

Commentary on Freeman *et al.* (2019): Why does cannabis potency still vary across European countries?

Although the potency of cannabis has increased in almost every European country between 2006 and 2016, substantial differences among countries persist, with important public health consequences. Possible explanations for variations across Europe in the cannabis market include tastes (demand-side) and enforcement or input price differences (supply-side).

An intriguing feature of illegal drug markets is the unexplained variability of product characteristics among countries. For example, markets equilibrate at strikingly different purity. European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) data for brown heroin purity from 2011 to 2016 show France with annual averages from 7 to 16% while, in the same period, the annual average purity of British brown heroin ranged from 18 to 44% [1]. Both countries have well-established heroin markets and the price per pure gram fluctuates, yet the purity differences persist. Similar variation can be found among cities in the United States. For example, a study using individual seizure and undercover purchase observations from 1987 to 1991 divided large cities into two groups by average purity; the interquartile range of heroin purity in 'low-purity cities' was 6–29%, whereas for 'high-purity cities' the range was 29–59% [2]. No study that I know of provides any insight into what determines the purity at which a market equilibrates, yet purity may be important for overdose risks. In theory, when purity averages 20% it is easy for a user to take two or three times more heroin than expected; that is, purity could turn out to be 40 or even 60%. When purity averages 50% the risk of such a large dosage mistake is eliminated; the user could receive no more than twice as much as expected. Evidence on this effect as measured by fatal overdoses is mixed [3].

Freeman *et al.* [4] contribute new observations to this puzzle of varying equilibria in national markets. They present data on the potency of cannabis [as measured by the percentage of tetrahydrocannabinol (THC)] in 21 European countries during the period 2006–16. For all but two countries, potency of herbal cannabis increases during that period, mostly by a substantial amount. There is reason to believe that there are common factors at work here, and Freeman and collaborators suggest that there has been an improvement in technology for cannabis production. However, in 2016, visual inspection of the fitted graphs for herbal cannabis ([4], Fig. S2) suggests a range of average potencies almost as broad as in 2006. Putting aside the Netherlands, with its quasi-legal market for cannabis

and unchanging potency of 15%, the 2016 range is approximately 3–15%, whereas in 2006 it was approximately 0.5–10%. Similar patterns can be observed for cannabis resin ([4], Fig. S1). There is little evidence of a convergence or harmonizing across markets.

What might explain these persistent differences in cannabis potency? I offer three hypotheses: one demand-side and two supply-side.

1. Differing national preferences: for a variety of reasons, alcohol markets have shown persistent differences in the shares of alcohol consumption accounted for by wine, spirits and beer. Although there is evidence in Europe of some convergence, at least in part because of more uniform tax and regulation policies, cross-national differences in these shares remain substantial [5,6]. Perhaps the cannabis market is similar: users in some countries prefer a higher potency, or at least have become accustomed to strong cannabis. However, during the 10-year period, there are marked changes in country ranking. For example, Croatia goes from having the second lowest average potency in 2006 to the sixth highest in 2016. This is inconsistent with the preferences account, although taste variation certainly plays some role.
2. Law enforcement variation: cannabis potency is a consequence of how it is produced [7]. Growing indoors, which is associated with more potent cannabis, reduces the risk of detection. Thus, more intense enforcement or higher penalties following conviction may favor smaller growing areas and higher potency. High potency may therefore be a function of more intense enforcement or harsher penalties.
3. Input cost variation: input prices, particularly labor, energy and land, vary among countries. Where labor is expensive and land and electricity are cheap, *ceteris paribus*, growers may choose to grow lower-potency cannabis. Thus, independent of enforcement, potency variation may reflect economic differences across countries.

No doubt other scholars can adduce yet more factors plausibly influencing average potency.

As with purity in the cocaine and heroin markets, cannabis potency is a product decision by producers, which partially reflects customer taste. The variation in potency probably matters for public health, as Freeman *et al.* note, because user titration is imperfect; those who consume very high-potency cannabis may consume more THC. Thus, it would be useful to investigate what factors drive

potency variation. To my knowledge, no such effort has been published. It is not necessary to rely on national-level data for such research. There may well be similar variation among cities within countries that would allow exploration of these hypotheses where city-level data are available. The fact that almost all European nations have experienced an increase in potency does not lessen the significance of the national variation; it merely deepens the puzzle.

Declaration of interest

None.

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