined for $z \in \sigma([w_{min}, w_{max}])$ - that is, "on the equilibrium path". Beliefs off the equilibrium path must satisfy the intuitive criteria requirement (Cho and Kreps, 1987; Banks and Sobel, 1987), as explained in the appendix.

[10]It is easy to show that if $\eta_y \neq \eta_z$, then the first order condition depends of η_y and η_z. Therefore, crime would affect consumption decisions via the substitution effect. For example, if crime disproportionally targets conspicuous consumption, then individuals would do less of it because it implies a more intense targeting by criminals; moreover, this higher targeting would be associated with greater expropriation of these goods, making their marginal utility per dollar invested fall relative to that of the numeraire.

From the reduced form utility function, we know that $V_2 = \lambda + \gamma'(\widehat{w})(zU_z + yU_y)$ captures the incentive to signal wealth. The sign of V_2 depends on the relative size of the concerns for status, captured by λ, and the extent of crime, captured by the negative term $\gamma'(\widehat{w})(zU_z + yU_y)$. Thus, as the level of property crime increases, the incentive to signal wealth diminishes. It could be the case that crime is so great relative to λ, that in fact $V_2 < 0$, and individuals have an incentive to hide their wealth. If, on the contrary, crime is small relative to λ, then $V_2 > 0$, and there is a positive incentive to signal wealth, despite the fact that the signal increases the likelihood that the individual will experience property crime. It could also be the case that the sign of V_2 changes with w and z. However, such a situation could exhibit many equilibria; in this case, there is no easy characterization of a separating equilibria.

Lemma 1 in the appendix shows that if V_2 is always greater than zero ($V_2 > 0$), then in any separating equilibrium the poorer individual will choose her complete information level of conspicuous consumption. The intuition behind this assertion is that since her type is going to be revealed in equilibrium, the individual in question strictly prefers to send her complete information signal. By doing so, neither audience can decrease her utility by changing its perception about her wealth, since w_{min} is a lower bound for $\widehat{w}$ both on and off the equilibrium path. Therefore, no matter what, this individual is strictly better off by sending the signal $z(w_{min})$. In the same fashion, if $V_2 < 0$, then in any separating equilibrium the richer individual will choose her complete information level of conspicuous consumption, the intuition being exactly analogous to that in the previous case.

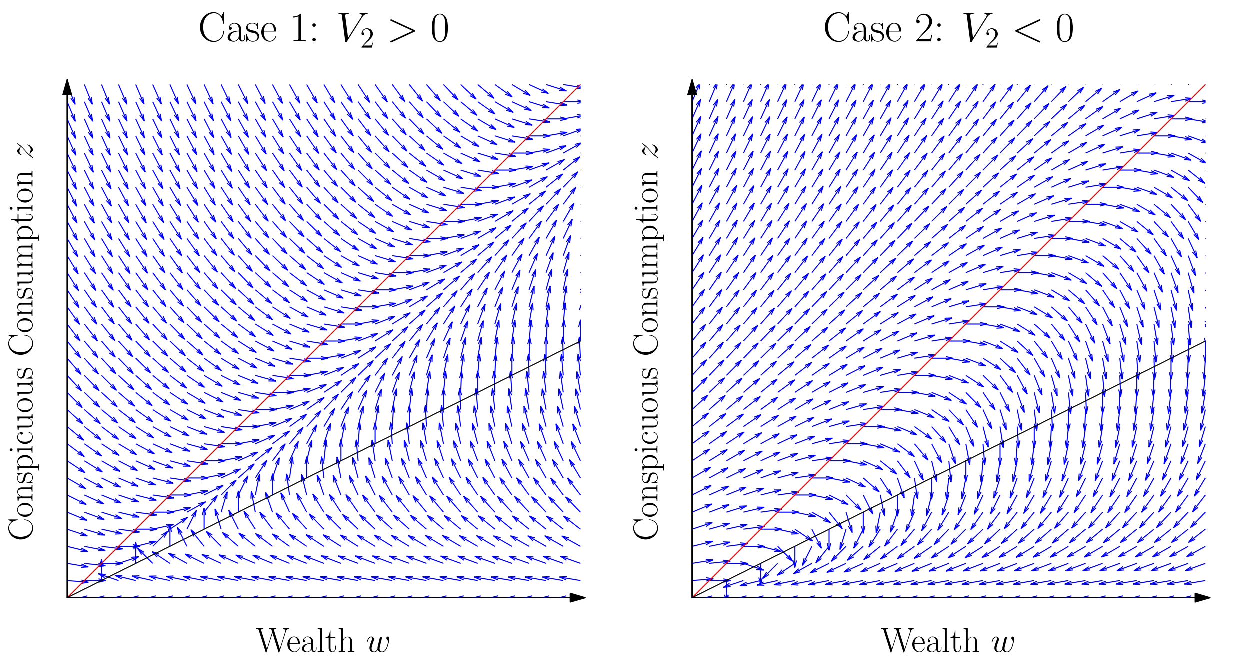
Lemma 2 completely characterizes the unique separating equilibrium (if it exists) and provides the necessary and sufficient conditions for its existence, when V_2 does not change sign and $V_{13} = \gamma^2(U_{zy} - pU_{yy}) > 0$ (which is always the case with homothetic preferences). The unique separating equilibrium (if it exists) must be the unique *increasing* solution to the following differential equation:

$$\sigma'(w) = \frac{\lambda + \gamma'(w)(\sigma(w)U_z + (w - p\sigma(w))U_y)}{\gamma(pU_y - U_z)}, \tag{6}$$

with the initial value condition $\sigma(w_{min}) = z(w_{min})$ if $V_2 > 0$, and $\sigma(w_{max}) = z(w_{max})$ if $V_2 > 0$. In order to make the notation more compact, we ignore the function's arguments; with the convention that all derivatives of U are evaluated at $(\sigma(w)\gamma(w), (w - p\sigma(w))\gamma(w))$. The following figures show the direction field for this differential equation, along with $z(w)$ (in black) and the upper bound for conspicuous consumption $z = w$ (in red). The left hand side panel shows the case where $V_2 > 0$, while the right hand side panel shows the case when $V_2 < 0$.

The idea behind the proof of lemma 2 is as follows. If individuals only choose actions on the equilibrium path, then their problem is equivalent to choosing which type they want

Figure 1: Direction field for the differential equation.



to mimic, inasmuch as there is a bijection between types and equilibrium path signals. An individual's problem may be therefore stated as

$$\max_{\widehat{w}\in[w_{min},w_{max}]} U(\sigma(\widehat{w})\gamma(\widehat{w}),(w-p\sigma(\widehat{w}))\gamma(\widehat{w}))+\lambda\widehat{w}. \tag{7}$$

Assuming that the problem is well defined and that its maximum is characterized by its first order condition, it has a unique global maximum w^* satisfying the following first order condition:

$$\sigma'(w^*)\gamma(w^*)[U_z-pU_y]+\lambda+\gamma'(w^*)(\sigma(w^*)U_z+(w-p\sigma(w^*))U_y)=0. \tag{8}$$

Here, the arguments of the derivatives of U are $(\sigma(w^*)\gamma(w^*),(w-p\sigma(w^*))\gamma(w^*))$. The first term captures the change at the margin in the direct consumption utility derived from sending a particular signal, while the second and third terms capture the incentives to mimic other types. More specifically, the second term captures the incentive to look wealthier in order to gain status, while the third term captures the cost associated with the potential risk of being targeted by criminals as a result of appearing to be a more attractive prey (e.g., wealthier).

The equilibrium must be *incentive compatible*, in the sense that every individual should be worse off by mimicking other types - that is, the equilibrium should indeed be separating, as individuals choose the signal corresponding to their type. This implies that $w^* = w$ for all $w \in [w_{min}, w_{max}]$. Plugging $w^* = w$ into the first order condition 8 and isolating σ', we obtain differential equation 6.

To guarantee that the first order condition actually characterizes a global maximum, and that the separating equilibrium does exist, we can follow different strategies. The most straightforward strategy is that used by Mailath (1987), who shows that the first order condition determining the differential equation gives a global maximum if we have the following *single crossing condition* (SCC):

$$\sigma' \left[\gamma^2(U_{zy} - pU_{yy}) - \frac{\gamma(U_z - pU_y)}{\lambda + \gamma'(\sigma U_z + (w - p\sigma)U_y)} \cdot \gamma'(U_y + \sigma\gamma U_{zy} + (w - p\sigma)\gamma U_{yy}) \right] \geq 0, \tag{9}$$

for all w and $\widehat{w}$. Here, γ and σ are evaluated at $\widehat{w}$, and the derivatives of U at $(\sigma(\widehat{w})\gamma(\widehat{w}), (w - p\sigma(\widehat{w}))\gamma(\widehat{w}))$. An easy way to guarantee the SCC is to assume that $U_y + zU_{zy} + yU_{yy} \approx 0$. This implies that $U_y + \sigma\gamma U_{zy} + (w - p\sigma)\gamma U_{yy} \approx 0$, and the term $\sigma'\gamma^2(U_{zz} - pU_{yy})$ dominates the other. Since $U_{zz} - pU_{yy} > 0$, and $\sigma' > 0$, because σ is increasing, we obtain the SCC. In this case then, there always exists a unique separating equilibrium given by the solution to the differential equation 6.

The last assumption is similar to A2, but says that crime, modeled here as the expropriation of equal fractions of both goods, hurts both poor and rich individuals in approximately the same way. This could be the case, as even though poorer individuals face a higher loss at the margin from losing wealth or consumption, richer individuals lose a higher fraction of their wealth. The assumption suggests that the magnitude of both effects is similar. In fact, this is equivalent to assuming that individuals have a relative risk-aversion coefficient close to one, as suggested by the empirical evidence in Kihlstrom and Mirman (1981).

