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Does Khat Consumption Affect Work Performance ? A Micro-Perspective from Djibouti

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Abstract

Khat consumption has become a widespread habit with immense socio-economic and cultural significance in Djibouti. As a cash crop, its production provides an important source of employment and income. Yet, its widespread consumption is of grave concern to policymakers. While the poor health implications of Khat use are well established, its impact particularly on the labor market remains relatively unknown. The present study, therefore, seeks to investigate the relationship between khat consumption and work performance using data comprising, 737 chewers and non-chewers based in six major urban centers of Djibouti. Using an instrumental variable identification strategy, and several econometric techniques, we find a negative and statistically significant relationship between the habitual use of Khat and work performance. The result is robust across all specification, econometric techniques, and even after accounting for the differences across income groups and educational levels. Our findings underscore the need for community sensitization on the negative labor market implications of khat use.

JEL Classification: O10, O55, C21, L65, J40

Keywords: Work performance;khat; instrumental approach;Djibouti.

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1. Introduction

Khat (*Catha Edulis*)[1] is increasingly becoming a drug of international importance despite being traditionally associated with East Africa and parts of the Middle East. Its cultivation provides a source of livelihood to millions of households, while its consumption is argued to enhance social cohesion and an increased sense of well-being (Gezon, 2012). Khat consumers report an immediate sense of euphoria with high levels of alertness and energy (Tesfaye, Krahl, and Alemayehu, 2020). Khat is perceived to increase concentration, enhance endurance and resistance to fatigue, and is credited for fostering social relationships (Borelli, 2009). Excessive use of Khat could however have a detrimental effect on the health of its users. Khat consumption is associated with depression and distress (Nakajima et al., 2017), high blood pressure (Tesfaye, 2008), and stroke (Benois et al, 2009).

Despite the growing public health concerns, khat use is rising in popularity particularly among the youth. It is estimated that over 20 million people use khat on regular basis around the world. This number is expected to increase over time with low and middle-income countries at the greatest risk (Eckersley, Salmon, and Gebru, 2010). This alarming trend has led to the ongoing debate on khat use with a growing international call to ban the production and use of the substance. Whereas the psychoactive component (Cathinone) of the drug has been banned under the international drug convention, the possession and use of the khat plant itself remain uncontrolled in many countries.

Several empirical studies have discussed consumption trends and highlighted the adverse health effects of Khat use see for instance Nakajima et al. (2017), Abebe (2018), Anderson et al. (2020), and Alemu et al. (2020). However, its economic implications are thus far less studied. Khat consumption could have significant implications for educational attainment, productivity, earnings, and economic growth. Yet, to our knowledge, no empirical analysis exists on the productivity and labor market implications of the increasing use of khat despite its potentially important negative impact on labor market outcomes.There are several ways via which khat use and addiction can impact the labor market. For instance, by impairing people's cognitive ability, khat use could limit productivity as excessive use of the drug could result in work accidents and delays. Moreover, prolonged use of khat could have a detrimental effect on the user's health and as a consequence, limit their ability to work or work effectively. Khat addiction could also increase the opportunity cost of leisure as it affects people's propensity and motivation to work, thus, leading to an increase in work absenteeism.

Against this backdrop, this paper examines the work performance implications of the growing use of khat, focusing on the African country of Djibouti. Khat consumption is an activity of immense social and cultural significance in Djibouti. Khat is usually consumed in social gatherings with sessions lasting many hours. It is estimated that 50% of households in Djibouti have at least one khat user, and an average household spends 40% of their income on khat consumption (Milanovic, 2008). Besides, khat users in Djibouti spend on average

[1] The Khat (Catha edulis) is a green plant, cultivated by gressage is in the form of a bush or small trees. The plant in question grows in arid areas at an attitude of 1500-2500 meters above sea level under optimal conditions (Anderson and Carrier, 2009).

1,440 hours on khat consumption (World Bank, 2011). In this study, we employ data from the survey of Khat consumption dynamics carried out in 2011 by the National Institute of Djibouti (INSD) in collaboration with the World Bank to examine in detail the impact of khat use on labor market outcomes with an emphasis on work performance. Moreover, we address the prevailing analytical issues in the literature using an instrumental variable identification strategy. Results from our analysis suggest that khat consumption impedes work performance in Djibouti.

The rest of the paper is structured as follows: Section 2 discusses the background and related literature on illicit drugs and labor market outcomes. Section 3 presents the data and outlines the estimation procedure. Section 4 presents the findings and discussion while section 5 concludes.

2. Background and Related Literature

This section discusses the cultural and social traditions of khat use in Djibouti and reviews literature relevant to our study. We combine the literature on the effect of drug use on education and labor market supply, and the role of substance abuse and addiction in influencing people's labor market decisions and outcomes.

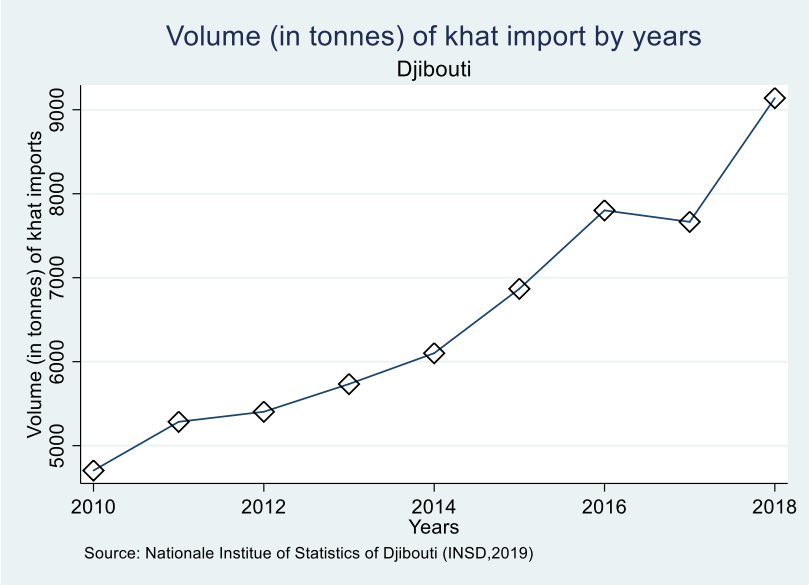
2.1. Productivity and the cultural traditions of khat use in Djibouti

Khat is considered a legal substance in Djibouti and its consumption is widely distributed across social circles. Khat plays an important social role in Djibouti due to its ability to facilitate social cohesion. Working groups, friendships, social networks, and relationships of proximity are established around a session of khat, often in a mabraze[2]. Khat is chewed for a few hours, usually in the afternoon in the company of friends and families. No conflict or dispute is settled in Djibouti without going through one or more sessions of khat. However, its addiction can lead to social problems, especially among young people. Social impacts at the family level are also often cited, including divorce, family conflict, and the prolonged and often repeated absence of one or both parents (World Bank, 2011).

