

Reassessing a cocaine shock: a contrary narrative from Rabo de Peixe

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Abstract

This work seeks to analyze the effects of an exogenous increase shock in the supply of cocaine using São Miguel Island, Portugal as a case study. Located in the Azores archipelago, the island is politically organized as an autonomous region. In January 2001, half a ton of cocaine unexpectedly washed ashore on Rabo de Peixe, São Miguel, leading to media reports of various alterations on the island, such as a surge in drug dealers and a significant reduction in the drug's price. These events even formed the basis for a documentary and a Netflix series. However, my comprehensive analysis utilizing a Synthetic Control approach paints a contrasting picture. I aimed to examine the short and medium-term repercussions of the increased accessibility of cocaine on São Miguel's crime rates, unemployment, and deaths. Contrary to the narrative constructed by the media and popular culture, I found no significant effects on these outcomes. This study challenges existing media narratives and provides a robust, data-driven insight into the actual impact of this incident on São Miguel.

Introduction

For many years, scholars from various disciplines have investigated the impact that drugs have on society as a whole. Drugs have both direct effects (for example, deaths by overdose), and indirect effects, such as an increase in unemployment due to addiction. Many authors attempted to identify its impact by finding a relationship between drug use and different outcomes, such as unemployment, consumption, etc. (see Miron 2001). The problem with this strategy does not need further explanation: those societies with the worst economic performance tend to contain individuals who resort to drugs, so the causality is reversed. The present work will use a natural experiment to estimate the causal effect that an increase in the supply of cocaine has on unemployment, health, and crime.

In the context of the experiment explored in this study, a unique incident occurred in January 2001 on São Miguel Island, Portugal.¹ Amid a cocaine trafficking operation, an unexpected turn of events led to half a ton of cocaine washing ashore, significantly increasing the local supply of the drug. This occurrence resulted in numerous reports of changes on the island, such as a surge in drug dealers and a significant reduction in drug prices, as reported by media outlets.

The natural experiment proposed in this work allows us to rule out the hypothesis of reverse causality because the economic performance of São Miguel did not cause the cocaine to reach the island. Although the term “natural experiment” is used inconsistently in the economic literature Titunik 2020 proposes a definition that tries to clarify what we call a natural experiment. A natural experiment occurs when “the treatment assignment mechanism (i) is neither designed nor implemented by the researcher, (ii) is unknown to the researcher, and (iii) is probabilistic by virtue of depending on an external factor.”

¹<https://www.theguardian.com/society/2019/may/10/blow-up-how-half-a-tonne-of-cocaine-transformed-the-life-of-an-island>

In this sense, the case study treated here not just constitutes a natural experiment but would be the first of its kind to exploit such a considerable increase in cocaine in such a short period of time.

Cocaine is generally classified as a “Hard Drug”, due to its addictive potential and its ability to cause harm, both to the consumer and to third parties (Janik et al. 2017). Through a multicriteria analysis, Nutt, King, Phillips, et al. 2010 ranks cocaine in a high position in terms of the damage it can cause. In terms of potential damage, it is located above tobacco, cannabis, amphetamine, ketamine, etc. At a global level, cocaine causes a total of 0.09 deaths per 100 thousand inhabitants (Ritchie 2018), surpassing the number of deaths from amphetamine overdose (0.06). Studies have demonstrated that cocaine users have a higher mortality rate than non-users (Peacock et al. 2021). In particular, deaths attributed to cocaine use are often due to heart failure (Pergolizzi Jr et al. 2021, Havakuk, Rezkalla, and Kloner 2017).

In 2001, half ton of cocaine got into São Miguel, Portugal. The yacht that was carrying the cocaine from Venezuela had planned to go to Spain, however weather conditions forced it to have to make a stop in São Miguel. Before arriving at port, the experienced sailor had to hide the cocaine he was carrying. The members of the crew tried to hide the cocaine in a cave in the north of São Miguel, with fishing nets and an anchor. But unfortunately for the smugglers, the waves dislodged the cocaine packages that ended up reaching the coasts of São Miguel. According to news reports², since this event, many islanders became small distributors of the drug. It was also commented that the price of cocaine completely collapsed to the point of distributors selling glasses with 150 grams of cocaine for 17 euros, which was extremely cheap. While these reported outcomes have been relayed through anecdotes from officials and citizens of the island, and even captured in popular media through a documentary titled “Azores on Cocaine” and a Netflix series named “Rabo de Peixe”, there has been little effort to document these changes in a more rigorous and empirical way.

Located in the Atlantic Ocean, São Miguel has a group of nearby islands that are part of the Azores Archipelago (Figure 1). These islands have similar characteristics in terms of climate because they are close to each other, but because they are separated by water, a shock that impacts one will not necessarily directly impact another. Furthermore, the increase in cocaine occurred at a particular point in time and not over multiple periods. All this makes it possible to estimate the causal effect of the aforementioned shock.

This work manages to contribute to various pieces of literature. First, the work proposes to find short and medium-term effects that drugs have on society. As will be seen below, there are similar works in the sense that they examine some type of exogenous variability in the supply of drugs, but the majority do so through a reduction in the supply and not an increase. On the other hand, this work tries to investigate the impact of a particular episode that could have significantly changed the destiny of an entire population. The literature that is responsible for investigating effects that have particular episodes over time is known as persistence literature.

