Chewing the Flower of Paradise
Economic and Social Aspects of Qat use in the Horn of Africa

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Abstract

The aim of this paper is to investigate the relationship between wages and Qat consumption for the Djiboutian male household head and the social dimension of Qat use by using a system of simultaneous equations with Qat consumption and Wage as endogenous variables. Our findings suggest that the impact of wage on Qat consumption is positive and significant and that social aspects of Qat consumption affect individual decisions.

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1. Introduction

The purpose of the following paper is to evaluate the economic and social aspects of drug consumption in an African society. Drug use does not affect only the way in which people trade-off present and future consumption, but it affects also the way people respond to changes in the value of time (i.e. wages) in a static framework. The analysis is carried out by means of the theoretical model developed by Becker in an early paper (Becker, 1965, Becker and Michael, 1973) and by using 1996 data for the African society of Djibouti. In the Horn of Africa the consumption of Qat (a substance similar to amphetamine) is an expensive habit of the male population. Qat is perceived as a desirable good by the consumers but it is also a private “bad” because is harmful to the personal health and heavily affects household budget.

Qat use in Djibouti has been subject of medical, sociological and anthropological research, but there are few studies that approach the problem from an economic point of view. By using the (realistic) assumption that Qat is a time intensive commodity, we want to investigate the relationship between wages and Qat use. Moreover, we investigate the social dimension of Qat consumption. The paper is organized as follows. Section 2 describes the consumption of Qat in Djibouti, section 3 presents the theoretical model, section 4 describes the data, section 5 presents the econometric model and the results. Section 6 reports the main conclusions.
2. Qat in Djibouti

The name Qat comes from the plant *Catha Edulis* Forsskål\(^3\), a plant growing at 1500-2500 meters of altitude. The increased consumption of Qat in the last century has been subject of concern. To describe the strong social and economic impact of this kind of consumption in Djibouti, sociologists often use the word "social plague". Qat consumption is prevalently a widespread male habit that heavily affects household budgets. The life of a Qat chewer plays around the so-called Qat parties held daily in the afternoon until dusk\(^4\). Qat sales start in the early afternoon when an airplane from Ethiopia\(^5\) brings daily tons of Qat\(^6\). Streets become empty for many hours during afternoon and the city “falls asleep”. Qat consumption is a really widespread and pervasive phenomenon. Moreover, the commerce of Qat is one of the most consistent sources of fiscal revenue for the Djiboutian Government\(^7\).

Widespread Qat use has often been interpreted by some authors as a clear manifestation of “dependence” (Kalix, 1983) even if especially in the past there was no scientific consensus on the addictive nature of Qat\(^8\). In medical terms, the notion is that true addiction is signalled by the experience of physical withdrawal symptoms when the drug is withheld from the habitual user, which causes craving for the drug. A concomitant idea is tolerance, the notion meaning that

\(^3\) The Swedish botanist Per Forsskål first named and described this plant of the Celestraceae family in the XVIII century. The term *edulis* comes from the Latin verb *edo*, that literally means to “eat”, and refers to the common way to consume Qat (Weir, 1985: 27). Qat can grow as a small leafy bush or as a tree with a flexible trunk.

\(^4\) During Qat parties Qat leaves are chewed to extract their juices but are not swallowed. Chewers progressively add new leaves in the cheek where they form a wad which becomes larger as new leaves are added. This cause a distension of the cheek, and the most swollen cheek are considered a symbol of prestige and admiration. Yemenis use the word *yikhazzin* for chewing Qat, which means to “store” and derives from this practice (Weir, 1985).

\(^5\) Ethiopia is a leading producer and exporter of Qat in the Horn of Africa. The Qat-business has transformed the economy in some Ethiopian provinces, like Harerige (Gebissa, 2004).

\(^6\) Qat use is legal in Islamic countries like Yemen Republic and Somalia, as among the Muslim members of Ethiopia, Djibouti and Kenya. Unlike alcohol, its use violates no precise proscription of the Koran. Qat is banned in some other Muslim countries as in Saudi Arabia. Among the European countries it is legal in the UK, Netherlands (Dhaifalah & Santavy, 2004).

\(^7\) In 1995 excise taxes on Qat amounted to the 9.5% of GDP (World Bank Report, 1997).

\(^8\) The United Nations Expert Committee on Addiction Producing Drugs recommended in 1957 that Qat need not to be classified as a narcotic or addiction-producing drug (UN Commission on Narcotic Drugs (1980)).
as the body becomes accustomed to some level of active ingredients, a continuously increasing
and compulsive need is felt for more of a substance to “sustain” the drug experience (Kennedy,
1987). The main active component of Qat is Cathinone, a substance that seems to have a high
stimulant capacity and produces effects similar to those of amphetamines (though it is
structurally different): it induces euphoria, increases heart rate, locomotor activity and oxygen
consumption.

The most comprehensive study on the science of Qat is the report of a major research project
undertaken in Yemen under the direction of John Kennedy. The possible stimulant and addictive
properties of Qat were investigated to assess the major effects of this institutionalized drug upon
different aspects of Yemeni life (Kennedy et al. 1987). The results of the study show that Qat
does not produce withdrawal symptoms. Kennedy points out that it would more appropriate to
talk about “social withdrawal symptoms”, meaning the negative experience of deprivation of the
“joys of companionship and comraderie which the Qat session almost unfailingly provides”
(Kennedy, 1987: 209). The question of tolerance seems more complex. The standard and custom
of use generally limit the physical amount of active ingredients that can be ingested, but evidence
exists that cumulative effects are important (latency effect). The study supports the hypothesis of
“stabilized” or “controllable” tolerance assessing that Qat users try to keep a level of intake that
they “feel right” for them through a process of self-limiting consumption. Thus, cultural and
social use patterns regulate somewhat the amount of Qat consumed, in contrasts to the traditional
western view of Qat use as a habit leading to a hopeless state of addiction. Theories of addiction
describe a wide range of reasons inducing people to develop an addictive behaviour despite its

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9. A mild form of physiological dependence does result from extremely heavy use. However, extremely heavy users (who consume Qat at any time during the day) represent a very small sub-category of Qat consumers, and are often regarded as deviants.

10. Other authors (Nencini et al., 1984) find that tolerance but not withdrawal symptoms develop as a consequence of Qat use.
negative health effects. A common element of analysis is based essentially on the idea that substance use can give pleasure, provide help in facing daily problems, handling feelings of anxiety, pain and inadequacy by offering an escape from reality (*analgesic effect*). Substance use can also ease the communication and the interaction among people and within the community in which one lives (Salvini *et al.* 1998, 2002). Most authors writing about Qat in Yemen propose the idea of escape from reality as a major explanation of Qat consumption, but this explanation has been challenged by Kennedy (1987: 208). He distinguishes three types of drugs: those relieving pain without consciousness-alerting properties, those used to relieve pain and escape from reality by means of a pleasurable experience (like heroin, morphine, psychedelics…) and a third group that does not produce significant alterations of perception or escape from reality. The main effect of these is to produce alertness, awareness feeling of content and connectedness with reality. Qat would belong more properly to this third category: Qat users do not go to Qat parties to chew Qat *per se* but to be socially active, to cultivate relationships and compete for social status, in sum to be “fully alive, fully social and therefore meaningful in any existential sense” (Kennedy, 1987).

