**Response to Referees/List of Changes**

**Reviewer 1:**

* “It may be beneficial to future readers to include a paragraph or two describing the differences between Measure 110 and the drug decriminalization policies implemented in Portugal. This comment stems from the fact that the results of this paper contradict the results of Felix et al. (2017). It is my understanding that those facing small possession charges in Portugal are referred to the Commission for Dissuasion of Drug Addiction which seems to be a more involved process than that of Measure 110.”:

I thank the reviewer for bringing this important point to my attention. In response, I now contrast the drug decriminalization in Oregon more clearly against Portugal in the literature review between the paragraphs on Portugal and Oregon:

“Both Oregon and Portugal decriminalized drugs but did not depenalize drugs, with Portugal’s 2001 reform requiring people who use drugs to face “Commissions for Dissuasions of Drug Addiction” which dictate treatment requirements, warnings, and fines (Greenwald, 2009). In the case of Portugal, treatment is considered the primary responses with fines being seen as a last resort tool used only on those deemed addicts (Greenwald, 2009). Since decriminalization, Portugal has seen crime and court costs decrease but treatment and other prevention costs increase (Félix, et al., 2017). Both Oregon’s and Portugal’s decriminalization make no distinction for public or private consumption, or between different specific drugs (Greenwald, 2009).”

* “It may also be worthwhile to include a short literature review on the determinants of drug use. Knowing how individuals travel the path to unintentional drug overdoses may help strengthen the story being told in this paper.”:

This is a relevant point that I thank the reviewer for bringing to my attention. To address this, I have incorporated four additional references in my paper and used the new sources to write a short paragraph on drug use determinants:

“The literature on drivers of drug use reaches many different fields and studies various types of factors that can contribute to drug use. An influential view was posited by Becker and Murphy (1988) in their seminal work on the theory of rational addiction. Considering PWUD as rational consumers maximizing utility over an intertemporal budget constraint, Becker and Murphy (1988) find that drug use is rational when viewed from the preferences of an addict weighing short term pleasure against long term downsides. Past experience with drug use would increase the preference for drug use, altering the rational decision. A decade later, Saffer and Chaloupka (1999) empirically study the demand for illicit drugs and find that increases in an illegal drug’s price can decrease its demand as well as that decriminalization of cannabis can increase cannabis demand. Established economic research demonstrates drug use as consumer behavior responding to preferences and economic incentives.

Beyond individual reasons for drug use, the broader and more recent literature emphasize three additional categories of factors that drive drug use: relational, societal, and contextual. Galea, Nandi, and Vlahov (2004) emphasize the social epidemiology of substance use, arguing that substance use patterns are significantly influenced by sociodemographic and environmental factors, such as socioeconomic status and the social environment in which individuals live. Research in recent years has turned its attention more towards the growing health priority of substance use among young people (Degenhardt et al., 2016). When someone uses substances at a young age, it can lead to a higher likelihood of developing substance use disorders later in life (Degenhardt et al., 2016). The onset of substance use appears largely influenced by social factors such as peer influence and family background (Degenhardt et al., 2016). Which such wide-ranging factors contributing to drug use, many different responses to substance use have been used or proposed throughout globe.”

Becker, Gary and Murphy, Kevin. 1988. “A theory of rational addiction”, *Journal of Political Economy*, Vol. 96, No. 4, pp. 675-700.

Degenhardt, Louisa, and Stockings, Emily and Patton, George and Hall, Wayne and Lynskey, Michael. 2016. “The increasing global health priority of substance use in young people”, *The Lancet Psychiatry*, Vol. 3, No. 3, pp. 251-264.

Galea, S., Nandi, A., and Vlahov, D. 2004. “The social epidemiology of substance use”, *Epidemiologic reviews*, Vol. 26, No. 1, pp. 36-52.

Saffer, H., and Chaloupka, Frank. 1999. “The demand for illicit drugs”, *Economic inquiry*, Vol. 37, No. 3, pp. 401-411.