²<https://www.cmjornal.pt/portugal/detalhe/alguns-pensavam-que-podiam-voar-testemunhas-recordam-o-dia-em-que-rabo-de-peixe-foi-inundado-de-droga>

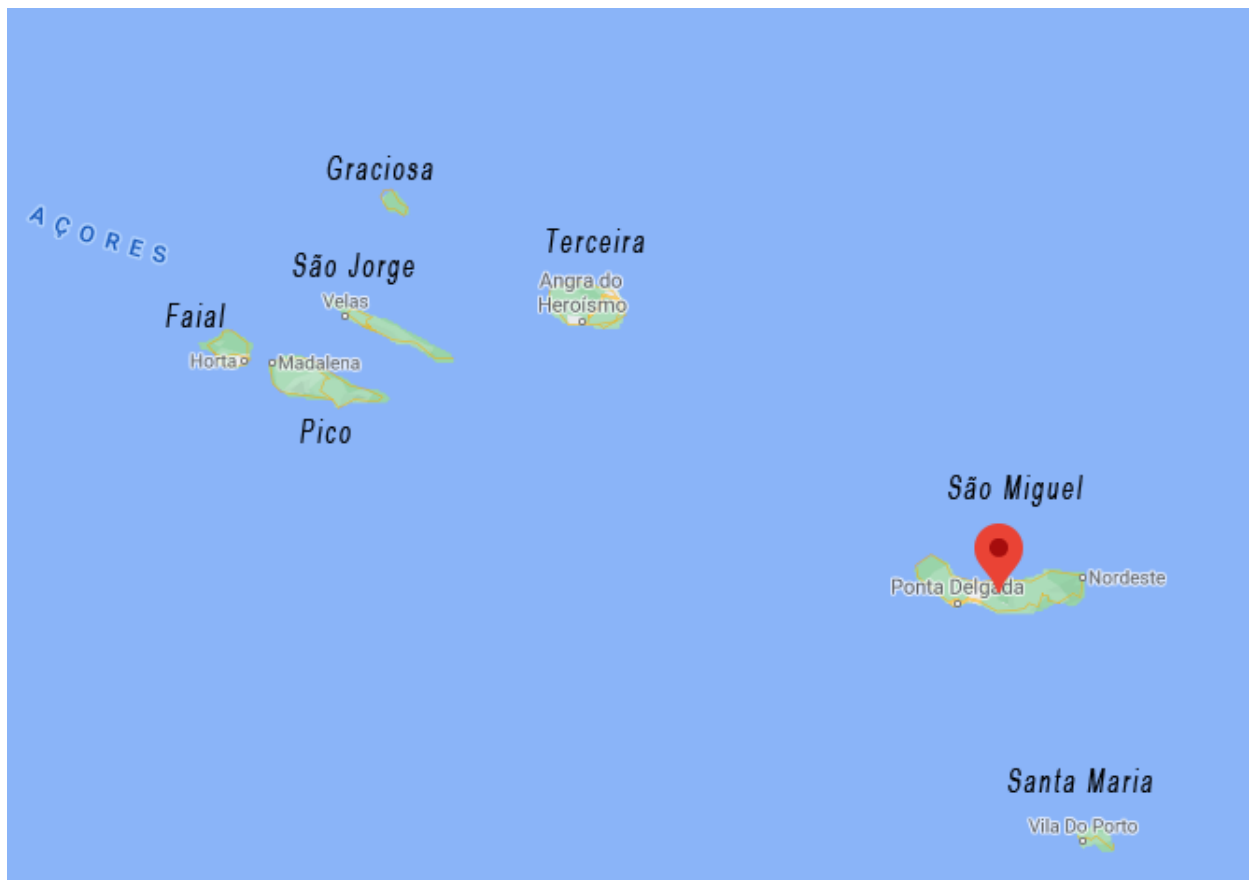


Figure 1: São Miguel and nearby islands in the Azores archipelago

Related Literature

The literature related to the effects of changes in the supply of drugs can be divided into at least two categories, one includes a reduction in supply, while the other includes an increase in supply. These two relevant kinds of literature will be detailed below.

Drug Impact

Reduction in the Supply of Drugs

Studying shocks in the drug market in Colombia [Abadie, Acevedo, et al. 2014](#) found evidence that a reduction in the supply of cocaine tends to produce an increase in violence. They argue that this could be due to an increase in disputes to capture the rents that are associated with cocaine sales.

[Castillo, Mejía, and Restrepo 2020](#) examined the role of a reduction in the supply of cocaine in the increase of violence in Mexico. Studying seizures in Colombia the authors found that a reduction in the cocaine supply could account for a 10% increase in violence in Mexico. In a similar vein, [Cunningham and Finlay 2016](#) pointed out that a reduction in the supply of drugs in illegal markets tends to increase the street price of drugs, and there are also substitution effects between different types of drugs.

Regarding changes in the supply of other drugs, we can find some studies that suggest that there are substitution effects between drugs, as the last study cited above. For example, [Alpert, Powell, and Pacula 2018](#) studies the effect of a supply disruption in abusable opioids in the United States, which could have caused a substitution effect with respect to heroin use. In the same spirit, [Meinhofer 2016](#) conducted research on the effect of a reduction in the supply of oxycodone. The research reveals that prices in the informal market have risen, resulting in a substitution effect that has had a substantial impact on heroin overdoses, yet no measurable effect on crime.

