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The Longer-Term Impacts of Trading Restrictions on Alcohol Related Violence: Insights from New South Wales, Australia

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Conflict of Interest Statement:

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ABSTRACT

Background and aims: In February 2014, the government of New South Wales (NSW), Australia introduced new restrictions (known as the 'lockout laws') on the sale of alcohol in licensed premises in two of Sydney's most prominent entertainment districts, Kings Cross (KX) and the central business district (CBD). This study aimed to determine (1) whether the introduction of the lockout laws was the point at which the time pattern of the assault series in the KX and CBD entertainment precincts changed, (2) whether the apparent reduction in assault in these precincts persists when we control for common variations in assault across the entire state of NSW, (3) whether the reduction in assault in the KX and CBD entertainment precincts resulted in a displacement of the assault problem into other areas, and (4) whether there is a net reduction in assault after taking any spill-over or displacement effects into account.

Design: Structural break analysis was used to determine the date at which the time pattern of assaults changed. Interrupted time series analysis with a rest-of-NSW comparator was used to assess the change in assault.

Setting, cases, and measurements: The monthly totals of incidents of non-domestic assaults reported to the NSW Police between January 2009 and March 2019 ($n = 123$).

Findings: The structural break in assaults occurred in January 2014 rather than in February 2014, when the lockout laws were introduced. The reduction in assault persists even when we control for common influences across NSW as a whole. In particular, from January 2014 onwards, assaults fell immediately by 22% (a downward step) in KX (90% confidence interval (CI) = 15%, 28%) and by 33% in CBD, (90% CI = 19%, 47%). Assaults continued declining in KX (trend-break coefficient = -0.094, 90% CI = -0.192, 0.005). The reduction in assault in the KX and CBD precincts is associated with a rise in assault in areas surrounding these precincts.

The net effect, nonetheless, remains a lower level of assault. In particular, we estimate that the net reduction over the three areas combined was 1670 assaults (i.e., 27 per month).

Conclusion: Some of the initial reduction in assault in the Kings Cross and the central business district of Sydney, Australia previously attributed to the February 2014 introduction of lockout laws may have been a response to publicity surrounding recent deaths connected with alcohol-related violence.

INTRODUCTION

Alcohol-related violence is a major problem in many countries [1], including Australia [2]. During the period between 2001 and 2013, alcohol-related violence and public concern about alcohol-related violence were growing in Australia, as was support for stricter controls on licenced premises [3, 4]. Public concern about the problem in New South Wales (NSW) was heightened following the death of a young man (Thomas Kelly) in an alcohol related assault in Kings Cross (KX) on July 7th, 2012. It reached a peak (see Figure 1 below) following the death of another young man (Daniel Christie) in an alcohol-related assault in KX on December 31, 2013. In February 2014, approximately one and a half months after the death of Daniel Christie (on January 11, 2014), the NSW Government introduced a raft of new laws designed to curb alcohol-related violence.

Insert Figure 1 about here

The NSW 'lock-out-laws', as they became known, included: (1) a 1.30 a.m. lockout at pubs, bars, registered clubs, nightclubs, and karaoke bars; (2) a 3.00 a.m. cessation of alcohol service in all venues; and (3) a prohibition on the granting of any new liquor licences. Other new restrictions included a ban on takeaway alcohol sales across NSW after 10.00 p.m., an extension of 'banning orders' on designated 'trouble-makers' to prevent them entering most licensed premises in the KX and CBD precincts, a ban on 'shots' and any ready to drink beverage with an alcohol by volume content of more than five per cent, and the introduction of a risk-based licence fee for all licensed premises based on licence type, compliance history and trading hours. Public health workers and police reported a reduction in rates of public violence following the introduction of the new laws, although a number of critics have argued that the new laws have substantially damaged Sydney's night-time economy [5].

The restrictions on access to licensed premises and trading hours implemented in Sydney and elsewhere over the last few years have been the subject of extensive evaluation [6-14], with

most studies concluding that they reduced the incidence of assault. This finding is consistent with studies examining the effects of expanding liquor trading hours in other parts of Australia and overseas [15-19]. Stockwell and Chikritzhs [15], for example, reviewed fourteen studies of expanded liquor trading hours that included baseline and control measures and found that 11 reported at least one significant adverse outcome. Most studies of the restrictions imposed in the KX and CBD precincts, however, assume the decline in assault begins in February, the same month in which the lockout laws were introduced. The lockout laws, however, did not commence until February 24th; when only four days of February 2014 were left, none of which involved a weekend. Taking February as the point where the access and trading hour restrictions began to influence rates of assault would have led to an overestimate of the lockout effects.

