THE “LEGAL” IMPORTATION OF CRIME

Master Thesis [International Economics]
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Contents

Abstract:

This paper studies the link between imports relative to GDP and drug overdose deaths per 100,000 residents for 23 countries in the EU plus Norway. Moore et al. (2023) argue there is a causal link between imports and drug overdose deaths in the US, where supply frictions between states create the geographical variation in overdose deaths, meaning states that import more are at higher risk. Making use of three independent variables of interest: real imports/real GDP, real merchandise imports/real GDP and real imports from drug producing countries/real GDP, as well as general economic control variables and drug specific variables; a positive link was established with some limitations. This analysis provides evidence and support for future research on this topic, as well as important insights to consider for those involved in trade, customs and health economics in Europe.

Introduction:

107,543 people died of drug related overdoses in the USA in 2023 (CDC, 2024b). Whilst this was the first decrease since 2018, this number represents a major problem of the richest nation in the world. There are seven larger causes of death in the USA, six of which are diseases (CDC, 2024a). Drug overdoses have become one of the leading avoidable causes of death. There are many theories regarding the causation of this rapid increase over the past two decades. The supply of drugs is in most cases imported from foreign countries. Certain countries have large market shares and tend to specialize in the production of one illicit substance. These drugs are usually smuggled across borders through legal means. The volume of trade is so large in certain regions that stopping these shipments before they reach market is a near impossible task. A recent paper presented a new theory on this topic, studying the relative imports of the 50 states of America and its link to relative overdose deaths. Moore, Olney and Hansen in their 2023 working paper "Importing the Opioid Crisis? International Trade and Fentanyl Overdoses" study fentanyl overdoses and the impact of importation on the geographical dispersion of them. They present a theory that the supply frictions of illicit substances means that states which import more will have easier access to them. These substances are smuggled across borders through legal means before being transported to other locations. They specify that there have been three phases of the opioid crisis from 2000-2022, where fentanyl has played a prominent role since 2012. In the period 2009 until 2017, there was a shift in the geographical prevalence of opioid overdoses and the authors provide evidence that this is a result of the rise in fentanyl use and its importation (Moore et al., 2023). Their results provide a supply side explanation to the recent rapid increase in the opioid crisis. The economic overdose literature usually provides two explanations for this occurrence: supply and demand side reasoning. The authors claim to have found the first causal link between legal importation and drug overdose deaths. By taking into account state characteristics and other causes of death, they establish that their inclusion does not change their main findings. They further incorporate machine learning methods of analysis which allows for interaction between import characteristics to support their findings.

The aim of this paper is to study whether this same positive connection between relative imports and relative overdoses can be made in Europe. There were 6,677 overdose deaths in the EU, Turkiye and Norway in 2021 compared to 107,543 in the US in 2023 (EMCDDA, 2023b). This is clearly not as large a problem in the EU as in the US. However, it has become one of the main causes of death for young people in the EU. Drug use is also associated with increased risk of suicide and transport accidents (Mino et al., 1999). Overall, overdose deaths have increased in the Netherlands by 65% from 2011 to 2021, and 21% from 2016 to 2021. Overall overdose deaths in the EU plus Norway, the U.K. and Turkey have increased by 36% from 2010 to 2017 (EMCDDA, 2023b). So whilst the size of the problem is not equal, the severity of the outcome means that it has negative consequences for the people who die, their friends and families, and the country as a whole in the long-term if the problem continues to grow. The European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) is concerned mainly with the wide and easy availability of illicit substances, a supply side issue.

Moore et al. (2023) claim that their findings are the first to establish how imports have an effect on overdose deaths through the supply of opioids rather than how import competition has an effect through the demand for opioids. This research is exclusive to the US. In that case, this paper focusing on Europe will be the first to study whether the same connection can be made for other regions, potentially providing external validity to their claims, if results can be replicated. This research is relevant to those involved in international and trade economics, economics of crime, as well as policymakers involved with both trade and drug addiction. Whilst this is currently not a major problem in Europe (relative to the US) the EMCDDA in their most recent drug report are concerned with the availability and easy access to illicit substances. Specifically, they mention the associated psychological and physical problems that arise with increased use, it’s exacerbation of complex issues like homelessnes, as well as increased youth criminality, violence, and corruption driven by the drug market in certain countries (EMCDDA, 2024b). These problems tend to be worse in low- to middle income countries, which already are strained in terms of government budgets and face more severe health and security challenges. However, high income countries like Sweden and Finland also have relatively high drug related deaths, meaning that this is a problem which has no wealth bias.

Previous literature focuses mainly on supply and demand side reasoning for drug overdoses. Demand side being changes in macroeconomic conditions that have left certain individuals and groups without the necesary skills and education to thrive in new market dynamics. Supply side being the widespread availability of illicit subsances. Supply side results find that controlling for population characteristics however removes the demand effect on drug overdoses arising from declining economic conditions. This research is focusing on supply side reasoning. Regarding drug related deaths, current literature suggests that Europe is not going through an opioid epidemic the size of the one in the U.S. but still represents a large preventable health burden. There seems to be a gap in the literature regarding why there is such a large difference in drug overdose prevalence in the U.S. and Canada compared to Europe and other regions. This however, is also a problem when comparing European nations. Regarding overdoses and the characteristics of those that suffer them, reviews have been conducted in individual nations and cities. The conclusions drawn are highly individual and qualitative but there are some population level risk factors. These include whether drugs were injected, polysubstance use, use of antidepressants, alcohol use, taking too much (whether deliberate or not), unusually strong doses, tolerance, starting treatment, not being in treatment, being dropped out of treatment, availability of prescribed drugs, lengthy use, homelessness, gender, age, unstable housing, witnessing an overdose, incarceration, psychopathology, actively seeking fentanyl and recent prison release.

An approach similar to Moore et al. (2023) is taken in the baseline specification of this analysis. Data from the EMCDDA was collected on drug overdose deaths and transformed into a per 100,000 resident unit, as well as drug specific controls. The countries of the EU plus Norway, Turkiye and the U.K. create the sample spanning the years 1999 – 2021. The World Bank provided import data as well as unemployment, GDP and life expectancy; whilst Eurostat provided data for sex and age demographics, population change and education levels. These variables form the first panel regression. The main changes come in the form of two new independent variables of interest as well as a set of drug specific control variables. Transit trade is something that has been unaccounted for, which is important as not all imports end up being consumed in that country but rather are shipped off to other countries and consumed there. Therefore, data on merchandise imports was collected which accounts for a significant part of transit trade. Whilst not all transit trade is considered, it provides a more accurate link between shipments to a country, which may have illicit substances hidden and the resulting drug overdose deaths in that country. The second novel independent variable is imports coming from known drug producing countries (DPC's). This variable looks at a subset of countries which are known drug producers and account for large shares of the production market. Imports from these countries are more likely to contain illicit substances and potentially explain the majority of the effect, if it is present. The drug related variables include mean price, potency and seizures of cannabis, heroin, cocaine and amphetamine; treatment demand for opioids and drug law offences. These variables unfortunately have significantly less observations and therefore are the last ones to be added to the specifications. They provide a more detailed picture of the situation in each country regarding drugs and help to control for characteristics of individuals which demand illicit substances.