Intuitively, if $U_y + zU_{zy} + yU_{yy}$ is negative and large, relative to rich individuals, poor individuals suffer a great deal from crime; they might thus end up pooling at the lowest possible consumption level, such that a separating equilibrium may not arise in this case. Conversely, if $U_y + zU_{zy} + yU_{yy}$ is positive and large, richer individuals suffer from crime more than poor individuals, and may end up pooling at the maximum level of conspicuous consumption. In fact, the SCC mainly rules out the possibility of individuals pooling at the maximum or minimum level of conspicuous consumption; in other words, it rules out corner solutions to the maximization problem of individuals. The SCC also guarantees that an individual's problem reaches a unique critical point at $\widehat{w} = w$.

Another approach for guaranteeing that the first order condition for an individual's problem actually characterizes a maximum is to prove that it provides a local maximum, and then to show that the FOC only has one zero. This is precisely the approach taken by Glazer and Konrad (1995). It turns out that the condition for a local maximum at w is exactly

$$\sigma' \left[\gamma^2 (U_{zy} - pU_{yy}) - \frac{\gamma(U_z - pU_y)}{\lambda + \gamma'(\sigma U_z + (w - p\sigma)U_y)} \cdot \gamma'(U_y + \sigma\gamma U_{zy} + (w - p\sigma)\gamma U_{yy}) \right] \geq 0, \tag{10}$$

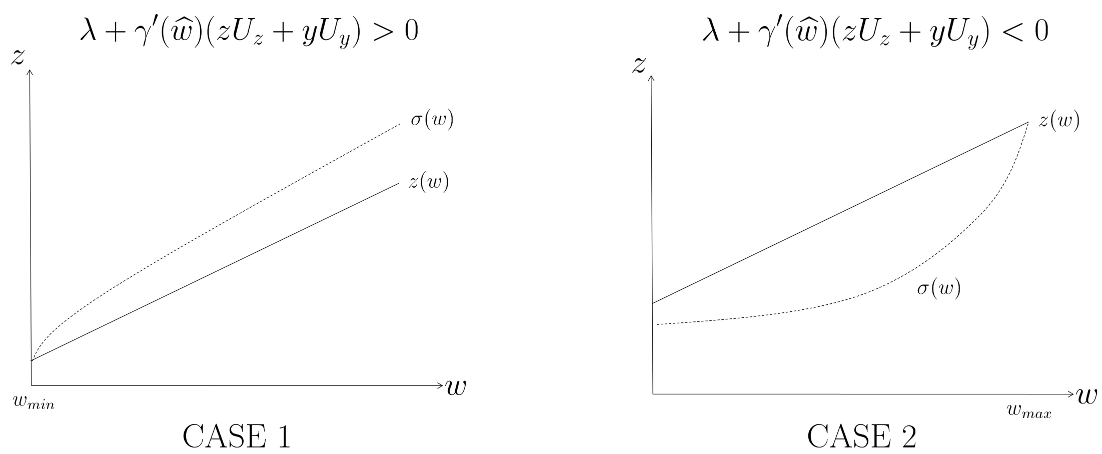
where γ and σ are evaluated at w, and the derivatives of U at $(\sigma(w)\gamma(w), (w - p\sigma(w))\gamma(w))$. In our case, this condition is satisfied because the term $\sigma'\gamma^2(U_{zz} - pU_{yy})$ is positive, and the last term can be written as $\frac{1}{\sigma'}\gamma'(U_y + \sigma\gamma U_{zy} + (w - p\sigma)\gamma U_{yy})$ which is positive based on assumption A2. However, to complete this approach, one ends up reaching the SCC, as proving that the FOC only has one solution requires proving the monotonicity of $\frac{V_2}{V_3}$ as a function of w.

One particular case arises where there is no criminal audience and $\gamma = 1$. Here, we get $\gamma' = 0$, so that the SCC becomes $\sigma'(U_{zy} - pU_{yy}) \geq 0$, and is trivially satisfied. In this case, the increasing solution to differential equation 6 is always a separating equilibrium.

Proposition 1 summarizes the main result of this section.

Proposition 1: If the unique separating equilibrium exists, the relevant strategies must solve differential equation 6. If crime is high enough relative to the concerns for status, then $V_2 = \lambda + \gamma'(zU_z + yU_y) < 0$ *and individuals underinvest in the conspicuous good relative to the complete information case with a criminal audience. Conversely, if crime is sufficiently low relative to the concerns for status, then* $V_2 = \lambda + \gamma'(zU_z + yU_y) > 0$ *and individuals overinvest in the conspicuous good relative to the complete information case with a criminal audience. Existence requires the SCC. In particular, if* $U_y + \sigma\gamma U_{zy} + (w - p\sigma)\gamma U_{yy} \approx 0$, *then a separating equilibrium exists.*

Figure 2: Equilibrium conspicuous consumption.



Proposition 1 is a straightforward consequence of lemmas 1 and 2, whose proofs and full statements can be found in the appendix, as well as the previous discussion about the SCC. It turns out that σ is increasing because of the initial value condition and the fact that $U_{zy} - pU_{yy} > 0$, so that wealthier individuals are thus able to send higher signals. Since σ is increasing, the differential equation implies that $V_2 = \lambda + \gamma'(zU_z + yU_y)$ and $-V_3 = \gamma(pU_y - U_z)$ have the same sign. If $V_2 > 0$ and individuals want to appear wealthier, then $\gamma(pU_y - U_z) > 0$ and $\sigma(w) > z(w)$ - that is, individuals overinvest in the conspicuous good. The intuition behind this result is that the poorer individual is exactly at $z(w_{min})$. From that point on, every individual pushes up her consumption (relative to their respective optimal consumption levels) in order to differentiate herself from the individuals just below her and thus appear richer. We end up with all individuals overinvesting in the observable good.

If, on the contrary, $V_2 < 0$ and crime is sufficiently high such that individuals actually want to hide their wealth, then $\gamma(pU_y - U_z) < 0$ and $\sigma(w) < z(w)$ - that is, individuals underinvest in the conspicuous good. The intuition behind this result is that the richer individual is exactly at $z(w_{max})$. From that point on, every individual pushes down her consumption (again, relative to their optimal consumption levels) in order to differentiate herself from the individuals just above and thus appear poorer. We end up with all individuals underinvesting in the observable good. Both the overinvesting or the underinvesting decrease welfare; if individuals were able to agree to consume $z(w)$, they would end up with the same status, the same level of crime targeting them, and a higher utility level.

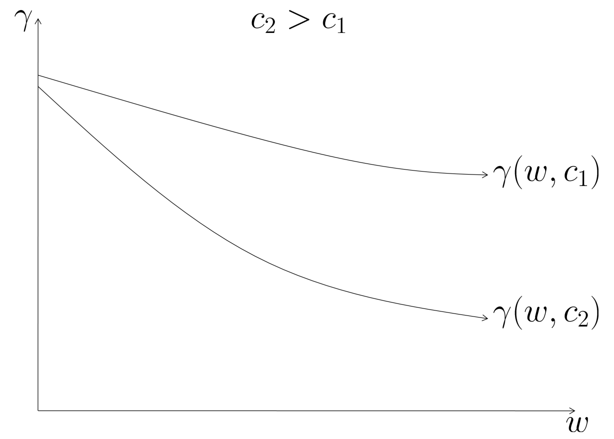
One special case that arises in this setting is when the level of crime is such that $\gamma'(zU_z + yU_y) = \lambda$. In this case, crime acts exactly as a pigouvian tax on conspicuous consumption, correcting the externality generated by incentives to differentiate from others. In this special case, $\sigma(w) = z(w)$.

Thus far, we have introduced crime without any measure of its intensity. Let c measure the crime level, and let us assume that the non-expropriated wealth depends on $\widehat{w}$ and crime level c, such that an individual with expected wealth $\widehat{w}$, does not have a fraction $\gamma(\widehat{w}, c)$ of her goods expropriated. Naturally, we assume that $\frac{\partial \gamma}{\partial c} < 0$. The intensity of crime then increases expropriation and $\frac{\partial(\gamma'/\gamma)}{\partial c} < 0$ (e.g. $\frac{\gamma'}{\gamma}$ decreases with c), and crime is more responsive to signals. Proposition 2 describes the main comparative statics result of our model.

Proposition 2: Let $\sigma(w, c)$ be the unique separating equilibrium when the crime level is c. For any $w \in (w_{min}, w_{max})$ then, conspicuous consumption for an individual with wealth w strictly decreases with c.

Proposition 2 also follows directly from lemma 3 in the appendix, and the following considerations concerning the effects of crime on the slope of σ (given by $-V_2/V_3$). Whenever,

Figure 3: The effect of the crime intensity c on the crime burden γ



via lemma 3, $V_2 > 0$, it is enough to demonstrate that $-V_2/V_3$ decreases with crime in order to show that the unique separating equilibrium for crime level c, $\sigma(w, c)$ decreases with the level of crime. If we rewrite the differential equation as

$$\sigma' = \frac{\lambda}{\gamma U_y \cdot (p - m(\sigma(w)/w))} + \frac{\gamma'}{\gamma}\left(\frac{\sigma(w)m(\sigma(w)/w) + w - p\sigma(w)}{p - m(\sigma(w)/w)}\right), \tag{11}$$

then, differentiating the right hand side with respect to c and holding w and σ constant, we obtain the following expression for the first term:

$$-\frac{\lambda}{(\gamma U_y)^2 \cdot (p - m(\sigma(w)/w))}\frac{\partial \gamma}{\partial c}(U_y + \sigma\gamma U_{zy} + (w - p\sigma)\gamma U_{yy}) < 0. \tag{12}$$