The restrictions imposed by the lockout laws were not the only events that could have influenced trends in assault in 2014. The mass media generated large amounts of content dealing with the deaths of Thomas Kelly and Daniel Christie and the issue of alcohol-fuelled assaults during January and February of that year. As can be seen from Figure 1, media coverage of the issue reached a peak prior to the introduction of the lockout laws. This publicity, rather than the restrictions, could have been a trigger for a reduction in visitors to and assaults in the KX and CBD entertainment precincts. Given this possibility, rather than assuming the lockout laws were the starting point for any change in the assault series, we test for the timing of the break as well as its type. Such a procedure provides statistical evidence as to whether that break coincided with the introduction of the lockout laws or at some earlier point.

Another problem with past research on the lockout laws is that, apart from Kyprri and Livingston [11] (who found that the lockout restrictions were followed by a substantial reduction in the incidence of assault in KX and to a lesser extent in the CBD), much of the research into the effect of the NSW lockout laws has proceeded on the assumption that, absent the new laws,

the pre-existing trend in assault in the KX and CBD entertainment precincts would have continued. This assumption has provided the counterfactual against which the effect of the new laws has been assessed, however the assumption is open to question. It is possible that, absent the lockout laws, assaults in the KX and CBD entertainment precincts would have followed the pattern in the rest of NSW rather than the pre-lockout trend in each of the entertainment precincts. It is now more than six years since the introduction of the lockout laws, and alcohol-related assaults in the rest of NSW (outside KX and CBD) have stopped declining [13]. If assaults in the KX and CBD entertainment precincts had followed the pattern in the rest of NSW, then treating the pre-existing trend as a counterfactual or control could have understated the effect of the lockout laws.

The passage of time has seen one other important change to the pattern of assaults since the commencement of the lockout laws. Although initial investigations found little evidence that assaults had increased in the areas surrounding the KX and CBD entertainment precincts, that situation has now changed. Donnelly and Poynton [13] report that there have been substantial increases in assault in the area immediately surrounding the KX and CBD entertainment precincts (where the assault rate rose by 18 per cent) and in a group of areas within easy reach of those precincts (where the assault rate rose by 30%). This raises the possibility that assaults have simply been displaced from KX and the CBD to other areas.

These considerations suggest there is value in reconsidering the effect of the lockout laws. We address four questions of importance concerning the specific effect of the lockout laws on alcohol related violence in Sydney that are relevant to the general question of how to manage alcohol-related violence. Our aims in this study were to determine:

1. Whether the introduction of the lockout laws was the point at which the fall in assault in the KX and CBD precincts began,

2. Whether the apparent reduction in assault in these precincts persisted when assault in the rest of NSW is used to control for unobserved common influences in assault behaviour;
3. Whether the reduction in assault in the KX and CBD entertainment precincts result in a displacement of assault into other areas; and
4. Whether there is a net reduction in assault after taking any spill-over or displacement effects into account.

METHODS

NOTE: The analysis reported here was not pre-registered and that the results should therefore be considered exploratory

DESIGN

The methods employed to answer these questions involve structural break and interrupted time series analysis. We use structural break analysis to identify the breakpoint in the assault series. We use interrupted time series analysis to test for possible changes in the level and slope of the assault series in four areas: the KX and CBD entertainment precincts; a zone we call the proximal displacement area (PDA); and a zone we call the distal displacement area (DDA). The PDA and DDA are employed to assess displacement. A map showing the boundaries of these areas and an account of the rationale for choosing them can be found in Menendez, Kypri & Weatherburn [7]. We control for common variations in assault across NSW (i.e., in areas other than the KX and CBD entertainment precincts, the PDA and the DDA). This approach differs from that adopted by Kypri and Livingston [11], who exclude Greater Sydney and other areas in NSW from their rest-of-NSW control.

SETTING

The setting for this study is Sydney, Australia. In 2014 (the year in which the lockout laws were introduced), the City of Sydney had a resident population of 198 331 and a resident population density of 74 people per hectare. KX is an entertainment area to the east of the central business district of Sydney. In 2011, KX had a resident population of 4087 with a resident population of 247 people per hectare. Although the resident populations in these areas are modest, the visitor populations are very large: in 2014, KX had 1.3 million overnight visitors. In the same year, 4 million visitors had an overnight stay in Darling Harbour, a second entertainment area to the west of the Sydney CBD.

MEASURES

The data analysed consist of incidents of non-domestic assaults reported to the NSW Police sourced from the NSW Bureau of Crime Statistics and Research (BOCSAR). Using address information, incidents were assigned in one of the following five areas of NSW:

1. The KX entertainment precinct;
2. The CBD entertainment precinct;
3. The Proximal Displacement Area (PDA)
4. The Distal Displacement area (DDA)
5. The rest of NSW

The first four regions are consistent with the data as defined and analysed in Menendez, Kypri and Weatherburn [7]. In approximately six percent (6%) of incidents on the boundaries of KX and CBD the precise address information was not available. To deal with these cases we implemented a procedure for allocating these incidents developed by the NSW Bureau of Crime Statistics and Research (BOCSAR), which eliminates any double counting of these incidents. Details of this procedure are provided in Appendix 2. Finally, we combine KX, CBD

and PDA, to create an area we label the affected zone (AZ). We create this zone to evaluate the extent to which any potential displacement effects into PDA, offset the reduction in assault in KX and CBD.