Literature Review:

Most economic literature on drug overdoses focuses on the US and demand side reasoning for individual drug taking behavior. As the organizations that produce, transport and sell illicit substances are involved in illegal activities, there is limited confirmed and accurate information on how the supply of drugs reaches Europe. The EMCDDA has articles on specific substances and the typical routes taken to get to Europe, but these are based on seizures and their locations. This means law enforcement must first intercept the shipments before they can make any assumptions as to where they are coming from and where they are heading. This of course is a function of their interception success. It is near impossible to estimate the percentage of shipments that law enforcement intercepts meaning the EMCDDA does not provide a number. However, they believe that traffickers are becoming more efficient as the quantity seized has been increasing over the last decade, but the number of seizures has decreased (EMCDDA, 2023c). Further, the EMCDDA believes that overdose numbers are underestimated due to systemic under-reporting and the fact that deaths involving new psychoactive substances are reported using the code "general stimulants," meaning that they do not fit the criteria for overdose deaths (EMCDDA, 2023a). The ageing population globally, especially in Europe, means that increases in deaths among young people have more severe consequences. The focus therefore in this paper is on countries which are known drug producers, rather than specific routes which are taken to Europe. With emphasis on the supply side of the problem, isolating the main drug producers rather than the main routes of entry is a more reliable variable as it is not contingent on law enforcement's success. The focus of Moore et al. (2023) is on the impact of imports on drug overdose deaths per 100,000 residents. Their reasoning for this effect is that supply frictions between states means that those which are relatively larger importers have easier access to drugs, which are smuggled through legal means across borders.

Heroin is the main driver of drug overdose deaths in the EU, and recently Afghanistan was taken over by the Taliban. Poppy cultivation for decades has been a large industry in Afghanistan, which is the main ingredient in opioids like heroin. However, with the Taliban takeover, they have stopped growing and harvesting poppies for opium and heroin production (EMCDDA, 2024a). With the largest worldwide producer suddenly stopping, this will have general equilibrium outcomes which will change the shape of the illicit substance market. Moore et al. (2023) mention three phases of the opioid crisis in the US. First, between 2000 and 2010 the introduction of OxyContin and other prescription opioids lead to a tripling of prescription opioid deaths. Policy changes around 2010 made it more difficult to get access to these prescription opioids and saw the market shift demand over to heroin. Heroin overdose deaths quadrupled between 2010 and 2015. The third and final phase saw the substitution of heroin for the synthetic opioid fentanyl, which is 50 times more potent and cheap. Fentanyl overdose deaths twenty-nine folded from 2012 to 2022, causing 76,000 deaths in 2022 and becoming the leading cause of death for Americans aged 18 – 49 years (Moore et al., 2023). There is a concern that heroin users will switch to fentanyl or other powerful synthetic opioids if the Afghani supply shock is significant enough for European markets. Previous short-term bans in Afghanistan created heroin shortages in Europe and in some countries were associated with long-term changes in opioid consumption (EMCDDA, 2024b). Whether a similar pattern in Europe transpires remains to be seen. But organizations like the EMCDDA are concerned and are currently observing how these markets are changing.

The situation in Europe is not drastic like the one in the US but the numbers suggest that it is a health burden which is preventable. The US is the largest consumer of prescription opioids 40,240 s-DDD/million inhabitants/day in 2015 to 2017, compared to Europe's 8,967 s-DDD/million inhabitants/day in 2014 to 2016 (van Amsterdam et al., 2021). The age-adjusted rate of drug overdose deaths is more than nine times higher in the US compared to the EU (Seyler et al., 2021). 122 per 100,000 US residents are in treatment for opioids compared to 32 per 100,000 EU residents (van Amsterdam et al., 2021). Attempts have been made to explain this large gap, but a common consensus is yet to be established. A survey of experts found that most believe the gap can be attributed to synthetic opioid prevalence in North America and differing treatment attitudes (Krausz et al., 2021). The overarching opinion is that drug addiction should be treated as a public health issue rather than a criminal charge (Krausz et al., 2021). However, the authors of the paper acknowledge the problems of surveys and the potential opinionated nature of answers. Males are four times more likely to die of an overdose than females in the EU (Seyler et al., 2021). 78% of deaths are caused by opioids, often in combination with other substances, heroin being the main culprit (Seyler et al., 2021). There is considerable variation between countries in the EU, highlighting the importance of their individual differences. The most recent uptick in deaths however is attributed to more accurate reporting across countries rather than a change in individual behavior, as well as an ageing population of people taking drugs (Seyler et al., 2021). The EMCDDA believe that there is a systematic underreporting of overdose deaths in the EU, as new substances are constantly entering the market which are not codified yet. This means when the cause of death is determined, the option "general substances" is chosen, rather than poisoning by an illicit substance (EMCDDA, 2023a). The degree to which these numbers are underreported is impossible to know but the problem remains.

To isolate the effect of supply of illicit substances on drug overdose deaths, indicators and factors which influence demand and deaths must be accounted for. The main problem with this is that the factors influencing demand tend to be very individual and situation based, for which data is limited. Further, within this subgroup of people that take drugs, there is a spectrum of usage which creates further variation in demand side variables. Park et al. (2020) describe a "continuum of overdose risk" framework, where there are five stages to an individual overdose. Drug initiation, active drug use, addiction, non-fatal overdose and fatal overdose (Park et al., 2020). This analysis is focused on capturing the last stage of the framework. Ideally, finding and using variables which apply specifically to those individuals in the final two stages of the framework would yield the most accurate estimates of demand side effects. However, data availability means that a general demand focus is more feasible. The price of illicit substances is found to have inelastic price elasticity of demand for alcohol, marijuana and heroin (Saffer & Chaloupka, 1999). The addictive nature of these substances provides intuition for this result. Individual level risk factors of overdose deaths include previous overdoses, injecting drugs, taking antidepressants, alcohol use, not being in and starting methadone treatment, polysubstance use, taking too much, and intolerance (Best et al., 2001; Lyons et al., 2019). Many studies have also specifically studied the impact of prison release on users' overdose risk. A review of studies reports that this group of people can be up to 40 times more likely to overdose than similar individuals (Binswanger et al., 2013; Leach & Oliver, 2011). Population level risk factors include availability of prescribed drugs, sex, age, homelessness, unemployment, low education, depression rates, low job availability, limited treatment supply, poverty rates and low economic growth (Best et al., 2001; Case & Deaton, 2015; Ruhm, 2019; Webster, 2017).

The cost of drug use and overdose deaths cannot only be attributed to those that make use of them. Negative externalities are present for friends and family as well as the overall welfare of their countries. Examples of negative externalities arising from drug overdoses include law enforcement and criminal justice costs, productivity costs, health and welfare system costs (Barrio et al., 2017). Attempts to calculate these costs have been made in numerous studies (Antonanzas et al., 2004; Barrio et al., 2017; Florence et al., 2021; Kopp & Ogrodnik, 2016). The main limitation however being a lack of methodological consensus. A review of 11 social cost studies found that these negative externalities amount to a range of 0.08 to 2.75% of GDP depending on the countries and years studied (Barrio et al., 2017). However, the high variability in methodology across the papers means that they cannot be compared. A standard set by the authors of the review was only met by two of the eleven papers with none having an optimal methodology. But the authors do conclude that despite these shortcomings there is a significant economic burden on countries because of these negative externalities. This defines the severity of the issue. Finally, a study of the US in 2017 quantified the cost of opioid use and overdose death at $1.02 trillion or 5.24% of GDP (Florence et al., 2021).

Data:

The main source of data on drug use in the Europe is provided by the EMCDDA. Firstly, annual overdose deaths (drug related deaths) were collected from the 2023 statistical bulletin of the EMCDDA. This provided the list of countries for which data would be collected. This includes: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Türkiye, and the U.K. Data for this variable goes back to 1985 for certain countries and ends in the year 2021. Therefore, if possible, data was collected for this entire period. The EMCDDA collects data from general mortality registers (GMR) and special registers (SR) of each country. There, they collect data on deaths that have been caused by mental and behavioral disorders due to psychoactive substance use and poisonings and "exposure to other and unspecified drugs" that are intentional, accidental or of undetermined intent. Deaths are classified using certain ICD-10 codes in each country. However, varying interpretations of the codes in each country create limitations in comparisons. Further, harmonization of methods is required over the entire country for collection to be accurate. In most cases, the EMCDDA's interpretations of the codes and each nation are the same and are becoming more integrated. Annual population data for each country was collected from the World Bank. Using these two variables, a new variable was created which will be the main dependent variable: drug overdose deaths per 100,000 residents.

