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Do consumers substitute opium for hashish? An economic analysis of simultaneous cannabinoid and opiate consumption in a legal regime

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ABSTRACT

Aim: To analyze interrelationships in the consumption of opiates and cannabinoids in a legal regime and, specifically, whether consumers of opiates and cannabinoids treat them as substitutes for each other.

Method: Econometric dynamic panel data models for opium consumption are estimated using the generalized method of moments (GMM). A unique dataset containing information about opiate (opium) consumption from the Punjab province of British India for the years 1907–1918 is analyzed ($n = 252$) as a function of its own price, the prices of two forms of cannabis (the leaf (bhang), and the resin (charas, or hashish)), and wage income. Cross-price elasticities are examined to reveal substitution or complementarity between opium and cannabis.

Results: Opium is a substitute for charas (or hashish), with a cross price elasticity ($\hat{\beta}_3$) of 0.14 ($p < 0.05$), but not for bhang (cannabis leaves; cross price elasticity = 0.00, $p > 0.10$). Opium consumption ($\hat{\beta}_1 = 0.47$ to 0.49, $p < 0.01$) shows properties of habit persistence consistent with addiction. The consumption of opium is slightly responsive (inelastic) to changes in its own price ($\hat{\beta}_2 = -0.34$ to -0.35 , $p < 0.05$ to 0.01) and consumer wages ($\hat{\beta}_4 = 0.15$, $p < 0.05$).

Conclusion: Opium and hashish, a form of cannabis, are substitutes. In addition, opium consumption displays properties of habit persistence and slight price and wage income responsiveness (inelasticity) consistent with an addictive substance.

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1. Introduction

The role of economic incentives in the decisions of consumers to consume psychoactive substances is well-studied. Economists have formulated models of addiction to study this topic (Becker and Murphy, 1988; Boyer, 1983), and there is a large empirical literature that examines how changes in prices of drugs and incomes of consumers are associated with their consumption (Becker et al., 1991; Gallet, 2014; Pacula and Lundberg, 2014; Van Ours, 2007; Van Ours and Williams, 2007). The substances that have received the most attention are legal substances, such as nicotine and alcohol, for which product price data are reliable and readily available (Bader et al., 2011; Chaloupka et al., 2002; Chaloupka, 1999). Contemporary studies of illegal substances, such as opiates, while important for the special regulatory context that they illuminate, are much

rarer, because they have been conducted in regimes in which these drugs are illegal. Therefore, data on the prices of these substances are difficult to obtain and, when they are available, are often unreliable because of their illegal status (Caulkins, 2007; Chandra and Barkell, 2013). In order to understand consumer behavior, therefore, researchers have often relied on historical data that were collected in the early 20th century, when these drugs were legal (Liu et al., 1999; Van Ours, 1995; Chandra, 2000, 2002). Such studies are, however, rare, and have focused exclusively on opium. To date there exist no studies that examine the simultaneous consumption of opium and other drugs and their interrelationships in a regime in which they are legal using reliable price data.

The aim of this study is to fill this important gap in the literature with a study of simultaneous opiate and cannabinoid consumption using unique data that were collected when both drugs were legal and tightly regulated by the government of the Punjab Province in British India. Within this broad aim, this study tests (i) how the consumption of opium responds to changes in its own price and those of two forms of cannabis, *bhang* and *charas* (hashish), (ii) whether opium has properties consistent with those of an addictive

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substance, and (iii) how the consumption of opium is associated with changes in consumer wages. The distinction between the different forms of cannabis is of great importance and demonstrates why they were treated as different products. *Bhang* refers to the dry leaves of the cannabis plant, which were traditionally ingested in liquid or solid (usually cooked) form. *Charas*, on the other hand, refers to the resinous material obtained from the cannabis plant, was usually smoked, and was significantly more potent in terms of THC content than *bhāṅg* (Indian Hemp Drugs Commission, 1894). The analysis utilizes consumption and price data for opium, *bhāṅg* and *charas* from 20th century British India.

Basic economic models of addiction link the consumption of a drug in the present time with its past consumption (Stigler and Becker, 1977; Boyer, 1983; Becker and Murphy, 1988; Becker et al., 1991; Suranovic et al., 1999). The driver of addiction in the economic model is the role that past consumption plays in increasing the reward (i.e., the marginal utility) of consuming the drug in the present (Becker et al., 1991; Becker and Murphy, 1988). Greater consumption in the past increases the reward in the present, leading to higher consumption in the present, all else being equal. This inter-temporal linkage has important implications for the effects that economic incentives, such as changes in the price or the consumer's income, have on consumption in the present and the future. The inverse relationship between consumption and price of goods is well known in the field of economics. Taking this relationship as a starting point, if the price of an addictive substance rises at a point in time, its consumption at that point in time is likely to fall. Because of the inter-linked nature of past and present consumption described above, this drop in consumption also lowers consumption in subsequent time periods by reducing the reward in the future. Similar logic holds for the relationship between changes in income and changes in short- and long-term drug consumption, with the key difference being that income should have a positive association with consumption. These changes are manifested in the form of short and long-term own-price (i.e., the price of the drug itself) and income elasticities, where an elasticity measures the percentage change in the consumption of the drug in response to a 1% change in the price of the drug, a related drug, or the income of the consumer. A focus of this paper is the estimation of the price and income elasticities of opium.