ANALYSIS

We begin by specifying the following regression model:

$$assaults_t^{(i)} = \beta_0^{(i)} + \beta_1^{(i)}t + \alpha_0^{(i)}D_t + \alpha_1^{(i)}D_t t + \gamma^{(i)}NSW_t + \sum_{j=1}^{11} \delta_j^{(i)} month_{jt} + \varepsilon_t^{(i)}; \quad (1)$$

for $i \in \{KX, CBD, AZ\}$ and $t = 1, \dots, T (= 123)$, where the variable $assaults_t^{(i)}$ denotes the number of assaults recorded in area i at time t ; NSW_t denotes the number of assaults across the whole state of NSW net of assaults that occurred in the four distinct areas (KX, CBD, PDA, and DDA) considered in the analysis; $\{month_{jt}\}_{j=1}^{11}$ denotes a set of monthly dummy variables that absorb seasonal variation in $assaults$; and $\varepsilon_t^{(i)}$ is a purely idiosyncratic error term. The variable D_t is defined as follows:

$$D_t = \begin{cases} 0 & \text{for } t = 1, \dots, \tau - 1, \\ 1 & \text{for } t = \tau, \dots, T. \end{cases}$$

The parameters β_0 and β_1 capture the “before” effects, whilst the parameters α_0 and α_1 capture the “after” effects relative to “before”. The variable NSW_t is included in order to control for a common factor (i.e. common variations) in area-specific assault rates across the state of NSW as a whole. Such a common factor is unrelated to the lockout laws, as the laws took place only in specific precincts in the inner-city suburbs of Sydney. Were we to fail to control for the effect of unobserved common shocks in the pattern of assaults, our counterfactual analysis would lead to biased results.

We begin by testing for the presence of a structural change in the level and trend coefficients in Eq. (1), using a supremum-Wald test, proposed by Andrews [20] and Perron [21]. As noted earlier, the structural break date, denoted as τ , is treated as unknown and we estimate this from the data. The testing procedure involves computing a structural change test for each possible date, and then comparing the maximum test statistic obtained in the sample with the asymptotic critical values. If the null hypothesis is rejected, the change is estimated to occur in the month corresponding to the maximum test statistic.

Once the presence of a structural change (if any) and the associated change date are determined for CBD, KX and AZ, we proceed by selecting an “optimal” model in Eq. (1), using a procedure known as “best-subset selection”, popular in the machine learning literature. To describe this, let $K_{max}(= 16)$ denote the maximum possible number of regressors including the intercept used in Eq. (1) and K be the number of regressors used in estimation. Best-subset selection involves finding the value of K together with the associated combination of regressors corresponding to the smallest AIC (Akaike Information Criterion) value.

To be more specific, the model is estimated using $K \in \{1, 2, 3, \dots, K_{max}\}$ regressors. For each value of K , all possible combinations of regressors (of size K) are considered. The best combination corresponds to the one minimising the residual sum of squares. Once the optimal combination of regressors is determined for each value of K , the optimal K is the one that minimises AIC. For further details and variations on variable selection processes and alternative information criteria please refer to Hyndman and Athanasopoulos [22].

A similar procedure is followed for the PDA and DDA but with one major difference. To examine whether there has been geographical displacement of crime, we included two additional regressors, namely the assault rate for CBD and KX. We specified the following regression model:

$$\begin{aligned}
assaults_t^{(i)} = & \beta_0^{(i)} + \beta_1^{(i)}t + \alpha_0^{(i)}D_t + \alpha_1^{(i)}D_t t + \gamma^{(i)}NSW_t + \sum_{j=1}^{11} \delta_j^{(i)} month_{jt} + \varepsilon_t^{(i)} \\
& + \theta_{KX}^{(i)} \left(D_t assault_t^{(KX)} \right) + \theta_{CBD}^{(i)} \left(D_t assault_t^{(CBD)} \right);
\end{aligned} \tag{2}$$

for $i \in \{PDA, DDA\}$ and $t = 1, \dots, T (= 123)$. Thus, the coefficients $\theta_{KX}^{(i)}$ and $\theta_{CBD}^{(i)}$ measure the displacement effect running from either CBD or KX towards PDA or DDA, following the structural change. The null hypothesis is $H_0: \theta_{KX}^{(i)} = \theta_{CBD}^{(i)} = 0, i \in \{PDA, DDA\}$. Failure to reject the null hypothesis provides evidence that no geographic displacement has occurred.

RESULTS

The results obtained for the optimal models for each area are reported in Table 1 below.

Insert Table 1 about here

For both the KX and CBD series, as well as the AZ series, the null hypothesis of no structural break is rejected at the 5% level of significance. In all cases the break date is estimated to occur at $t = 61$, which corresponds to January 2014. Figure 2 plots the series of interest with the red vertical line plotted in January 2014.