Import data was collected from World Integrated Trade Solutions (WITS) of the World Bank. This data will make up the independent variables of interest. Annual imports of goods and services were collected for each country, as well as merchandise imports of goods and trade partner shares for known DPC's. Merchandise imports are used to partly control for any transit trade which may be within the import variable. Whilst this variable does not consider all transit trade, it does only consider imports which were consumed in the country. The known drug producing countries considered are Afghanistan, Bangladesh, Belgium, Bolivia, Brazil, China, Colombia, Czechia, Guatemala, India, Indonesia, Iran, Laos, Malaysia, Mexico, Morocco, Myanmar, Netherlands, Pakistan, Peru, Thailand and Venezuela (Gibbons, 2021). The World Bank provides percentage shares of total imports for each of these countries. Then, these percentages were multiplied (in decimal form) by the total real imports for each country of study, to get the dollar value share of real imports from drug producing countries. Splitting imports into drug producing and non-drug producing countries helps to establish whether the possible connection between imports and drug overdoses is a general one or a more specific problem pertaining to countries which are large producers of these substances. This distinction will have important implications for the handling of this issue in both result scenarios. If the effect is present but general, then the entire trade system must be considered. If the effect is present but contained to known producers, then trade from these countries can be focused on to prevent illicit substances being smuggled across borders. Merchandise imports are defined by the World Bank as “the cost, insurance and freight (c.i.f.) value of goods received from the rest of the world.” The most important difference between imports and merchandise imports, is that merchandise imports exclude services, meaning only tangible goods are included. The World Trade Organization (WTO) is in most cases the source of this data. The chosen methodologies of countries differ, meaning that aggregation is not identical across the board. Depending on the choice of the general or special system of trade, merchandise imports will count imports into bonded warehouses and free trade zones (World Bank, 2024). All import variables have been deflated using an import value index provided by the World Bank. The base year is 2015. All real import values were then divided by Real GDP (base 2015) from the World Bank.

The EMCDDA has other variables pertaining to the use, misuse, crime, and the price and purity of drugs in each country. To control for demand side explanations of drug overdose deaths, data was collected for: the mean purity and price of cannabis, heroin, cocaine, and amphetamine. These illicit drugs were chosen mainly due to data availability as well as their popularity among users. Whilst it is not possible to overdose on cannabis, it still provides a good indicator of the overall demand for illicit substances within each country and is often a complementary good among polysubstance users. Polysubstance users are also at higher risk of overdoses. Prices are all in euros and retail prices for one gram of the substance. Cannabis purity is measured using the mean amount of THC in cannabis herbs on a percentage basis. Heroin purity is measured using the mean base percentage. Cocaine purity is measured using mean HCI percentage. Amphetamine is simply measured using the mean percentage of amphetamine in the product in its various forms like powder and paste.

Treatment demand is a more specific measure of the misuse of drugs, providing a clear number of individuals who feel they are at risk of overdosing or are currently engaging in misuse which they believe may be harmful to them at present or in the future. This variable was then converted into a per 100,000 population unit to make comparisons fair between countries of varying population sizes. Treatment demand for opioids is considered, due to data availability and the higher risk of overdose death resulting from usage. Drug law offences finally provide a measurement of the number of individuals who are either engaged in the manufacturing, sale or use of illicit substances and have been charged with these crimes. As each country has differing laws regarding what is considered unlawful behavior regarding drugs, this provides an important source of variation in the negative incentives they provide for users and providers, which potentially will lead to differing drug overdose deaths. It also provides an indication of the severity of the problem and/or the attitude towards the proper management of these issues on a policing basis. This variable is also transformed to a per 100,000 population unit to make fair comparison. Seizure data for these substances has also been collected (in kgs) and converted into a per 100,000 resident unit. This variable incorporates data from the police, customs, National Guard etc. This provides an indicator of the success of law enforcement to remove illicit substances from the market.

An important consideration of this data from the EMCDDA is that these variables are all collected on a national level using national methods. The sovereignty of these countries means that these methods will all differ slightly and what is considered an overdose death in one country might not be in another. However, assuming national methods do not change significantly over the period studied, the comparison of trends is possible using panel data. Further, the EMCDDA has only combined data on a country basis which they consider to be comparable. Whilst other EMCDDA data like treatment demand for opioids is more robust to national definitions, drug seizures and especially drug law offences are variables which will have significant national differences. But the comparison of trends assuming limited national changes to methodology makes fairer comparisons across countries than cross-sectional analysis.

On a more general level, unemployment rates are considered from the World Bank. These are national estimates and on the demand side, unemployment is a good predictor of drug use. Life expectancy is also used to control for any health and health provision differences within countries which can explain the relative differences in overdose deaths, collected from the World Bank. Eurostat provides age and sex demographics for each country, where certain groups of people tend to be more at risk of drug overdoses than others. Each country's population was split into groups of males and females and then males aged 0 - 19, males aged 20-39, males aged 40-59 and males aged 60+. These groups were then divided by the overall population in their country to get a percentage figure of each group. A change in population variable was created by taking the difference between the population in one year and the previous year. Eurostat also has education data, splitting the working population (those aged 15-64) into groups that have completed primary, secondary and tertiary education. Education is a good predictor of drug overdoses from the demand side where those with lower education levels are at higher risk. GDP data was collected from the World Bank as well as a GDP deflator with the base year in 2015. GDP was deflated creating a real GDP variable, which was then divided by the population variable to get real GDP per capita. Collecting data from multiple sources creates certain problems, including varying time periods and missing data. After considering the entire dataset, the period of study will be from 1999 – 2021 unless otherwise explicitly stated. As a result, Belgium, Cyprus, Greece, Romania, Slovakia, Türkiye, and the U.K. are dropped from the analysis. Overdose death data is not available in these countries for this period. The summary statistics of each variable can be found in Table 1 below.

Table 1 – *Summary statistics of dependent, independent variables of interest and drug related control variables*

	Observations	Mean	Std. Dev.	Minimum	Maximum
Drug Overdose Deaths per 100k	509	2.025	1.883	0.0857	12.853
Real Imports/Real GDP	529	0.6084	0.3576	0.1861	2.103
Real MerchImports/Real GDP	529	0.4612	0.2590	0.1476	1.757
DPC Real Imports/Real GDP	529	0.1072	0.0898	0.0357	0.6700
NonDPC Real Imports/Real GDP	529	0.5011	0.3036	0.1464	1.789
Mean Purity Cannabis (%)	302	7.945	3.734	0.5	21
Mean Purity Heroin (%)	259	20.657	9.028	5.8	54.89
Mean Purity Cocaine (%)	389	44.915	13.339	11.8	83
Mean Purity Amphetamine (%)	353	20.991	11.663	0.6	62.1
Mean Price Cannabis	305	8.80	5.942	0.8	70
Mean Price Heroin	277	59.29	34.16	15	190
Mean Price Cocaine	313	68.95	19.92	32.53	175
Mean Price Amphetamine	266	18.21	12.36	4	89.8
Treatment Demand Opioids per 100k	327	43.938	60.734	0.8960	372.25
Drug Law Offences per 100k	317	306.91	250.13	33.617	1198.1
Cannabis Seized per 100k	431	14.11	25.16	0.025	274.36
Heroin Seized per 100k	436	1.493	3.041	0	36.32
Cocaine Seized per 100k	431	13.546	33.882	0	327.661
Amphetamine Seized per 100k	435	1.885	2.972	0	23.912

Notes: Dataset in table consists of observations from 1999 until 2021. Countries in dataset are Austria, Bulgaria, Croatia, Czechia, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovenia, Spain and Sweden.