Other authors (Weir, 1980, Gebissa, 2004) stress the importance of analyzing Qat consumption in a broader perspective. Social and economic factors are of primary importance in determining individual consumption levels and account for individual differences in the consumption of Qat. These aspects strongly characterize the consumption of Qat also in Djibouti, and they are used to support the assumptions stated in the theoretical model.
2.1 The Theoretical Model

As described in the previous session, the “social” aspect of drug consumption is very strong in the case of Qat. Thus, in a very simple way, we could say that Qat consumers “feel” what we define a utility gap \( \gamma \) deriving from the need to be part of a society where this kind of consumption represents a very important mean of social integration\(^{11}\). Thus, the utility function of an individual can be represented in the following way:

\[
U^i = U(Z_1, ..., Z_N; \gamma)
\]

where \( Z_i, i = 1, ..., N \) is a “commodity” (Becker 1965, Becker and Lewis, 1963) with \( U_{Z_i} > 0 \), \( U_{Z_i Z_j} < 0 \). Note that \( \gamma \) is not directly observable, but when this utility gap reaches some individual threshold level we could observe some changes in consumption patterns. Through Qat consumption the individual replaces the utility gap with a new \( D \) good that directly enter the utility function and provides subjective satisfaction through a drug experience (this is what is called euphoria in Stigler and Becker’s terms (1977)). In fact, the first experimental effects of Qat are a gradually developing mild euphoria, alertness, and feeling of contentment, confidences, and gregariousness. However, these effect are not valued per se (or at least not entirely) but assume value in the social context of Qat parties in which they can be shared. Thus, by

\(^{11}\) For a truly addictive substance this utility gap could represent the feeling of users’ inadequacy with respect to their self-image or in relation to the surrounding environment, which is often reported as one of the ‘causes’ of addictive substances use. As explained in the previous session, we adopt a different view for Qat, so that this utility gap has not to be interpreted (at least not exclusively) as dissatisfaction with a life in a poor environment but as a “social” utility gap.
consuming Qat, people attempts to reach a state of general well being. For these reasons, Qat consumers seem to consider it as a real “good” despite of its negative health effects\textsuperscript{12}.

We assume that the $Z$ goods and the “drug experience” good $D$ enter the utility function through a productive process that uses as inputs time and market goods. In the present framework we ignore the consumption capital aspects of drug consumption which allows to establish a relationship between past and current consumption. This is an important limitation of the following analysis that can be in part justified by the data available, not adequate to estimate a dynamic model, and in part by the nature of the drug experience associated with Qat, that is such that more weight has to be placed on the social dimension of addiction.

The individual optimisation process can be described as follows:

$$\max U = U(Z_1...Z_N, D)$$

s.t.

$$Z_i = z(x_i, T_{Z_i})$$
$$D = d(Q, T_D)$$

$$T = \left( \sum_{i=1}^{n} T_{Z_i} + T_D \right) + T_w = T_c + T_w$$

\textsuperscript{12} The euphoric state immediately associated to the use of Qat can be followed by a state of confusion, misperception of time and space and hallucinations. The habit of chewing Qat causes insomnia, anorexia, and constipation. Qat consumers are more susceptible to the contraction of venereal diseases, hearth diseases, tuberculosis and others. Qat consumption is also associated with high tobacco consumption: during their meetings, Qat users usually smoke 1-2 packages of cigarettes because this enhances the pleasurable experience associated with the chewing. Thus, even if most Djiboutian males consider absurd to associate Qat-use with health problems and think that Qat can even help at work by reducing fatigue, evidence reports negative health effects related to Qat use (see for example World Bank, 1997, Kennedy, 1987, UN Commission on Narcotic and Drugs, 1956, 1980, Ishraq Dhaifalah & Jiří Šantavýb, 2004). However, it is important to note that the relationship between Qat use and health has to be considered in the context of the Djiboutian general health conditions. Endemic problems such as malnutrition, tuberculosis, malaria, cholera and AIDS affect the population in general. If this might lead to not exaggerate the health arguments against Qat, these arguments are not without foundations, and the drug cannot be discounted as health threat, especially in a country where the use of Qat can add an additional risk factor to already precarious health conditions.
where equation (3) represents the time constraint describing how the total time is divided between consumption time, i.e. the time spent in producing the goods directly entering the utility function \( \left( \sum_{i=1}^{N} T_{zi} + T_{D} = T_{c} \right) \), and time spent at work. The first constraint describes how the input vector of market goods \( x_{i} \ (i=1,...,N) \), Qat (Q) and the vector of time inputs \( T_{j} \ (j=i,D \ with \ i=1,...,N) \) are used in the production of the \( Z_{i} \) and \( D \) goods. The last one is the usual budget constraint that distinguishes between labor and non-labor income \( (m) \).

We assume production functions homogenous of first degree with

\[
\frac{\partial Z_{i}}{\partial T_{zi}} > 0, \quad \frac{\partial Z_{i}}{\partial x_{i}} > 0, \quad \frac{\partial D}{\partial T_{D}} > 0, \quad \frac{\partial D}{\partial T_{D}} > 0 ,
\]

and specify \( T_{D} = tQ \), where \( t \) is the amount of time necessary to chew one unit of Qat.

We can combine the time, budget and technological constraint in a more compact form:

\[
\sum_{i} (p_{x_{i}}x_{i} + p_{q}Q) + (p_{q} + wt)Q = wT + m .
\] (5)

The LHS of equation (5) represents the full expenditure and \( \pi_{D} = p_{q} + wt \) is the full price of the \( D \) good. Thus, the full price is composed by two distinct elements, the out-of-pocket (or direct) price \( p_{q} \) for the input bought on the market, and the time or indirect price \( wt \), which expresses
the cost of time in terms of foregone earnings involved in the production of the drug experience. Thus, the full income (RHS of equation 2) is given by the sum of the money income achievable if all the time available were devoted to work and the non-labor income. The total, or full, budget constraint describes how the full income is spent on the commodities either directly, through the expenditures on market goods, or indirectly through the forgoing of income, i.e. by using time at consumption rather than at work.

From the first order conditions of the consumer’s optimization problem we get\(^1\):

\[
\frac{\partial U}{\partial Z_i} = \lambda \pi_{Z_i} \quad i=1,\ldots,N 
\]

\[
\frac{\partial U}{\partial D} = \lambda \pi_D ,
\]

which implies:

\[
MRS_{DZ_i} = \frac{\pi_D}{\pi_{Z_i}} = \frac{p_q}{p_{si}} \frac{dQ}{dD} + w \frac{tdQ}{dD} = \frac{dx_i}{dZ_i} + w \frac{dT_{Z_i}}{dZ_i} .
\]  

\(^{13}\) Maximizing the utility function, subject to the full income constraint, using the fact that the production functions are homogeneous of the first degree gives:

\[
\frac{\partial U}{\partial Z_i} = \lambda \left[ p_q \frac{dx_i}{dZ_i} + w \frac{dT_{Z_i}}{dZ_i} \right] = \lambda \pi_{Z_i} 
\]

\[
\frac{\partial U}{\partial D} = \lambda \left[ p_q \frac{dQ}{dD} + w \frac{dT_D}{dD} \right] = \lambda \left[ p_q \frac{dQ}{dD} + w \frac{tdQ}{dD} \right] = \lambda \pi_D ,
\]

where \(\lambda\) is the Lagrange multiplier and the full prices \(\pi_{Z_i}, \pi_D\) are determined by the market good and time inputs requirement necessary to the production of one unit of the \(Z_i\) and \(D\) goods.
Thus, using this approach, we can distinguish the different commodities based on their intrinsic degree of time and good intensity\textsuperscript{14} to investigate the effect of an increase in the wage. As described in the previous session, Qat consumers spend a large fraction of their time in chewing Qat with friends. Men meet usually in the afternoon at the so-called Qat parties to spend together many hours until dusk. Thus, we can reasonably assume that the production of the typical Djiboutian drug experience is a relatively time intensive activity. This can be formalized as follows:

\textbf{Assumption 1.} Time intensity: \[\frac{w}{p_q} \frac{dT_D}{dQ} > \frac{w}{p_{x_i}} \frac{dT_{x_i}}{dx_i}\]