Insert Figure 2 about here

The graphs reveal a substantial drop in alcohol related assaults that commenced in the month of January 2014, especially for both the KX and CBD series. Other features of the time series patterns in Figure 2 worth noting are:

- (i) there is an upward trend in assaults in the PDA following January 2014;
- (ii) the trends pre- and post-January 2014 in the AZ follow closely the rest of NSW, which shows that assaults flatten out and stop declining post January 2014;
- (iii) there is no visible structural change pre- and post-January 2014 for the DDA.

The final estimated models for each of the five areas of interest are presented in Table 1. For KX, the negative values for α_0 and α_1 indicate that there is a downward shift in the level of the series after January 2014, and the existing negative trend has become more pronounced over time. In particular, from January 2014 onwards, assaults fell immediately by 22% (a downward step) in KX, with 90% CI = (15%, 28%). Assaults continued declining in KX (trend-break coefficient = -0.094, 90% CI = -0.192, 0.005). Interestingly, however, the optimal specification does not include the rest of NSW variable, indicating that KX is a unique area that does not share a common factor in assault with the other areas in NSW.

For the CBD, the optimal specification shows only a downward shift in the level, reflected by a negative estimate for α_0 , but not a downward shift in the pre-existing trend. In particular, from January 2014 onwards, assaults fell immediately by 33% (90% CI = 19%, 47%). In this case, however, it turns out that the rest of NSW absorbs other major shocks.

For the PDA, on average, a one unit decrease in assaults in KX is associated with a 0.28 unit increase in assaults. After controlling for the rest of NSW, the positive estimate for β_1 indicates a positive pre-existing trend for the DDA, but there is no displacement effect. This result is consistent with Kypri and Livingston [20].

Insert Figure 3 about here

Figure 3 shows the fitted values of the optimal models, allowing for the effect of the intervention of the lockout laws (in blue), labelled “Fitted intervention”, as well as the fitted values obtained by setting the coefficients corresponding to the post January 2014 period equal to zero (in yellow), labelled “Fitted counterfactual”. The results show a contrasting story between KX and CBD versus PDA. The lockouts have clearly had the desired effect on KX and the CBD, but they seem to have had the opposite effect in the PDA. Focusing on the results for the AZ (affected zone) however, reveals that the lockouts have led to an overall reduction in the

number of assaults. In particular, we estimate that the net reduction over the three areas combined was 1670 assaults, i.e. 27 per month.

DISCUSSION

This study adds further knowledge into the issue of alcohol violence and the impact of government policy several years after the introduction of lock out laws in the KX and CBD. We sought to address four questions of interest concerning the effect of the lockout laws on alcohol related violence. Firstly, was the introduction of the lockout laws the point at which the fall in assault in the KX and CBD precincts began? Secondly, does the apparent reduction in assault in these precincts persist when the trend in assault in the rest of NSW is used as the counterfactual? Thirdly, did the reduction in assault in the KX and CBD entertainment precincts result in a displacement of the assault problem into other areas? Finally, is there a net reduction in assault after taking any spill-over or displacement effects into account?

Our results indicate that the turning point for both the KX and CBD entertainment precincts occurred in January 2014; immediately following the death of Daniel Christie and during the month in which his death and the general problem of alcohol-related violence received saturation publicity. It is possible that mass media coverage of alcohol violence impacted consumer behaviour prior to the legislation effect, resulting in reduced patronage of licensed premises in the affected venues. For instance, Menendez, Kypri and Weatherburn [7] noted evidence of a decline in rail passenger journeys to Kings Cross during the period in which the trading hour restrictions were in effect.

This is not to say the lockout laws exerted no effect. The two events (viz. the publicity in January and the introduction of the new laws in February) were too close in time to model their separate contributions to the fall in assault. This study shows that some of the initial reduction in assault in Kings Cross and the CBD previously attributed to the lockout laws may in fact have been a response to the death of Daniel Christie and attendant publicity.

This said, the evidence indicates that a significant reduction in assault in the KX and CBD entertainment precincts persists even when we control for the trend in the rest of NSW. The fall in assault appears much sharper in the KX precinct than in the CBD precinct. In the former case we see a large drop in the level and a marked acceleration of the downward trend from January 2014 onwards. In the latter case there is an acceleration in the downward trend but no change in the level. We note that the assault in the rest of NSW was not selected in the final specification of the model for the KX precinct. However, it was selected and contributes significantly to the change in assault in the CBD entertainment precinct.