Table 2 – *Summary statistics of general control variables*

Unemployment Rate (%)	529	8.136	4.161	1.805	32.61
Life Expectancy	529	78.406	3.365	69.742	83.831
Population Change (1000s)	529	41.209	158.020	-1,501.947	829.484
Primary Education (%)	520	29.238	14.120	10.8	79.7
Secondary Education (%)	520	46.797	12.850	12.3	72.2
Tertiary Education (%)	520	23.966	8.250	4.9	45.4
Real GDP per capita	529	35,688.15	26,281.18	3,089.53	145,940.20
Male pop. 0 – 19 (%)	527	11.373	1.310	9.135	16.078
Female pop. 0 – 19 (%)	527	10.799	1.272	8.516	15.233
Male pop. 20 – 39 (%)	527	13.897	1.169	11.000	17.866
Female pop. 20 – 39 (%)	527	13.463	1.112	10.522	16.509
Male pop. 40 – 59 (%)	527	13.771	0.8745	11.079	15.789
Female pop. 40 – 59 (%)	527	13.979	0.7941	11.611	15.811
Male pop. 60+ (%)	527	6.962	1.008	4.953	9.286
Female pop. 60+ (%)	527	8.272	1.214	5.254	10.906

Notes: Dataset in table consists of observations from 1999 until 2021. Countries in dataset are Austria, Bulgaria, Croatia, Czechia, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovenia, Spain and Sweden.

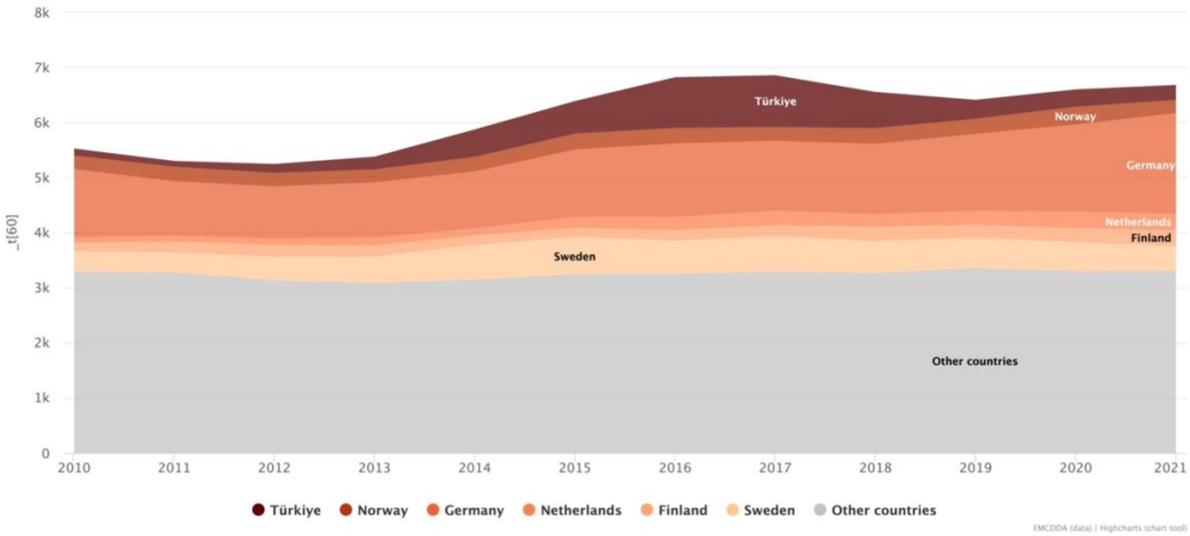
Considering table 1, the main problem with the chosen variables is the variation in observations. The dependent variable drug related deaths per 100k has 509 observations, whilst mean purity of heroin has 259 observations, about half of the dependent variable. All other independent variables have more observations. The variables chosen are otherwise broad encompassing and for the panel chosen include a large variety of values. Table 3 provides a correlation matrix of a set of variables.

Table 3 – *Correlation matrix of chosen variable set*

	Drug overdose deaths per 100k	Unemployment Rate	Secondary Education	Real Imports/Real GDP	Real Merch Imports/Real GDP	DPC Real Imports/Real GDP
Drug overdose deaths per 100k	1					
Unemployment Rate	-0.204	1				
Secondary Education	-0.051	-0.048	1			
Real Imports/Real GDP	-0.089	-0.094	-0.046	1		
Real Merch Imports/Real GDP	-0.219	0.101	0.356	0.356	1	
DPC Real Imports/Real GDP	-0.010	-0.2476	-0.111	0.681	0.186	1

Looking at the matrix above, there are some interesting results. Firstly, all import variables are negatively correlated with drug overdose deaths per 100k. This means an increase in relative imports is associated with a decrease in relative drug overdose deaths, the opposite of what was found in the U.S. The magnitude of the relationship is largest for merchandise imports. It is however important to distinguish between correlation and causation. Secondly, the unemployment rate is also negatively associated with drug overdose deaths. This is unintuitive as the literature is quite clear with the increased risk of overdose death for those that are unemployed. There are some other interesting results like relative DPC imports being negatively associated with secondary education and the unemployment rate. These results however cannot be interpreted at face value as there may be unknown variables influencing these relationships. This is why it is important to make use of more complex methods of analysis to establish these relationships, controlling for known influential variables. Figure 1 is a chart created by the EMCDDA showcasing the number of drug overdose deaths in the EU, Norway and Türkiye from 2010-2021.

Figure 1 – *EMCDDA chart of drug overdose deaths EU, Norway and Türkiye 2010-2021*



Note: The y-axis has total drug overdose deaths whilst the x-axis is years.
Source: EMCDDA, 2023 Statistical Bulletin

Figure 1 provides a short overview of drug overdose deaths for the original country sample. Overall, the total number of overdose deaths has increased in the period from 5,523 to 6,677, a 20.9% increase. Over 11 years this is a significant increase considering the total population over the same period increased by 3.68%. The similar areas of Netherlands, Finland and Norway and slightly larger area of Sweden provide further evidence that this is a problem which cannot simply be explained by variation in population across these countries. This is evidence that drug overdose deaths in the EU, Norway and Türkiye is on the rise and has the potential to become a more severe problem if current trends continue.

Figure 2 – *Total drug overdose deaths for final sample*

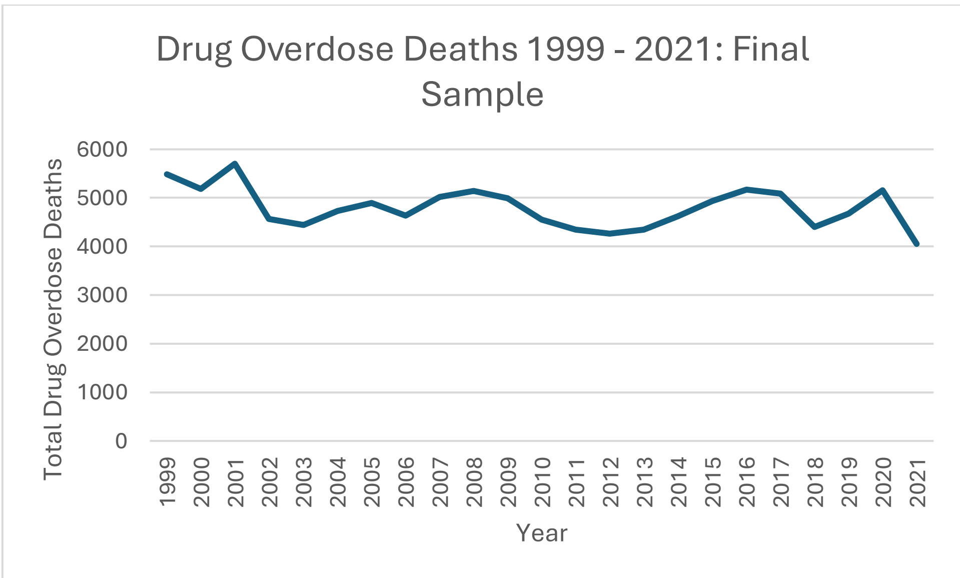


Figure 2 above showcases the total drug overdose deaths for the final sample in each year of study. Values range from 4,054 to 5,704. There is no trend found but overdose deaths seem to be on the decline currently for the 23 countries considered. The reasoning behind this difference in figures is unclear but the omission of seven countries likely has a role to play. Türkiye is omitted which is a large country in terms of population and accounts for a large increase between 2013 and 2017 in figure 1. Looking at the 'other countries' region of figure 1, there is no trend as well. Whilst a concrete conclusion cannot be drawn, the main difference between the two figures is the countries which make up the figures.