The khat consumed in Djibouti is mostly imported from Ethiopia. Since 2010, khat import has increased remarkably, except for 2017 where imports were disrupted due to political tensions and instability (see Figure 1). The khat industry accounts for 4% of the country's GDP and employs thousands of workers, mostly women, in the private sector. The trade of this hallucinogenic drug is taxed up to six dollars per kilogram[3]and contributes over 30 million dollars per year to the country's GDP (World Bank, 2011).

[2] A place to meet and consume khat.
[3] 10 to 11 tonnes of khat are imported daily.

Figure 1: Volume (in tonnes) of khat imports by year



Users spend an average of 1,440 hours a year on khat consumption. At the national level, a total of more than 900,000 hours per day are devoted to khat consumption. Widespread use of khat could be a cause of Djibouti's low labor productivity and international competitiveness. On average, nominal wages at the current exchange rate are 3 to 6 times higher in Djibouti than in nearby Ethiopia and Yemen respectively. Low labor productivity is therefore a handicap for the competitiveness of the Djiboutian economy (World Bank, 2011).

2.2. Illicit drug use and labor market outcomes

Theoretical literature has emphasized the potential adverse effect of illegal drug use on labor market outcomes and education. Inherent in the theoretical literature on the nexus between labor market outcomes and illicit drug use is its potential adverse effect on users' wages and income. Economic theory posits that the price of labor (wages) in a competitive labor market is determined by demand and supply forces. By extension, profit-maximizing firms pay wages that equals the market value of the marginal product of labor. Productivity thus becomes important in determining the differences in wages. More productive workers are expected to earn more than less productive workers and vice versa.

By impairing people's cognitive ability, drug use has the potential to limit not just the productivity of the user but also the productivity of others via accidents. This in turn impacts wages. Drug use could also affect productivity and wages indirectly through its impact on human capital. High educational attainment signals high levels of skills and knowledge (human capital accumulation) and as a result, commands higher wages and income. Conversely, increased drug use is associated with lower educational attainment (Ellis, Kasper, and Cicero, 2020), low levels of skills (Pacula et al., 2003), and lower wages (Mezza and Buchinsky, 2020). Besides, drug use increases the cost associated with being hired, and as a consequence, lowers the employment prospects of users as more firms resort to screening potential hires.

Another relevant labor market outcome is the incidence and quantity of work. Labor earning is a function of wages and hours worked. Drug use could affect people's propensity to work, and this, in turn, can impact total earnings and wellbeing. A drug user must allocate his/her time among three competing alternatives; work, leisure, and other non-work activities. The optimal time allocation among the given alternatives according to economic theory depends to some extent on the wages, the price of market goods (drug), and the user's taste and preferences. High wages increase the cost (opportunity cost) associated with leisure and drug use, thus motivating drug users to spend more time working. Similarly, increases in the price of a drug increase the opportunity cost of using drugs while making the time spent on leisure and work more lucrative. There is also a growing indication that drug use influences people's labor supply decisions through its impact on health and cognitive judgment. Prolonged drug use could have a detrimental effect on users' health while limiting their ability to work. Drugs could also encourage work absenteeism as excessive usage impairs rational judgment and time management. Austin, Skinner, and Watson (2020) document that drug use increases work absenteeism with the effect greater for illegal drugs. Hilte (2019) also study the effect of psychoactive drug use on time management and find that illegal drug users face enormous challenges in synchronizing time compared to legal drug users.

Empirically, researchers have examined the aforementioned theoretical assertions. For example, Chatterji (2006) uses data from the National Education Longitudinal Study, and an instrumental variable approach to examine the effect of illicit drug use on educational attainment. Using state-level drug policy as an instrument, the author finds a negative and statistically significant association between prior marijuana and cocaine use, and educational attainment. Likewise, findings from Pacula et al. (2003) suggest that marijuana use impairs cognitive ability and leads to a reduction in human capital formation. Drug use is also disproportionately associated with people with less than a high school diploma (See, Carliner et al., 2017).

The effect of drugs such as cannabis and cocaine use on labor market outcomes has also been empirically explored with mixed results. Whereas the traditional view is that illicit drug use harms labor market outcomes, recent indications show that the effect may be conditional on the level of addiction, the type of drug use, and age group. Kaestner (1991), and Gill and Michaels (1992) for example, find a positive relationship between drug use and wages. Registrer and Williams (1992), reached a similar conclusion but, find no significant effect of cocaine use on wages. Conversely, Mezza and Buchinsky (2020) find a negative association between marijuana use and wages, and this effect increases with the frequency of marijuana use.

Regarding the effect of illicit drug use on employment outcomes, French et al. (2001) document that chronic drug use hinders employment and labor force participation while non-chronic drug use has no statistically significant effect. Similarly, Buchmueller and Zuvekas (1998) provide evidence of a negative association between heavy illicit drug users and employment for people in their mid-ages (35-45 years) but find no significant employment effects for younger drug users. Past drug use is also linked with the likelihood of future unemployment (MacDonald and Pudney, 2001). Illicit drug use has also been found

to hamper users' motivation (Pelissier and Jones, 2006), memory and cognitive skills (Levent and Davelaar, 2019), and lifetime earnings (Kandel, Chen, and Gill, 1995).

Overall, the literature remains ambiguous when it comes to the impact of illicit drugs on labor market outcomes. This ambiguity stems from the differences in the data sample, and more importantly, the problem of endogeneity. Most of the studies fail to account for the potential reverse causality between labor market outcomes and drug use, which leads to biased estimates. Besides, while previous studies have emphasized the role of illicit drugs such as cocaine and marijuana in influencing labor market outcomes, no consideration has been given to Khat, a natural stimulant of growing global importance. Previous research on khat has been limited to its growing adverse effects and cultural significance. We address this important research oversight by analyzing the effect of Khat consumption on educational attainment, employment, productivity, and income while controlling for potential endogeneity.