Over the six-year period following the lockout laws covered by this study, assaults in the PDA are estimated to increase by approximately 5%. This figure is based on the difference between the total actual number of assaults versus the counterfactual. This increase in the PDA, seems to stem from the reduction in assault in KX; a finding reflected by the significant coefficient on the parameter ($\theta_{KX}^{(PDA)}$) measuring displacement from KX to the PDA. This could just be a case of assaults returning to their pre-lockout levels but no evidence of this appeared elsewhere in the State. Therefore, the possibility of displacement should be considered in the future whenever place-based restrictions on liquor licensing are investigated. The evidence of displacement observed in this study contrast with those of earlier studies of the effects of the lockout [7,12]. This is perhaps not surprising. Early studies had limited follow-up periods. The restrictions placed on trading hours for licensed premises in the KX and CBD entertainment precincts may have created business opportunities for licensed premises in other areas.

The results above show that following the lockout the estimated increase in assaults in the PDA remains lower than the decline in assaults in the KX and CBD entertainment precincts. The creation of a single affected zone (AZ) means that this conclusion is unaffected by our uncertainty in some cases as to whether the assault occurred in the KX precinct or the CBD precinct.

All research is subject to caveats and this study is no exception. As others [7] have noted, we cannot rule out the possibility that factors other than the liquor licensing restrictions might account for the reduction in assaults in the intervention areas. As noted earlier, other key elements of the intervention included the extension of temporary and long-term banning orders issued to designated 'trouble-makers' to prevent them entering most licensed premises in the Kings Cross and Sydney CBD entertainment precincts. There was also the introduction of a new risk-based licence fee for all licensed premises in which the annual fee payable by a particular venue depends upon its licence type, compliance history and trading hours. The first of these initiatives might have helped reduce the number of 'violence-prone' individuals coming to Kings Cross or the Sydney CBD entertainment precincts. The second may have created an incentive for licensed premises to serve alcohol in accordance with the law.

Whether and how long the significantly lower levels of assault that now prevail in the affected zone of Sydney will continue is impossible to say. Public support for restrictions on late night trading of licensed venues increased substantially between 2001 and 2013 in Australia but fell substantially between 2013 and 2016 [4]. In response to this, the NSW Government reversed some of the trading restrictions imposed on licenced premises imposed in 2014, including the restrictions in relation to lockouts and trading hours [8]. It will be interesting to see what effect, if any, these changes have on alcohol-related violence.

REFERENCES

1. Graham K, Livingston M. The Relationship between Alcohol and Violence-Population, Contextual and Individual Research Approaches, *Drug and Alcohol Review* 2011; 30(5): 453-457.
2. Australian Institute of Health and Welfare. National Drug Strategy Household Survey 2016: Detailed findings. Canberra. AIHW, 2017.
3. Donnelly N. Alcohol-related emergency department (ED) presentations and persons of interest proceeded against by police for assault. Crime and Justice Bulletin 218. Sydney. NSW Bureau of Crime Statistics and Research, 2018. Available at: <https://www.bocsar.nsw.gov.au/Publications/CJB/2018-Report-Alcohol-related-ED-presentations-assault-CJB218.pdf>. Accessed 17/07/2020.
4. Livingston M. Callinan S. Changing Attitudes to Alcohol in Australia. *Journal of Studies in Alcohol and Drugs* 2017; 78(6): 844-852.
5. Holman, S. 'Lockout' laws or 'rock out' laws? Governing Sydney's night-time economy and implications for the 'music city'. *International Journal of Cultural Policy*, 2019; 25(4): 500-514.
6. Kypri K., Jones C., McElduff D., Barker D. Effects of restricting pub closing times on night-time assaults in an Australian city. *Addiction* 2011; 106: 303–10.
7. Menendez P, Kypri K, Weatherburn, D. The effect of liquor licensing restrictions on assault: a quasi-experimental study in Sydney, Australia. *Addiction* 2016; 112: 261-268.
8. Donnelly N, Poynton S, Weatherburn D. The effect of lockout and last drinks laws on non-domestic assaults in Sydney: An update to September 2016. Crime and Justice Bulletin 201. NSW Bureau of Crime Statistics and Research. Sydney, 2017. Available at: <https://www.bocsar.nsw.gov.au/Publications/CJB/Report-2017-Effect-of-lockout-and-last-drinks-laws-on-non-domestic-assaults-cjb201.pdf>. Accessed 16/07/2020.