Methodology:

The aim of this paper is to establish whether the same relationship between relative imports and relative overdose deaths is present in the EU as it is in the U.S. The overarching theory behind this relationship is that supply frictions between states in the U.S. create the variation in relative drug overdose deaths across states. Illicit substances are mainly smuggled across borders through legal transport, meaning that states which import relatively more are at higher risk of drug overdose deaths due to higher availability. As this is a supply driven effect, controlling for demand is important in order to take away any demand side explanations behind the number of drug overdose deaths in each state. The dataset collected for this analysis includes more specific demand side indicators provided by the EMCDDA, which the Moore, Olney and Hansen (2023) paper does not include. Ideally, this additional data will further control for these demand side effects helping to isolate effects from supply. The control variables used in their paper were general economic and demographic indicators. Whilst their chosen variables have been shown to affect demand, the EMCDDA has drug specific variables which likely provide a more detailed and segmented picture of the demand situation in each country. With the panel data collected, there are a wide variety of analytical methods to choose from to test for this relationship. A panel regression was chosen as it makes it possible to compare trends across countries given the variables, which is necessary considering the differing national methods of death accounting. Assuming these methods have not changed significantly over the 1999 – 2021 period, this will provide a more accurate answer than a simple cross-sectional analysis.

This analysis has the potential to replicate and provide external validity to the results of the Moore et al. (2023) paper. However, in either case results will provide insights into whether this claim is true and if not an interesting avenue for future research into the differences between the two regions which explain the varying results. Three specifications of panel regressions will be run to test this relationship, listed below. The plan for each set of regressions is to perform an analysis which follows the Moore et al. (2023) paper as closely as possible with the available data. Once this has been done, more control variables will be added to see how they change the first result. As the number of observations is significantly lower for drug related variables, they are the last to be added. This is so that changes due to observations and changes due to variables themselves can be somewhat distinguished. This will hopefully help to answer whether the same connection can be made in Europe and will provide new interesting insights through variables which were untested in the Moore et al. (2023) paper.

1) $DrugOverdoseDeaths_{ct} = \alpha_c + \gamma_t + \beta_0 + \beta_1(RealImports_{ct}/RealGDP_{ct}) + \mathbf{X_{ct}}\beta + \varepsilon_{ct}$
2) $DrugOverdoseDeaths_{ct} = \alpha_c + \gamma_t + \beta_0 + \beta_1(RealMerchImports_{ct}/RealGDP_{ct}) + \mathbf{X_{ct}}\beta + \varepsilon_{ct}$
3) $DrugOverdoseDeaths_{ct} = \alpha_c + \gamma_t + \beta_0 + \beta_1(RealImportsDPC_{ct}/RealGDP_{ct}) + \beta_2(RealImportsNDPC_{ct}/RealGDP_{ct}) + \mathbf{X_{ct}}\beta + \varepsilon_{ct}$

Drug overdose deaths per 100,000 residents is the dependent variable and contains the values for each country in the years 1999 – 2021 of deaths caused by drug overdose. Fixed effects and time fixed effects are included in all specifications, as the sovereignty of each nation provides its own variation in time fixed variables which influence the relative drug overdose deaths within its borders. This includes institutional, cultural and socio-economic, legal and many other differences which must be accounted for to make comparisons across countries fairer. There will also be time-varying global factors which will influence both imports and drug overdose deaths and must be controlled for. This includes the global financial crisis, trade shocks, supply shocks for illicit drug manufacturers and other unknown variables which time fixed effects will absorb. The key difference between the three specifications lies in the main independent variable. RealImports/RealGDP provides the relative imports in each country controlling for price level and is the most similar specification to previous literature. Next, RealMerchImports/RealGDP attempts to remove effects of transit trade which is not consumed by the country of interest and only considers imports of goods not services. This variable does not take out the entire effect but provides a more accurate value of the effect of relative trade on relative overdose deaths.

The final specification considers a group of the main known DPC's on its own and other countries separately. This variable is included to provide important market segmentation information. If trade with this specific group of countries explains the relationship, then they must be treated separately if policymakers feel that they create a negative externality for their citizens through the availability of illicit substances. If there is no difference in effects, then more sweeping and encompassing trade decisions must be made to mitigate the negative externality. If no effect exists, policymakers in the US might be interested to understand why this is for their own decision-making processes. The control variables in all cases are the same.

These specifications will each be run multiple times adding control variables to understand the dynamics between them. The control variables have the intended effect of removing any effects on drug overdose deaths related to demand. The mean price of a gram of cannabis, heroin, cocaine and amphetamine is included. This intuitively will control for differences in price across countries and over time which will influence the amount of each substance consumed and the price elasticity of demand for each of these substances. The mean purity of these substances is also controlled for, as it is an important driver in individual demand and the prices charged. Treatment demand for opioids per 100,000 residents gives an idea of the relative size of the market for opioids and specific information on the subsection of the market which believes that their current behavior could result in their deaths or physical harm. Those that enter and leave treatment are also more at risk of overdosing. Opioids are the main driver of overdose deaths in Europe, specifically heroin. Drug law offences per 100,000 residents again points to the size of the market in each country, as well as legal and law enforcement attitudes towards drug related crimes. This can influence individuals' behavior for example through the relative severity of punishment for consumption and possession of illicit substances. Further, users which go to prison are also at higher risk of overdosing, specifically shortly after release, where addicts gain access to drugs again and end up taking doses which they are no longer used to due to their diminished tolerance because of their imprisonment. Seizure values for cannabis, heroin, cocaine and amphetamine are included to control for law enforcements' influence over the drugs market which can have both behavioral and supply side implications for drugs and overdoses. Finally, on a broader level there are controls for the unemployment rate, life expectancy, population changes, education, and age and sex demographics within each country. These variables are all influential to the demand side of the effect. Those that are unemployed and less educated are at higher risk of consuming drugs, whilst life expectancy helps to control for health-related factors which will impact the risk of overdoses in each country. Certain age groups are at higher risk of overdosing, mostly young adults and long-term users reaching the end of their working age. Differences across countries will have varying effects on drug overdoses. Changes in population are included so that any sudden increases or decreases resulting from migration mostly is taken into account.