3. Data and empirical methodology

3.1. Data

Our analysis is based on the survey of khat and its dynamics in Djibouti in 2011. This survey of 737 households was conducted by the National Institute of Statitics of Djibouti (INSTAD) in collaboration with the World Bank. The survey area covers the capital, Djibouti-Ville, and the five regional capitals, Ali-Sabieh, Arta, Dikhil, Obock, and Tadjourah.These six urban centers collectively account for the country's population. The survey contains a wide range of information including the socio-economic and demographic characteristics of households, Khat expenditure, and the number of days khat was consumed during the week/month preceding the survey. Table 1 corresponds to the percentage of khat chewers and non-chewers by household characteristics. The percentage of khat chewer households is significantly higher among male-headed households at each income level and in each geographical location (i.e.the capital Djibouti-Ville and other urban places). Therefore, we can reasonably treat the male-headed household as the representative consumers of khat. Table 2 presents descriptive statistics of the variables used in the analysis (see Appendix A for a description of the variables). The table reveals that about 69% of observations in the sub-sample live in Djibouti-Ville while 31% live in other urban areas. The literacy rates in Djibouti are very low compared to the average literacy rates for lower-middle-income countries: 46% of household heads are illiterate. The data show that Khat consumption is widespread among the population, with khat users (qateurs) making up half (49%) of the total number of household heads. Food items represent the largest share of household expenditure (see Table 3). This is followed by spending on Khat, which is even higher than education and healthcare expenditure.

Table 1: Percentage of Khat chewers and non-chewers by household characteristics

Household characteristics	Whole sample (%) (n= 737)	Chewers (%) (n= 364)	Non-chewer (%) (n= 374)
	(1)	(2)	(3)
Income group[a]			
50,000 – 160,000 Fdj	82	88	77
> 160,000 Fdj	18	12	23
Education of the head			
Illiterate	46	41	52
Literate	54	59	48
Location			
Djibouti -Ville	69	66	71
Other urban	31	34	29

Source: Authors' elaboration using khat (2011). [a]Extreme poverty (poverty) at Fdj 50,000 (160,000) per year per adult equivalent; US $1 = Fdj 177.72 in 2020.

Table 2: Descriptive statistics of household heads

		Mean	SD
Location			
	Djibouti-ville	0.688	
	Other urban	0.312	
Age of HH		46.24	12.85
Gender of HH			
	Male	0.817	
	Female	0.183	
Marital status of HH			
	Married	0.821	
	Unmarried	0.179	
Education of HH			
	Illiterate	0.461	
	Secondary school	0.214	
	Higher education	0.102	
Weekly khat expenditure (Fdj)		707.353[a]	640.905
Chewer		0.493	
Dependency ratio		9.260	
Household size		2.099	
Domestic violence		0.559	

Source: Authors' elaboration using Khat (2011). Note : Standard deviation reported for non-dummy variables. n=737, [a]Values computed for chewers

Table 3: Average expenditure share of the household head

Variables	Chewers (n= 364)		Non- chewers (n= 374)	
	Mean	SD	Mean	SD
Food	743.501	307.102	803.804	365.979
Education	26.802	141.502	38.023	177.109
Rent	26.383	150.366	36.018	177.505
Clothing	445.527	490.899	515.040	494.478
Health	23.483	141.805	36.161	177.566
Transportation	23.452	132.603	35.432	170.423
Energy	299.730	440.582	311.810	444.986
Khat	699.173	623.019	0.000	0.000
Others	88.311	548.828	138.244	699.830

Source: Author's elaborations from Khat Data (2011)

3.2. Variable description

3.2.1 Dependent variable: Work performance

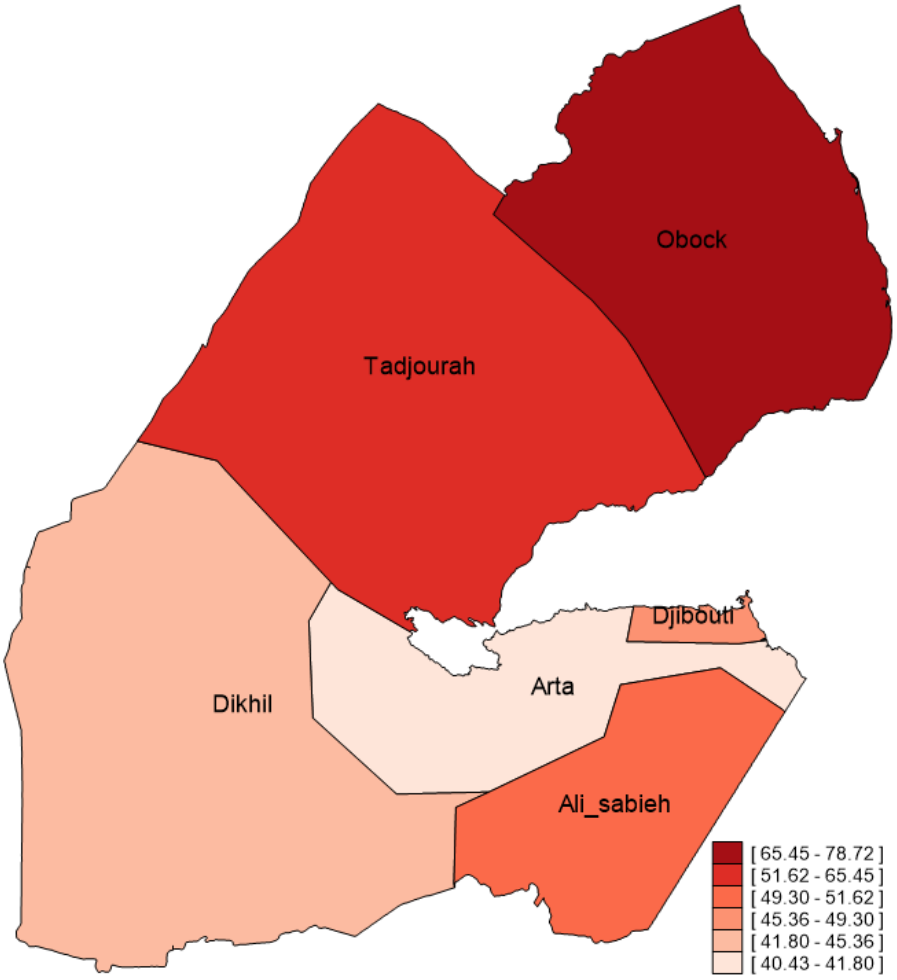
The dependent variable used in our empirical analysis corresponds to work performance or productivity. It is a binary variable that takes the value of 1 if the heads of households experienced poor work performance as a result of khat consumption and zero otherwise. At least 82% of households report experiencing a deterioration in work performance as a result of khat consumption while 18% claim that moderate consumption improves work performance (see Table A1 in the appendix).