* “In my opinion, the equation for MSPE should be included on page 7. As I have no experience with synthetic control methods, I found it difficult to tell how the optimal weights are determined.”:

This is an important part of SCM and I appreciate the reviewer asking to see it, I now note the equation for MSPE on a separate line:

* “An explanation for the size of the Iowa weight may be enlightening. My assumption was that it was just the state that had values closest to Oregon, but I am unfamiliar with synthetic control methods as mentioned before.”:

This is a relevant comment as the weights are of high importance in SCM. I have improved the data and no one state carries that large of a weight anymore.

* “Though it may be speculative, an explanation for the results that this paper found would be helpful. Comments as to why the results conflicted with Felix et al. (2017) and agreed with Spencer (2022) would help conclude the paper.”:

I thank the reviewer for the comment and I now speculate at an explanation of the result in my discussion section.

* “In addition, the introduction mentions that marijuana decriminalization in Western Australia boosted youth consumption for five years. Is it possible that the increase found in this paper and in Spencer (2022) are the result of an initial boost that will end up being a reduction in the long run?”:

I thank the reviewer for pointing this out and have included some speculation of the mechanisms behind the result as well as whether it may be a short-term impact like the Australian decriminalization cited.

* “In my opinion, many of the equations on page 7 could be presented on their own lines instead of alongside the text. This change may make it easier to see which equations are of interest.”:

This is an important style comment, and I thank the reviewer for helping my paper achieve greater clarity. I agree with this point and have now presented the main equations of interest as individual lines.

* “Page 6: A working paper by Spencer (2022) found that Measure 110 increased overdose deaths in Oregon, but his analysis is limited to the first 11 months of Measure 110’s implantation.”:

Thanks to the reviewer for pointing out this typo, I have corrected the word: “implementation”.

* “Page 8: States with suppressed values will be dropped from the main analysis, and I plan to either impute values 0-9 randomly using a uniform distribution as a robustness check.”:

I have altered this sentence and corrected the grammatical issue, I thank the reviewer for catching this.

* “Page 10: If the in-time studies show substantially smaller estimated treatment effects, the result be more robust.”:

I thank the reviewer for catching this mistake and have inserted the missing word in the sentence: “would”.

**Reviewer 2:**

* “From my understanding, this paper studies the impact of Measure 110 which has only been passed in Oregon as of recent. I think that the date of the “sudden and isolated implementation of drug decriminalization in the U.S” could be introduced up front in the paper.”:

I thank the reviewer for bringing this to my attention and I have altered the second sentence in my Measure 110 background section to mention the specific date of implementation: “This ballot measure became law on 1 February 2021, making Oregon the first US state to decriminalize the possession of small amounts of all drugs (Oregon Legislative Policy and Research Office, 2020; Towles, 2022).”

* “Preview of Results: When describing the main findings of the paper, the results that are shared are the initial overdose death estimates from the synthetic control method without testing for statistical significance. I suggest stating the significant results found from the in-space placebo studies (462 extra overdose deaths) rather than the initial findings (510 extra overdose deaths) or clarifying this difference when summarizing the main results”:

I have only mentioned the statistically significant impacts and have clarified that when mentioning the resulting extra overdose deaths.

* “The study focuses on one part of Oregon’s Measure 110 (the decriminalization of small possession of drugs) and not the funding aspect of addiction and drug treatment programs which are created. I think that this could be mentioned as a possible limitation and an avenue for further research to analyze Measure 110 in its totality.”:

I thank the reviewer for making this important point and have accordingly emphasized the limitation and further need for more research on other relevant outcomes. In my discussion section I now mention the limitation of only focusing on overdose deaths and the potential for other outcome variables to different impacts of drug decriminalization.

* “Harm reduction policies, which do not directly work to reduce drug use but rather associated harms, have been shown to be effective at reducing health issues of drug use while not increasing drug use. • Citing sources when discussing harm reduction policies and their effectiveness can further strengthen the analysis of the paper. i. One possible source could be Ritter and Cameron (2009)”:

I thank the reviewer for the helpful feedback and for kindly pointing me towards a relevant paper. I have increased my citations in the literature review, and have incorporated the noted paper.