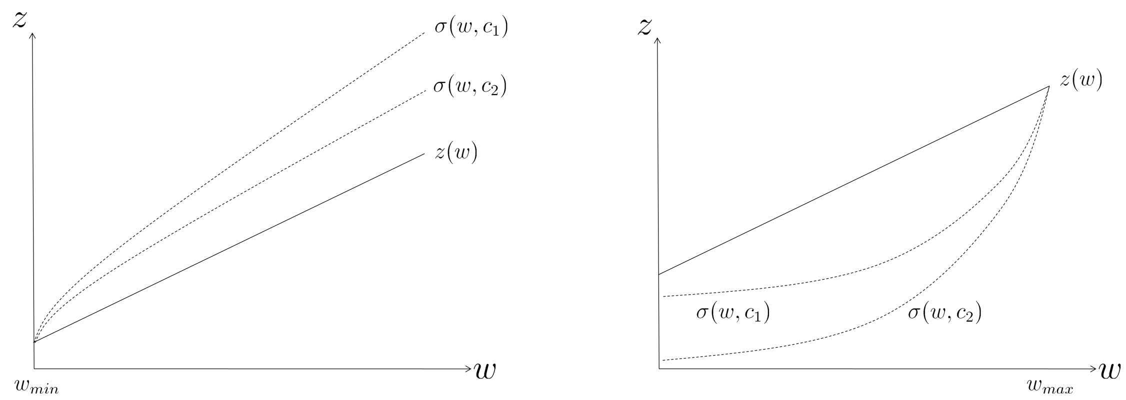
Here, we make use of the fact that $U_y + \sigma\gamma U_{zy} + (w - p\sigma)\gamma U_{yy} < 0$ (assumption A2). For the second term, we obtain the following expression:

$$\frac{\partial(\gamma'/\gamma)}{\partial c}\left(\frac{\sigma(w)m(\sigma(w)/w) + w - p\sigma(w)}{p - m(\sigma(w)/w)}\right) < 0, \tag{13}$$

which proves that $-V_2/V_3$ decreases with crime. Consequently, based on lemma 3, conspicuous consumption decreases with crime. In a completely analogous way, and utilizing lemma 3B, we also find that conspicuous consumption decreases with crime when $V_2 < 0$, by demonstrating that $-V_2/V_3$ increases with crime. Figure 4 summarizes proposition 2. The left and right hand side panels show how conspicuous consumption varies with crime when $V_2 > 0$ and $V_2 < 0$, respectively. In both cases, we have $c_1 < c_2$.

Intuitively, crime decreases the incentive to signal wealth by making it more costly, since it is more likely that a criminal will see the signal and respond to it. Therefore, individuals trade-off security and status when deciding whether to reveal information about their wealth via the consumption of observable goods. Proposition 2 shows that the solution to this trade-off becomes more tilted towards not demonstrating wealth in high crime environments.

Figure 4: The effect of crime on conspicuous consumption.



3 Empirical evidence

3.1 Data

In order to test the predictions of the model, we use the data from Charles et al. (2009) on consumption expenditures based on different categories at the household level. This dataset contains the 1986-2002 CEX family-level extracts made available by the NBER and collected by the United States Department of Labor. The CEX is an ongoing rotating panel in which a random sample of U.S. households are interviewed up to 5 times each over three month intervals. For each household, we have the state of residence; the year of the interview; consumption expenditures aggregated by the categories proposed by Harris and Sabelhaus (2000); demographic characteristics; household composition; the education level for each member; and certain income measures. A complete description of this dataset can be found in Harris and Sabelhaus (2000), and Charles et al. (2009).

Regarding crime variables, we use available information at the state level about crime rates, with crime divided into several categories, among them homicide, murder, rape, violent assault, robbery, larceny theft, burglary and car theft. This data comes from the FBI uniform crime reporting system (UCR) and is taken from John Lott's dataset.[11] This dataset contains information for all states between the years 1977 and 1999. We use the average for robberies, burglaries and larceny thefts in order to construct a measure of the property crime rate (per 100,000 inhabitants), and match each household to the property crime rate in its respective state during the year it was surveyed. Although the FBI defines property crime as either

[11]This dataset is downloadable from http://www.johnlott.org/.

larceny, burglary or car theft, we also include robbery, defined here as the use of force or threat against an individual in order to expropriate her property. Since our model involves criminals making inferences about individuals' wealth (which they can steal but do not observe), we exclude car theft from our property crime measure in the baseline specifications, inasmuch as it targets a very specific and observable good the value of which can be easily estimated without the need of specific signals. In other words, car theft does not correspond to the mechanism proposed in the model since, intuitively, criminals just have to look for the right car to steal, and doing so does not require information they are unable to observe. On the other hand, a burglar or a robber does not observe the value of the objects he might potentially steal; thus, he has to make an inference about it by observing a victim's characteristics or signals such as their conspicuous consumption.

Given our focus on the relationship between crime and conspicuous consumption, for our empirical exercises we divide different consumption goods along two dimensions: *visibility* and the degree to which they are stealable ("*stealability*"). Visible goods are those which can easily be observed by others without it being necessary to have several interactions in order to notice them. Visible goods then are perfect candidates for signals of individuals' wealth. On the other hand, stealable goods are those which can be targeted for robbery, larceny or burglary. Table 1 shows our division of Harris and Sabelhaus (2000) original consumption categories into the five consumption measures used in this paper - visible and non-stealable (VN); Stealable (S); not visible and non-stealable (NN); car expenditures; and housing expenditures.[12] Rather than just guessing which goods are visible, we use surveys conducted by Charles et al. (2009) and Heffetz (2009) about the visibility of different consumption categories and their expected income elasticity. We code durable recreation goods (such as televisions and other electronic devices), furniture and jewelry as stealable, or at least potentially stealable, since, following annual FBI crime reports and the ethnographic evidence in Wright and Decker (1996) and Wright and Decker (1997), thieves, burglars and robbers seem to have a marked preference for cash. Appendix B discusses both surveys and explains the criteria used to define our consumption categories. We assign house rents and house rent equivalents to a different category called "housing expenditures," because this constitutes a large investment, the logic of which differs from the one outlined in our model. We also put all car-related expenses into a different category called "car expenditures", since, as explained before, we do not want to capture the relationship between car theft and car expenditures in our empirical models.[13]

[12]Stealable goods are not divided in visible or non visible since all of them were indicated as being very visible in one of the surveys we used to construct these categories. The details can be found in Appendix B.

[13]Cars appear to be highly visible in both surveys. Moreover, since they are not directly targeted among

In order to control for some factors varying over time and across states, we match each household to a series of state-level controls for the year the household was surveyed. These controls include mean income and standard deviation of income for the household head's reference group, from Charles et al. (2009) (defined by race and sex); the Gini coefficient; the poverty rate; population and population density; and the percentage of males within some age and race brackets. All of these controls are important since they may be related to crime and conspicuous consumption, and omitting them could create a spurious relationship between our variables of interest.

We follow Charles et al. (2009) and use the average consumption expenditure for each of our categories over the periods that a particular household was surveyed. Although some households are not surveyed five times, we still use the average over the times that they were interviewed.[14] Correspondingly, the unit of analysis is the average quarterly expenditure of a consumption category over the period that the household was in the sample.[15] We restrict our sample to household heads between 18 and 59 years of age, and we exclude households reporting 0 consumption in the aggregate expenditure categories that we use in this paper. Our main sample contains 41,152 households for almost all states, for the years between 1986 and 1998. We do not use the CEX observations for 1999-2002, because we do not have the corresponding state-level controls and crime variables for this period.

Table 2 presents the descriptive statistics for the main variables described above. As shown in this table, housing expenditures represent about 27% of households' total expenditures, suggesting that, indeed, housing is an expenditure whose logic is beyond the scope of our model, thus corroborating our decision to leave it outside of the proposed classification.

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the types of crime in our property crime measure, it could be considered as a visible, non-stealable good. However, although cars are not directly targeted by property crime as we define it, most car accessories are. Additionally, car theft is highly correlated with our property crime measure, and including it as a visible, non-stealable good may create a trivial association between property crime and visible, non-stealable consumption, an association not driven by the mechanism proposed in our model.

[14]Although the reasons why some households leave the panel might be related to crime (for example, due to crime-driven migration), the results that we will present are robust to using only those households for which all five surveys were completed. Including those households that left the panel could in fact bias our results against us, since they might maintain a high level of conspicuous consumption despite a high crime level, inasmuch as they expect to move to another city (perhaps one with less crime) soon.

[15]We do not exploit the panel structure of the original CEX data since we do not have the corresponding state controls and crime variables varying at a quarterly frequency. Moreover, it is highly unlikely that households will adjust their consumption over the course of a year, likewise that crime variables will exhibit enough variation within the space of a year so as to identify the effect of crime on consumption due to changes in the latter within a household in a given year.

3.2 Empirical strategy

The main prediction of our model is that crime affects conspicuous consumption; moreover, that this effect should be observed not only for visible and stealable goods (S) - as the direct substitution effect predicts - but also for visible and non-stealable goods (VN), since the consumption of these goods provides criminals information about individuals' wealth, thus inducing the latter to do less conspicuous consumption as crime increases. More precisely, the model predicts that, in the presence of higher property crime rates, households should cut their consumption of visible, non-stealable goods relative to other goods which are not stealable nor visible. We thus estimate the following baseline specification:

$$\ln\left(\frac{VN_{i,t,s}}{NN_{i,t,s}}\right) = \beta_o + \beta_1 \ln PC_{s,t} + \beta_2 \ln W_{i,s,t} + \Phi Z_{i,s,t} + \gamma X_{s,t} + \varepsilon_{i,s,t}, \tag{14}$$

where $\frac{VN_{i,s,t}}{NN_{i,t,s}}$ is the ratio of visible, non-stealable consumption to non-visible, non-stealable consumption for household i, in state s, and year t (the year the household was interviewed). $PC_{s,t}$ is the property crime rate in state s and year t; $W_{i,s,t}$ is household i's permanent income at time t; $Z_{i,s,t}$ is a set of household controls; $X_{s,t}$ is a set of state-level controls; and $\varepsilon_{i,s,t}$ denotes the error term. For all specifications, we also include state and year fixed effects. Given that the error term might be correlated for households in the same state, we cluster the errors at the state level in all regressions.