This means that if we look at two hypothetical isoquants of production for the $D$ and $Z_i$ good, we have more time (in real terms) embodied in the production of the drug experience than in the production of other goods. Note that if we assume that the drug experience provides direct satisfaction, we cannot directly measure the amount of euphoria produced. What we can observe is the use of the (input) Qat. However, given the above specified production function of $D$, we can determine a one to one correspondence between the use of Qat in the production of $D$ and the good $D$. This is equivalent to say that Qat users identify and directly associate the output of the productive process ($D$) with the input, so that by stating that the production of euphoria is a time intensive activity is equivalent to say that Qat consumption is time intensive. In psychological literature, the repeated use of substances is described as a behaviour determined by the perception of the physiological alterations produced by the substance itself. Moreover, the fact

\textsuperscript{14} Becker (1965) defines the relative marginal importance of time as $\frac{t_i}{\pi_i}$. 
that the person associates a positive meaning to these perceptions has a function of “reinforcement” on the use or abuse (Turchi, 2002). As reported by Weir (1980): “Qat stands for much more significant activities than simply the communal consumption of a pleasant substance. It is the significance of those activities which largely generates and excites anticipation, and this excitement is transferred onto the substances which are the focus of the gatherings”.

Given the role Qat plays as *social aggregator* in the life of the typical male Djiboutian community, we could reasonably say that this kind of consumption generates a cultural or social form of dependence.

**Assumption 2.** Addiction: *Qat does not generate addiction in the strict medical sense but generates a form of “social” dependence.*

The first step in this paper is to analyse the consumption of Qat in the theoretical framework developed above. Given the assumption of time intensity, we want to analyse the effect of an increase in the value of time, represented by an increase in wages. From equation (9) we have\(^\text{15}\):

\[
\frac{w}{p_q} \frac{dT_D}{dQ} > \frac{w}{p_{s_i}} \frac{dT_{s_i}}{dx_i} \Rightarrow \frac{\partial \left( \frac{\pi_D}{\pi_{Z_i}} \right)}{\partial w} > 0. \quad (10)
\]

Thus, an increase in wages determines a relatively large increase in the full price of the relatively more intensive commodity \(D\). The importance of considering the full price becomes here evident, because it allows to distinguish goods in terms of the amount of time necessary to their production. An increase in the wage will determine therefore two effects. On one side, by the

\(^{15}\) See Appendix A.
substitution effect, an increase in the value of time will determine a shift away from the production of $D$ (or equivalently from the consumption of Qat) time intensive commodity to the good intensive ones, since now the opportunity cost of spending time at Qat parties is higher. On the other side we have an income effect, which operates exactly in the opposite direction. The former would reduce Qat use, the second would increase it, and the total effect will depend on the relative strength of the two.

2. 2 Social Aspects of Qat Consumption

In the previous session we stressed the importance of social factors in the widespread use of Qat. Different authors refer to the “social pressure” to consume Qat as a key element that determines individual consumption decisions and to the role of Qat parties as instruments of social conformity\textsuperscript{16}.

We can think of the widespread Qat-culture in the Horn of Africa as a form of social capital (Coleman, 1988) that is embodied in the structure of the relations among men sharing this culture. To formalize this argument in terms of our model, we could think of the social environment as a resource available to the individual and as an input in the production function of the individual drug experience, so that the social environment influences the response of the chewer.

Social interactions have been widely recognized in the literature as an important element in determining behavioral and economic outcomes. However, the definition of these social interactions and especially the way through which they contribute to observed outcomes is not always clear. In particular, Mansky (2000, 1995, 1993) identifies three forms of interactions

\textsuperscript{16} See for example Bernheim (1994) for a formalization of the argument of social conformity.
which give rise to the same observed behavior: endogenous and contextual interactions express
different ways in which the social environment affects the individual, while correlated effects are
a non-social phenomenon. We have endogenous effects when the propensity of an individual to
engage in some behavior varies with the prevalence of that behavior in the group. Contextual
effects arise wherein individual behavior is influenced by the exogenous characteristics of the
group. Correlated effects express the fact that individuals in the same group tend to behave
similarly because they have similar individual characteristics or they face the same institutional
environment. Distinguishing between these effects is important, because endogenous effects give
rise to social multipliers. Manski (1993) shows that in a linear-in-means regression model it is
possible to distinguish social and non-social effects only in a limited set of situations. Moreover,
lacking empirical data on group composition, assumptions have to be made about the relevant
sphere of interaction to proceed with the analysis.

Our whole sample includes the capital of the country (Djibouti-Ville), other small urban areas
and rural villages. For adult males living outside the capital it is reasonable to assume that their
sphere of interaction relevant for the participation to the Qat parties is defined by the small
geographic area in which they live, that is the minor urban centers or the rural villages\textsuperscript{17}. For the
capital Djibouti-Ville we use information about the subdivision of the city in five principal
\textit{arrondissements} (districts) and consider the district where the household lives as the relevant
sphere of interaction. Thus, once defined the reference group composition, we want to
investigate the relationship between the individual consumption of Qat and the prevalence of Qat
use in the area in which one lives.

\textsuperscript{17} There are five minor urban centers other than the capital Djibouti-Ville, and their overall population comprises
about 6000 households, eight times less than the capital Djibouti-Ville. The rural villages are even smaller than the
minor urban centers. Once Qat arrives at the Djibouti airport is quickly distributed in every corner of the capital and
to the other villages that can be quickly reached by road.
4. Data

The cross-section data set is the national household survey (EDAM, Enquête auprès des ménages) conducted in 1996 by the Statistics Department of Djibouti (DINAS) among the sedentary population\textsuperscript{18}. The survey was articulated in separate questionnaires for households and individuals. The survey sampled 15,701 individuals belonging to 2,380 families\textsuperscript{19}. Data reveal that Qat consumption is prevalently a male habit. In the overall sample, the 48\% of households can be defined \textit{Qateur}, i.e. Qat expenditures are a non-zero component of the household budget, but the 94\% of \textit{Qateur} households does not have female consumers. Inspection of Table 1 shows that the sex of he household head is a key determinant to define a household as \textit{Qateur}\textsuperscript{20}. Thus, we can reasonably assume that male household heads are the representative consumers of Qat (or at least they can be considered as representative of the male household party, whose Qat consumption can be considered an exclusive good). Raw data in the same table show also that the percentage of \textit{Qateurs} varies with the region of residence and with the socioeconomic status, with richer and urban households being more likely to use Qat\textsuperscript{21}. Because Qat is perceived as a good rather than a bad, the consumption is revealed truthfully\textsuperscript{22}.

For the purpose of the paper, we select a subgroup of 1,647 adult male household heads\textsuperscript{23} aged 18-65. About 66 percent of the households live in the capital Djibouti-Ville, 18 percent in other

\textsuperscript{18} Four main groups represent the Djiboutian population: nomads, homeless, refugees and sedentary tribes, but only the last one is the group targeted by the EDAM. For this reason, it is important to keep in mind that the population in the data is unlikely to be very representative of the overall population.

\textsuperscript{19} Data on Qat use report weekly consumption and the number of users in the household by sex. Thus, we do not directly have information on who consumes Qat in the household, but we can reasonably assume that Qat use is a representative \textit{habit} of the male household head. For further evidence on this point see for example UN Commission on Narcotics Drugs, 1956 and \textit{Rapport National sur le Développement Social} (1995), République du Djibouti.

\textsuperscript{20} Table 1 compares the overall number of sampled households with the subsample of male-headed households selected according to the following detailed criteria.

\textsuperscript{21} Definition of poverty status according to the poverty lines described in the World Bank Report (1997).

\textsuperscript{22} Non response information to the question related to Qat consumption amount only to 0.02 percent of the overall sample and has been dropped.