* “I \*think\* that placing the full equation of interest on a single line of its own with a label like the example below may make the discussion of the synthetic control method a bit easier to follow and for easy reference later on in the paper. It also would allow readers to better identify the main equation. ”:

I agree with this note and thank the reviewer for pointing it out, I have identified the main equation of interest on its own line and have numbered it for easy reference in the text.

* “Clarification: Is the average of the annual drug overdose deaths the only variable you are using to match and construct the synthetic control group? If so, it should be made clear when discussing the construction of the control group and possible limitations from this.”:

The average of the monthly drug overdose deaths was the only variable being used for matching; however, I have now added many more variables from the ACS, BEA, BLS, BRFSS, and PDAPS.

* “Following the point above, it may be beneficial to find more variables that may be relevant to overdose deaths experienced in a state. The inclusion of more matching variables may strengthen the robustness of the papers results. i. A potential variable to match on could be percent of homelessness in a state as people experiencing homelessness are disproportionately affected by substance use disorders and opioid related overdose deaths. This could be an interesting outlet to explore. The National Alliance to End Homelessness and Fine, Dickins, Adams, et al. (2022) discuss this issue further. https://endhomelessness.org/resource/opioid-abuse-and-homelessness/ doi:10.1001/jamanetworkopen.2021.42676”:

This is a very relevant issue and I appreciate the reviewer noting this. I have incorporated fourteen more matching variables in my analysis, ranging from medical coverage and GDP levels to unemployment rates, related drug use, and some relevant policies. I have specifically implemented similar variables to Félix et al., for comparison.

* “If you are to find more variables and data to use when constructing the synthetic control method, I would consider labelling your current data section as 4.1 “Overdose Death Data”.”:

I thank the reviewer for this helpful comment and have accordingly renamed the section and inserted a following section with data on matching variables.

* “Potential typo: “This state-level mortality data is based on death certificates and contains one underlying cause of death while multiple additional cause can be listed.”:

I thank the reviewer for catching this typo and have edited it to be correct: “causes”.

* “Including information on suppressed data provides readers with information on the lowest values of overdose deaths experienced by certain states. I think it could be of value to also include or briefly mention the state or month(s) where the overdose deaths are the largest.”:

This is an interesting note and I have made a sentence addressing this: “In my sample, the state with the most overdose deaths is California with a total of 38208 deaths in the 58 months considered, the month with the most overdose deaths is April 2021 with 8713 deaths in all 50 states and DC combined and the state-month pair with the most deaths is California in August 2021 with 964 deaths.”

* “\*\* I was also thinking about the connection between drug overdose deaths and suicide. I’m not sure if the data from CDC’s WONDER system makes this distinction or accounts for drug overdose death due to suicide rather than from an accidental death from people who use drugs (PWUD). If not, then I believe the results could be impacted in some way and should be controlled for or mentioned since the program is specifically to help those with addiction and recovery and its effects on this population are of interest.”:

Thanks to the reviewer for pointing this out, this could have been confusing for many readers so I have addressed this in the data section. I now mention explicitly that the unintentional drug overdose death data does not include deaths listed as intentional drug overdose deaths, homicidal, or undetermined drug overdose deaths.

* “Table 3 presents the estimated monthly treatment effects and their corresponding p-values” I think this phrase would better fit in the inference section since the p-values are found with the use of the in-space placebo tests or possibly referencing to Table 3 again in the inference section.”:

I agree with this clarifying point and have moved this statement to the inference section to improve the document’s flow.

* “I suggest providing graphs/figures to supplement the results section from the in- space placebo studies. If I am understanding this right, then the distribution of placebo effects is what is used to determine statistical significance of the post/pre-Measure 110 MSPE ratio of Oregon. Graphs showing this distribution of the donor pool states could be useful to help the reader understand the placebo study and overall inference.”:

I thank the reviewer for mentioning this, I have now included a footnote under table three which provides a bit more information on the MSPE here, noting that Oregon has MSPE rank of 1 from April 2021 through October 2022.