If this specification has a causal interpretation, then a negative estimate of β_1 would suggest that households reduce their consumption of visible, non-stealable consumption relative to non-visible, non-stealable goods as a result of higher property crime rates. We prefer a specification with the ratio $\frac{VN_{i,s,t}}{NN_{i,t,s}}$, rather than with the level $VN_{i,s,t}$ as the dependent variable, inasmuch as by comparing the consumption of visible, non-stealable goods with the consumption of those goods that appear not to be affected by crime, we partially isolate important budget effects and general falls in consumption resulting from higher property crime. By way of illustration, let us assume that households reduce their consumption of stealable goods when they face more crime. If this is the case, households will substitute stealable goods for non-stealable goods, thus increasing the consumption of visible and non-visible, non-stealable goods. Therefore, by focusing on the ratio rather than on the level, we partially rule out this effect. In fact, there are many theoretical reasons for thinking that other important mechanisms exist whereby crime affects consumption decisions besides the one proposed in our model. For example, crime may cause a general fall in consumption, as potential victims may increase precautionary savings (see De Mello and Zilberman (2008)), or firms may increase prices to cover losses caused by criminal activities. Therefore, an estimation of β_1 in a specification based on levels could be capturing a general fall in consumption. It might also be the case that households increase their protection expenses when facing higher property crime rates, thus tightening their budget constraint. More specifically, households might increase their expenses on such things as housing or security, since they would be more willing to pay higher rents to avoid geographical areas with high levels of crime (see Levitt (1999)).[16] In any case, since visible, non-stealable goods differ from non-visible, non-stealable goods only by virtue of being observable, a negative estimation of β_1 suggests that crime must have a negative impact on visible, non-stealable consumption, precisely because it is observable (i.e., by criminals).

The first problem we face when directly estimating model 14 using OLS is that, as noticed by Charles et al. (2009), the CEX income measure does not perform well, mainly because the survey was designed to measure consumption expenditures, not income. It is important to control for income, since visible goods tend to have an income elasticity greater than 1 (e.g., if they are luxury goods). If there is a correlation between crime and income, ignoring this control will cause our estimate to capture this correlation, thus biasing our results in favor of our hypothesis. To avoid this problem, we use total consumption in our empirical specification as a proxy for permanent income, and estimate equation 14 using total expenditures instead of income.[17] However, total consumption is endogenous in this model because all consumption categories are simultaneously determined. Consequently, the OLS coefficient will be biased. More problematic for our purposes is that, in this regression, total consumption could be a bad proxy for permanent income, inasmuch as the relationship between current consumption and permanent income could be affected by the level of property crime. This might be the case, for instance, if people save more when facing a higher crime rate, as suggested by De Mello and Zilberman (2008). Having a bad proxy could bias our coefficient of interest. To address this issue, we present all of our estimations using two different specifications. First, we show the OLS estimates; second, we show the results based on Charles et al. (2009) and based on instrumenting total consumption using the poorly measured data for income, household head's occupation, industry, and educational levels. The last strategy solves the bad proxy problem, because it "cleans" non-structural determinants of consumption (such as variations in the property crime rate).[18]

The second and more troubling problem for the consistent estimation of β_1 is that our

[16] On the other hand, it is possible that the urban flight caused by crime Cullen and Levitt (1999) reduces housing prices and rents, and consequently, expenditures on housing.

[17] The use of total expenditures as a proxy for permanent income is motivated by the fact that, in life cycle models, consumption is directly proportional to permanent income.

[18] In the robustness checks, we use several treatments of permanent income. We exclude total consumption from the right-hand side; use the CEX poorly measured proxy for income; and use the CEX measure instrumented. All of our results still hold under these alternative specifications.

property crime measure is an imperfect measure of the likelihood of being victimized. Thus, we have a measurement error problem that might attenuate our OLS coefficients. In order to solve the measurement error problem, we instrument the property crime rate using homicide rates and burglary-related police arrests, which are highly correlated with property crime and are arguably more precisely measured.

Finally, in order to be able to give β_1 the causal interpretation our model proposes, conditional on all other controls, property crime must be exogenous to consumption decisions made at the individual level. However, a reverse causality problem in this case is highly unlikely, as one would have to argue that state-level crime reacts to consumption decisions made at the individual level. Nevertheless, it is very important to control for a wide range of socioeconomic factors varying at the state level, because, as we have argued, visible consumption is a social phenomenon, and thus, it might be affected by the demographic structure at the state level, the level of inequality, average income and poverty, among other factors. Failing to include these controls might create an omitted variable bias, and our estimates for β_1 would not provide convincing evidence supporting the mechanism proposed in our model.

3.3 Results

Table 3 shows four different estimations of model 14. For all columns, the log of the ratio VN/NN is the dependent variable; a full set of state and household level controls, time effects and year effects are included. Column 1 presents the OLS results; in column 2 we instrument PC; in column 3 we instrument total consumption; and in column 4 we instrument PC and total consumption. For all specifications, property crime appears to cause a fall in visible, non-stealable consumption relative to non-visible, non-stealable consumption. When property crime is not instrumented, the estimate suggests that a 10% increase in our measure of property crime causes the consumption of visible, non-stealable goods to fall by 1.73% more than the consumption of non-stealable, non-visible goods, with the effect being significant at the 1% level. When we instrument property crime, the point estimate becomes larger (e.g., more negative), suggesting that the OLS coefficients were attenuated. More precisely, the IV estimates indicate that a 10% increase in our property crime measure causes visible, non-stealable consumption to fall by 2.93% more than non-stealable, non-visible consumption (column 2), and by 2.52% more in the most demanding specification (column 4).

Total consumption, our proxy for permanent income, has a significant and positive effect on the ratio of visible, non-stealable consumption to non-visible, non-stealable consumption, suggesting that the former has a larger income elasticity. In particular, we find that a 10%

increase in permanent income is associated with a 8.72% increase in visible, non-stealable consumption relative to non-visible, non-stealable consumption.

In order to isolate other potential explanations, we add a new set of controls for the results presented in Table 4. All models in this table are estimated instrumenting both property crime and total consumption. Column 1 presents the results of our baseline specification. In column 2, we add the consumption of stealable goods and cars as a control, as it is very likely that visible, non-stealable goods differ from non-stealable goods in their degree of complementary with stealable goods (including car-related expenses). As an example, take the expenditures on jewelry (stealable) and country clubs (visible, non-stealable). If the complementarities between going to a country club and wearing jewels are large enough, wearing fewer jewels because they could be stolen would imply less spending in country clubs, not because the country club signals wealth and this information might attract criminals (as proposed by our model), but because crime "taxes" a good complementary to country clubs. Therefore, if visible, non-stealable goods are more complementary to stealable goods than non-visible, non-stealable goods, it might be the case that our estimates exaggerate the negative impact of property crime on visible, non-stealable consumption. To address this concern, we directly control for the level of consumption in stealable goods (the consumption of which presumably falls with property crime). Consistent with the intuition just described, the coefficient of stealable consumption is positive, indicating strong complementarities with visible goods. Furthermore, the coefficient of property crime becomes smaller (e.g., less negative) but remains highly significant, precisely because the effect of crime was being exaggerated when ignoring the complementarities between visible, non-stealable goods and stealable goods.[19]

In column 3, we directly control for housing expenditures, which, among all the consumption categories in the CEX, represent the one more closely related to private protection. In fact, this category includes security service fees, expenditures on fences and housing rents. The latter can be seen as a private protection strategy, because moving to a safer neighborhood reduces the likelihood of victimization. We include this control because protected households likely consume more visible goods, and this could bias our coefficient upwards; moreover, by spending more on protection, households have a smaller available budget for other goods. In this case, the income change caused by increased protection is not captured in the permanent income measure, causing the more elastic visible, non-stealable goods to fall more than the less elastic non-visible, non-stealable goods, thus biasing our coefficient

[19] We obtain the same results if we separately control for car expenditures and stealable consumption, or if we put them together in a new category as a control. Due to space limitations, these results are not presented, but are available from the authors upon request.

downwards. The negative coefficient on housing expenditures suggests that the latter effect dominates the former, and, in fact, the property crime coefficient becomes less negative (as suggested by the previous discussion). In column 4, we add the household liquid position as a control in order to capture potential effects via the budget constraint. In this case, our coefficient of interest remains unchanged.

In column 5, we directly control for the average level of visible consumption in the household's state of residence. We do this because, as argued, visible consumption is a social phenomenon, and a household's visible consumption might be correlated with the average visible consumption in its respective state. Not including average visible consumption in the state as a control could create an omitted variable problem, as property crime could react to it even if it does not react to visible consumption at the individual level. The results in column 5 indicate that including this control does not affect our estimate of β_1. Most probably, this is because the state fixed effects were already picking up this source of heterogeneity across states. We find that average state visible consumption is positively correlated with individual visible consumption, although the effect is not significant. Finally, in column 6 we include all controls simultaneously. Our estimate of β_1 remains negative, significant and statistically not different from that obtained in the baseline specification (column 1).