Increase in the Supply of Drugs

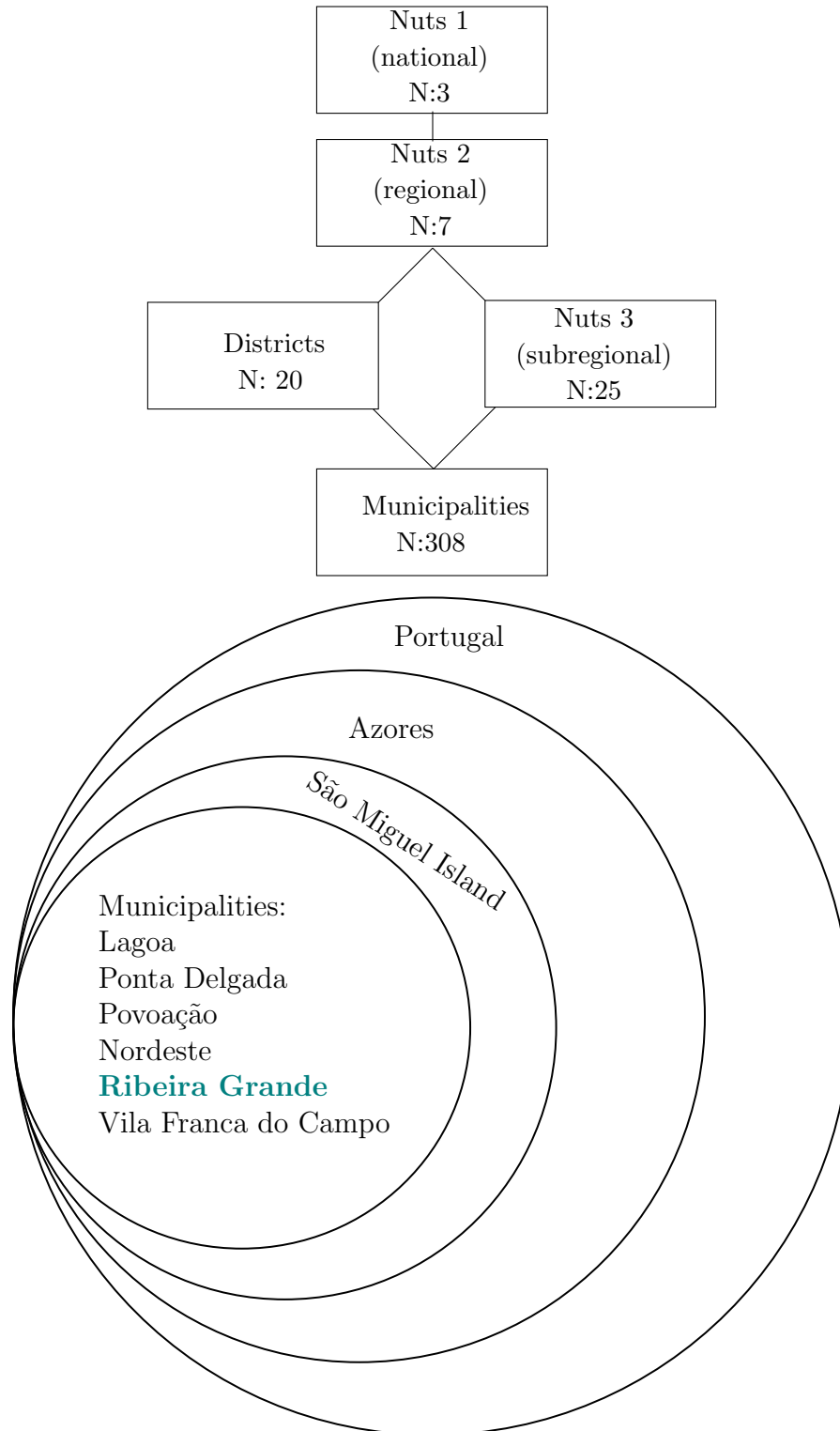
Finding exogenous increases in the supply of drugs is more difficult than finding decreases. An exception is [Beeder 2020](#) who makes use of an exogenous increase in the supply of cocaine and analyzes the subsequent violence in Colombia. The showed found that when cocaine production becomes cheaper, violence increases. This result suggests that in the case of São Miguel, there could be a similar effect in terms of crime rates. Taken together, the evidence would suggest that both an increase in the supply of drugs and a reduction could lead to an increase in crime.

Persistence Literature

In the past few years, there has been a growing body of research on persistence in economics. That is, studies that investigate the impact of a particular event and how it shapes the destiny of a particular city or country in the following years. As shown in [Nunn 2009](#), empirical evidence has supported the claim that some historical events can have long-lasting effects in different variables such as economic performance, culture, or even gender differences. Generally, studies of this nature primarily concentrate on long-term effects (see for example the seminal work of [Acemoglu, Johnson, and Robinson](#)

2001), but there are also those that study the short and medium-term consequences of certain shocks (for example, Jones and Olken 2009). The work presented here would evaluate short and medium-term effects (around 10 years).

Data



For the purpose of this study, the data will be obtained through the National Institute of

Statistics of Portugal, which contains disaggregated data for the different regions of the country. It has data on, for example, crime, hospitalizations, deaths and unemployment.

If for some reason it is not possible to obtain some of the explanatory variables of interest, a close proxy would be sought. For example, there may not be data with such a high frequency for hospitalizations, but it is more likely to obtain data of this type with regard to deaths, the impact on health would then be studied through this last variable.

The synthetic control method provides the possibility of using covariates to construct the pre-treatment paths of the outcome variables of the donors. These covariates will be chosen based on the availability of data and on how good a predictor they can be of pre-treatment path. That is, they are not decided in advance. In an extreme scenario the exercise could be carried out without covariates, simply using lagged values of the outcome variables.

Methodology

Causal relationships can be defined through potential counterfactual results that cannot be observed. [Lewis 1974](#) was one of the first authors to make this explicit: “The proposal has not been well received. True, we do know that causation has something or other to do with counterfactuals. We think of a cause as something that makes a difference, and the difference it makes must be a difference from what would have happened without it. Had it been absent, its effects—some of them, at least, and usually all—would have been absent as well”.

The ideal scenario to evaluate the impact of an increase in drug availability in a region is to take a certain number of regions (the more the better) and randomize the application of the treatment (increase in the supply of drugs). Such an experiment cannot be carried out easily. But considering such an ideal experiment can be helpful in finding a valid source of exogeneity as [Angrist and Pischke 2008](#), p. 4 say.

Given the above, it is necessary to find a counterfactual of what would have happened without the increase in the supply of cocaine in São Miguel. Once this counterfactual is found, according to Rubin’s Causal Model ([Rubin 2005](#)) the difference between what is observed and what would have happened in the absence of the shock would be the causal effect of interest. One approach to constructing counterfactuals in this situation, where there is only one treated unit and several untreated units which are not necessarily similar, is to use the synthetic control method.