3.2.2 Variables of interest

Our variables of interest include : (i) the consumption of khat, a binary variable indicating whether or not households consume khat (ii) the expenditure of khat in two ways: (a) as a binary variable, i.e. whether households spent between $2 - 30 DF to chew or not. The reason for choosing this range is that 38% of households that consumed khat had an income of less than 50,000 Djibouti francs ($281). This shows that most consumers were poor and had low wages. (b) as a continuous variable, which corresponds to the total amount of expenditure of khat. (iii) The proportion of household expenditure allocated to khat.

About 51% of households consume khat while the remaining 49 percent do not consume khat but use their expenditure for other purposes such as food, clothing, etc. (Table A1 in appendix). In terms of khat consumption, households from the northern regions (Obock and Tadjourah) show the highest incidence with consumption rates of 79% and 52% respectively. Households from the southern regions (Dikhil and Ali-sabieh) and the capital Djibouti City have lower khat consumption rates of 43%, 51%, and 48% respectively. Households from the Arta region have the lowest khat consumption rate compared to other regions, with a consumption rate of 40% (Map 1).

Map 1: Khat consumption by region



Source : Authors' elaboration using khat data (2011)

3.2.3 Control variables

The control variables used in our econometric analysis relates to the sociodemographic characteristics of the household including, age of the head of household, gender, marital status, education (or education) level, household income, number of days during the past week/month khat was consumed, regions, household size, and dependency ratio. The data show that 82% of households in which the head is married consumed khat. Out of the households that consume khat, 46% of the heads are uneducated, 22% have primary or secondary level education while only 10% possess a university education. 69% of households that consume khat are from the capital (Djibouti-city), while the remaining 30% are from the interior regions, Ali-sabieh, Arta, Dikhil, Obock, and Tadjourah. 38% of households had an income below $282, 20% had an income between $282 - 451, 10% had an income between $451- 676, 6% had an income between $676-900, and 8% of households had an income above $900.

3.3. Empirical methodology

In this study, the relationship between khat consumption and work performance is established as follow:

$$\text{Work}_\text{i}^* = \beta X_i + \alpha K_i^* + \varepsilon_i \quad (1)$$

$$\varepsilon_i \sim NID\ (0,1)$$

$$\text{Work}_\text{i}^* = = 1\ if\ \text{Work}_\text{i}^* = > 0$$

$$\text{Work}_\text{i}^* = = 0\ if\ \text{Work}_\text{i}^* = \leq 0$$

Where Work_i^* defines the Work Performance, taking 1 if the household head has experienced a low performance at work following the consumption of khat, and 0 otherwise. K_i^* is a vector of khat indicators. X_i is a set of additional controlled variables, which are assumed to be exogenous and may influence work performance. ε_i is the error term. The probit model follows a standard normal distribution function. β and α are the coefficients of the parameters, which are estimated using the maximum likelihood method.

According to Amemiya, (1981), Maddala (1983), Lee (1996), Franses and Paap (2001), and Wooldridge (2002), the likelihood contribution of observation i with $\text{Work}_\text{i}^* = 1$ is given by $P\{\text{Work}_\text{i}^* = 1|K_i^*\} = 1$ as a function of the unknown parameter vector β, and, similarly for $Work_i = 0$. The likelihood function is estimated as follows:

$$L(\beta) = \prod_{i=1}^{N} P\{\text{Work}_\text{i}^* = 1|K_i^*;\beta\}^{y_i} P\{\text{Work}_\text{i}^* = 0|K_i^*;\beta\}^{1-y_i} \quad (2)$$

It is estimated with the log-likelihood function and substitutes $P\{\text{Work}_\text{i}^* = 1|K_i^*;\beta\} = F(\ K_i^{*\prime})$. We obtain:

$$log\ L(\beta) = \sum_{i=1}^{N} \text{Work}_\text{i}^* = logF(K_i^*\beta) + \sum_{i=1}^{N}(1 - Work_i)\log(1 - F(K_i^*\beta)) \quad (3)$$

We then estimate the first-order condition of the maximum likelihood problem. Differentiating with respect to β yields:

$$\frac{\delta log\ L(\beta)}{\delta \beta} = \sum_{i=1}^{N}\left[\frac{Work_i - F\left(K_i^{*\prime}\beta\right)}{F\left(K_i^{*\prime}\beta\right)(1-F\left(K_i^{*\prime}\beta\right))} F\left(\ K_i^{*\prime}\beta\right)\right] K_i^* = 0 \quad (4)$$

According to Verbeek et al. (2004), the first-order conditions states that each explanatory variable should be orthogonal to the generalized residual (over the whole sample). This is comparable to the OLS first-order conditions, which state that the least-squares residuals are orthogonal to each variable in K_i^*.

The solution of equation (4) is the maximum likelihood estimator β. From this estimation, we then calculate the probability that $Work_i = 1$ for a given K_i^*. The probit model specifies the conditional probability:

$$p = \phi(K_i^{*\prime}\beta) = \int_{-\infty}^{K_i^{*\prime}\beta} \phi(z)dz \quad (5)$$

$$p = \int_{-\infty}^{K_i^{*\prime}\beta} \frac{1}{\sqrt{2\pi}} exp^{-0.5(K_i^{*\prime}\beta)^2} dz \quad (6)$$

Where $\phi(.)$ is the standard normal CDF, with derivative $\phi(z)$ which is the standard normal density function. The probit model marginal effect are:

$$\frac{\delta p_i}{\delta K_{ij}^*} = \phi(K_i^{*\prime}.\beta)\beta_j \quad (7)$$

From equations(1), the estimated results may be biased by the potential endogeneity of the treatment. We, thus address this problem via the introduction of instrumental variables. Rationally, the orthogonality of instruments to the error term requires that they be uncorrelated with omitted variables so that when we are interested in the effect of K_i^* on $Work_i$, and Z_i is an instrument, then Z_i can only affect $Work_i$ through its effect on K_i^*, and not through any other mechanism (Deaton, 2010).