So far, we have argued that the negative effect of crime on the ratio VN/NN provides evidence for the mechanism proposed by our model, because VN and NN goods only differ in their visibility. However, in Table 3, we estimate that income has a positive and significant impact on the ratio VN/NN, suggesting that, indeed, visible, non-stealable goods have a larger income elasticity than non-visible, non-stealable goods.[20] This creates a problem for the interpretation of our results; if crime generates negative income shocks that are not correctly captured by our income measure, households might cut consumption of all goods, especially those with a large income elasticity. This could also explain why VN goods fall more rapidly than NN goods as property crime increases. In order to address this concern, we present the estimations in Table 5. More precisely, we estimate IV regressions similar to the ones in equation 14, but having as the dependent variable the log of different consumption categories - that is, we use those categories coded as NN that have large estimated income elasticities. These include publications and books, education, other lodging, airline fares, and contributions to charity. In columns 1 through 5, we show the IV coefficient of property crime for each of the different dependent variables just described, confirming that crime has

[20]In fact, our model predicts that visible goods should have higher income elasticity than those implied by preferences alone. In our particular case, homothetic preferences imply unitary elasticities, but the equilibrium consumption path was above this optimal consumption. In a related paper, Heffetz (2009) shows that visibility increases goods' income elasticity goods.

no negative and significant effect on these types of consumption goods. If our estimations were capturing the effects of income shocks, one would expect the consumption of high elasticity NN goods to fall with property crime. As we show in Table 5, however, this is not the case. In column 6, we show the same estimates for the log of the level of NN consumption as the dependent variable, finding, again, no significant effect of crime. Table 6 also addresses this concern, though here we remove from the NN goods those with a low income elasticity until the remaining goods have a similar income elasticity to the one estimated for VN goods. This table exactly corresponds to Table 3, though here we use as the dependent variable the log of the ratio of VN consumption to the consumption of high income elasticity NN goods. For all estimations, the coefficient for total consumption is insignificant, suggesting that, indeed, both consumption categories have similar income elasticities and isolating . Importantly, our estimation of β_1 does not change and remains negative and significant, suggesting that the consumption of visible, non-stealable goods falls more rapidly with property crime than comparable (with respect to the income elasticity dimension) non-visible, non-stealable goods.

As a falsification test, in Table 7 we include violent crime as a dependent variable in order to show that it is indeed property crime, and not crime in general, that drives our estimations. We use two different measures of violent crime, the violent assault rate and the forcible rape rate. In columns 1 and 2, we include the property crime measure without instrumenting it; its effect remains negative and significative. In columns 3 and 4, we instrument the property crime measure, and in columns 5 and 6, we exclude the property crime measure. For all specifications, none of the violent crime variables turn out to be significant, and their inclusion does not affect our estimation of β_1. From this exercise, we conclude that, consistent with our theory, it is property crime and not other types of crimes or violence that explains our main result. This table also shows that our results are not driven simply by the fact that people might be scared to go out when they face a higher crime rate (either violent or property crime), another mechanism that could potentially explain why people spend less on food off-premise or in recreational services. If it were a general fear of going out, then one would expect to find a negative association between VN/NN and violent crime, one that we do not find in the data.[21]

After observing these results, the next logical question is, where did the money go? We already know that, in the presence of property crime, households reallocate resources from visible to non-visible consumption, but since the intertemporal budget restriction must be

[21] Although not reported here, other consumption goods which are enjoyed off-premise, like alcohol or expenditures on night life, do not decrease with property crime, suggesting, again, that we are not capturing the effect of being afraid of going out.

satisfied, households must increase savings or their consumption of other goods (or the extra money could also be stolen, if crime acts as an income shock). Table 8 shows the effect of crime on the log of each consumption category (estimated using IV). Consistent with our results, in response to a 10% increase in the property crime rate, in absolute terms, households decrease their consumption of visible, non-stealable goods by 1.9%; not surprisingly, households also decrease their consumption of stealable goods by 3.53%. Additionally, consistent with our treatment of housing expenditures as our best proxy for private protection expenditures, households increase their expenditures on this category by 1.72% when property crime increases by 10%. Car expenditures do not fall significantly with property crime, perhaps because we intentionally excluded car theft from this measure. Of those categories coded as non-visible and non-stealable, education, food at home and airline fares increase with the level of property crime, suggesting that there is some substitution towards non-visible, non-stealable goods in response to higher property crime.

4 Robustness Checks

In order to establish the robustness of our results, we conduct several robustness checks. First, we explore the sensibility of our results to changes in our property crime measure. In Table 9, we use the robbery rate alone (columns 1 through 3), the burglary rate alone (columns 4 through 6) and the larceny theft rate alone (columns 7 through 9) as the measures for property crime. Although the size of the coefficient changes, it remains negative and significant for all property crime measures.

In Table 10, we explore the sensibility of our results to our baseline classification of consumption goods categories. In order to do so, we show the results of estimating equation 14 using the log of the ratio of each of the consumption categories coded as visible, non-stealable to non-visible, non- stealable consumption. The coefficient for property crime is negative and significant when we use separately clothing and tailoring, food out and recreational services as visible, non-stealable goods. In the case of health and beauty, which includes health clubs, spas, beauty services, barbershops and parlors, the coefficient for property crime is not significant.

Finally, our results are also robust to different treatments of our permanent income measure. Table 11 shows that our results hold if we remove total consumption as a control when estimating the specification in model 14 (columns 1 and 2). Our results also hold if we use the CEX income measure rather than total consumption as a proxy for permanent income (columns 3 and 4); also, if we instrument the CEX income measure using occupation, industry and education dummies (columns 5 and 6).

Although not reported here, our results are also robust to using only those households that were surveyed all five times.

5 Concluding remarks

This paper proposes and empirically tests a new channel through which criminal activities affect individual behavior. In particular, we develop the idea that individuals face a trade-off between status and security when making (observable) consumption decisions. On the one hand, by choosing a higher level of conspicuous consumption, individuals signal higher wealth to their peers and may thus enjoy higher social status. On the other hand, signaling higher wealth via more conspicuous consumption also makes an individual a more attractive target for criminal activities. Thus, when making observable consumption decisions, individuals trade-off status for security and vice-versa. This channel is different in nature from that where crime directly increases the cost of observable consumption. More precisely, the proposed channel argues that crime affects consumption decisions, not only because consumption can be directly targeted by criminal activities, but also because the level of (observable) consumption reveals information about individuals' wealth that criminals may actually use to target their potential victims.

We use individual-level data for U.S. households in order to test the main prediction of our model. We find robust empirical evidence in favor of the channel proposed in this paper through which crime affects consumption decisions. In particular, we find that property crime has a negative and significant impact on consumption goods that reveal information about individuals' wealth (both stealable and non stealable).

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Table 1: Consumption categories.

Spending categories	Harris and Sabelhaus (2000) categories
Stealable Consumption (S)[a]	Recreation and sports durables (063)
	Jewelry (031)
	Furnishing (036)
Visible, Non-stealable Consumption (VN)	Beauty, parlors and health clubs (033)
	Food off-premise (024)
	Clothes and tailors (029, 030)
	Recreational services (064)
Non-visible, Non-stealable Consumption (NN)	Tobacco and alcohol (026, 027, 028)
	Other rented lodging (035)
	House maintenance (038, 039, 040, 041, 042)
	Health (044, 045, 046, 047, 048, 049, 051)
	Business services (050)
	Transportation (other than car) (058, 059)
	Airfare tickets (060)
	Books and publications (061, 062)
	Education (066, 067, 068)
	Food at home and work (023, 025)
	Gambling (065)
	Charity (069)
Car Expenditures	Cars (052, 053, 054, 055, 056, 057)
Housing Expenditures	Home rent (034, 075)
	Servants and house services (043, 078)

Notes: The numbers in parentheses refer to Harris and Sabelhaus (2000) original consumption categories in the CEX family extracts. Toiletry (032) and Household supplies (037) are missing in our data.

[a] The goods coded as stealable turned out to be very visible according to the survey by Heffetz (2009). Therefore, we do not divide stealable goods into visible and non-visible sub-categories.

Table 2: Descriptive statistics for the main variables.

	Mean	Std. Dev.
Visible, non-stealable consumption	1402.67	(1311.26)
	13.42%	
Non-visible, non-stealable consumption	3428.64	(2462.68)
	35.22%	
Stealable consumption	636.88	(1394.30)
	5.27%	
Car expenditures	2390.73	(3329.42)
	19.04%	
Housing expenditures	2742.33	(3171.09)
	27.05%	
Total consumption	10601.24	(7781.44)
Robbery rate	230.86	(131.51)
Burglary rate	1137.03	(380.65)
Larceny-theft rate	3127.09	(718.00)
Property crime rate	1498.33	(358.59)
Murder rate	8.32	(4.72)
Arrest rate for burglaries	12.25	(4.06)

Notes: For each consumption category, the average quarterly expenditure is reported in 2005 dollars and its share of total consumption is reported below it. The construction of all expenditure categories is explained in Appendix B. The data used to construct expenditure measures comes from the NBER CEX family-level extracts. Crime rates are taken from the FBI Uniform Crime Reporting System (UCR) and the rates in the table are per 100,000 people. Some of the covariates not reported in this table were extracted from John Lott's dataset.

Table 3: Effects of property crime on the ratio VN/NN.

	OLS	Instrumenting Crime[a]	Instrumenting Consumption[b]	Instrumenting both[a,b]
	(1)	(2)	(3)	(4)
Property crime	-0.173***	-0.293***	-0.162***	-0.252***
	(0.047)	(0.073)	(0.050)	(0.077)
Total consumption	0.473***	0.473***	0.872***	0.872***
	(0.012)	(0.012)	(0.020)	(0.020)
R-squared	0.196	0.196	0.113	0.113
Observations	38876	38876	38876	38876
First stage:				
F (Property crime)	-	32.77	-	21.75
F (Total consumption)	-	-	598.39	726.62

NOTE: The table reports the coefficient of Property Crime from a regression of the log of household's Visible, Non-stealable Consumption over Non-visible, Non-stealable Consumption (VN/NN) on the log of Property Crime and other controls, including state-level controls, householod controls, year and state-fixed effects. Robust standard errors with clustering by state are shown in parentheses. For the reported coefficients, those with *** are significant at the 1% level; those with ** are significant at the 5% level; and those with * are significant at the 10% level.

[a] Property crime is instrumented using the log of the murder rate and the log of the arrest rate for burglaries.

[b] Total consumption is instrumented using the log of the CEX income measure, a dummy for households reporting zero income, occupation and industry dummies related to the household head's employment and household head's education.

Table 4: IV effects of property crime on the ratio VN/NN with aditional controls.