9. Holmes RF, Lung T, Fulde G, Fraser CL. Fewer orbital fractures treated at St. Vincent's Hospital after lockout laws introduced in Sydney. *Medical Journal of Australia* 2018; 208(4): 174.
10. Chopra S, van der Rijt R, Ngo Q, Clarke FK, Southwell-Keely JP, Robledo KR, Moisisidis E. A comparison of maxillofacial trauma before and after the implementation of the lockout laws in Sydney. *Australasian Journal of Plastic Surgery* 2018; 1(1): 64-70.
11. Kypri K, Livingston M. Incidence of assault in Sydney, Australia, throughout 5 years of alcohol trading hour restrictions: controlled before-and-after study. *Addiction* 2020; 115: 2045-2054.
12. Donnelly N, Weatherburn, D, Routledge, K, Ramsey, S, Mahoney N. Did the 'lockout law' reforms increase assaults at The Star casino, Pyrmont. Bureau Brief 114, NSW Bureau of Crime Statistics and Research. Sydney, 2016. Available at: <https://www.bocsar.nsw.gov.au/Publications/BB/Report-Did-the-lockout-law-reforms-increase-assaults-at-The-Star-casino-Pyrmont-bb114.pdf>. Accessed 16/07/2020.
13. Donnelly N, Poynton S. The effect of lockout and last drinks laws on non-domestic assaults in Sydney: A update to March 2019. Bureau Brief 142. NSW Bureau of Crime Statistics and Research. Sydney, 2019. Available at: <https://www.bocsar.nsw.gov.au/Publications/BB/2019-Report-Effect-of-lockout-and-last-drinks-laws-on-assaults-BB142.pdf>. Accessed 16/7/2020. Accessed 5/1/2021.
14. Chikritzhs T. N., Stockwell T. R. The impact of later trading hours for Australian public houses (hotels) on levels of violence. *J Stud Alcohol* 2002; 63: 591-9.
15. Stockwell T., Chikritzhs T. Do relaxed trading hours for bars and clubs mean more relaxed drinking? A review of international research on the impacts of changes to permitted hours of drinking. *Crime Prev Community Saf* 2009; 11: 153-70.
16. Douglas M. Restriction of the hours of sale of alcohol in a small community: a beneficial impact. *Aust NZ J Public Health* 1998; 22: 714-19.

17. Voas R. B., Lange J. E., Johnson M. B. Reducing high-risk drinking by young Americans south of the border: the impact of a partial ban on the sale of alcohol. *J Stud Alcohol* 2002; 63: 286–92.
18. Voas R. B., Romano E., Kelly-Baker T., Tippetts A. S. A partial ban on sales to reduce high-risk drinking south of the border: seven years later. *J Stud Alcohol* 2006; 67: 746–53.
19. Dualibi S., Ponicki W., Grube J., Pinsky I., Laranjeira R., Raw M. The effect of restricting opening hours on alcohol-related violence. *Am J Public Health* 2007; 97: 2276–80.
20. Andrews D. W. K. Tests for Parameter Instability and Structural Change With Unknown Change Point. *Econometrica* 1993; 61 (4): 821- 856.
21. Perron P. 2006. Dealing with structural breaks. In *Palgrave Handbook of Econometrics, Vol. 1: Econometric Theory*, ed. K. Patterson and T.C. Mills. Basingstoke: Palgrave Macmillan
22. Hyndman R. J., Athanasopoulos G. 2021. *Forecasting: Principles and Practice* (3rd Ed.). OTexts. <https://otexts.com/fpp3/selecting-predictors.html>

APPENDIX 1: NEWS COVERAGE ON ALCOHOL-RELATED VIOLENCE

A total of 10 terms were used in the Factiva website for news coverage data search, including the name of victims, the name of intervention place, the name of alcohol-related behaviour and the general nouns that include word alcohol. The full list appears below:

- Alcohol assaulted
- Alcohol related assaulted
- Alcohol restricted & Sydney
- Alcohol restrictions
- Alcohol Violence
- Alcohol-fuelled violence
- Coward Punch
- Daniel Christie
- Kings Cross & Alcohol & Assaulted
- King hit
- Sucker punch
- Thomas Kelly

Note: The terms that connected by “&” symbol means the news report must include all the words. For example, the term 9 means the news report must contain both ALCOHOL RESTRICTED and SYDNEY. The upper-case and lower-case will not influence the search results.

The six news sources in the Sydney area we searched were:

- Australian Broadcasting Corporation

- The Sydney Morning Herald
- The Australian
- Daily Telegraph (Sydney, Australia)
- Sun Herald (Sydney Australia)
- The Australian (Online)

The Sydney Morning Herald, The Australian, Daily Telegraph (Sydney, Australia) and Sun Herald (Sydney, Australia) are the most popular and accessible newspapers for the public. We also selected Australian Broadcasting Corporation (ABC) and The Australian (Online) as news coverage sources because people might access the news via internet rather than traditional news tools. After we restricted the key words and key media sources in Factiva website, the monthly number of news coverage related to alcohol violence was obtained.