\textsuperscript{23} In addition to these criteria, we also exclude individuals with missing data.
towns and the remaining 17 percent in rural areas. The selected subgroup is composed by *Qat users (Qateurs)* and *non Qat users (non-Qateurs)*, respectively the 56 and 44 percent of the sub-sample (Table 1). Inspection of Table 2 reveals that on average the largest household expenditure item is food, with large differences between *Qateurs* and non-*Qateurs*. Qat represents 20 percent of the total household expenditure in *Qateurs* households, and the data reveal that it is the second “priority” in the household budget. This is impressive especially if we consider the low amount of resources devoted to health and education.

5. Econometric Model and Results

The purpose of our paper is to study the relationship between wages and drug use. Thus, we want to estimate our drug function to evaluate the effect of male household head’s wage on drug use. The first problem that arises in this context is that drug use and wages are simultaneously determined. As we want to see how wages affect drug consumption, it could be well the case that causality runs in both directions, i.e. also drug use affect wages. The detrimental physical and psychological effects of drug use suggest that wages should be affected by drug use. For this reasons we estimate a simultaneous system of equations with wages and drug use being jointly determined. The model that will be estimated in this paper is:

\[
Q = \alpha_0 + \alpha_1 X_q + \alpha_2 W + u_q
\]

\[
W = \beta_0 + \beta_1 X_w + \beta_2 Q + u_w
\]

---

25 Qat users eventually become physically run down because they eat only occasionally, go without sleep and use up their nervous energy (UN Commission on Narcotics Drugs, (1956,1980)).
where $X_Q$ ($X_w$) is a set of explanatory variables in the Qat equation (wage equation). In estimating the system we have to consider that Qat use is observed for the whole sample, while wages are observed only for working individuals. Consistent estimates for the wage equation would require taking into account that wages are observed only for working individuals (Heckman, 1974, 1979). However, to implement the Heckman procedure we would need at least two exclusion restrictions, one for the equation determining selection and one for the endogenous wage. Unfortunately, we do not have valid exclusion restrictions for the selection equation, and we estimate the model ignoring selection. We estimate the wage equation by OLS\textsuperscript{26} and predict the wage for the whole sample and use it in the second stage to estimate the drug equation\textsuperscript{27}. Qat consumption can be considered as expression of the power of the household head within the household and therefore of his ability to divert resources toward the consumption of an exclusive good. Thus, we include both individual and household characteristics in the drug equation\textsuperscript{28}: household head’s education level, number of children 0-5 years old, number of children 6-12 years old, marital status, language spoken, geographic dummies, dummy for whether there is a source of non-labor income, distance (in hours) to the nearest supplies market, dummy for home property\textsuperscript{29}. The set of independent variables in the wage equation includes household head’s age\textsuperscript{30}, education level, dummy variables for location and language spoken, marital status and number of children. As measure of drug consumption we use the (logarithm of) weekly Qat consumption in hundreds of grams. The dependent variable for the wage equation is the

\textsuperscript{26} One could argue that we have a censored sample in terms of Qat use. Least square estimates of the coefficient in a Tobit model are proportional to the MLEs by the proportion of non limit observations (Greene, 2003). In this framework OLS estimates could be taken as conservative. We tested for misspecification of the Tobit model using a Langrange Multiplier test (Greene, 2003, Wooldridge). The results of the test show that we reject the null hypothesis that the Tobit model is correctly specified.

\textsuperscript{27} See Appendix B.

\textsuperscript{28} See Appendix D for variables description.

\textsuperscript{29} Unfortunately we cannot control for prices since our data provide information only on standard prices at which bundles can be purchased ad we have no regional variations.

\textsuperscript{30} We use both a quadratic specification and a specification with age dummies.
(logarithm of) weakly wage. For this two-step procedure to be credible we need some valid exclusion restrictions, that is some variables predicting wages that do not belong to the drug equation. Inspection of the data reveals that Qat use is related to both household and individual characteristics of the household head. The key individual characteristics of the household head determining drug use are the sex (male) and his level of education, but age does not seem to significantly affect Qat consumption if not through its effect on wages. If we consider that Qat consumption works as a mean of social integration, it is reasonable to assume that age does not affect the decision of consuming Qat (once we control for other characteristics): this decision would in fact be relevant for the adult household head’s social life regardless of his age, given the role of the male as head in promoting and achieving social advancement. We tested for overidentification restrictions and we found that age variables can be excluded from the drug use equation\(^{31}\). Moreover the F-test for the identifying instruments in the first stage confirms that we are not replacing actual values with a noisy measure\(^{32}\). The results of the estimates are reported in Table 4\(^{33}\). Men with education level at the bottom and at the top of the education distribution consume significantly lower amount of Qat with respect to those with low level of formal schooling (primary education). Conditional on others individual and household characteristics, it is reasonable to expect that those with more education are more aware of the negative effects related to Qat use and are able to face front to the social pressure to consume Qat. However, this positive effect of education does show up only at the higher level of education (secondary and

\(^{31}\) Overidentification restrictions are tested by estimating an exact identified model for the Qat equation and testing the restrictions in the Qat equation. This means that exclusion restrictions are divided into a set of just-identifying restrictions and a set of overidentifying restrictions (Hae-Shin Hwang, 1980) where the latter are tested using an F-test. If the p-value is high it means that we can accept the null hypothesis that my instruments do not belong to the Qat equation. Note that this test cannot be applied in the case of an exactly identified model.

\(^{32}\) The F-test for the quadratic specification of age variables is 27.14 (Table 4 column 1) and 10.58 in the specification with the age dummy variables (Table 4 column 2). These values are above the threshold reference value of 10 described in Staiger and Stock (1997).

\(^{33}\) Column 1 in table 4 reports estimates with a quadratic specification of age, column 2 reports estimates with age dummies as identifying instruments in the first stage.
above), while those with just basic education level consume more than those without formal schooling and illiterate. Afar and Somali ethnic groups\textsuperscript{34}, as represented by the language spoken, consume significantly more Qat per week. These ethnic groups have been traditionally described as economically disadvantaged, unused to a money economy and heavily influenced by the force of their tribal custom, whose one of the most powerful expression was the consumption of Qat (Thompson and Adloff, 1968). Living one hour more distance to the supplies market and home property are associated with significantly lower Qat consumption per week. This latter variable captures to some extent living conditions, since those who own their home are usually those who lives in precarious housing conditions. Marital status and number of children do not affect Qat use. This seems to confirm the fact that Qat is really a priority for the male household head consuming it. There is weak evidence that geographic location of the household affects Qat consumption. Then percent higher household head wages are associated with 7.2\%-8.9\% weakly higher Qat consumption. The head’s wage can be considered as a resource over which the household head has full control and that he decides to devote to the consumption of an exclusive good. This confirms anecdotal evidence\textsuperscript{35} suggesting that wage earners spend their resources on the consumption of Qat. In terms of our model, an increase in the value of time let Qat consumers feel “wealthier” and more willing to increase the consumption of a commodity representing a very important mean of social integration. Even if the main focus of this article is the estimation of the drug equation, we report OLS and two stage least square estimates for the wage equation (Table 5). The identifying instruments used for the wage equation are non-labor

\textsuperscript{34} The two larger ethnic groups in Djibouti are Afar and Somali (the latter comprises three sub-groups; the more numerous being that of the Issas).

income, distance to the supplies market and home property\textsuperscript{36}. We assume that these variables affect drug use but not directly wages. The results show the absence of any negative effect of Qat use on wage in both the OLS and 2SLS regression, but the coefficients are significantly different. However, these results have to be interpreted carefully. Individuals might in fact have unobservable characteristics related to Qat use that also affect wages; Qat users might particularly value the communication and behaviour the society has to offer through the Qat parties or be particularly subject to the social pressure to consume Qat, and this could in turn affect their labor supply decisions and hence wages.