	(1)	(2)	(3)	(4)	(5)	(6)
Property crime	-0.252***	-0.241***	-0.181*	-0.257***	-0.251***	-0.201**
	(0.077)	(0.078)	(0.099)	(0.079)	(0.077)	(0.096)
Total consumption	0.872***	0.820***	1.320***	0.934***	0.871***	1.442***
	(0.020)	(0.027)	(0.041)	(0.022)	(0.020)	(0.070)
Stealable consumption		0.005				-0.051***
		(0.006)				(0.010)
Housing expenditures			-0.420***			-0.440***
			(0.021)			(0.029)
Liquid position				-0.007***		-0.006***
				(0.001)		(0.001)
State visible consumption					0.027	0.005
					(0.044)	(0.051)
R-squared	0.113	0.101	0.018	0.087	0.113	.
Observations	38876	35626	38356	38876	38875	35188

NOTE: The table reports the IV coefficient of Property Crime from a regression of the log of household's Visible, Non-stealable Consumption over Non-visible, Non-stealable Consumption (VN/NN) on the log of Property Crime and other controls, including state-level controls, household controls, year and state-fixed effects. Robust standard errors with clustering by state are shown in parentheses. For the reported coefficients, those with *** are significant at the 1% level; those with ** are significant at the 5% level; and those with * are significant at the 10% level. For all regressions, Property crime is instrumented using the log of the murder rate and the log of the arrest rate for burglaries, and Total consumption is instrumented using the log of the CEX income measure, a dummy for households reporting zero income, occupation and industry dummies related to the household head's employment and household head's education.

Table 5: IV effects of property crime on NN goods.

	Publications, and books	Education	Other lodging	Airfare tickets	Charity	All NN goods
	(1)	(2)	(3)	(4)	(5)	(6)
Property crime	-0.222	0.803*	0.171	0.556*	-0.056	0.055
	(0.188)	(0.444)	(0.225)	(0.294)	(0.298)	(0.041)
Total consumption	1.676***	1.642***	1.722***	1.343***	1.945***	0.713***
	(0.038)	(0.112)	(0.070)	(0.096)	(0.090)	(0.009)
R-squared	0.283	0.119	0.173	0.136	0.156	0.736
Observations	36213	15322	17545	11196	15030	38876

NOTE: The table reports the IV coefficient of Property Crime from a regression of the log of different consumption categories on the log of Property Crime and other controls, including state-level controls, household controls, year and state-fixed effects. Robust standard errors with clustering by state are shown in parentheses. For the reported coefficients, those with *** are significant at the 1% level; those with ** are significant at the 5% level; and those with * are significant at the 10% level. In all regressions, Property crime is instrumented using the log of the murder rate and the log of the arrest rate for burglaries, and Total consumption is instrumented using the log of the CEX income measure, a dummy for households reporting zero income, occupation and industry dummies related to the household head's employment and household head's education.

Table 6: Effects of property crime on the ratio VN over high elasticity NN goods.

	OLS	Instrumenting crime[a]	Instrumenting consumption[b]	Instrumenting both[a,b]
	(1)	(2)	(3)	(4)
Property crime	-0.139**	-0.275**	-0.138**	-0.259**
	(0.066)	(0.108)	(0.066)	(0.108)
Total consumption	-0.018	-0.018	0.037	0.037
	(0.018)	(0.018)	(0.025)	(0.025)
R-squared	0.077	0.077	0.076	0.076
Observations	38634	38634	38634	38634

NOTE: The table reports the coefficient of Property Crime from a regression of the log of household's Visible, Non-stealable Consumption over Non-visible, Non-stealable goods with a high income elasticity, on the log of property crime and other controls, including state-level controls, househholod controls, year and state-fixed effects. Robust standard errors with clustering by state are shown in parentheses. For the reported coefficients, those with *** are significant at the 1% level; those with ** are significant at the 5% level; and those with * are significant at the 10% level.

[a] Property crime is instrumented using the log of the murder rate and the log of the arrest rate for burglaries.

[b] Total consumption is instrumented using the log of the CEX income measure, a dummy for households reporting zero income, occupation and industry dummies related to the household head's employment and household head's education.

Table 7: Effects of property crime on the ratio VN/NN including violent crime.

	Property crime not instrumented		Property crime instrumented[a]		Property crime excluded	
	(1)	(2)	(3)	(4)	(5)	(6)
Property crime	-0.183***	-0.139**	-0.295***	-0.205***		
	(0.056)	(0.055)	(0.099)	(0.069)		
Violent assaults rate	0.043		0.075		-0.011	
	(0.047)		(0.057)		(0.042)	
Forcible rape rate		-0.034		-0.017		-0.069
		(0.055)		(0.052)		(0.053)
Total consumption	0.872***	0.871***	0.871***	0.871***	0.872***	0.871***
	(0.020)	(0.020)	(0.020)	(0.020)	(0.019)	(0.020)
R-squared	0.114	0.113	0.113	0.113	0.113	0.113
Observations	38876	38202	38876	38202	38876	38202

NOTE: The table reports the coefficient of Property Crime from a regression of the log of household's Visible, Non-stealable Consumption over Non-visible, Non-stealable Consumption (VN/NN) on the log of Property Crime, and other controls, including state-level controls, househoold controls, year and state-fixed effects. Robust standard errors with clustering by state are shown in parentheses. For the reported coefficients, those with *** are significant at the 1% level; those with ** are significant at the 5% level; and those with * are significant at the 10% level. Total consumption is instrumented in all regressions using the log of the CEX income measure, a dummy for households reporting zero income, occupation and industry dummies related to the household head's employment and household head's education.

[a] Property crime is instrumented using the log of the murder rate and the log of the arrest rate for burglaries.

Table 8: Effects of property crime on different consumption categories.

Category	Property Crime	Income elasticity
Visible, non-stealable consumption	-0.198***	1.585***
	(0.076)	(0.019)
Non-visible, non-stealable consumption	0.055	0.713***
	(0.041)	(0.009)
Stealable consumption	-0.353**	1.863***
	(0.179)	(0.044)
Cars expenditures (including repair and services)	-0.012	1.231***
	(0.093)	(0.031)
Housing expenditures (rent and services)	0.172*	1.041***
	(0.093)	(0.020)
Alcohol and tobacco	-0.089	-0.355***
	(0.182)	(0.081)
Books, magazines and nondurable toys	-0.222	1.676***
	(0.188)	(0.038)
Education (al levels)	0.803*	1.642***
	(0.444)	(0.112)
Food at home and work	0.098*	0.209***
	(0.052)	(0.013)
Other rented lodging	0.171	1.722***
	(0.225)	(0.070)
Airline fares	0.556*	1.343***
	(0.294)	(0.096)
Transportation (other than cars)	-0.110	0.569***
	(0.320)	(0.097)
Health and life insurance	-0.079	1.158***
	(0.149)	(0.047)
Charity and welfare activities	-0.056	1.945***
	(0.298)	(0.090)
Household utilities	0.167	0.631***
	(0.110)	(0.019)
Business services	0.032	0.931***
	(0.222)	(0.057)

NOTE: The table reports the coefficient of Property Crime from a regression of the log of different consumption categories on the log of Property Crime and other controls, including state-level controls, householod controls, year and state-fixed effects. Robust standard errors with clustering by state are shown in parentheses. For the reported coefficients, those with *** are significant at the 1% level; those with ** are significant at the 5% level; and those with * are significant at the 10% level. Property crime is instrumented using the log of the murder rate and the log of the arrest rate for burglaries. Total consumption (the income proxy) is instrumented using dummies for occupation and industry, and dummies related to the household head's employment and household head's education.

Table 9: Effects of property crime on the ratio VN/NN modifying the property crime measure

	Defining crime as robberies		Defining crime as burglaries		Defining crime as larceny-theft	
		IV[a]		IV[a]		IV[a]
	(1)	(2)	(3)	(4)	(5)	(6)
Property crime	-0.094***	-0.125***	-0.167***	-0.204***	-0.141**	-0.312***
	(0.027)	(0.038)	(0.030)	(0.059)	(0.060)	(0.100)
Total consumption	0.473***	0.872***	0.473***	0.871***	0.473***	0.872***
	(0.012)	(0.020)	(0.012)	(0.020)	(0.012)	(0.020)
R-squared	0.196	0.113	0.196	0.113	0.196	0.113
Observations	38876	38876	38876	38876	38876	38876

NOTE: The table reports the coefficient of Property Crime from a regression of the log of household's Visible, Non-stealable Consumption over Non-visible, Non-stealable Consumption (VN/NN) on the log of Property Crime, defined in different ways, and other controls, including state-level controls, househoold controls, year and state-fixed effects. Robust standard errors with clustering by state are shown in parentheses. For the reported coefficients, those with *** are significant at the 1% level; those with ** are significant at the 5% level; and those with * are significant at the 10% level.

[a] Property crime is instrumented using the log of the murder rate and the log of the arrest rate for burglaries. Total Consumption is instrumented using the log of the CEX income measure, a dummy for households reporting zero income, occupation and industry dummies related to the household head's employment and household head's education.

Table 10: Effects of property crime on the ratio between VN consumption categories and NN.

	Clothing		Food off-premise		Recreational services		Health and beauty	
		IV[a]		IV[a]		IV[a]		IV[a]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Property crime	-0.293***	-0.371***	-0.231**	-0.349***	-0.166**	-0.200*	0.011	0.278
	(0.071)	(0.139)	(0.107)	(0.109)	(0.071)	(0.110)	(0.093)	(0.181)
Total consumption	0.438***	0.857***	0.511***	0.955***	0.548***	1.044***	0.081***	0.483***
	(0.017)	(0.037)	(0.014)	(0.027)	(0.024)	(0.036)	(0.017)	(0.040)
R-squared	0.112	0.060	0.210	0.159	0.174	0.120	0.076	0.029
Observations	38114	38114	37346	37346	36725	36725	33924	33924

NOTE: The table reports the coefficient of Property Crime from a regression of the log of each category labeled as Visible, Non-stealable over Non-visible, Non-stealable Consumption (VN/NN) on the log of Property Crime and other controls, including state level controls, househOlod controls, year and state-fixed effects. Robust standard errors with clustering by state are shown in parentheses. For the reported coefficients, those with *** are significant at the 1% level; those with ** are significant at the 5% level; and those with * are significant at the 10% level.