Results:

Table 4 – *Regressions of specification one: Drug overdose deaths per 100,000 on Real Imports/Real GDP*

Dependent variable: Drug overdose deaths per 100,000 residents

Independent Variables	Model 1	Model 2	Model 3
Real Imports/Real GDP	-1.11*** (0.348)	-1.13** (0.451)	-0.342 (0.851)
Unemployment Rate (%)		-0.008 (0.020)	-0.003 (0.034)
Life Expectancy		0.301*** (0.110)	0.135 (0.155)
Population Change (1000s)		-0.0001 (0.0004)	0.00004 (0.0004)
Primary Education (%)		0.224 (0.840)	-1.62 (1.12)
Secondary Education (%)		0.216 (0.839)	-1.57 (1.12)
Tertiary Education (%)		0.233 (0.838)	-1.60 (1.12)
Real GDP per capita		-0.00001	0.000009

		(0.00001)	(0.00002)
Male pop. 0 – 19 (%)		0.691	11.53***
		(1.53)	(2.43)
Female pop. 0 – 19 (%)		-0.630	-11.40***
		(1.58)	(2.47)
Male pop. 20 – 39 (%)		0.749**	1.55***
		(0.346)	(0.549)
Female pop. 20 – 39 (%)		-0.904**	-0.905
		(0.347)	(0.594)
Male pop. 40 – 59 (%)		-1.58***	-1.42***
		(0.261)	(0.421)
Female pop. 40 – 59 (%)		1.13***	1.98***
		(0.301)	(0.534)
Male pop. 60+ (%)		-1.18***	-0.504
		(0.341)	(0.761)
Female pop. 60+ (%)		1.20***	2.02***
		(0.346)	(0.672)
Cannabis seized per 100k			0.009**
			(0.004)
Heroin seized per 100k			0.052**
			(0.021)
Cocaine seized per 100k			-0.003
			(0.005)
Amphetamine seized per 100k			-0.012
			(0.027)
Treatment demand opioids per 100k			0.009**
			(0.004)
Drug law offences per 100k			-0.001
			(0.0009)
Constant	2.66***	-37.68	112.1
	(0.354)	(84.20)	(114.04)
Country FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Observations	509	500	245
Within r^2	0.0567	0.1733	0.3588

Notes: * = p < 10% significance level; ** = p < 5% significance level; *** = p < 1% significance level

To start with, the first specification is considered. Table 4 above considers the regressions. The coefficients are reported for each independent variable with standard errors in parentheses below them. The first column, labeled model 1, contains only the main independent variable of Real Imports/Real GDP and time and country fixed effects. The main coefficient of interest is negative and significant at a 1% level. This suggests that there is a negative association between drug imports per 100,000 residents and real imports relative to real GDP. A one unit increase in real imports relative to real GDP therefore reduces the number of overdose deaths per 100,000 residents by just over 1. This is similar to the results in table 2, where these two variables are negatively correlated. The mean value of the dependent variable is 2.025. A one standard deviation increase in relative real imports will have an effect size of -0.386, which relative to the mean of the dependent variable is -19.1%. This is an economically significant effect.

The second column in table 4 adds general control variables to the model. As a result, the magnitude of the main coefficient becomes more negative, but the statistical significance goes from a 1% to a 5% significance level, being very close to a 1% level at 1.3%. This suggests that the control variables absorb variation from the main independent variable and explain a modest part of its significance. Life expectancy interestingly is found to be positively associated with drug overdose deaths and is significant at a 1% level. Further, the magnitude of 0.3 means that a one-year increase in life expectancy increases drug overdose deaths per 100,000 residents by 0.3. Therefore, for every additional 3 years of life expectancy, the dependent variable increases by almost 1, an economically significant result. All sex and age demographic splits are statistically significant from males aged 20 – 39 onwards, initially at a 5% level before reaching a 1% level from males aged 40 – 59 onwards. However, the sign of these magnitudes is not consistent, being positive for males aged 20 – 39, females aged 40 – 59 and females aged 60+, and negative for the other significant coefficients. The fact that the sign changes for both genders for different age groups is a result which justifies the study of differential effects for countries with varying demographics and can potentially help to find groups at higher risk of overdose death. The magnitudes of the effects are also largest overall for certain demographic coefficients. Finally, GDP per capita, education levels and the unemployment rate are found to have no significant effect on the dependent variable.

The third column adds drug specific variables to the model but as a result, the number of observations drops significantly to 245, less than half of the first regression. Further, only the period 2007 – 2021 is considered. When running the regression with all drug related variables, certain variables are dropped due to multicollinearity, likely due to the low number of observations. As a result, some variables had to be omitted in order to get to an interpretable result. As the mean price and purity variables had the lowest number of observations, they have been dropped from the analysis. This means, only seizures of illicit substances per 100,000 residents, treatment demand for opioids per 100,000 residents and drug law offences per 100,000 residents are considered. Table A1 in the appendix runs models 1 and 2 using the same observations as model 3. Looking at the coefficients for the main independent variable, they are both insignificant. However, the magnitude in absolute terms is smaller in table 4 compared to A1. This means that both the addition of drug related variables and the dropped observations contribute to the change in significance and magnitude. Distinguishing between the two is therefore challenging. Life expectancy changed signs but is no longer significant. The sign of demographic coefficients remained the same, but their magnitudes have all changed and some considerably so. The youngest groups now produce highly significant coefficients whilst the female population aged 20 – 39 is now insignificant. Cannabis and heroin seized are both positively associated with the dependent variable at a 5% level. Finally, treatment demand for opioids per 100k is positively associated with the dependent variable at a 10% level. Other drug specific variables are insignificant.

Table 5 – *Regressions of specification two: Drug overdose deaths per 100,000 on Real Merchandise Imports/Real GDP*

Dependent variable: Drug overdose deaths per 100,000 residents

Independent Variables	Model 1	Model 2	Model 3
Real Merchandise Imports/Real GDP	-0.789* (0.422)	-1.17** (0.511)	6.68** (2.60)
Unemployment Rate (%)		-0.003 (0.020)	-0.019 (0.034)
Life Expectancy		0.297*** (0.110)	0.067 (0.153)
Population Change (1000s)		-0.0002 (0.0004)	0.00002 (0.0004)
Primary Education (%)		0.151 (0.841)	-1.59 (1.10)
Secondary Education (%)		0.138 (0.840)	-1.53 (1.10)
Tertiary Education (%)		0.153 (0.839)	-1.54 (1.10)
Real GDP per capita		0.000009 (0.00001)	0.00002 (0.00002)
Male pop. 0 – 19 (%)		1.54 (1.53)	10.65*** (2.40)
Female pop. 0 – 19 (%)		-1.64 (1.56)	-10.18*** (2.46)
Male pop. 20 – 39 (%)		0.725 (0.346)	1.63*** (0.537)
Female pop. 20 – 39 (%)		-1.05** (0.340)	-0.815 (0.546)
Male pop. 40 – 59 (%)		-1.73*** (0.266)	-1.34*** (0.389)
Female pop. 40 – 59 (%)		1.15*** (0.305)	1.86*** (0.525)
Male pop. 60+ (%)		-1.24*** (0.339)	-0.592 (0.719)
Female pop. 60+ (%)		1.22*** (0.346)	2.05*** (0.650)
Cannabis seized per 100k			0.008** (0.003)
Heroin seized per 100k			0.052** (0.021)
Cocaine seized per 100k			-0.005 (0.005)
Amphetamine seized per 100k			-0.009 (0.025)
Treatment demand opioids per 100k			0.005 (0.004)

Drug law offences per 100k			-0.002**
			(0.0008)
Constant	2.28***	-24.35	105.99
	(0.356)	(84.05)	(112.05)
Country FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Observations	509	500	245
Within r^2	0.0434	0.1715	0.3803

Notes: * = p < 10% significance level; ** = p < 5% significance level; *** = p < 1% significance level

The first column of table 5 considers only the independent variable real merchandise imports relative to real GDP. As before, this coefficient is negative, but the magnitude of the effect is smaller, and the result is only significant at a 10% level.

The second column adds the general control variables to the regression. In this case, the coefficient of interest is larger in absolute terms just as in table 4 but the statistical significance is higher at a 5% level, whereas previously significance got smaller with additional variables. Life expectancy was again significant at a 1% level and the magnitude is very close to the previous specification. The only other significant results came from certain demographic groups, as with the previous specification.

The third column includes drug specific control variables. Making comparisons between models in table 5 is unfair, as the number of observations is significantly lower in model 3. However, comparing model 3 across tables 4 and 5 is possible as they have the same observations and other than the main independent variable, have the same specification. Using this specification, the sign of real merchandise imports relative to real GDP goes from negative to positive, the same result as in Moore et al. (2023) and is the first time in the analysis that this is the case. The result is statistically significant at a 5% level and almost at a 1% level (1.1%). Further, the magnitude of the effect is significantly larger in absolute terms, going from 0.342 to 6.68. A one standard deviation increase in relative real merchandise imports will have an effect size of 17.37, which relative to the mean of the dependent variable is 858%. This is a highly economically significant result.