The rest of the article is devoted to the analysis of the social dimension related to Qat use. We want to investigate whether the individual decision of consuming Qat is related to the prevalence of Qat use in the area in which one lives. We follow Case and Katz (1991) and Gaviria and Raphael (2001) in constructing the following estimating equation:

\[
K_i = \alpha_0 + \alpha_1 X_{ik} + \alpha_2 W_i + K_{-i} + u_{ik} \tag{12}
\]

Where \( K_i \) is a binary variable equal to one if observation \( i \) is \textit{Qateur}, and \( K_{-i} \) is the proportion of male household heads in the area considered who consume Qat (excluding the behaviour of individual \( i \)). This variable thus represents our peer measure. \( X \) and \( W \) represent as before a set of exogenous variables and the household head’s weakly wage. Note that even if we specify the above equation as if average behaviour affects individual behaviour, it is possible that causality

\textsuperscript{36} The F-test for the identifying instruments in the first stage reduced form Qat regression is 8.90. This value is below the reference value provided by the “rule of thumb” in Staiger and Stock (1997). However in a more recent paper Stock and Yogo (2002) provide an improvement of the previous rule of thumb that takes into account the number of endogenous variables as well the number of instruments. In the case of a single endogenous variable, instead of comparing the first stage \( F \) to ten, it is compared to the reference values provided according to the criteria used to “judge” whether instruments are weak (TSLS bias, TSLS size or LIML size). According to the TSLS bias criterion in the case of three instruments and one endogenous variable, the first stage \( F \) value should be in the range 5.39-13.91, depending on the desired maximal bias of the IV estimator relative to the OLS.
runs in the other direction since the individual itself can affect the behaviour of his peers. This would produce a correlation between the peer measure and the individual error term and inconsistent estimates of our peer measure. To address this problem we use an IV procedure. As described above, we assumed that the widespread Qat culture directly affects the individual response to the social pressure to chew Qat as summarized by equation (12). In this framework, it is reasonable to assume that the average quality of peer-Qateurs can influence the individual behaviour only through the peer measure. Thus, under this assumption (i.e. no contextual effects) we can use the background characteristics\textsuperscript{37} of the peers as identifying instruments to correct for potential endogeneity. If this procedure allows to correct for simultaneity bias, we do not explicitly take into account another potential source of bias, that is the fact that similar behaviour in Qateurs males can arise from similar unobserved individual characteristics (Manski’s correlated effect). If this source of bias is present it would confound the estimates of the endogenous effect we are trying to sort out. However, the great value placed on Qat seems to reflect more its role as social lubricant that fosters group relationships, cooperation and amity, so that individual choices are largely driven by the social pressure to consume rather than unobserved individual attributes. We report the estimates of equation (12) in table 6. A linear probability model is estimated for our discrete dependent variable. The first column shows the results from the estimated equation by assuming the peer effect is exogenous. The estimates show a positive and significant effect of the peer measure on the probability of consuming Qat. The second column reports the estimates of our endogenous per measure instrumented by means of the average education level of i’s peers\textsuperscript{38}. The estimates show that an increase in 1 percentage point in the proportion of Qateurs in the area in which one lives is associated with a 53.6

\textsuperscript{37} In particular, we use the average education level of the peers for each educational category; so for example the proportion of peers with primary schooling, secondary schooling and so on.

\textsuperscript{38} We used the quadratic specification of age to instrument wages.
percentage points increase in the probability of consuming Qat. If this effect reflects the existence of true endogenous social effects, then policy measures aimed to reduce the economic burden that Qat consumption places on often poor household budgets will have a multiplier effect, that is a direct effect on individual consumption and an indirect effect through an impact of peer’s consumption.

6. Conclusions

The purpose of this paper was to study how the consumption of a “socially” addictive good responds to changes in the value of time as represented by wages, in a model in which the Drug experience is produced by using both market and time inputs, and to investigate the social dimension related to this kind of institutionalized phenomenon. Estimating a simultaneous system of equations with wage and Qat consumption as endogenous variables, our findings suggest that there is a positive relationship between Qat consumption and the wage level. In particular, the paper found that the last one positively and significantly affect the consumption of Qat. Given the realistic assumption that Qat is a time intensive commodity, this means that income effect (generated by a wage increase) will overcome the substitution effect. The monetary emphasis placed on Qat consumption may be contrasted with Western attitudes toward other addictive behaviours which focus primarily on the quantity of cigarettes or drinks a person regularly consumes and secondary on the money cost. The preoccupation is more with the consumer’s physical or psychological susceptibility to these substances and less on how his consumption habits affect or reflect his economic circumstances. With Qat the emphasis is reversed. This is because each person’s level of Qat consumption is related to his financial status more than his bodily or emotional needs, and so the more one can consume the more prestige he
will be able to gain at social level. The social dimension of Qat consumption is also an important element in determining individual consumption choices. If, as it seems reasonable to assume, our estimates reflect the presence of endogenous social effects, policy measures aimed to reduce Qat use can have a greater impact through the discussed multiplier effects. Given that Qat consumption responds in part to economic incentives, an increase in the taxes on Qat might help reducing its demand and generate additional revenues that could be used for the implementation of social programs in a country in which the consumption of a male exclusive good takes the priority over the need of addressing household resources to the amelioration of the poor level of human capital levels.

References


Kalix, P. (1983), The Pharmacology of Khat and of the Khat Alkaloid Cathinone, in B.
International Conference on Khat*, Lausanne 1983.

North Yemen*, Dordrecht: Reidel.

*Journal of Econometrics*, 72, 197-229.


Manski, C., F. (1993), Identification of Endogenous Social Effects: the Reflection Problem,

University Press.


Plan, de l’Amenagement du Territorie, de l’Environnement et de la Cooperation.

Editore, Roma, Italy.


Thompson, and Adloff (1968), *Djibouti and the Horn of Africa*. Stanford University Press.


UN Commission on Narcotics Drugs, (1980) *Catha Edulis (Khat)*, Special Issue devoted to Catha Edulis UN Bulletin on Narcotics 32(2).
### Table 1: Profile of Qateur Households

<table>
<thead>
<tr>
<th>Household Characteristics</th>
<th>Qateur Households (Percentage)</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>All sample</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>48</td>
</tr>
<tr>
<td><strong>Poverty Group</strong></td>
<td></td>
</tr>
<tr>
<td>Very Poor</td>
<td>7</td>
</tr>
<tr>
<td>Poor</td>
<td>36</td>
</tr>
<tr>
<td>Non Poor</td>
<td>67</td>
</tr>
<tr>
<td><strong>Location</strong></td>
<td></td>
</tr>
<tr>
<td>Djibouti-ville</td>
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</tr>
<tr>
<td>Other urban</td>
<td>43</td>
</tr>
<tr>
<td>Rural</td>
<td>33</td>
</tr>
<tr>
<td><strong>Observations</strong></td>
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</tr>
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</table>

Source: Author Elaborations from EDAM, 1996.