* “Clarification: Why is the pre/post MSPE used? Perhaps more discussion of why the post/pre MSPE is used or possibly citing a source could help clarify this.”:

This is a relevant point that I appreciate the reviewer bringing up. I have now added more explanation for the purpose of post/pre MSPE in the analysis of statistical significance:

“Non-negative weights that sum to one are chosen to optimize the pre-intervention mean square prediction error (MSPE):

for Oregon, where V optimally weights the importance of matching the predictor variables in X. Various predictor variables will be used to match the donor states to Oregon, these specific variables will be noted in the next section. Pre-treatment MSPE is used to measure the fit of the synthetic, and post-treatment MSPE is used to measure the difference between the real unit and the estimated synthetic counterpart. This paper will follow a common approach in the SCM literature for estimating p-values using placebo tests and the ratio of post/pre-MSPE, with a larger than one suggesting a significant impact.”

* “Small note: The font looks to be smaller at the end of this section compared to the rest of the paper.”:

I thank the reviewer for mentioning this and although I have not seen the same issue I have double-checked the font and formatting to make sure it is consistent.

* “Potential typo: “If the in-time studies show substantially smaller estimated treatment effects, the result be more robust””:

I appreciate these typos being caught, as it’s easy to miss these types of mistakes when rereading your own paper many times. I have fixed this typo and added “would”.

* “The mentioned robustness checks sound good, I would suggest including graphs/figures of the in-time placebo tests showing the results (if applicable or available).”:

I thank the reviewer for the relevant and useful feedback for making my paper as clear as possible. I have now conducted the in-time placebo tests and have, as the reviewer asked, included figures of these tests in the manuscript.

* “Although your results suggest that the decriminalization of drugs (through the implementation of Measure 110) actually increased drug overdose deaths, conclusive results on the ineffectiveness of the measure should not be assumed. As mentioned in the paper, “It should also be emphasized that Measure 110 may have other important outcomes such as arrests and incarcerations that have not been studied in this paper.” And “The result indicates a need for adopting a holistic and multifaceted approach to drug policy that incorporates not only decriminalization, but also emphasizes improved access to treatment, implementation of harm reduction strategies, and the development of preventive measures” I think that adding somewhere that there could be a potential effect on drug overdose deaths from the funded drug addiction treatment and recovery programs could be helpful when discussing the implications and other ways Measure 110 can impact important outcomes (like incarceration that is also not considered in this study). This could also highlight the need for a complete analysis of the impact of Measure 110 that considers both the drug decriminalization aspect and funding of recovery programs/addiction treatment.”:

I greatly appreciate this relevant and important feedback. It is very important to not judge Measure 110 solely based on drug overdose deaths, this is just one relevant outcome variable. To address this issue, I have added more discussion about the lack of other relevant outcome variables and pointed towards further research on the complete impact of Measure 110 on various related outcomes.

* “Table 1: Looking at the table it is unclear on the months that are considered “Pre-Measure 110” and “post-Measure 110” as well as for the pre and post Covid-19 periods. I would suggest adding a note at the bottom of the table to clarify.”:

I appreciate this clarifying note and have incorporated the suggested note beneath the table, mentioning what months were selected as the cutoffs for each event: “Pre-Measure 110 refers to January 2018 through January 2021, Post-Measure 110 refers to February 2021 through October 2022. Pre-COVID-19 Lockdowns refers to January 2018 through February 2020. Post-COVID-19 Lockdowns refers to March 2020 through October 2022. Pre-Measure 110 Vote refers to January 2018 through October 2020, and Post-Measure 110 Vote refers to November 2020 through October 2022.”

* “Figure 1: Similar to the point made above, I suggest adding a note to define/label the two reference lines included in the graph”:

This is a good clarifying suggestion and I have added the note defining the reference lines.

* “Table 2: The paper mentions not including Washington as a donor pool state in constructing the synthetic control group (because it had a similar policy). I would include this information again as a note with this table.”:

This is a good clarifying suggestion and I now note that

* “Table 3: In the notes section, I would suggest adding a note that the p-values are constructed with the use of the pre/post-Measure 110 MSPE ratios from the in-space placebo tests.”:

This is a good clarifying suggestion and I now put a note under the table mentioning where the p-values come from.