However, in table A2 (appendix), the regressions of specification two are run but only with the observations in models 3. That is, only the 245 observations used in models 3 are considered. There, a very similar result is found for model 2, which only includes general control variables. The main independent variable is estimated at 6.87 which is almost equal to model 3 in table 5 and is significant at a 1% level. This suggests that the drop in observations results in the sign change of relative real merchandise imports, rather than the inclusion of drug specific control variables. Model 1 in table A2, which only regresses the dependent variable on real merchandise imports, also has a positive and significant coefficient.

Mirroring results from table 4, cannabis and heroin seized are positively associated with the dependent variable at a 5% significance level. Drug law offences per 100,000 is significant at a 10% level and is negatively associated with the dependent variable.

Table 6 – *Regressions of specification three: Drug overdose deaths on Real DPC Imports/Real GDP and Real NDPC Imports/Real GDP*

Dependent variable: **Drug overdose deaths per 100,000 residents**

Independent Variables	Model 1	Model 2	Model 3
Real DPC Imports/Real GDP	3.59** (1.68)	5.76*** (2.00)	5.61 (3.61)
Real NDPC Imports/Real GDP	-1.81*** (0.425)	-2.37*** (0.567)	-2.68* (1.61)
Unemployment Rate (%)		-0.011 (0.020)	0.007 (0.0345)
Life Expectancy		0.325*** (0.108)	0.152 (0.154)
Population Change (1000s)		-0.0002 (0.0003)	0.00000003 (0.0000004)
Primary Education (%)		0.109 (0.830)	-1.58 (1.11)
Secondary Education (%)		0.105 (0.830)	-1.53 (1.12)
Tertiary Education (%)		0.125 (0.828)	-1.56 (1.12)
Real GDP per capita		0.000004 (0.00001)	0.000008 (0.00002)
Male pop. 0 – 19 (%)		1.40 (1.52)	11.68*** (2.42)
Female pop. 0 – 19 (%)		-1.28 (1.57)	-11.67*** (2.46)
Male pop. 20 – 39 (%)		0.625* (0.343)	1.45*** (0.550)
Female pop. 20 – 39 (%)		-0.773** (0.345)	-0.925 (0.591)
Male pop. 40 – 59 (%)		-1.74*** (0.262)	-1.53*** (0.424)
Female pop. 40 – 59 (%)		1.26*** (0.300)	1.95*** (0.531)
Male pop. 60+ (%)		-1.31*** (0.339)	-0.646 (0.762)
Female pop. 60+ (%)		1.22*** (0.342)	2.07*** (0.669)
Cannabis seized per 100k			0.008** (0.004)
Heroin seized per 100k			0.051** (0.021)
Cocaine seized per 100k			-0.004 (0.005)
Amphetamine seized per 100k			-0.010 (0.027)

Treatment demand opioids per 100k			0.010** (0.004)
Drug law offences per 100k			-0.002* (0.0009)
Constant	2.66*** (0.351)	-28.82 (83.16)	112.41 (113.47)
Country FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Observations	509	500	245
Within r^2	0.0731	0.1962	0.3687

Notes: * = p < 10% significance level; ** = p < 5% significance level; *** = p < 1% significance level

The third and final specification considers two independent variables of interest, real imports from known DPC's relative to real GDP, and real imports from NDPC's relative to real GDP. Column one considers only these two variables and finds that whilst imports from DPC's are positively associated with the dependent variable, NDPC imports are negatively associated with the dependent variable. This result is significant at a 5% level for DPC's and a 1% level for NDPC's.

Column two makes use of general control variables and increases the absolute magnitude of both coefficients of interest. Further, DPC imports are now significant at a 1% level. The effect sizes are also economically significant. A one standard deviation increase in DPC and NDPC imports corresponds to a 568% increase and 66.4% decrease in overdose deaths relative to its mean respectively. As with all model 2's, life expectancy and certain demographic groups are the only other significant coefficients.

Column three adds drug specific control variables to the specification. Now, the two coefficients of interest are both smaller, and have decreased in statistical significance. DPC imports are insignificant and NDPC are significant at a 10% level. As before, certain demographics are significant at a 1% level. Cannabis and heroin seized are significant at a 5% level and both treatment demand for opioids and drug law offences are significant, at a 5% and 10% level respectively.

Table A3 (appendix) runs the regressions of specification three with the 245 observations present in models 3, to make fairer comparisons across models. The same trend is present, where model 2 in table A3 has very similar coefficients of interest as model 3 in table 6. This again points to the insignificance of the inclusion of drug specific control variables. It is the drop in observations which creates the difference in the coefficients of interest, rather than the inclusion of drug specific control variables.

Conclusion:

The aim of this paper was to investigate whether real imports relative to real GDP had a positive effect on the drug overdose deaths per 100,000 residents in the EU and Norway. Taking inspiration from Moore et al. (2023) which established a similar connection in the US, three specifications were used to test this. These specifications were designed to control for any demand side effects on the dependent variable and made use of drug specific control variables which were not used in Moore et al. (2023). Correlation tests were conducted initially and found that all three independent variables of interest: real imports/real GDP, real merchandise imports/real GDP and DPC real imports/real GDP are negatively correlated with drug overdose deaths per 100,000.

The panel regressions found a statistically significant negative association between real imports/real GDP for models 1 and 2 but once the drug specific controls were added, this effect was no longer significant. Merchandise imports were chosen as not all imports are consumed within the country, it controls partially for transit trade and only imports of goods are considered, which is how illicit substances are smuggled across borders. The first two models found the same negative association between merchandise imports and drug overdose deaths with increased significance after adding general control variables. However, once the drug specific controls were added, this effect turned positive, and the absolute magnitude of the effect increased significantly. Further, the statistical significance for this model was the highest for the merchandise import specification. Comparing models 3 in table 4 and 5, which utilize the same observations, the use of merchandise imports and drug specific controls provided the first replication of the Moore et al. (2023) result. However, only 245 observations compared to 500 with general control variables were used for all model's 3. As a robustness check, models 1 and 2 for each specification were run using only those 245 observations. Based on this analysis, it is concluded that the drop in observations was the more likely cause of the change in sign rather than the inclusion of drug specific controls. Model 2 of specification one (table A1), which only used general control variables looked similar to the results of model 3 in table 4, whilst for specification two, merchandise imports were positively associated with the dependent variable across the board using only the 245 observations. Whilst the Moore et al. (2023) result was replicated with the use of merchandise imports, the role of drug specific demand side control was not as important as expected in replicating the results. It is important to note that the 245 observations only considered the period from 2007 – 2021 which corresponds better to the increased use of fentanyl, the main drug of study for Moore et al. (2023). Further research should have the added goal of focusing on this shorter period as well as using more consistent drug specific control variables.

The third specification found a positive and significant association between relative real DPC imports and a negative and significant association between relative real NDPC imports for models 1 and 2 in table 6, with increased significance after adding general controls. Model 3 however with drug specific controls resulted in an insignificant DPC coefficient and an NDPC coefficient significant at a 10% level. The robustness checks for models 1 and 2 had a similar result, where DPC imports were consistently insignificant whilst

NDPC imports was significant at a 10% and 5% level respectively. Here the role of drug specific controls is even less significant, as the DPC import coefficients are almost identical between model 3 in table 6 and model 2 in table A3.