### Table 2: Average Weekly Expenditure Shares-Male Headed Households

<table>
<thead>
<tr>
<th>Qateurs (Obs. 926)</th>
<th>Mean</th>
<th>Std.Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food</td>
<td>0.41</td>
<td>0.13</td>
<td>0.06</td>
<td>0.85</td>
</tr>
<tr>
<td>Education</td>
<td>0.02</td>
<td>0.05</td>
<td>0.00</td>
<td>0.64</td>
</tr>
<tr>
<td>Rent</td>
<td>0.16</td>
<td>0.10</td>
<td>0.00</td>
<td>0.79</td>
</tr>
<tr>
<td>Clothing</td>
<td>0.03</td>
<td>0.02</td>
<td>0.00</td>
<td>0.18</td>
</tr>
<tr>
<td>Health</td>
<td>0.01</td>
<td>0.03</td>
<td>0.00</td>
<td>0.47</td>
</tr>
<tr>
<td>Transportation</td>
<td>0.04</td>
<td>0.07</td>
<td>0.00</td>
<td>0.76</td>
</tr>
<tr>
<td>Energy</td>
<td>0.07</td>
<td>0.05</td>
<td>0.00</td>
<td>0.42</td>
</tr>
<tr>
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<td>0.12</td>
<td>0.00</td>
<td>0.75</td>
</tr>
<tr>
<td>Cigarettes</td>
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<td>0.03</td>
<td>0.00</td>
<td>0.37</td>
</tr>
<tr>
<td>Others</td>
<td>0.04</td>
<td>0.06</td>
<td>0.00</td>
<td>0.76</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Non-Qateurs (Obs. 721)</th>
<th>Mean</th>
<th>Std.Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food</td>
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<td>0.17</td>
<td>0.02</td>
<td>0.90</td>
</tr>
<tr>
<td>Education</td>
<td>0.02</td>
<td>0.04</td>
<td>0.00</td>
<td>0.61</td>
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<tr>
<td>Rent</td>
<td>0.21</td>
<td>0.14</td>
<td>0.00</td>
<td>0.85</td>
</tr>
<tr>
<td>Clothing</td>
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<td>0.04</td>
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<tr>
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<td>0.08</td>
<td>0.00</td>
<td>0.50</td>
</tr>
<tr>
<td>Energy</td>
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<td>0.06</td>
<td>0.00</td>
<td>0.38</td>
</tr>
<tr>
<td>Qat</td>
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<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Cigarettes</td>
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<td>0.00</td>
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<tr>
<td>Others</td>
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<td>0.05</td>
<td>0.00</td>
<td>0.50</td>
</tr>
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Source: Author Elaborations from EDAM, 1996.
<table>
<thead>
<tr>
<th></th>
<th>All Household Heads</th>
<th>Working Household Heads</th>
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</thead>
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<tr>
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<td>Std.Dev.</td>
</tr>
<tr>
<td>djibouti ville</td>
<td>0.66</td>
<td>0.47</td>
</tr>
<tr>
<td>urban</td>
<td>0.18</td>
<td>0.38</td>
</tr>
<tr>
<td>rural</td>
<td>0.17</td>
<td>0.37</td>
</tr>
<tr>
<td>weakly non labor income</td>
<td>0.36</td>
<td>0.48</td>
</tr>
<tr>
<td>age</td>
<td>42.95</td>
<td>10.46</td>
</tr>
<tr>
<td>children0-5</td>
<td>1.07</td>
<td>1.17</td>
</tr>
<tr>
<td>children6-12</td>
<td>1.44</td>
<td>1.51</td>
</tr>
<tr>
<td>married monogamous</td>
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<td>0.38</td>
</tr>
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<td>0.13</td>
<td>0.33</td>
</tr>
<tr>
<td>unmarried</td>
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<td>0.21</td>
</tr>
<tr>
<td>illiterate</td>
<td>0.48</td>
<td>0.50</td>
</tr>
<tr>
<td>basic literacy</td>
<td>0.11</td>
<td>0.32</td>
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<tr>
<td>some primary school</td>
<td>0.03</td>
<td>0.17</td>
</tr>
<tr>
<td>primary school completed</td>
<td>0.17</td>
<td>0.38</td>
</tr>
<tr>
<td>some low secondary school</td>
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<td>0.21</td>
</tr>
<tr>
<td>low secondary school</td>
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<td>0.24</td>
</tr>
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<td>some upper secondary school</td>
<td>0.03</td>
<td>0.18</td>
</tr>
<tr>
<td>upper secondary school</td>
<td>0.03</td>
<td>0.16</td>
</tr>
<tr>
<td>more than secondary school</td>
<td>0.04</td>
<td>0.20</td>
</tr>
<tr>
<td>weakly qat consumption</td>
<td>9.65</td>
<td>15.22</td>
</tr>
<tr>
<td>Qateur</td>
<td>0.56</td>
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<tr>
<td>somali language</td>
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<td>afar language</td>
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<td>other language</td>
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<td>hours market access</td>
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<td>home property</td>
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<tr>
<td>log of weakly wage</td>
<td>(a)</td>
<td>(a)</td>
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<tr>
<td>Observations</td>
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<td>1121</td>
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Source: Author Elaborations from EDAM,1996.

(a)variable not entered
Table 4: Estimates of the Qat Equation

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1)</th>
<th>(2)</th>
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</thead>
<tbody>
<tr>
<td><strong>location (rural reference)</strong></td>
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<td></td>
</tr>
<tr>
<td>djibouti-ville</td>
<td>0.191</td>
<td>0.135</td>
</tr>
<tr>
<td></td>
<td>(1.67)*</td>
<td>(1.14)</td>
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<tr>
<td>urban</td>
<td>0.091</td>
<td>0.084</td>
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<td>(0.86)</td>
<td>(0.79)</td>
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<td>0.079</td>
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<tr>
<td></td>
<td>(1.31)</td>
<td>(0.97)</td>
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<td>children0-5</td>
<td>0.021</td>
<td>0.029</td>
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<tr>
<td></td>
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<tr>
<td>children6-12</td>
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<td></td>
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<td>-0.047</td>
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<tr>
<td></td>
<td>(-0.33)</td>
<td>(-0.28)</td>
</tr>
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<td>0.020</td>
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<td></td>
<td>(0.16)</td>
<td>(0.11)</td>
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<tr>
<td></td>
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<td>(-2.34)***</td>
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<tr>
<td>basic literacy</td>
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<td>some low secondary school</td>
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<tr>
<td></td>
<td>(-1.90)*</td>
<td>(-2.03)**</td>
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<tr>
<td>lower secondary school completed</td>
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<tr>
<td></td>
<td>(-1.78)*</td>
<td>(-2.01)**</td>
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<tr>
<td>some upper secondary school</td>
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<td>-0.538</td>
</tr>
<tr>
<td></td>
<td>(-2.11)**</td>
<td>(-2.30)**</td>
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<tr>
<td>upper secondary school completed</td>
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<tr>
<td></td>
<td>(-2.74)***</td>
<td>(-2.96)***</td>
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<td>more than secondary school</td>
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</tr>
<tr>
<td></td>
<td>(-2.71)***</td>
<td>(-3.07)***</td>
</tr>
</tbody>
</table>
The $F$-statistic tests the collective significance of the excluded instruments in the first stage regression. t-statistics in parenthesis; significant at *10% level, **5% level, ***1% level.