The first work that used the synthetic control method was [Abadie and Gardeazabal 2003](#). In their seminal paper, they examine the effect of terrorist conflicts in the Basque country. Their work generated a whole new literature in which, to estimate causal effects one has to present only one treated unit and a pool of donors to construct a synthetic control. It acquired such relevance that [Athey and Imbens 2017](#), p. 9 states that “the synthetic control method is arguably the most important innovation in the policy evaluation literature in the last 15 years”.

First, we define the unobservable causal effect of the treatment, that is $\Delta_{1t} = Y_{1t}(1) - Y_{1t}(0)$. The problem is that $Y_{1t}(0)$ is not observable (it is the potential outcome if the treated unit was untreated). We approximate $Y_{1t}(0)$ using a weighted average of donors,

so the estimated causal effect is: $\hat{\Delta}_{1t} = Y_{1t}(1) - \sum_{j=2}^{J+1} w_j Y_{jt}(0)$ for $t = T_0 + 1, \dots, T$. [Abadie, Diamond, and Hainmueller 2010](#), p. 496 shows that $\hat{\Delta}_{1t}$ is an unbiased estimator of Δ_{1t} even if we have data from only one pre-treatment period.

The key step in the synthetic control method is the minimization of the distance between the treated unit and the synthetic control unit. This distance is typically measured using a weighted sum of the differences between the treated unit and the control units on the pre-intervention outcome variable of interest, such as GDP or employment. The weights used in the distance measure are chosen to ensure that the synthetic control unit is a weighted average of the control units that closely match the treated unit on the pre-intervention outcome variable.

The minimization problem can be formulated as follows:

$$\underset{w}{\text{minimize}} \sum_{t=1}^T \left(y_t - \sum_{j=1}^J w_j y_{jt} \right)^2 \quad \text{such that: } w_j \geq 0, \sum_{j=1}^J w_j = 1$$

where y_t is the outcome variable for the treated unit at time t , y_{jt} is the outcome variable for control unit j at time t , w_j is the weight assigned to control unit j , and T is the number of time periods. The minimization problem ensures that the synthetic control unit is a weighted average of the control units that closely match the treated unit on the pre-intervention outcome variable.

At the time of constructing the $Y_{jt}(0)$, the outcome predictors can be other relevant variables as well as lagged values of the outcome. In principle, it seems reasonable to add the entire pre-treatment path of the outcome as a predictor, but [Kaul et al. 2015](#) shows that this makes all other predictors irrelevant, this can cause the estimator to be biased. The conclusion derived from [Kaul et al. 2015](#) is that two alternatives can be followed; include all lagged values of the outcome variable and do not include covariates or do not include all lagged values and include covariates.

Building Synthetic Control

As mentioned before a synthetic control is a way of constructing a counterfactual in a case where there is no unit similar to the one that receives a treatment, but there are several units that have a certain similarity and did not receive the treatment. The latter are called donors. Starting from the islands near São Miguel, a weighted average of the variables of interest would be created in such a way as to minimize the gap between the series of our treated unit and the synthetic control. One of the alternatives to synthetic control would be to perform a before and after analysis with a trend. That is, the current result is compatible with the value that the variable would have taken if it had followed the trend and it is assumed that in the absence of treatment that would have been the result. The problem with this is that during the shock of interest, there could have been various shocks that muddle the effect and therefore do not allow us to distinguish the effect of interest from others.

The first step to performing synthetic control is to define the outcome of interest (in this case the outcomes will be hospitalizations, crime, and unemployment rates). Next, we will define the predictors of each outcome. And finally, we will decide the period in which

the difference between the treated and synthetic regions will be minimized (the largest number of years prior to 2001 for which data is available).

The synthetic control method requires the choice of donors, these donors can be chosen based on a decision according to the similarity between the donors and the unit treated or a data-driven approach can also be carried out, where donors are selected through methods like LASSO (Amjad, Shah, and Shen 2018). Donors could be chosen based on their proximity to the island of São Miguel, as well as other observed characteristics (if they are very different, it would not make sense to include them). Fortunately, there is no evidence that cocaine ships got on the other islands at the time of the shock to the island of São Miguel. If another island had received the same treatment, it would have to be removed from the donor list.

Results

NUTS 1 aggregation

Upon utilizing the NUTS 1 disaggregation method, the results prove to be non-significant. In other words, no discernible impact is observed in terms of increased mortality rates, unemployment, criminal activity, and deaths.

The following graphs demonstrate that there seems to be no observable effect on either the crime rate or the mortality rate. The same analysis is also conducted with other variables such as hospitalization rates and unemployment rates, yielding similar results.