Due to the inconsistency of the dataset, concluding that there is a positive relationship between the relative imports of countries in Europe and their relative drug overdose deaths is not possible. However, given the results of this analysis, it provides evidence that this is a question worth studying. The result if drug specific variables were more consistently reported is unknown but the robustness checks provide anecdotal evidence that the lower number of observations was more important in replicating results for merchandise imports. The more interesting result however is the opposite effects found between DPC imports and NDPC imports. Model 1 in table 6 with no control variables already found this difference in sign across coefficients. The addition of general control variables, which partly control for demand side effects, increased the absolute magnitude of both coefficients and made them more significant. Model 3, which added drug specific controls, reduced the significance of both coefficients. Comparing this to table A3, again the drop in observations seems to be the main cause of the lower significance level. This result however is promising as the worldwide illicit drug market is concentrated and there are usually a handful of countries which contribute to most of the worldwide supply for certain substances. Especially when isolating supply to Europe. Focusing on model 2 in table 6, it considers the entire period of study and finds economically significant effect sizes. Controlling partially for demand in a similar manner to Moore et al. (2023), this is evidence that there is a significant impact on the health of countries based on where they are importing from and the volume of trade with certain countries relative to GDP. This is an important result to consider for those interested in health economics, economics of trade and crime, and in terms of policy making; those involved with customs and trade. There clearly are countries which present higher risk of overdose death if trade with them is increased, through the illegal supply of illicit substances. As merchandise import data cannot be filtered by import partners, this provides an interesting avenue for future research.

Regarding other control variables, this analysis provides information which is important to consider. The common consensus regarding drug overdoses is that it is mostly uneducated, unemployed young people which are at the highest risk of death from a drug overdose. However, something that can be concluded across the board is that GDP per capita, the unemployment rate and the education level of a country has no impact on drug overdose risk. These variables were always insignificant for all specifications. Only when conducting robustness checks with fewer observations, education level was found to have a significant negative effect but never at more than a 10% level. This is evidence of the homogenous risk of drug overdose risk, regardless of wealth and economic situation and development. Whether there is some unknown variable which explains this homogenous risk, like happiness or depression rates perhaps, is a question left for future research. The significance of certain demographics like age and sex, and their differing effects, suggests that countries should analyze which groups are at most risk, in order to better target them and prevent overdoses and deaths. Finally, whether the drug specific control variables are bad controls is something to consider. Whilst it seems the drop in observations arising from their inclusion was the main contributing factor to changes in results, their inclusion nevertheless potentially added a mechanism to the analysis through which supply of illicit substances has an impact on overdose deaths, rather than controlling for demand side effects. For example, with regards to seizures, it includes data from customs. This means, intercepted international packages of illicit substances are counted and therefore take away from the effect of imports.

Policy decisions require strong theoretical and empirical evidence before they are made. The main takeaway from this analysis is that questions posed in this paper should be analyzed further, ideally with better data. Should countries focus more on certain import partners to minimize the supply of illicit substances? What groups are at higher risk of overdose death and why? Heroin is the main driver of drug overdose deaths in Europe. With Afghanistan stopping production, the resulting general equilibrium changes have the potential to grow this problem. Previous Afghani supply shocks have created short term changes in demand for synthetic opioids, which are more potent, cheaper and therefore more lethal. Further research on this topic can provide policymakers with important information which may help mitigate supply side effects of illicit substances on drug overdose deaths.

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Appendix

Table A1 – *Regressions of specification one using only model 3 observations: Drug overdose deaths per 100,000 on Real Imports/Real GDP*

Dependent Variable: Drug overdose deaths per 100,000 residents

Independent Variables	Model 1	Model 2
Real Imports/Real GDP	-1.78***	-0.792
	(0.597)	(0.800)
Unemployment Rate (%)		0.006
		(0.034)
Life Expectancy		0.050
		(0.150)
Population Change (1000s)		0.0001
		(0.0004)
Primary Education (%)		-1.99*
		(1.14)
Secondary Education (%)		-1.98*
		(1.14)
Tertiary Education (%)		-2.01*
		(1.14)
Real GDP per capita		0.000008
		(0.00002)
Male pop. 0 – 19 (%)		11.57***
		(2.40)
Female pop. 0 – 19 (%)		-11.04***
		(2.48)
Male pop. 20 – 39 (%)		1.25**
		(0.533)
Female pop. 20 – 39 (%)		-0.453
		(0.568)
Male pop. 40 – 59 (%)		-1.38***
		(0.418)
Female pop. 40 – 59 (%)		2.21***
		(0.521)
Male pop. 60+ (%)		-0.014
		(0.755)

Female pop. 60+ (%)		1.77*** (0.659)
Constant	3.16*** (0.357)	147.30 (116.06)
Country FE	Yes	Yes
Time FE	Yes	Yes
Observations	245	245
Within r^2	0.0726	0.3017

Notes: * = p < 10% significance level; ** = p < 5% significance level; *** = p < 1% significance level

Table A2 – *Regressions of specification two using only model 3 observations: Drug overdose deaths per 100,000 on Real Merchandise Imports/Real GDP*

Dependent Variable: Drug overdose deaths per 100,000 residents

Independent Variables	**Model 1**	**Model 2**
Real Merchandise Imports/Real GDP	7.64*** (2.25)	6.87*** (2.47)
Unemployment Rate (%)		-0.010 (0.034)
Life Expectancy		-0.032 (0.149)
Population Change (1000s)		0.00008 (0.0004)
Primary Education (%)		-1.90* (1.12)
Secondary Education (%)		-1.86 (1.13)
Tertiary Education (%)		-1.88* (1.12)
Real GDP per capita		0.00002 (0.00002)
Male pop. 0 – 19 (%)		10.45*** (2.40)
Female pop. 0 – 19 (%)		-9.86*** (2.46)
Male pop. 20 – 39 (%)		1.36** (0.523)

Female pop. 20 – 39 (%)		-0.672
		(0.512)
Male pop. 40 – 59 (%)		-1.35***
		(0.388)
Female pop. 40 – 59 (%)		1.88***
		(0.518)
Male pop. 60+ (%)		-0.170
		(0.712)
Female pop. 60+ (%)		1.72***
		(0.639)
Constant	-0.387	146.78
	(0.830)	(113.99)
Country FE	Yes	Yes
Time FE	Yes	Yes
Observations	245	245
Within r^2	0.0837	0.3252

Notes: * = p < 10% significance level; ** = p < 5% significance level; *** = p < 1% significance level

Table A3 – *Regressions of specification three using only model 3 observations: Drug overdose deaths per 100,000 on Real DPC Imports/Real GDP and Real NDPC Imports/Real GDP*

Dependent Variable: Drug overdose deaths per 100,000 residents

Independent Variables	Model 1	Model 2
Real DPC Imports/Real GDP	0.831	5.69
	(3.59)	(3.59)
Real NDPC Imports/Real GDP	-2.90*	-3.39**
	(1.63)	(1.61)
Unemployment Rate (%)		0.014
		(0.034)
Life Expectancy		0.085
		(0.150)
Population Change (1000s)		0.0001
		(0.0004)
Primary Education (%)		-1.95*
		(1.14)
Secondary Education (%)		-1.93*

		(1.14)
Tertiary Education (%)		-1.97*
		(1.14)
Real GDP per capita		0.000007
		(0.00002)
Male pop. 0 – 19 (%)		11.95***
		(2.40)
Female pop. 0 – 19 (%)		-11.52***
		(2.47)
Male pop. 20 – 39 (%)		1.11**
		(0.536)
Female pop. 20 – 39 (%)		-0.432
		(0.564)
Male pop. 40 – 59 (%)		-1.510***
		(0.421)
Female pop. 40 – 59 (%)		2.18***
		(0.518)
Male pop. 60+ (%)		-0.208
		(0.758)
Female pop. 60+ (%)		1.87***
		(0.657)
Constant	3.36***	146.22
	(0.449)	(115.33)
Country FE	Yes	Yes
Time FE	Yes	Yes
Observations	245	245
Within r^2	0.0750	0.3140

Notes: * = p < 10% significance level; ** = p < 5% significance level; *** = p < 1% significance level