We employ two instrumental variables, namely social pressure and enjoyment. As emphasized by Weir (1985) and Kennedy (1987), social pressure to consume is a key element influencing individual consumption decisions. As discussed previously, khat is often consumed in social gatherings which are also the venues for discussing local matters and solving disputes. Participants of these gatherings consume khat not only for recreation but also out of expectations to conform to group.

Subsequently, we can transform the $probit$ model with continuous endogenous regressors, applying with stata commend $ivprobit$, as follows:

$$\text{Work}_\text{i}^* = \beta X_i + \alpha K_i^* + \varepsilon_i \quad (8)$$

$$K_i^* = \gamma X_i + \xi Z_i + \eta_i$$

Where, Z_i is $1 \times z$ vector of additional instruments. By the assumption, $(\varepsilon_i, \eta_i) \sim N(o, \sigma)$, where $\sigma_{11}$is normalized to one to identify the model. ξ is the matrix of parameters. ε_i and η_i are the independent and identically distributed multivariates for all i. The equation $Work_i$ is observed then:

$$Work_i = \begin{cases} 0 & \text{Work}_\text{i}^* < 0 \\ 1 & \text{Work}_\text{i}^* \geq 0 \end{cases} \quad (9)$$

For equation(9), the Wald test for exogeneity of the instrumented variable is applied. An insignificant test statistic implies, no sufficient information in the sample to reject the null hypothesis that there is no endogeneity. Thus, a regular $probit$ regression may be appropriate. The point estimates from $ivprobit$ are consistent, though those from $probit$ are likely to have smaller standard errors (StataCorp, 2013). Finally, the minimum chi-squared estimator with the two-step estimators of Newey (1987) are computed for the endogenous $probit$ model.

Besides, three matching techniques, namely PSM, IPW and AIPW are used to account for the possibility that households who benefited from the microcredit differ from those who did not could be considered non-random. The mean treatment effects (ATE) and the mean treatment effects on treated persons (ATT) are obtained. After the PSM estimations, we check the balance of the treatment groups and the sensitivity. Finally, we also perform a variety of

robustness measurements.

According to StataCorp (2013), the PSM estimator uses a treatment model, $\rho(z_i, t, \gamma)$ to model the conditional probability that observation i receives treatment t given covariates z_i. When matching on the estimated propensity score, the set of nearest-neighbor indices for observation $i, i = 1; \ldots ; n$, is:

$$\Omega_m^p(i) = \{j_1, j_2, \ldots, j_{mi} | \, t_{jk} = 1 - t_i, | \, \hat{p}_i(t) - \hat{p}_{jk}(t)| < |\hat{p}_i(t) - \hat{p}_l(t)|, \, t_l = 1 - \, t_i, l \# j_k\} \tag{10}$$

where $\hat{p}_i(t) = \rho(z_i, t, \hat{\gamma})$. m_i is the smallest number such that the number of elements in each set, $m_i = |\Omega_m^p(i)| = \sum_{j \epsilon \Omega_m^p(i)} w_j$, is at least m, the desired number of matches.

The IPW implements a smooth treatment-effects estimator, which then developed to the AIPW. According to StataCorp (2013), the AIPW estimating functions for the treatment parameters include terms from a conditional probability model and a conditional mean model for the outcome. The sample-estimation-equations vector has three parts for the AIPW estimators:

$$S_{aipw,i}(x_i, z_i, \hat{\theta})' = \left[S_{aipw,e,i}(x_i, z_i, \hat{\theta})', \; S_{aipw,tm,i}(z_i, \hat{\gamma})', S_{aipw,om,i}(x_i, w_i(t), \hat{\beta})'\right] \tag{11}$$

Where $S_i(x_i, z_i, \hat{\theta})'$ are the sample realizations of the estimating functions. The $aipw, e, tm, om, i$ and $x_i, z_i, \hat{\theta}, \hat{\gamma}, w_i(t), \hat{\beta}$ are the parameters of smooth treatment-effects estimators.

4. Empirical results

Firstly, we study the overall relationship between khat consumption and work performance. The analysis is carried out in relation to khat expenditures by dividing households into two groups: households having spent between $\$2 - 30$ to chew khat and those having spent more than \$30. More than 77% of the households in the data set spent between 2 and 30 dollars on khat consumption. Secondly, we analyze the proportion of household expenditures allocated to khat consumption. We begin by presenting some descriptive statistics showing the difference between chewers and non-chewers (i.e. consuming and non-consuming households). Table 4 presents the bivariate statistics for khat consumption. We observe that chewers and non-chewers households differ somewhat in most of the economic, demographic, and geographical characteristics. Moreover, we observe that khat consumption decreases with the level of education.

4.1. Probit estimation and IV approach

Table 5 presents the results of the effects of khat use on work performance using the incidence of khat consumption and expenditure of khat as our variables of interest (Columns 1 and 2). Using the Probit and IV-Probit approach, we find a negative and statistically significant association between khat consumption and work performance (Column 1 of Table 5).

Table 4: Socio-demographic characteristics of the respondent

Dependent variable	Total Sample		Chewers		Non-Chewers		Mean difference
	(1)		(2)		(3)		(4)
	Mean	SE	Mean	SE	Mean	SE	D.Mean (t-test)
Work performance	0.428	(0.018)	0.594	(0.025)	0.266	(0.022)	-0.327
Age of HH	46.224	(0.456)	45.069	(0.590)	47.352	(0.688)	2.282**
Gender of HH							
Male	0.817	(0.014)	0.964	(0.010)	0.674	(0.024)	0.291***
Female	0.182	(0.014)	0.036	(0.010)	0.326	(0.024)	0.290
Marital status							
Married	0.821	(0.014)	0.920	(0.014)	0.725	(0.023)	0.196***
Unmarried	0.136	(0.122)	0.034	(0.009)	0.236	(0.021)	0.203
Education of HH							
Illiterate	0.459	(0.018)	0.401	(0.025)	0.505	(0.025)	0.114***
Secondary school	0.221	(0.015)	0.270	(0.023)	0.173	(0.019)	-0.097**
Higher education	0.103	(0.018)	0.082	(0.014)	0.123	(0.016)	0.041*
Location							
Djibouti-Ville	0.687	(0.009)	0.662	(0.025)	0.711	(0.023)	0.049***
Other urban	0.313	(0.017)	0.338	(0.025)	0.289	(0.023)	0.049**
Dependency ratio	9.276	(0.117)	9.204	(0.169)	9.346	(0.163)	0.142
Household size	2.098	(0.030)	2.075	(0.042)	2.121	(0.042)	0.046