### Table 5: Estimates of the Wage Equation

<table>
<thead>
<tr>
<th>Variables</th>
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</thead>
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<td>age</td>
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<tr>
<td>age square/100</td>
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<tr>
<td>location (rural reference)</td>
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<tr>
<td>djibouti-ville</td>
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<td>urban</td>
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<tr>
<td>children0-5</td>
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<td>-0.013</td>
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<tr>
<td>children6-12</td>
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<tr>
<td>married poligamous</td>
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<td>-0.076</td>
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<tr>
<td>afar_lan</td>
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</tbody>
</table>

N = 1647, R² = 0.108, F-statistic = 27.14
<table>
<thead>
<tr>
<th>Education (Primary Education Completed Reference)</th>
<th>Coefficient</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illiterate</td>
<td>-0.518</td>
<td>(-8.55)***</td>
</tr>
<tr>
<td>Basic literacy</td>
<td>-0.382</td>
<td>(-4.88)***</td>
</tr>
<tr>
<td>Some primary school</td>
<td>-0.218</td>
<td>(-1.72)*</td>
</tr>
<tr>
<td>Some low secondary school</td>
<td>0.115</td>
<td>(1.08)</td>
</tr>
<tr>
<td>Lower secondary school completed</td>
<td>0.303</td>
<td>(3.38)***</td>
</tr>
<tr>
<td>Some upper secondary school</td>
<td>0.376</td>
<td>(3.35)***</td>
</tr>
<tr>
<td>Upper secondary school completed</td>
<td>0.452</td>
<td>(3.68)***</td>
</tr>
<tr>
<td>More than secondary school</td>
<td>0.545</td>
<td>(5.25)***</td>
</tr>
<tr>
<td>Log of weakly Qat consumption</td>
<td>0.043</td>
<td>(2.84)***</td>
</tr>
<tr>
<td>N</td>
<td>1121</td>
<td></td>
</tr>
<tr>
<td>R²</td>
<td>0.699</td>
<td></td>
</tr>
<tr>
<td>F-statistic</td>
<td>(d)</td>
<td>8.90</td>
</tr>
</tbody>
</table>

The F-statistic tests the collective significance of the excluded instruments in the first stage regression. T-statistics in parenthesis; significant at *10% level, **5% level, ***1% level. (d) value not relevant.
### Table 6: Estimates of the Probability of Qat Use Related to the Peer Measure

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1)</th>
<th>(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>weakly non labor income</td>
<td>0.039</td>
<td>0.042</td>
</tr>
<tr>
<td></td>
<td>(1.47)</td>
<td>(1.57)</td>
</tr>
<tr>
<td>children0-5</td>
<td>0.009</td>
<td>0.008</td>
</tr>
<tr>
<td></td>
<td>(0.83)</td>
<td>(0.77)</td>
</tr>
<tr>
<td>children6-12</td>
<td>0.003</td>
<td>0.005</td>
</tr>
<tr>
<td></td>
<td>(0.38)</td>
<td>(0.64)</td>
</tr>
<tr>
<td><em>marital status (unmarried reference)</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>married monogamous</td>
<td>-0.030</td>
<td>-0.029</td>
</tr>
<tr>
<td></td>
<td>(-0.52)</td>
<td>(-0.49)</td>
</tr>
<tr>
<td>married polygamous</td>
<td>-0.029</td>
<td>-0.023</td>
</tr>
<tr>
<td></td>
<td>(-0.44)</td>
<td>(-0.36)</td>
</tr>
<tr>
<td><em>education (primary education completed reference)</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>illiterate</td>
<td>-0.143</td>
<td>-0.160</td>
</tr>
<tr>
<td></td>
<td>(-2.92)**</td>
<td>(-3.39)**</td>
</tr>
<tr>
<td>basic literacy</td>
<td>-0.005</td>
<td>-0.022</td>
</tr>
<tr>
<td></td>
<td>(-0.10)</td>
<td>(-0.42)</td>
</tr>
<tr>
<td>some primary school</td>
<td>-0.003</td>
<td>-0.013</td>
</tr>
<tr>
<td></td>
<td>(-0.05)</td>
<td>(-0.18)</td>
</tr>
<tr>
<td>some low secondary school</td>
<td>-0.065</td>
<td>-0.060</td>
</tr>
<tr>
<td></td>
<td>(-1.03)</td>
<td>(-0.96)</td>
</tr>
<tr>
<td>lower secondary school completed</td>
<td>-0.075</td>
<td>-0.062</td>
</tr>
<tr>
<td></td>
<td>(-1.34)</td>
<td>(-1.12)</td>
</tr>
<tr>
<td>some upper secondary school</td>
<td>-0.158</td>
<td>-0.145</td>
</tr>
<tr>
<td></td>
<td>(-2.07)**</td>
<td>(-1.92)**</td>
</tr>
<tr>
<td>upper secondary school completed</td>
<td>-0.227</td>
<td>-0.209</td>
</tr>
<tr>
<td></td>
<td>(-2.67)**</td>
<td>(-2.46)**</td>
</tr>
<tr>
<td>more than secondary school</td>
<td>-0.247</td>
<td>-0.224</td>
</tr>
<tr>
<td></td>
<td>(-3.21)**</td>
<td>(-2.95)**</td>
</tr>
<tr>
<td>hours market access</td>
<td>-0.0156935</td>
<td>-0.015</td>
</tr>
<tr>
<td></td>
<td>(-1.72)*</td>
<td>(-1.65)*</td>
</tr>
<tr>
<td>home property</td>
<td>-0.096</td>
<td>-0.086</td>
</tr>
<tr>
<td></td>
<td>(-3.58)**</td>
<td>(-3.19)**</td>
</tr>
<tr>
<td><em>language (other language reference)</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>somali language</td>
<td>0.216</td>
<td>0.211</td>
</tr>
<tr>
<td></td>
<td>(3.91)**</td>
<td>(3.90)**</td>
</tr>
<tr>
<td>afar language</td>
<td>0.175</td>
<td>0.180</td>
</tr>
<tr>
<td></td>
<td>(2.62)**</td>
<td>(2.79)**</td>
</tr>
</tbody>
</table>
log of weakly wage 0.183 0.127
(2.28)** (1.68)*
peer Qateur 0.282 0.536
(1.67)* (3.08)**
N 1647 1647
R² 0.094 0.099
(a) F 23.64 19
(b) F (d) 828.23

(a) F- statistic tests the collective significance of the excluded instruments in the wage equation
(b) F- statistic tests the collective significance of the excluded instruments in the peer equation
(d) value not relevant

Appendix A.

Taking the derivative of (9) with respect to \( w \) we get:

\[
\frac{\partial}{\partial w} \left( \pi_D \right) = \frac{\partial}{\partial w} \left( \frac{p_q^D}{p_{xi}^D} \right) = \frac{p_q^D}{p_{xi}^D} \frac{dQ}{dD} + \frac{dQ}{dD} \frac{dD}{dZ_i} = \frac{p_{xi}^D}{p_q^D} \frac{dx_i^D}{dZ_i} - p_q^D \frac{dQ}{dZ_i} \frac{dZ_i}{dZ_i} = \frac{p_{xi}^D}{p_q^D} \frac{dx_i^D}{dZ_i} + \frac{dQ}{dZ_i} \frac{dZ_i}{dZ_i}.
\]

This implies that:

\[
\text{sign} \left( \frac{\partial}{\partial w} \left( \pi_D \right) \right) = \text{sign} \left( p_{xi}^D \frac{dx_i^D}{dZ_i} - p_q^D \frac{dQ}{dZ_i} \right).
\]

Assumption 1 implies that this term is positive. In fact we have that

\[
\left( p_{xi}^D \frac{dx_i^D}{dZ_i} - p_q^D \frac{dQ}{dZ_i} \right) > 0 \iff \frac{dx_i^D}{p_{xi}^D} > \frac{dQ}{p_q^D} \frac{dx_i^D}{p_{xi}^D} \iff \frac{dx_i^D}{p_{xi}^D} > \frac{dQ}{p_q^D} \frac{dx_i^D}{p_{xi}^D} \iff \begin{cases} t = \frac{dT_D}{dQ}. \end{cases}
\]

Appendix B.

A complete description for the simultaneous system would be the following:

\[
Q = \alpha_0 + \alpha_1 X_q + \alpha_2 W + u_q
\]

\[
W = \beta_0 + \beta_1 X_w + \beta_2 Q + u_w
\]

\[
P = \lambda_0 X_p + \lambda_1 Q + u_p
\]

where the last equation is (a semi-reduced form for) the job participation-selection equation, in which it is assumed that Qat use affect the probability to work. \( W \) is observed only when \( P=1 \) (only working agents), so the estimating equation for \( W \) can be written as:
\[ W = a_1 X_w + a_2 Q + g(P, X_p, Q) + e, \]

where \( g(.) \) is the counterpart of the mill ratio. If we want to estimate the drug equation with a two stage estimation procedure, we need to write a reduced form for wages in two phases. We estimate first a reduced form for \( g(.) \) using all exogenous variables in the system:

\[ P = I \{ \pi_p X_p + \pi_q X_q + \pi_w X_w > 0 \}, \]

and get \( \hat{\lambda}(X_p, X_q, X_w) \).