Extant literature on substitution effects for opium and cannabis is very limited due to a lack of reliable population level data suitable to analyze these relationships. Saffer and Chaloupka (1999) is one of the few studies which simultaneously analyzes the consumption of an opiate (heroin) in the context of changes in the cannabis market. However, unlike the present study, the cannabis variable included in those models is not its price, but rather its decriminalization. The empirical literature that focuses only on the price sensitivity of opium consumption is, however, larger (see Chandra, 2000, 2002; Van Lwijk and Van Ours, 2002; Van Ours, 1995). Additionally, there are a few studies that focus on the consumption of cannabis in conjunction with other substances, but these studies are limited by unreliable price information based on consumption in an illegal regime (Chaloupka and Laixuthai, 1997; DiNardo and Lemieux, 2001; Pacula, 1998).

Given the scarcity of reliable population-level data to study cannabis and opium consumption and cross-price effects for these substances, this work advances current understanding of multi-drug consumption. Additionally, because cannabis and opium consumption were legally controlled by the government in British India, the data used are reflective of “naturally” occurring behavior instead of behavior that is constrained by an environment of prohibition. This distinction is doubly important because, first, behavior under prohibition might be perceptibly different from naturally

occurring behavior and may therefore not accurately reflect cross-price (i.e., substitution or complementarity) effects and second, cannabis consumption is gradually becoming legal in the USA and a number of other countries, making a study of cannabis consumption in a legal regime timely.

1.1. Historical and regulatory context

Consumption of opium and cannabis in British Punjab was governed by a different legal regime from the one in effect today. In early 20th century Punjab, the consumption of opium and cannabis in both its forms (*charas* and *bhāṅg*) for recreational purposes was legal. Today opium and *charas* consumption are illegal, while *bhāṅg* remains legal and can be purchased at government-licensed shops. Opium and cannabis were and are part of the traditional Indian medical (Ayurvedic) pharmacopeia. However, the bulk of these substances was being consumed for non-medical purposes. While accurate estimates of the total number of users of opium or cannabis are not available because the government did not collect such data, it is clear that the “occasional use” of *bhāṅg* in Punjab as a seasonal drink and for social and religious purposes was “very common” but the number of “habitual consumers” was much smaller (Indian Hemp Drugs Commission, 1894, Volume 1, p. 140). For opium, a plot of per capita consumption is presented in Fig. 1.

The production and sale of opium and cannabis were largely controlled by the government. While the cultivation of opium was managed through a system of licensing the cultivation of the opium poppy, it was produced in large quantities for domestic consumption across British India as well as for export to destinations across Asia, including but not restricted to the Dutch East Indies, French Indochina, Japanese Taiwan, and British Malaya. The Punjab market, therefore, represented a fraction of the market supplied by opium production controlled by the British India government. Opium was produced in a variety of locations both within and outside the Punjab, from where it was distributed to consumers through a government controlled (wholesale) or licensed (retail) supply distribution network. The wholesale price of government-issued excise opium was set by fiat. In addition, retailers had to pay license fees for the privilege of retailing opium. This two-tier (i.e., wholesale and retail) regulatory system enabled the government to exercise a significant degree of control over the retail price of opium.

While aggregate production of opium (for all British controlled provinces and the much larger worldwide export market) was in effect determined by the government through the licensing system, consumption in the domestic markets was driven by consumers. The system of distribution in the Punjab ensured that demand was filled. When inventories in the warehouses ran low, they were re-supplied by the government. In addition, opium produced from beyond the borders of British-controlled India (the so-called ‘hill opium’) was occasionally imported upon payment of duty into the Punjab to fulfill residual demand. In the event that there was surplus opium in government warehouses, this surplus was carried over into the following accounting period. So, while aggregate production and distribution were controlled by the government, consumption was driven by consumers in response to prices, and the supply side of the market was therefore responsive to demand at the regulated price. The Excise Administration Reports of the Punjab repeatedly bear witness to the phenomenon of price-responsiveness. For example, the covering letter by the Financial Secretary of the Punjab transmitting the 1915–1916 report opens with the statement “The year 1915–16 was marked by a further decrease in the consumption ... of opium... This is mainly a consequence of the increase in prices arising from the enhanced taxation. . .” (Punjab Excise Department, 1916).

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