Source: Authors' calculation**. Note:** D.mean is the differences in mean of non-chewers (3) and chewers (2). Standard errors are given in parentheses. *** p< 0.01; **p<0.05; *p<0.1

The marginal effect of the khat indicator presented at the bottom of Table 5 shows that households that chewed khat are 31.4% less likely to be efficient or productive at work. In the same vein, the result in column 2 of Table 5 shows that the relationship between khat expenditure and work performance is negative and statistically significant at the 1% significance level. The marginal effect of khat expenditure shows that a 1% spending on khat is associated with a 2% lower likelihood that the household head would be productive at work. This result is consistent with findings that suggest that drug use leads to work delays, accidents, and absenteeism (see, Giannini and Castellani, 1982).

This result is valid for IV-Probit model estimates with the both interest variable, khat expenditure and the porportion of households expenditure on khat (Columns 1 and 2, Tables 6).

We also investigate whether there is a link between the proportion of household expenditure allocated to khat and work performance. The results presented in Table 6 (columns 2) show that the households which allocate larger proportions of their finance to khat consumption have poorer work performance. The control variables included in the estimates are more or less significantly associated with work performance. The probability of consuming khat is negatively associated with the education level of the household head. Levels of education above secondary school significantly reduce the probability of

consuming khat compared with those with no education, with the largest effect associated with education levels above secondary school. When other household characteristics are taken into account, higher levels of education are likely to reflect some education efficiency effect. For example, highly educated people may have more knowledge about the harmful effects of qat use and thus be less likely to use. On the other hand, education may alter tastes and preferences in ways that promote healthy behaviors (Boreli, 2009).

Table 5: Khat use and work performance – Probit estimation

Variables	Work performance			
	Khat consumption		Khat expenditure	
	Coef	SE	Coef	SE
	(1)		(2)	
khat consumption/ expenditure	-1.625***	(0.217)	-0.081**	(0.157)
Age of HH	0.008**	(0.006)	0.005**	(0.005)
Gender of HH (ref=female)				
Male	0.534***	(0.283)	0.889***	(0.249)
Marital status				
Married	0.562**	(0.124)	0.423**	(0.254)
Single	0.567	(0.272)	0.419	(0.329)
Education level of HH (ref: primary)				
Illiterate	0.079	(0.200)	0.060	(0.159)
Secondary	-0.166**	(0.169)	-0.068**	(0.174)
Higher	-0.162**	(0.191)	-0.253**	(0.255)
Region (ref: Djibouti)				
Ali-sabieh	0.371**	(0.170)	1.400**	(0.460)
Dikhil	0.260	(0.386)	0.359	(0.331)
Obock	0.447*	(0.251)	0.524*	(0.264)
Tadjourah	0.839*	(0.436)	0.931	(0.390)
Income				
> 50 000	-0.245*	(0.252)	-0.324*	(0.217)
50 000 - 80 000	-0.498**	(0.258)	-0.464**	(0.221)
80 000 - 120 000	- 0.677**	(0.296)	-0.523*	(0.299)
120 000 - 160 000	-0.235*	(0.329)	-0.249*	(0.299)
> 160 000	-0.506*	(0.370)	-0.413*	(0.314)
Self-employment	-0.437**	(0.415)	0.206	(0.375)
Employe	-0.202***	(0.182)	0.268	(0.178)
Worker/craftsmen	0.074**	(0.277)	0.069	(0.271)
Dependency ratio	0.007	(0.021)	0.007	(0.019)
Household size	-0.089	(0.074)	0.085	(0.070)
Marginal effects	0.314***	(0.036)	0.018***	(0.035)
Constant	2.612	(0.474)	2.221***	(0.370)
Observation	737		737	

Source: Author's Elaborations from khat Data (2010).

Notes: Standard errors given in parentheses. *** p< 0.01; **p<0.05; *p<0.1

Table 6: Khat use and work performance – IV probit estimation

Variables	Work performance			
	Khat expenditure		The proportion of household expenditure on khat	
	(1)		(2)	
	Coef	SE	Coef	SE
khat expenditure/Proportion of household expenditure allocated to khat	-0.002***	(0.001)	-0.004***	(0.002)
Age of household head	-0.007	(0.004)	-0.003	(0.004)
Gender of HH (ref=female)				
Male	0.284*	(0.249)	0.350*	0.267
Marital status of the household head				
Married	0.312	(0.247)	0.409**	(0.266)
Single	-0.240	(0.293)	0.209	0.310
The education level of HH (ref: primary)				
Illiterate	0.004	(0.119)	0.039	(0.124)
Secondary	-0.186**	(0.137)	0.189	(0.143)
Higher	-0.009**	(0.205)	0.044	(0.214)
Region (ref: Djibouti)				
Ali-sabieh	0.860**	(0.248)	0.952	(0.262)
Dikhil	0.128	(0.212)	0.038	(0.226)
Obock	0.123*	(0.183)	0.227	(0.188)
Tadjourah	0.205*	(0.222)	0.167	(0.238)
Income				
> 50 000	-0.053*	(0.150)	-0.398	(0.169)
50 000 - 80 000	-0.166*	(0.169)	-0.115**	(0.179)
80 000 - 120 000	-0.416*	(0.191)	-0.392**	(0.201)
120 000 - 160 000	-0.325**	(0.239)	-0.047	(0.250)
> 160 000	-0.277**	(0.235)	-0.254	(0.247)
Self-employment	-0.122**	0.303	0.030	0.274
Employed	-0.208**	0.155	0.260	0.145
Worker/craftsmen	0.102**	0.226	0.086	0.210
Dependency ratio	0.011	(0.013)	0.015*	(0.014)
Household size	-0.028	(0.053)	-0.091	(0.056)
Constant	0.869***	(0.366)	1.017***	(0.379)
Observation	737		737	
Wald test of exogeneity				
Peer pressure	58.69***		62.87***	
Enjoyment	20.19***		35.59***	

Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 7: Khat use and work performance – PSM estimation

Propensity score match	Khat consumption		Khat expenditure	
	Coef	SE	Coef	SE
Unmatched	-0.650***	(0.026)	-0.575***	(0.041)
ATT	-0.6501***	(0.031)	-0.7294***	(0.051)
Observation	737		737	

Source: Author's Elaborations from khat Data (2010). Notes: Standard errors given in parentheses. *** p< 0.01; **p<0.05; *p<0.1

4.2. Sensitivity and robustness measures

4.2.1 Matching estimations

Next, we estimate our model using three propensity score methods: propensity score matching (PSM), inverse probability weighting (IPW), and augmented inverse weighting (AIPW). Matching estimates are based on Rubin's causal model (Rosenbaum and Rubin 1983).

The PSM matches treated and untreated individuals based on a propensity score for participation given observable characteristics of the individual. Nevertheless, the idea of the IPW gives greater weight to those who are unlikely to receive treatment. The aim is to obtain a pseudo-sample (or weighted sample) in which the distribution of covariates is identical between exposed and unexposed individuals. Finally, AIPW combines regression fitting aspects and inverse probability weighted methods to estimate the means of potential outcomes and average treatment effects. This method is deemed 'doubly robust' (Cao, Tsiatis, and Davidian 2009). Propensity score matching estimates provide two effects, namely: 'mean treatment effect on treated individuals' (ATT), which is the effect on individuals in the treatment group, and "mean treatment effect (ATE), which is the effect on all individuals (treatment and control). However, ATE is more interesting if each treatment can potentially be offered to each subject, whereas ATT is preferable when the treated individual's characteristics are more likely to determine the treatment received.

Table 7 present the results of PSM estimates. The results of the latter are identical to those of our base estimates, i.e. the probit and iv-probit estimates. The ATT for khat consumption is statistically significant at the 1% significance level. The result of the khat expenditure too follows the same direction as previous results. We check the balance of the processing groups using kernel density graphs. The graphs of the first series of estimates are presented in Figures 3 and 4. The covariates of the groups were found to be well balanced.

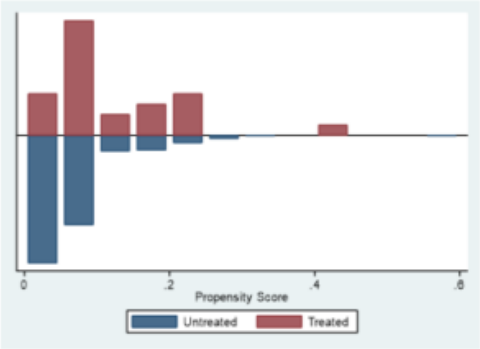
Table 8 presents the IPW and AIPW estimates. For both techniques, the results of khat consumption are statistically significant at the 1% threshold. The results for khat expenditure are likewise significant and follow the same direction as previous results.

Table 8: Khat use and work performance – IPW and AIPW estimations.

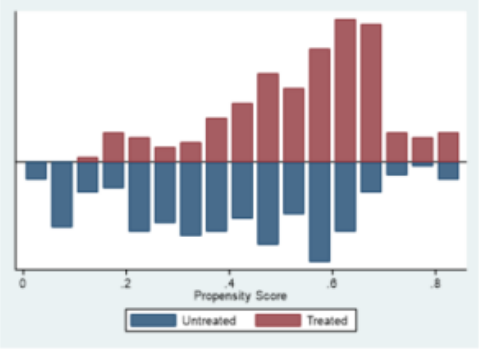
	Khat consumption		POmean		Khat expenditure		POmean	
	Chewers	Non-chewers	Chewers	Non-chewers	Spends [$2 - 30] to chew	Spends more than $30 to chew	Spends [$2 - 30] to chew	Spends more than $30 to chew
ATE	-0.317***	-0.021***	-0.941**	-0.997**	-0.454***	-0.997***	-0.286**	-0.997**
	(0.028)	(0.009)	(0.015)	(0.003)	(0.172)	(0.003)	(0.171)	(0.003)
ATET	-0.309***	-0.032***	0.957*	0.998*	-0.744***	-0.997 ***	-0.006**	-0.997**
	(0.028)	(0.011)	(0.014)	(0.001)	(0.002)	(0.003)	(0.001)	(0.003)
Observation	363	374	363	374	170	567	170	567
Augmented IPW								
ATE	-0.216***	-0.841***	-0.022**	-0.997**	-0.408***	-0.215***	-0.331**	-0.998**
	(0.064)	(0.060)	(0.009)	(0.003)	(0.193)	(0.041)	(0.191)	(0.002)
Observation	363	374	363	374	170	567	170	567

Source: Author's Elaborations from khat Data (2010). Notes: Standard errors given in parentheses. *** p< 0.01; **p<0.05; *p<0.1

Figure 3: Density distribution for the estimated propensity scores for khat consumptioand expenditure.



Source: Authors' calculations using khat data 2011.

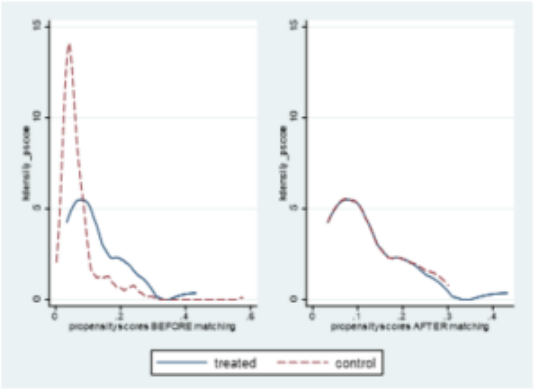


Source: Authors' calculations using khat data 2011

Source : Authors' calculation using khat data (2011)

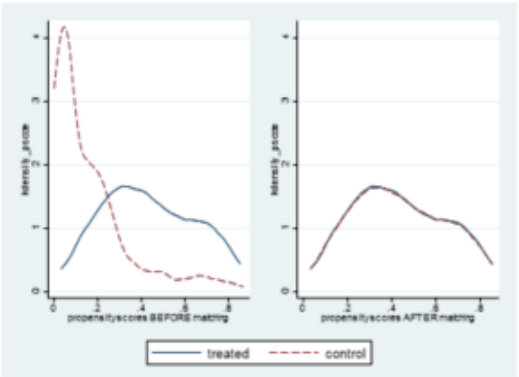
Figure 4: Kernel density plots after propensity score matching.