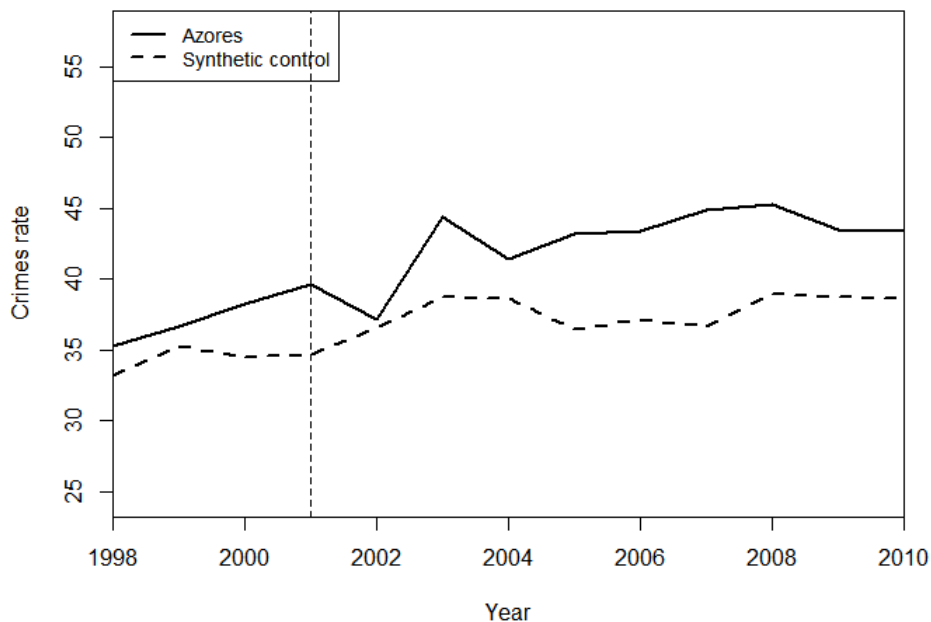


Figure 2: Synthetic control using NUTS 1 aggregation

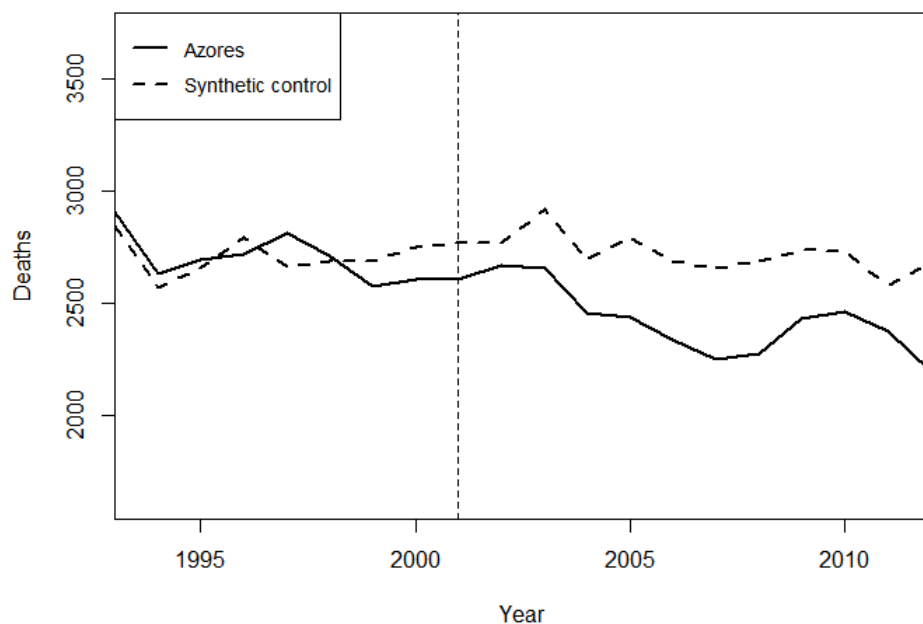


Figure 3: Synthetic control using NUTS 1 aggregation

NUTS 2 aggregation

Using a NUTS 2 level disaggregation and running synthetic control with the mortality rate variable as the dependent variable and the following variables as covariates: prices, divorce rate, number of employed individuals, energy consumption. As shown in [Figure 4](#), although there is some match between the Azores region, and the synthetic control, no discernible effect post the year 2001 can be identified.