Then we estimate a reduced form for \( W \):

\[ W = \Pi_w X_w + \Pi_q X_q + \hat{\lambda}(X_p, X_q, X_w). \]

Finally, we should predict the wage for the whole sample (without including the mill ratio to predict wage, i.e. we are assuming that \( E(W \mid X) = \Pi_w X_w + \Pi_q X_q \)), insert the predicted wage \( \hat{W} \) into the drug equation and estimate it over the whole sample. Thus, we could estimate the drug equation even without exclusion restrictions for the selection equation (assuming for the moment that we have valid exclusion restrictions for the wage equation, that is variables affecting wage but not drug use), and the coefficients would be identified through the non-linearity of the mill ratio. This, however, would not work very well because of multicollinearity problems between the mill ratio and the regressors (see reduced form for the wage equation). This is a situation analogous to the application of the standard two stages Heckman procedure when we do not have exclusion restrictions in the structural equation. When there are no valid exclusion restrictions, the severe multicollinearity problems arising from the use of the Heckman procedure lead the two step estimation procedure to perform badly. In this case two part model is superior to the selection model even if the latter is the true one (Leung and Yu, 1996).

**Appendix C**

Standard errors need to be corrected here for the fact that when we predict wages at the first stage for the whole sample, wages are actually unobserved for part of the population. The problem is similar to that presented by Murphy and Topel (1985). They consider a model in which imputed unobserved regressors from an auxiliary econometric model are used in a two step procedure which uses these imputed values in place of the unobserved components and thus standard errors has to be corrected for the fact that unobservable regressors are estimated. We correct standard errors using the sandwich estimate for variance (Hardin, 2002, Hardin & Carroll, 2003). The general formulation for the sandwich estimator can be described as follows:

Model 1: \( E(Y_1 \mid X_1, \theta_1) \) and \( \psi_1(\theta_1) \) estimating equation for model one;

Model 2: \( E(Y_2 \mid X_2, \theta_2, E(Y_1 \mid X_1, \theta_1)) \) and \( \psi_2(\theta_2 \mid \theta_1) \) estimating equation for model two.

The sandwich estimate of the variance of the second stage model is the lower-right element of the sandwich variance-covariance matrix: \( V_s = A^t B A \), where
In the case of a linear (two stage) model this expression reduces to the (robust) asymptotic
covariance matrix of TSLS. In our model, we replace actual wages with predicted wages (for the
whole sample) from the first stage regression. We can rewrite our second stage estimating
equation in the following way:

\[ Q = \alpha_0 + \alpha_1 X_{q} + \alpha_2 \hat{W} + \alpha_2 (W - \hat{W}) + u_q = \alpha_0 + \alpha_1 X_{q} + \alpha_2 \hat{W} + \nu, \]

where \( \hat{W} \) is the predicted the wage for the whole sample form the first stage and
\( \nu = \alpha_2 (W - \hat{W}) + u_q = \alpha_2 \epsilon + u_q. \) Then the sandwich estimator of the variance gives:

\[
V_S = \left( \hat{X}^T \hat{X} \right)^{-1} \hat{X}^T \nu \nu^T \hat{X} \left( \hat{X}^T \hat{X} \right)^{-1} = \left( \hat{X}^T \hat{X} \right)^{-1} \hat{X}^T \left[ \hat{\sigma}_{u_q}^2 \left( 1 + \hat{\alpha}_2 \hat{\sigma}_\epsilon^2 \hat{\sigma}_{u_q}^2 \right) \right] \hat{X} \left( \hat{X}^T \hat{X} \right)^{-1}
\]

\[
= \left[ \hat{\sigma}_{u_q}^2 \left( 1 + \hat{\alpha}_2 \hat{\sigma}_\epsilon^2 \hat{\sigma}_{u_q}^2 \right) \right] \left( \hat{X}^T \hat{X} \right)^{-1}
\]

where \( \hat{X} = (X_q \ \hat{W}) \).

Appendix D: Variables Description

**Dependent Variables**

**Qat Equations**

*Log of weakly Qat consumption:* natural logarithm of weakly Qat consumption in hundreds of grams. Qat is bought on the market in bundles of different sizes at a given price. We summed all the grams corresponding to the different types of bundles purchased.

*Qateur* defined to equal one if Qat is consumed and zero otherwise.

**Wage equation**

*Log of weakly wage:* natural logarithm of weakly wages. Data were available in terms of daily, weakly and monthly wages. We transformed all the figures in weakly wages.

**Explanatory Variables**

**Education level**

The education system in Djibouti is patterned after the French system: six years of primary education, followed by four years of lower and three years of upper secondary education. The questionnaire asks about both formal years of schooling completed and literacy level (i.e. ability
to read and make calculations). The literacy levels in Djibouti are very low compared to the average literacy rates for lower middle-income countries. We construct a set of nine dummies variables that combine both types of information and identify nine broad levels of education: *Illiterate* defined to equal one if the individual cannot read and make simple calculations. *Basic Literacy*: defined to equal one if the individual can read and make simple calculations but has no formal years of schooling and zero otherwise. *Some Primary School*: defined to equal one if the individual has some level of primary education and zero otherwise. *Primary School Completed*: defined to equal one if the individual has completed the primary education and zero otherwise. *Some Low Secondary School*: defined to equal one if the individual has some level of low secondary education and zero otherwise. *Low Secondary School Completed*: defined to equal one if the individual has completed the low secondary school and zero otherwise. *Some Upper Secondary School*: defined to equal one if the individual has some level of upper secondary education and zero otherwise. *Upper Secondary School Completed*: defined to equal one if the individual has completed the upper secondary school and zero otherwise.  *More than Secondary*: defined to equal one if the individual has more than upper secondary school education and zero otherwise.

**Marital Status**
*Unmarried*: defined to equal one if the individual is never married widow or divorced and zero otherwise.  *Married monogamous*: defined to equal one if the individual has one wife and zero otherwise  *Married polygamous*: defined to equal one if the individual has more than one wife and zero otherwise.

**Language**
The linguistic criteria selected for the interview allow the households to choose the language in which complete the interview. This allowed the three principal ethnic groups (Somali, Afar and Arabic) in the population responding in their language. *Somali language*: defined to equal one if the individual use Somali language and zero otherwise.  *Afar language*: defined to equal one if the individual use Afar language and zero otherwise.  *Other language*: defined to equal one if the individual use Arabic, French or others languages and zero otherwise.

*Djibouti-ville*: defined to equal one if the individual lives in the capital Djibouti-ville and zero otherwise.  *Urban*: defined to equal one if the individual lives in other urban centers and zero otherwise.  *Rural*: defined to equal one if the individual lives in the rural areas and zero otherwise.  *Weakly non labor income*: defined to equal one if there is a source of non-labor income in the household. This includes, among others, financial revenues, pensions, subsidies and in particular transfers from friends and relatives abroad or in the country.  *Children0-5*: number of children aged 0-5 years.  *Children 6-12*: number of children aged 6-12 years.  *Age*: age in years of the household head.
**Hours market access:** distance in hours to the nearest supplies market.

**Home property:** defined to equal one if the household owns the home and zero otherwise.

**Peer Qateurs:** is the proportion of male household heads in the area considered who consume Qat (excluding the behaviour of individual $i$)