[a] Property crime is instrumented using the log of the murder rate and the log of the arrest rate for burglaries. Total consumption is instrumented using the log of the CEX income measure, a dummy for households reporting zero income, occupation and industry dummies related to the household head's employment and household head's education.

Table 11: Effects of property crime on the ratio VN/NN with different treatments of permanent income

	Ignoring income		Using CEX income		IV with CEX income[b]	
		IV[a]		IV[a]		IV[a]
	(1)	(2)	(3)	(4)	(5)	(6)
Property crime	-0.187***	-0.347***	-0.179***	-0.324***	-0.180***	-0.352***
	(0.055)	(0.084)	(0.055)	(0.083)	(0.055)	(0.084)
Total income			0.012***	0.012***	0.011***	0.010***
			(0.001)	(0.001)	(0.001)	(0.001)
R-squared	0.080	0.080	0.086	0.086	0.086	0.086
Observations	38876	38876	38876	38876	38876	38876

NOTE: The table reports the coefficient of Property Crime from a regression of the log of household's Visible, Non-stealable Consumption over Non-visible, Non-stealable Consumption (VN/NN) on the log of Property Crime and other controls, including state-level controls, househólod controls, year and state-fixed effects. Robust standard errors with clustering by state are shown in parentheses. For the reported coefficients, those with *** are significant at the 1% level; those with ** are significant at the 5% level; and those with * are significant at the 10% level.

[a] In the even columns, Property crime is instrumented using the log of the murder rate and the log of the arrest rate for burglaries.

[b] Income is instrumented using dummies for occupation and industry, and dummies related to the household head's employment and household head's education.

Appendix A: Model proofs and lemmas

Lemma 1: Assume V_2 is nonzero and never changes sign. Let σ be a separating equilibrium. If $V_2 > 0$, then $\sigma(w_{min}) = z(w_{min})$. If $V_2 < 0$, then $\sigma(w_{max}) = z(w_{max})$. That is, the initial value condition is always satisfied.

Proof:

Case 1: $V_2 > 0$. Suppose by way of contradiction that $\sigma(w_{min}) \neq z(w_{min})$. Then

$$V(w_{min}, w_{min}, \sigma(w_{min})) < V(w_{min}, w_{min}, z(w_{min})) \leq V(w_{min}, \widehat{w}, z(w_{min})) \tag{A1}$$

for all expected $\widehat{w}$. The first inequality occurs because, by definition, $z(w)$ maximizes $V(w, w, z)$. The second inequality occurs because $V_2 > 0$, and $\widehat{w} \geq w_{min}$ for every expected wealth, because every $\widehat{w}$ must be a convex combination of the $w \in [w_{min}, w_{max}]$. Since this inequality holds for all possible beliefs, $\widehat{w}$, it holds in particular for any beliefs, in or off the equilibrium path, attached to the signal $z(w_{min})$. Thus, those individuals with w_{min} strictly prefer to signal $z(w_{min})$, contradicting the fact that $\sigma(w_{min})$ was a best response.

Case 2: $V_2 < 0$. Suppose by way of contradiction that $\sigma(w_{max}) \neq z(w_{max})$. Then

$$V(w_{max}, w_{max}, \sigma(w_{max})) < V(w_{max}, w_{max}, z(w_{max})) \leq V(w_{max}, \widehat{w}, z(w_{max})) \tag{A2}$$

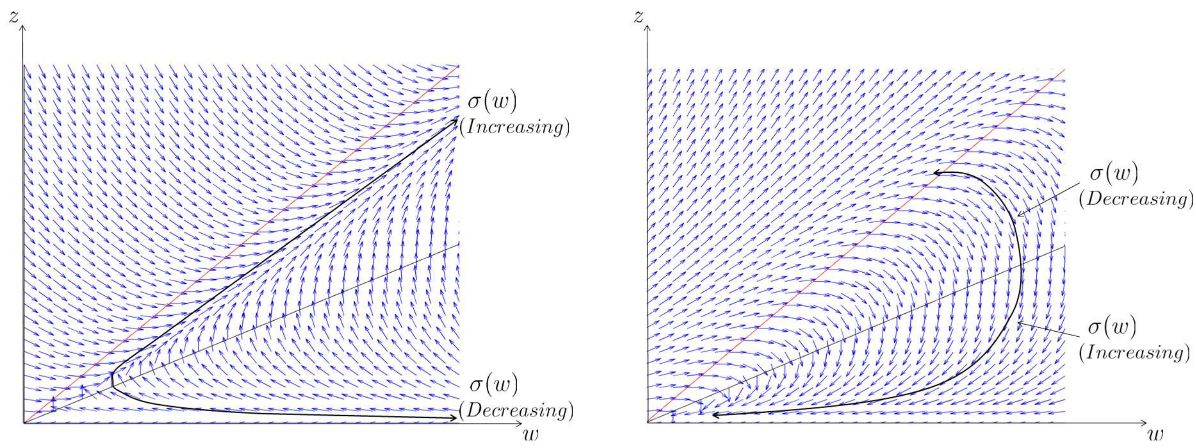
for all expected $\widehat{w}$. The first inequality occurs because, by definition, $z(w)$ maximizes $V(w, w, z)$. The second inequality occurs because $V_2 < 0$, and $\widehat{w} \leq w_{max}$ for every expected wealth, because every $\widehat{w}$ must be a convex combination of the $w \in [w_{min}, w_{max}]$. Since this inequality holds for all possible beliefs, $\widehat{w}$, it holds in particular for any beliefs, in or off the equilibrium path, attached to the signal $z(w_{max})$. Thus, those individuals with w_{max} strictly prefer to signal $z(w_{max})$, contradicting the fact that $\sigma(w_{max})$ was a best response.

Lemma 2: Assume V_2 is nonzero and never changes sign. Then σ is the unique separating equilibrium of our game if and only if (i) it is the unique increasing solution to the boundary value problem given by the differential equation DE in equation 6 and the initial value condition; and (ii) It satisfies the single crossing condition (SCC), which is equivalent to $V_{13}V_2 - V_3V_{12}$ having the same sign as V_2 for all $(\widehat{w}, z)$ on the graph of σ.

Proof: This lemma is implied by theorems 2 and 3 in Mailath (1987). Conditions (1),(3), (4) and (5) in Mailath's theorems are satisfied when U is C^2, and strictly convex as we assumed was the case. Additionally, condition (2) is satisfied when V_2 is nonzero and never changes sign.

We also have the initial value condition, which is condition (6) in Mailath (1987). Based on theorem 2, these six conditions together imply that every separating equilibrium must be monotonic and differentiable, and solve the boundary problem given by the differential

Figure A1: Lemma 2. Solutions to the differential equation.



equation 6. Additionally, σ' must have the same sign as V_{13}, which in our case, makes every separating equilibrium increasing, since $V_{13} = \gamma^2(U_{zy} - pU_{yy}) \geq 0$, given that z is a normal good.

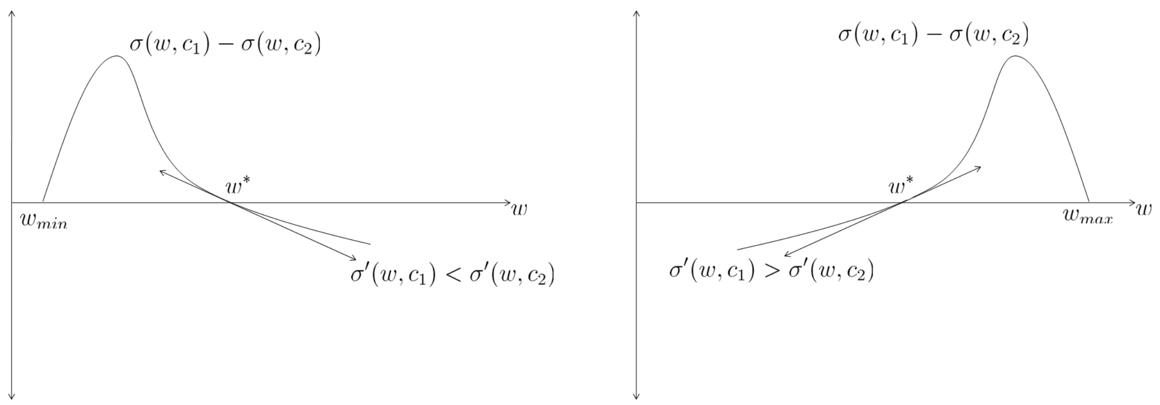
The corollary to theorem 2 implies that the separating equilibrium is unique (if it exists) because the boundary problem with the condition $\sigma' > 0$ has a unique solution when $|V_2(w, w, z)|$ is bounded. In our model $V_2 = \lambda + \gamma'(zU_z + yU_y)$ is bounded because it is a continuous function in a compact set. This is true because we assume U and γ are smooth functions, and because the set of all possible equilibrium signals is bounded by the concavity of U. Figure A1 shows the direction field for the differential equation. It shows that the boundary problem always has an increasing and a decreasing solution. The condition $\sigma' > 0$ rules out the decreasing solution and implies the unicity of the separating equilibrium.

Theorem 3 guarantees that the increasing solution to the boundary problem is indeed a separating equilibrium if and only if it satisfies the SCC. The SCC guarantees incentive compatibility in the sense that every individual is in fact maximizing his utility by revealing his type and choosing his expected signal. These observations imply that if it exists, the unique separating equilibrium of our game must satisfy all properties stated in lemma 2.

Finally, to guarantee the stability of this equilibrium, we need only to define the off equilibrium path beliefs sustaining it. The most intuitive option is to define $\widehat{w} = w_{max}$ for $z > \sigma(w_{max})$ and $\widehat{w} = w_{min}$ for $z < \sigma(w_{min})$.