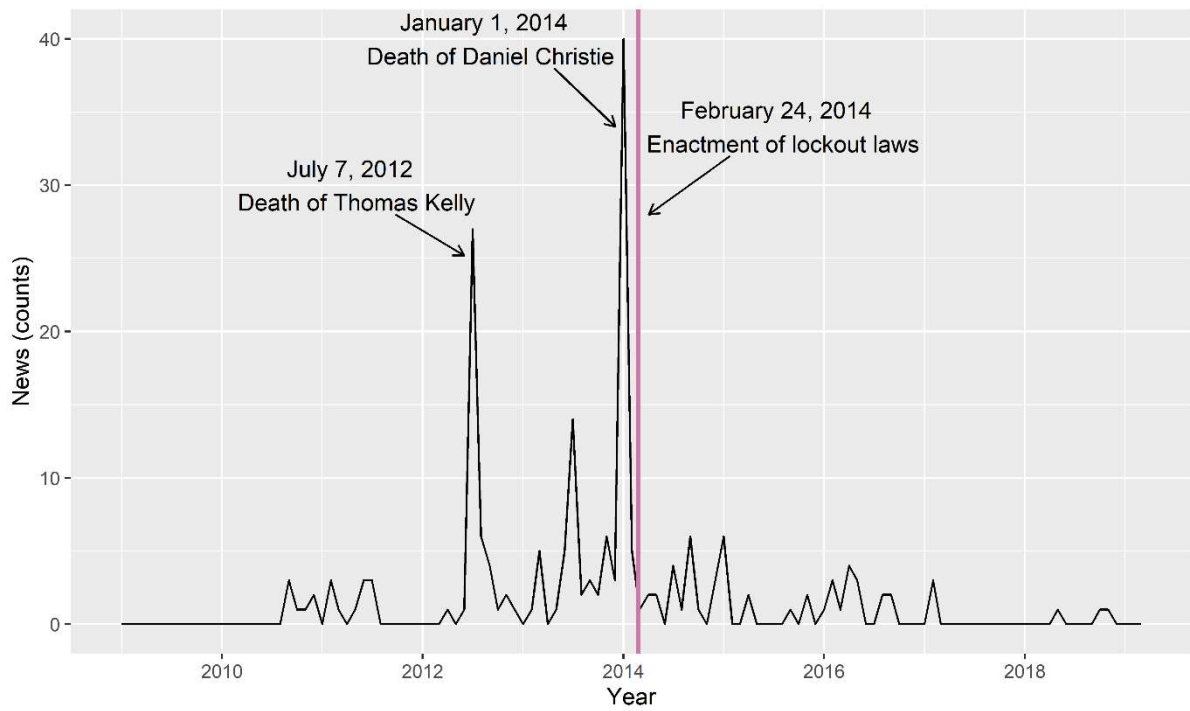
APPENDIX 2: CBD AND KX PRECINCT INCIDENT

ALLOCATION

There are some very long streets in Sydney which cross the Sydney CBD or Kings Cross areas and When the spatial allocation process was initially designed, BOCSAR staff manually assigned these uncertain street level incidents to the Sydney CBD or Kings Cross precincts or, when precise address information was missing but the incident was reported as on a street boundary between the Sydney CBD and KX precincts; to both. After reviewing this procedure BOCSAR introduced a new procedure that ensures no incident is allocated to both the CBD and the KX entertainment precincts. The revised procedure for incidents without exact address information is as follows:

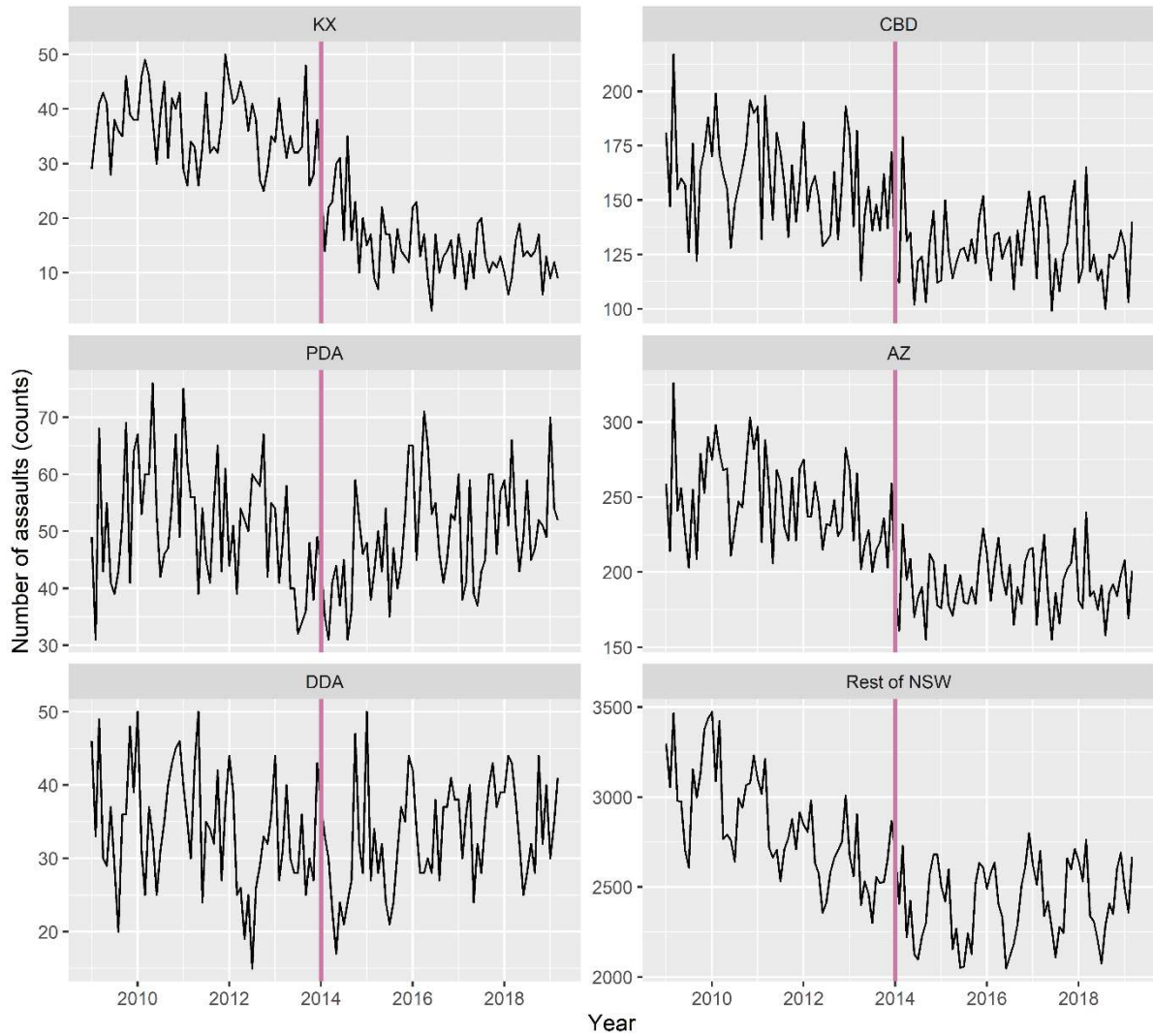
- Brougham St incidents are assigned to the Sydney CBD entertainment precinct
- Darlinghurst Rd incidents with a suburb of Potts Point are assigned to the KX precinct
- Darlinghurst Rd incidents with any other suburb identifier are assigned to Sydney CBD precinct
- Macleay St Elizabeth Bay incidents are split 50/50 using random assignment between the KX and CBD precincts
- Victoria St incidents are split 50/50 using random assignment between the KX and CBD precincts
- William St incidents are assigned to the KX precinct if the suburb is Potts Point
- William St incidents involving all other suburbs are assigned to Sydney CBD precinct
- Incidents occurring in Potts Point without any other identifier are assigned to Kings Cross
- Incidents occurring in Woolloomooloo without any other identifier are assigned to the CBD precinct

Figure 1: Monthly count of news coverage on alcohol-related violence



N.B. For details of the method used to construct this figure, see Appendix 1

Figure 2: Number of assaults across the different areas of interest. The vertical line shows January 2014.



The Longer-Term Impacts of Trading Restrictions on Alcohol Related Violence

Regressor: coefficient	KX	CBD	PDA	AZ	DDA
Intercept: $\beta_0^{(i)}$	39.1520***	43.5081***	11.8587	87.2286***	-15.9886**
	(1.5828)	(15.7497)	(10.5870)	(19.6924)	(7.3441)
Time trend t: $\beta_1^{(i)}$	-0.0777*		0.1070***		0.0969***
	(0.0456)		(0.0285)		(0.0223)
Level break D_t: $\alpha_0^{(i)}$	-8.4670*	-14.4257***		-30.9620***	
	(4.3102)	(3.5585)		(4.4355)	
Trend break $D_t \times t$: $\alpha_1^{(i)}$	-0.0935				
	(0.0604)				
Rest of NSW t: $\gamma^{(i)}$		0.0407***	0.0121***	0.0580***	0.0165***
		(0.0056)	(0.0036)	(0.0069)	(0.0024)
$D_t \text{assaults}_t^{(PDA)}$:					
$\theta_{KX}^{(PDA)}$			-0.2761**		
			(0.1149)		
Sample size – N	123	123	123	123	123
Sup-Wald	43.86 [.000]	15.09 [.011]	-	24.11 [.000]	-
\hat{t}	61	61		61	
White's LM test statistic for heteroskedasticity	9.36 [.095]	12.13 [.277]	12.71 [.918]	27.43 [.037]	5.87 [.318]
Breusch-Pagan LM test for serial	3.04 [.552]	5.40 [.249]	9.97 [.0409]	4.41 [.353]	1.98 [.739]

correlation up to 4th order

Table 1. Regression results for the optimal models

Standard errors in parentheses based on robust standard errors. p-values in square brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. “Sup-Wald” denotes the supremum Wald test for the null hypothesis of no structural break, with an unknown break date under the alternative. $\hat{\tau} = 61$ corresponds to January 2014. Residuals pass both tests of no serial correlation (Breusch-Godfrey LM test) and homoskedasticity (White LM test).

Figure 3: Observed and predicted trends in assault for fitted unrestricted and fitted restricted models