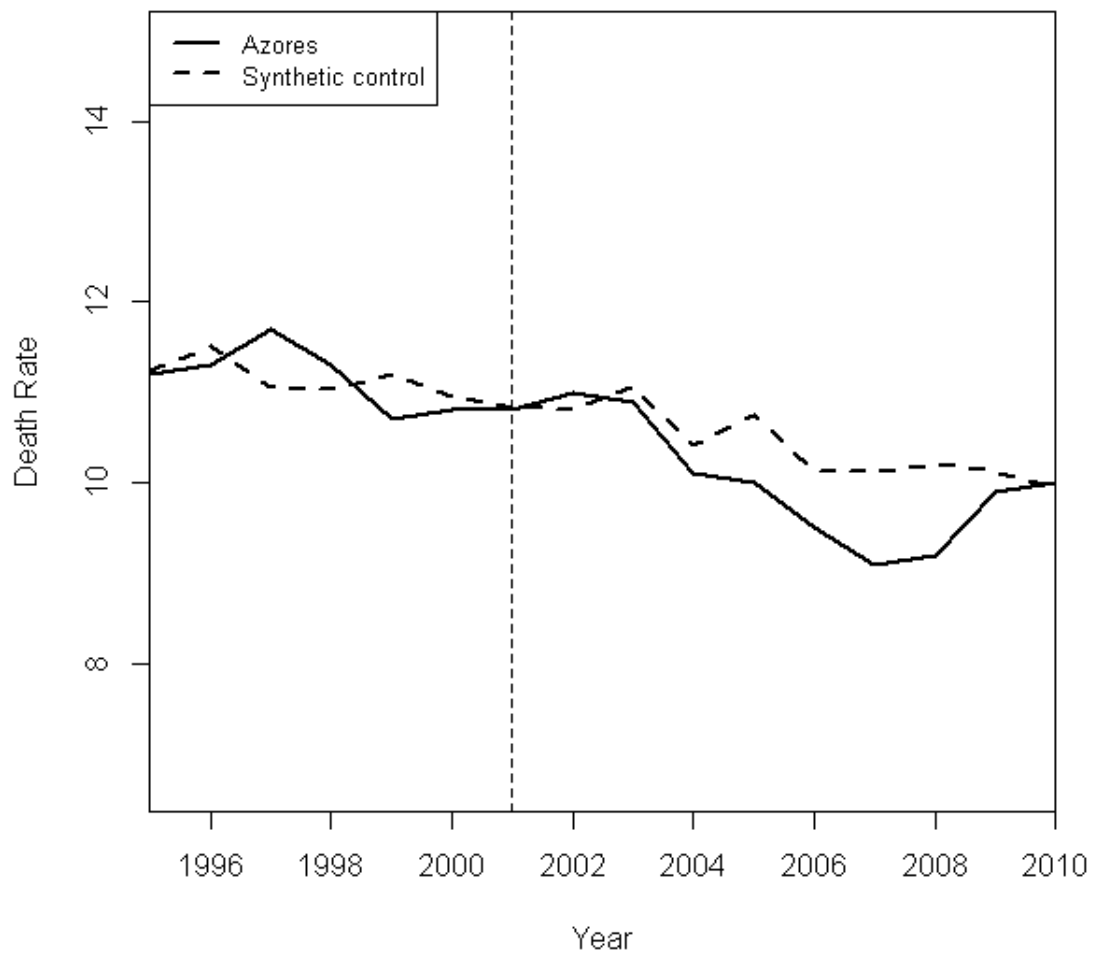


Figure 4: Synthetic control using NUTS 2 aggregation

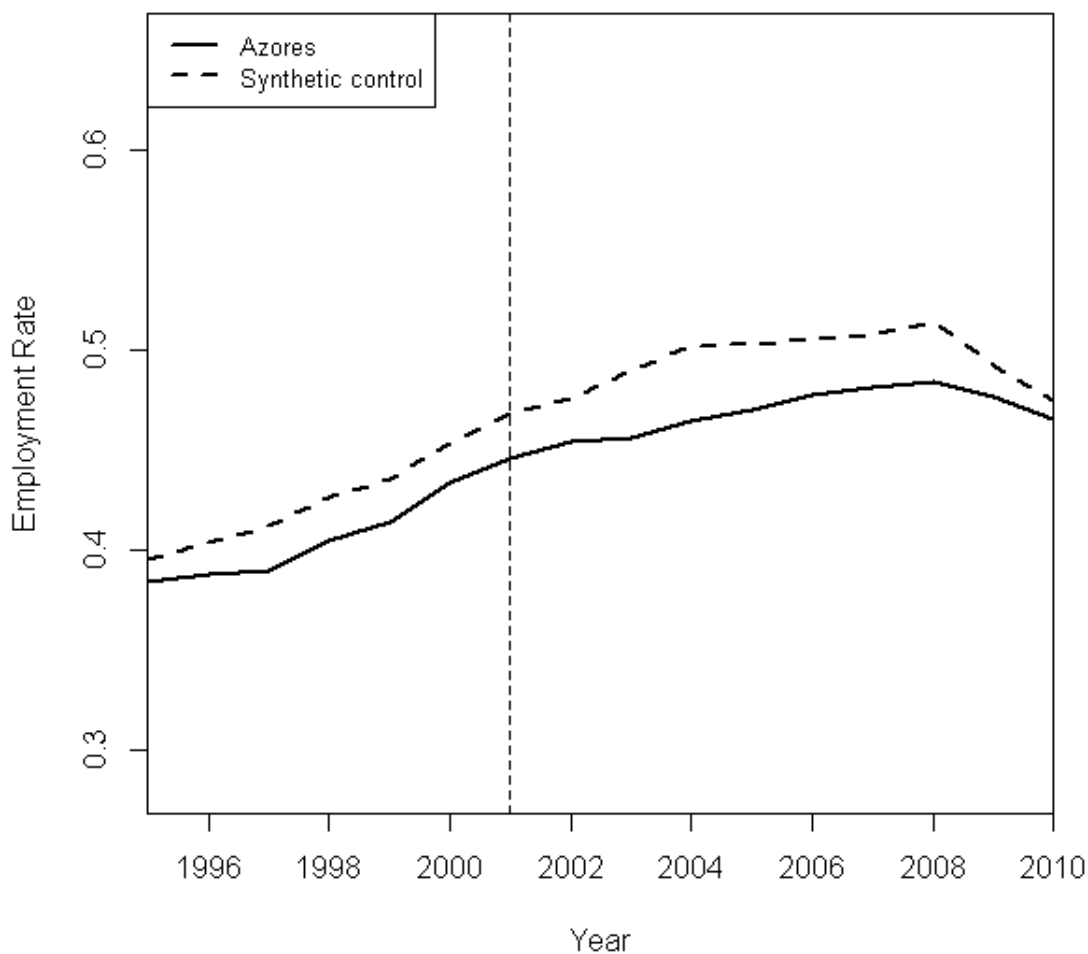


Figure 5: Synthetic control using NUTS 2 aggregation

If we conduct another synthetic control analysis, but this time with the employment rate variable (Figure 5), we observe a match in the trends, however, we still do not observe any significant effect.

NUTS 3 aggregation

Using disaggregation at the subregional level (NUTS 3), an analysis was conducted using the synthetic control method, in which the dependent variable is the mortality rate and the covariates include energy consumption, dependency rate, aging rate, export intensity, fertility rate, live births, official clinics, divorces, and progression proceedings.

The Figure 6 demonstrates that the mortality rate remains unaffected subsequent to the year 2001 (indicated by a vertical black line).

If we use the data on the number of registered crimes as the dependent variable and the same covariates, we obtain only 3 subregions due to missing data on this variable in the other subregions. However, these 3 subregions provide a better match to the