Lemma 3: (A) Consider the differential equation $\sigma'(w, c) = -\frac{V_2(w,w,\sigma(w),c)}{V_3(w,w,\sigma(w),c)}$ *in* $[w_{min}, w_{max}]$, *with the initial value condition* $\sigma(w_{min}, c) = z(w_{min})$. *If* $\frac{\partial V_2/V_3}{\partial c} > 0$, *then any continuous solution* $\sigma(w, c)$ *satisfies* $\frac{\partial \sigma}{\partial c} < 0$. *(B) Consider the differential equation* $\sigma'(w, c) = -\frac{V_2(w,w,\sigma(w),c)}{V_3(w,w,\sigma(w),c)}$ *in* $[w_{min}, w_{max}]$, *with the initial value condition* $\sigma(w_{max}, c) = z(w_{max})$. *If* $\frac{\partial V_2/V_3}{\partial c} < 0$, *then*

Figure A2: Lemma 3.



any continuous solution $\sigma(w,c)$ satisfies $\frac{\partial\sigma}{\partial c}<0$.

Proof:

(A) We proceed by contradiction. Define $\Delta(w)=\sigma(w,c_1)-\sigma(w,c_2)$, with $c_1<c_2$. Then $\Delta(w_{min})=0$ and Δ satisfies that if $\Delta(w^*)=0$, then $\Delta'(w^*)>0$. This is because

$$\Delta'(w^*) = \sigma'(w^*,c_1)-\sigma'(w^*,c_2) \quad \text{(A3)}$$

$$= -\frac{V_2(w^*,w^*,\sigma(w^*,c_1),c_1)}{V_3(w^*,w^*,\sigma(w^*,c_1),c_1)}+\frac{V_2(w^*,w^*,\sigma(w^*,c_2),c_2)}{V_3(w^*,w^*,\sigma(w^*,c_2),c_2)} \quad \text{(A4)}$$

$$= \frac{V_2(w^*,w^*,z,c_2)}{V_3(w^*,w^*,z,c_2)}-\frac{V_2(w^*,w^*,z,c_1)}{V_3(w^*,w^*,z,c_1)} \quad \text{(A5)}$$

$$> 0. \quad \text{(A6)}$$

The last step follows from the fact that V_3/V_2 is assumed to be an increasing function of c. Here, $z=\sigma(w^*,c_1)=\sigma(w^*,c_2)$. Since $\Delta(w_{min})=0$, we get $\Delta'(w)>0$ for w close to w_{min}.

Suppose by way of contradiction that $\Delta(w)\le 0$ for some $w>w_{min}$. By the mid-value theorem there must be a point w^* such that $\Delta(w^*)=0$. If we take the smallest value w^* satisfying this (it exists since it is a closed and bounded set), we get $\Delta(w)>0$ for $w\in(w_{min},w^*)$. Approximating $\Delta(w)$ with $w\in(w^*-\epsilon,w^*)$ using a Taylor expansion we obtain

$$0<\Delta(w)\approx\Delta(w^*)+(w-w^*)\Delta'(w^*)<0. \quad \text{(A7)}$$

A contradiction which implies there cannot exist a $w\in(w_min,w_{max}]$ such that $\Delta(w)\le 0$. Therefore, $\Delta(w)>0$ for all $w>w_{min}$ and $\sigma(w,c_1)>\sigma(w,c_2)$, which implies $\frac{\partial\sigma}{\partial c}<0$. The left panel in figure A2 shows graphically what is happening. If $\Delta(w^*)=0$ for the first time then we must have $\Delta'(w^*)\le 0$, a contradiction.

(B) Again, we proceed by contradiction. Define $\Delta(w) = \sigma(w, c_1) - \sigma(w, c_2)$, with $c_1 < c_2$. Then $\Delta(w_{max}) = 0$ and Δ satisfies that if $\Delta(w^*) = 0$, then $\Delta'(w^*) < 0$. This is because

$$\begin{aligned} \Delta'(w^*) &= \sigma'(w^*, c_1) - \sigma'(w^*, c_2) && \text{(A8)} \\ &= -\frac{V_2(w^*, w^*, \sigma(w^*, c_1), c_1)}{V_3(w^*, w^*, \sigma(w^*, c_1), c_1)} + \frac{V_2(w^*, w^*, \sigma(w^*, c_2), c_2)}{V_3(w^*, w^*, \sigma(w^*, c_2), c_2)} && \text{(A9)} \\ &= \frac{V_2(w^*, w^*, z, c_2)}{V_3(w^*, w^*, z, c_2)} - \frac{V_2(w^*, w^*, z, c_1)}{V_3(w^*, w^*, z, c_1)} && \text{(A10)} \\ &< 0. && \text{(A11)} \end{aligned}$$

The last step follows from the fact that V_3/V_2 is assumed to be a decreasing function of c. Here $z = \sigma(w^*, c_1) = \sigma(w^*, c_2)$. Since $\Delta(w_{max}) = 0$, we have $\Delta'(w) < 0$ for w close to w_{max}.

Suppose by way of contradiction that $\Delta(w) \leq 0$ for some $w < w_{max}$. By the mid-value theorem there must be a point w^* such that $\Delta(w^*) = 0$. If we take the biggest w^* satisfying this (it exists since it is a closed and bounded set), we get $\Delta(w) > 0$ for $w \in (w^*, w_{max})$. Approximating $\Delta(w)$ with $w \in (w^*, w^* + \epsilon)$ using a Taylor expansion we obtain

$$0 < \Delta(w) \approx \Delta(w^*) + (w - w^*)\Delta'(w^*) < 0. \tag{A12}$$

A contradiction which implies there cannot exist a $w \in [w_min, w_{max})$ such that $\Delta(w) \leq 0$. Therefore, $\Delta(w) > 0$ for all $w < w_{max}$ and $\sigma(w, c_1) > \sigma(w, c_2)$, which implies $\frac{\partial \sigma}{\partial c} < 0$. The right panel in figure A2 shows graphically what is happening. If $\Delta(w^*) = 0$ for the last time then we must have $\Delta'(w^*) \geq 0$, a contradiction.

Appendix B: Consumption categories

In order to code the consumption categories as visible, we use two surveys shown in Table A1. First we use the survey in Charles et al. (2009), posted in their online appendix. This survey includes a visibility index and a perceived income elasticity index for the consumption categories in their paper. We also use the survey conducted by Heffetz (2009) about the visibility of these consumption categories; which includes a visibility index (Vindex). Both surveys have the original categories in Harris and Sabelhaus (2000) aggregated into particular categories, whereas the survey in Heffetz (2009) is more disaggregated. We define visible goods as those having a high visibility index in both surveys, relying on Heffetz (2009) when the surveys show different results. We also require that visible goods have a high estimated income elasticity or a high expected income elasticity, so as to guarantee that these goods are actually interpreted as signals of wealth. We estimate the income elasticity for each consumption category using the model

$$\ln cat_i = \beta_0 + \beta_1 \ln totexp_i + \varepsilon_i \tag{A13}$$

in which cat_i are the total reported expenditures for any given consumption category. We instrument $totexp_i$ using the CEX income measure and a vector of occupation and industry of employment for the household head following Charles et al. (2009).

We code recreational durables, furnishing and jewelry as stealable goods following the ethnographical evidence in Wright and Decker (1996) and Wright and Decker (1997). Although we classify them as stealable, criminals repeatedly mention in their interviews a strong preference for cash over all of these goods.

Table A1: Consumption categories, visibility and stealable goods

Consumption categories	Income elasticity	Charles et al. (2009) survey		Heffetz (2009) survey	
		Visibility	Perceived income elasticity	Vindex	Coded as:
Jewelry and watches (31)	1.26	0.67	0.52	0.67	S
Furniture and durable household equipment (36)	1.567	0.09	0.37	0.68	S
Recreation and Sport equipment (63)	1.54	0.17	0.53	0.66	S
Clothing, shoes and taylors (29, 30)	1.572	0.64	0.57	0.71	VN
Food off-premise (23)	1.676	0.24	0.47	0.62	VN
Barbershops, beauty parlors, health clubs (33)	1.206	0.31	0.35	0.6	VN
Other rectreational services (64)	1.76	0.12	0.5	0.58	VN
Alcohol and tobacco (23,26,28)	-0.355	0.4	0.1	0.68	NN
Books, magazines and other nondurable toys (62)	1.676	0.12	0.5	0.57	NN
Education (66,67,68)	1.642	0.15	0.3	0.56	NN
Food at home and work (24, 25)	0.209	0.04	0.18	0.51	NN
Rent of other lodging (35)	1.722	0.04	0.18	0.46	NN
Airline fares (60)	1.343	0.12	0.5	0.46	NN
Transportation (other than cars) (58,59)	0.569	0.05	0.08	0.45	NN
Health (44,45,46,47,48,49,51)	1.158	0.02	0.07	0.36	NN
Charity, religious and welfare activities (69)	1.945	0.04	0.18	0.34	NN
Household utilities (39, 40, 41, 42)	0.631	0.06	0.05	0.31	NN
Business services (50)	0.931	0.04	0.18	0.26	NN
Gambling (65)	-	0.04	0.18	-	NN
Cars (52,53,54,55,56,57,71)	1.231	0.49	0.44	0.73	Cars
Housing (34,43,75,78)	1.041	0.37	0.47	0.5	Housing

NOTE: Income elasticity estimated using a regression of the form $\ln cat_i = \beta_0 + \beta_1 \ln totexp_i + \varepsilon_i$ instrumenting $\ln totexp$ using the CEX income and occupation measures (see Charles et al., 2009). Here, cat_i is the quarterly expenditure of household i in any given category and $totexp$ are its total quarterly expenditures. The numbers in parentheses refer to Harris and Sabelhaus' original consumption categories in the CEX family extracts (2000). Toiletry (032) and household supplies (037) are missing in our data. When our consumption categories overlap with those of Charles et al. (2009) and Heffetz (2009), we use the surveys' results for the more relevant goods in the category, or from an average.