a) Khat consumption



Source: Authors' calculations using khat data 2011.

b) Khat expenditure



Source: Authors' calculations using khat data 2011

Source : Authors' calculation using khat data (2011)

4.2.2 Testing multiple hypotheses

Multivariate analysis is used to study more complex data sets than univariate analysis methods can handle. In addition to this, it is used to address situations where multiple measurements are made on each experimental unit and the relationships between these measurements and their structures are important. We perform the multi-variance and covariance (MANOVA) tests using our dependant variable work performance. The results of the four statistics (Wilks' Lambda, Trace de Pillai, Laweley-Hotelling, and Roy) show that the null hypothesis of equality of means of khat consumption is statistically significant at the 1% level. The result of the test for khat consumption is statistically significant at the 1% level. The result of the test for khat expenditure is similar. Finally, we use the Bonferroni correction to test the statistical significance of the regression coefficients of our variables of interest. The method corrects the p-value in the case where several tests are carried out

simultaneously on the same data. The corrected coefficients remain significant at the 1% level.

Table 9: Multivariate analysis of variance and covariance – khat consumption

Source		Statistic	Df	F (df1, df2)		F	Prob>F
Khat	W	0.8245	1	1.0	736.0	156.61	0.0000e
consumption	P	0.1755		1.0	736.0	156.61	0.0000e
	L	0.2128		1.0	736.0	156.61	0.0000e
	R	0.2128		1.0	736.0	156.61	0.0000e
Residual		736					
Total		737					

Source: Authors' calculations W = Wilks' lambda, L = Lawley-Hotelling trace, P = Pillai's trace R = Roy's largest root e = exact, a = approximate, u = upper bound on F

Table 10: Multivariate analysis of variance and covariance – khat expenditure

Source		Statistic	Df	F (df1, df2)		F	Prob>F
Khat	W	0.9852	1	1.0	736.0	11.08	0.0000e
consumption	P	0.0148		1.0	736.0	11.08	0.0000e
	L	0.0151		1.0	736.0	11.08	0.0000e
	R	0.0151		1.0	736.0	11.08	0.0000e
Residual		736					
Total		737					

Source: Authors' calculations W = Wilks' lambda, L = Lawley-Hotelling trace, P = Pillai's trace R = Roy's largest root e = exact, a = approximate, u = upper bound on F

5. Conclusion

Khat has attained the prominence of significant proportions in the Djiboutian economy, constituting the main source of income for farmers, as well as jobs for thousands of others employed in the value chain. Its widespread use in Djibouti and its role as a national and institutionalized drug make it a unique and relevant case that has not been studied in depth from an economic point of view. This paper contributes to this literature by investigating the relationship between khat consumption and selected labor market outcomes using a household survey of khat consumption conducted in 2011 in the major urban centers of Djibouti. Our empirical analysis is based on an instrumental variable approach and several econometric techniques. The analysis shows that khat consumption is widely accepted by all age groups. In addition to this, we find a negative and statistically significant relationship between khat consumption, the level of education attained by the consumer, and work performance. The marginal effect of the khat indicator shows that households that chewed khat are 31.4% less likely to be efficient or productive at work.

These results are robust across the specifications and econometric techniques. The findings underscore the need for effective control of khat consumption to improve the country's low

productivity and efficiency at work. Some measures can be envisaged in this regard. These include:

1) defining clear strategies and policies regarding the trade of khat in Djibouti, for example, the delivery and serving of khat must be strictly controlled to avoid disrupting office hours.
2) Implementing and reinforcing policies that require government employees to adhere to work ethics and respect office hours.
3) Basing promotions on performance and efficiency.

Measures need also be taken to discourage excessive consumption of khat. The government should introduce or at least incorporate into the existing curriculum, courses that explain the social, economic, and cultural problems associated with khat consumption. A mass communication campaign should be launched to better sensitize the population. Besides, tax on the sale of khat should be increased, and alternative sources of income should be explored for those engaged in the khat sector.

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Appendix

Table A1: Data Description

Variable	Definition	Proportion/ Mean
Dependent variable		
Work performance	1 if the household head experienced poor performance at work following the consumption of khat , 0 otherwise.	0.18 0.82
Interest variables		
Khat comsumption	1 if the household head consume khat, 0 otherwise	0.49 0.51
Khat expenditure	Continuous variable corresponds to the total of khat expenditure.	162.94
Khat expenditure	Dummy variables, takes the value of 1 if the household head spends $2 - 30 to chew, 0 otherwise.	0.23 0.77
Porportion of household expenditure allocated to khat	Ratio of khat expenditure to total household expenditure.	100.61
Control variables		
Age of HH	Age of household head (in years)	46.28
Gender of HH	1 if the household head is a male, 0 otherwise.	0.82 0.18
Marital status	1 if the household head is married, 0 otherwise	0.82 0.18
Income	Categorical variables, 1 if the household head has less than $282 ,2 if income between [$282 - 451] , 3. income between [$451 – 676] , 4. If income between [$676– 900] and 5. more than $900 .	0.38 0.20 0.10 0.06 0.08
Number of days khat was consumed	Continuous variable corresponds to the number of days khat was consumed.	7.43
Education level	Categorical variable, takes the value of 1 if household head has no education,2. has primary level 2. secondary level and 4. Higher education.	0.46 0.22 0.21 0.10
Location	Categorical variable, takes the value of 1 if the household lives in : 1.Djibouti, 2. Ali-sabieh 3. Arta, 4. Dikhil, 5. Obock and 6.Tadjourah.	 0.69 0.06 0.06 0.06 0.06 0.06
Household size	Number of household members.	2.10
Dependency ratio	Dependency ratio (ratio of household members under age of 15 years or over 60 years to total members).	9.26
Instrumental variable		
Peer pressure	Freinds who are khat chewer initiated you to chew khat.	0.73 0.27
Enjoyment	Chewed for recreation and makes enjoy and excite	0.63 0.37

Source: Authors' calculations using khat data (2011).