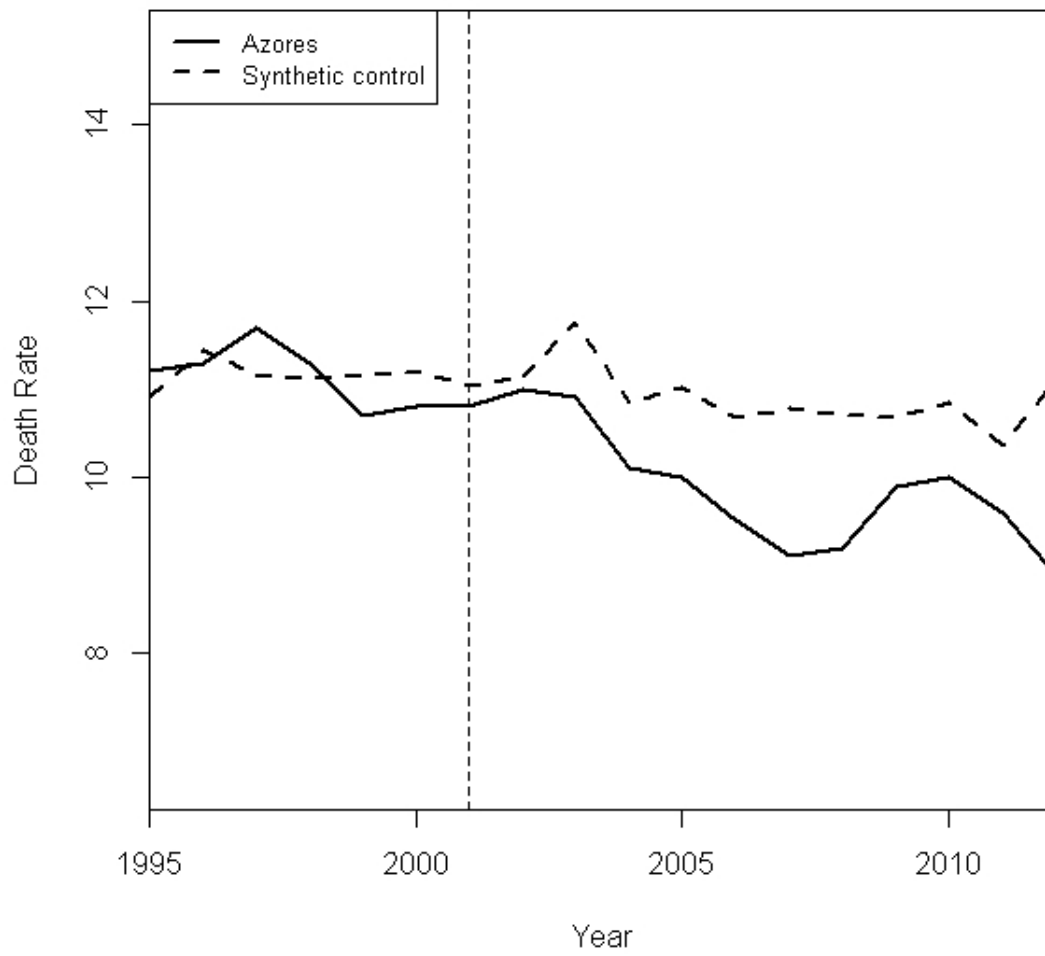


Figure 6: Synthetic control using NUTS 3 aggregation

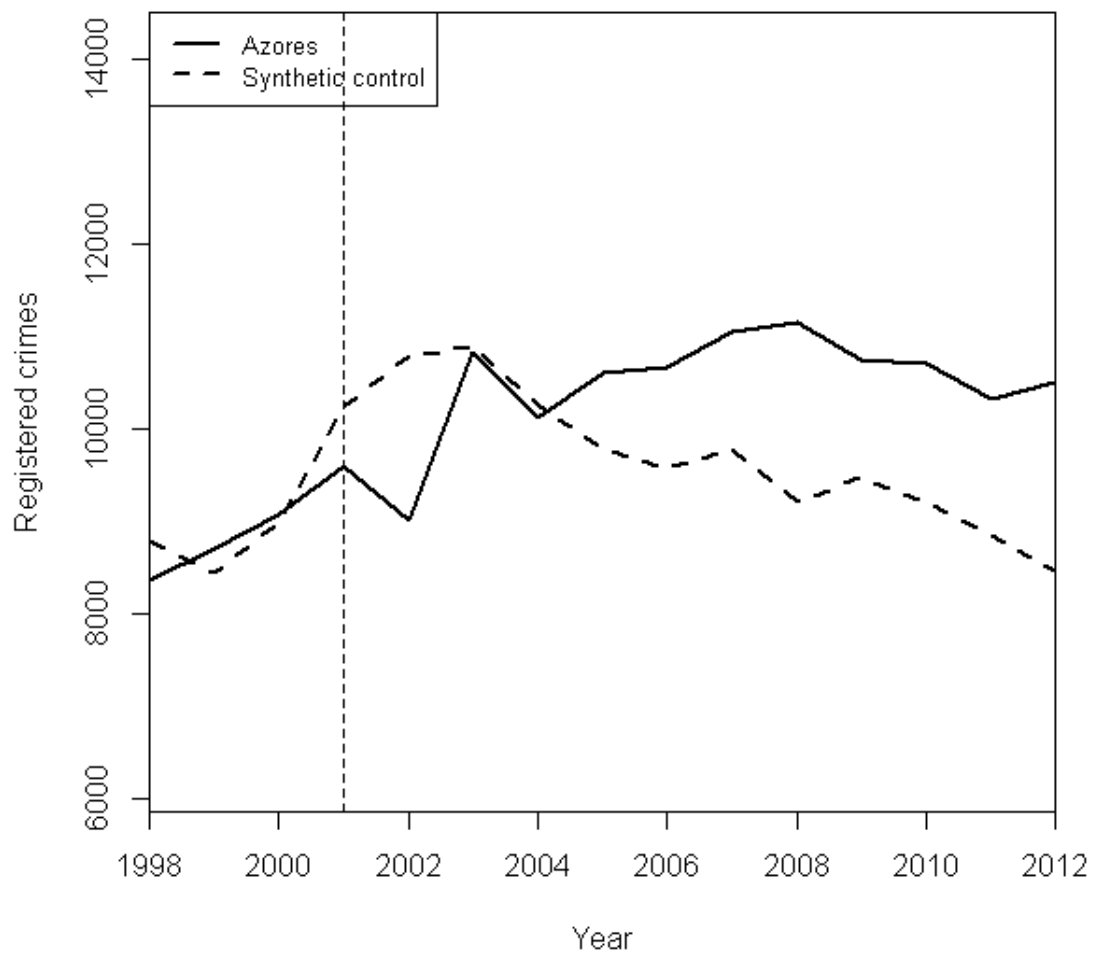


Figure 7: Synthetic control using NUTS 3 aggregation

pre-treatment period than before. Nevertheless, the result in [Figure 7](#) to be of limited relevance, as after 2001 there is a decline in the number of registered crimes followed by an increase and then a plateau, whereas for the control group the number of crimes decreases over time.

Main findings

The results indicate that there is no effect of the shock in the short term, and even less so in the long term. The supply shock does not appear to have impacted the analyzed variables, even when conducting a graphical analysis without considering p-values. Subsequently, I will make an attempt to account for or understand why this result may be meaningful.

- First and foremost, all the news covering this event report the arrival of cocaine as a catastrophe or something that deeply impacts the island. For instance, we can observe more than 10 sources that suggest this including newspapers from countries other than Portugal.
- Secondly, the previously cited studies demonstrate that there usually are effects from an increase or decrease in drug supply in a specific country or territory. The absence of research with conclusions similar to this one may be related to the phenomenon of publication bias, which only leads academics to publish studies with significant effects as those with null effects receive much less attention in terms of citations ([Brodeur, Cook, and Heyes 2020](#), [Blanco-Perez and Brodeur 2020](#) [Auspurg and Hinz 2011](#) and [Weiß and M. Wagner 2011](#)). It is worth considering that the null effects found in our study might be due to cocaine being a novel substance in São Miguel. Unlike regions with established cocaine use, where fluctuations in supply could significantly affect crime rates by disrupting existing market dynamics, the sudden influx of cocaine in São Miguel might not have resulted in immediate or substantial shifts in crime rates. This divergence emphasizes the influence of regional sociocultural and economic contexts on the relationship between drug supply dynamics and crime rates, offering an alternative explanation for the observed null effects.

Explaining null effects

It is possible that the fact that individuals did not become addicted to cocaine after a single increase in supply may explain why no significant effects on health or crime were observed in the study. Cocaine addiction is a process that may take time and repeated exposures to the drug to develop. In some cases, even a single exposure to cocaine can lead to addiction, but this is less common. If individuals in the study only received a single dose of cocaine, they may not have experienced enough effects to develop an addiction.

In addition, the short-term effects of cocaine can vary significantly among individuals. Some people may experience intense euphoria, while others may feel anxious or even depressed. If island dwellers in the study did not experience significant short-term effects, they may not have been affected by the single dose of cocaine.

The likelihood of developing addiction from cocaine consumption will depend on the method of administration. It is well known that the probability of addiction is not the

same when cocaine is snorted as compared to when it is smoked in the form of crack or injected. The latter two methods of administration often carry a greater risk of addiction (O'Brien and Anthony 2005). The probability of developing dependence on cocaine, while higher than with other drugs such as marijuana, may not be high enough to have caused an increase in the number of addicted users in San Miguel. For example, there are estimates showing that 5 to 6 percent of individuals who have tried cocaine become dependent within the first year (F. A. Wagner and Anthony 2002). This percentage, although not zero, may not be high enough to generate statistically significant effects on the analyzed variables.

Becker and Murphy's theory of rational addiction

In terms of Becker and Murphy's rational addiction model, it is possible to understand the lack of generation of an addictive effect of cocaine. One of the main conclusions of the model is that there is an inverse relationship between the future price of the good and its demand (Becker and Murphy 1988). Since the shock that the island received is a one-time event, this means that scarcity will prevail in the future and therefore prices will rise. If individuals take into account the fact that prices will be higher in the future, this reduces current demand. Higher prices in the near future, therefore, make demand not high enough to achieve a large number of addicted individuals.

Operant conditioning

Operant conditioning refers to the process of learning in which the consequences of a behavior influence the likelihood of the behavior being repeated in the future. In the context of drug use, if the experience of using a drug increases the probability of using it again, the drug is considered a reinforcer. Primary reinforcers, such as drugs, are intrinsically rewarding, similar to food or sex. In contrast, secondary reinforcers are only rewarding because they have acquired some learned value, such as money. The value of money is learned through its ability to provide primary reinforcers like food and other necessities.

However, not all experiences are reinforcing. Some individuals may find the first experience with a drug unpleasant, which may lead to the avoidance of the drug in the future. This is an example of punishment, as the unpleasant experience discourages drug-taking behavior. The reinforcing power of a drug depends on several factors, including satiation, immediacy, contingency, and the size of the stimulus.

Satiation refers to the state of being "full" or satiated. In the context of food, it is evident that food is more rewarding when an individual is hungry, and less rewarding when they are satiated. Similarly, drug use may be more rewarding when other sources of pleasure, such as relationships, work, or hobbies, are lacking in an individual's life. Additionally, the particular effect of the drug may influence satiation. For instance, caffeine is more rewarding when an individual is tired and needs a boost.

In this sense, it could happen that factors such as the context have caused diverse individuals to not become addicted simply because they did not have a good experience (or good first experiences) with the consumption of cocaine. On the other hand, it also has to do with the context of these individuals, if their lives were already full of sources of pleasure, then the consumption of cocaine may not have been as satisfying (Edwards

2016).

Other reasons

Finally, we can consider certain factors that are related to the quality of the cocaine. If the cocaine was sufficiently adulterated, it could have affected the level of addiction in users. Alternatively, if users' preferences lead them to prefer other types of drugs (such as depressants instead of stimulants), cocaine may not have been in demand simply due to a matter of taste.

Conclusion

In conclusion, this study aimed to analyze the impact of a shock increase in the supply of cocaine on an island in Portugal using the synthetic control method. Despite the news reports, series, and documentaries suggesting otherwise, **our findings indicate that there was no significant effect on any of the variables analyzed.** This suggests that the increase in the supply of cocaine did not lead to any observable changes in drug-related behaviors or outcomes on the island. These findings highlight the importance of rigorously evaluating claims made in news reports. It is evident from our findings that not all assertions in such reports are backed by substantial evidence.

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Appendix 1

Source	Language
El País	Spanish
Diario do nordeste	Portuguese
Ara	Spanish
Clarín	Spanish
Cultura Colectiva	Spanish
Noticias Ya	Spanish
The Guardian	English
Digismak	English
I Love Azores	Portuguese
Cadena Ser	Spanish
Yahoo Noticias	Spanish
Ardina News	Portuguese
Correio da Manhã	Portuguese

Table 1: Some sources that documented the event