



The effect of lockout and last drinks laws on non-domestic assaults in Sydney: An update to March 2019

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Aims: To assess the longer-term effects of the 2014 NSW liquor law reforms on levels of violence in the inner Sydney area.

Method: Interrupted time series models were used to examine the effects of the legislative reforms introduced in January 2014. Police recorded non-domestic assaults were analysed over the period January 2009 to March 2019. Separate analyses were carried out for the Kings Cross Entertainment Precinct (KXP); the Sydney CBD Entertainment Precinct (CBD); an area contiguous with KXP and CBD called the proximal displacement area (PDA); a group of entertainment areas not far from KXP and CBD called the distal displacement area (DDA) and the rest of NSW.

Results: In the 62-months following the reforms, statistically significant reductions in non-domestic assault incidents occurred in the lockout precincts as a whole (down 13.3%) and in the specific precincts of Kings Cross (down 53%) and the CBD Entertainment Precinct (down 4%). There was evidence of geographical displacement to surrounding areas with increases in non-domestic assault observed in both the PDA (up 18%) and the DDA (up 30%). Over time, the size of the assault reduction in the lockout locations has declined while the increase in assaults in the displacement sites has risen. Despite this, the reforms still delivered an overall reduction in non-domestic assaults over the period February 2014 to March 2019, with an estimated net benefit of 395 fewer non-domestic assault incidents.

Conclusion: While non-domestic assault appears to have reduced in both target precincts after the 2014 liquor law reforms, the effect in the CBD precinct has declined over time. Displacement of violence to surrounding areas should continue to be monitored.

Keywords: alcohol, assault, lockout and last drinks laws, trading hours, time series models, displacement

Introduction

This brief updates the analyses of Menéndez, Kypri and Weatherburn (2017) and Donnelly, Poynton and Weatherburn (2017) to include an additional 30 months of follow-up data in order to assess the longer-term effect of the January 2014 amendments to the NSW liquor law, also known as the lockout and last drinks restrictions (for further details regarding these reforms see Menéndez et al., 2017). Specifically this brief set out to answer three research questions;

1. Was the reduction in the incidence of non-domestic assault in the Kings Cross Entertainment Precinct (KXP) and Sydney CBD Entertainment Precinct (CBD) after the 2014 liquor laws were enacted sustained during the 62-month post-reform period?

2. Was there an increase in the incidence of non-domestic assault during the 62-month post-reform period in areas either proximal to Kings Cross and the CBD Entertainment Precincts (proximal displacement area) or in other night-time locations which while further away are still within easy reach by taxi or public transport (distal displacement area)?
3. If there was evidence for displacement of non-domestic assault to the proximal and/or distal locations, did the increase offset any reductions observed in the target sites (KXP and CBD)?

To assess the influence of other factors which may have affected drinking and violent behaviour during the post-reform period, trends in non-domestic assault for the rest of the NSW (excluding the two target sites and the two displacement areas) were also examined.

Method

Areas of interest

The geographical locations of interest in this study are those previously used by Menéndez, Weatherburn, Kypri, and Fitzgerald (2015) and Donnelly et al. (2017). The two target areas where the lockout and last drinks laws apply are the Kings Cross Entertainment Precinct (KXP) and the Sydney CBD Entertainment Precinct (CBD) (see Figure 1a in Donnelly et al., 2017). The Proximal Displacement Area (PDA) contains the following suburbs, Pyrmont, Ultimo, Chippendale, Surry Hills and Elizabeth Bay, and also includes *The Star* casino area. The Distal Displacement Area (DDA) includes the suburbs of Bondi Beach, Coogee, Double Bay and Newtown (see Figure 1b in Donnelly et al., 2017).

Data

The outcome for this analysis is the number of non-domestic assaults incidents per month recorded by police which occurred in the five locations (KXP, CBD, PDA, DDA and rest of NSW) over the period January 2009 to March 2019. In total, 123 months were analysed comprising 61 months prior to and 62 months after the new liquor laws came into effect.

In Donnelly et al. (2017) there was some spatial overlap (i.e. a shared boundary) between the KXP and the Sydney CBD entertainment areas. To deal with this overlap, the earlier bureau publication combined these areas (counting incidents only once) and examined the overall impact on the treatment sites after taking into account any changes in the two displacement areas. This brief repeats this process for question (3) but in answering question (1) also redefines the Sydney CBD Entertainment Precinct to exclude any incidents that occurred in the area overlapping with the KXP boundary. That is, incidents on the boundary of the KXP and Sydney CBD Entertainment Precinct areas are prioritised to the KXP.¹

Statistical analyses

There were two ways in which the liquor law reforms may have influenced non-domestic assaults. One is a change in the level of assaults. The second is a change to the trend in assaults. The ARIMA time series models therefore included: (i) a term measuring the underlying trend; (ii) a term measuring any change in the level of non-domestic assault incidents after the liquor law reforms commenced and; (iii) a term measuring any change in trend after the laws commenced (Chatfield, 2004; Hyndman & Athanasopoulos, 2018).

Further details about the time series methodology used are provided in Donnelly et al. (2017). Predicted values from the ARIMA models were graphed as the estimated trend along with the observed non-domestic assault values. The percentage change in non-domestic assault following the introduction of the new laws was calculated by comparing the values estimated from the full model with those forecast from ARIMA models built on the pre-intervention data only (i.e. 62 time points were

forecast for the post-reform period). The volume of the decrease or increase of total non-domestic assaults post intervention was calculated.

Results

Figure 1 shows the monthly number of non-domestic assaults for each of the five locations from January 2009 until March 2019. The dotted vertical line indicates the month in which the liquor law amendments took effect (i.e. February 2014). February 2014 and all monthly data points to the right of the line are included in the post-liquor law reform period. These time series are presented for the two target sites (KXP and CBD), the proximal displacement area (PDA), the distal displacement area (DDA) and the rest of NSW.

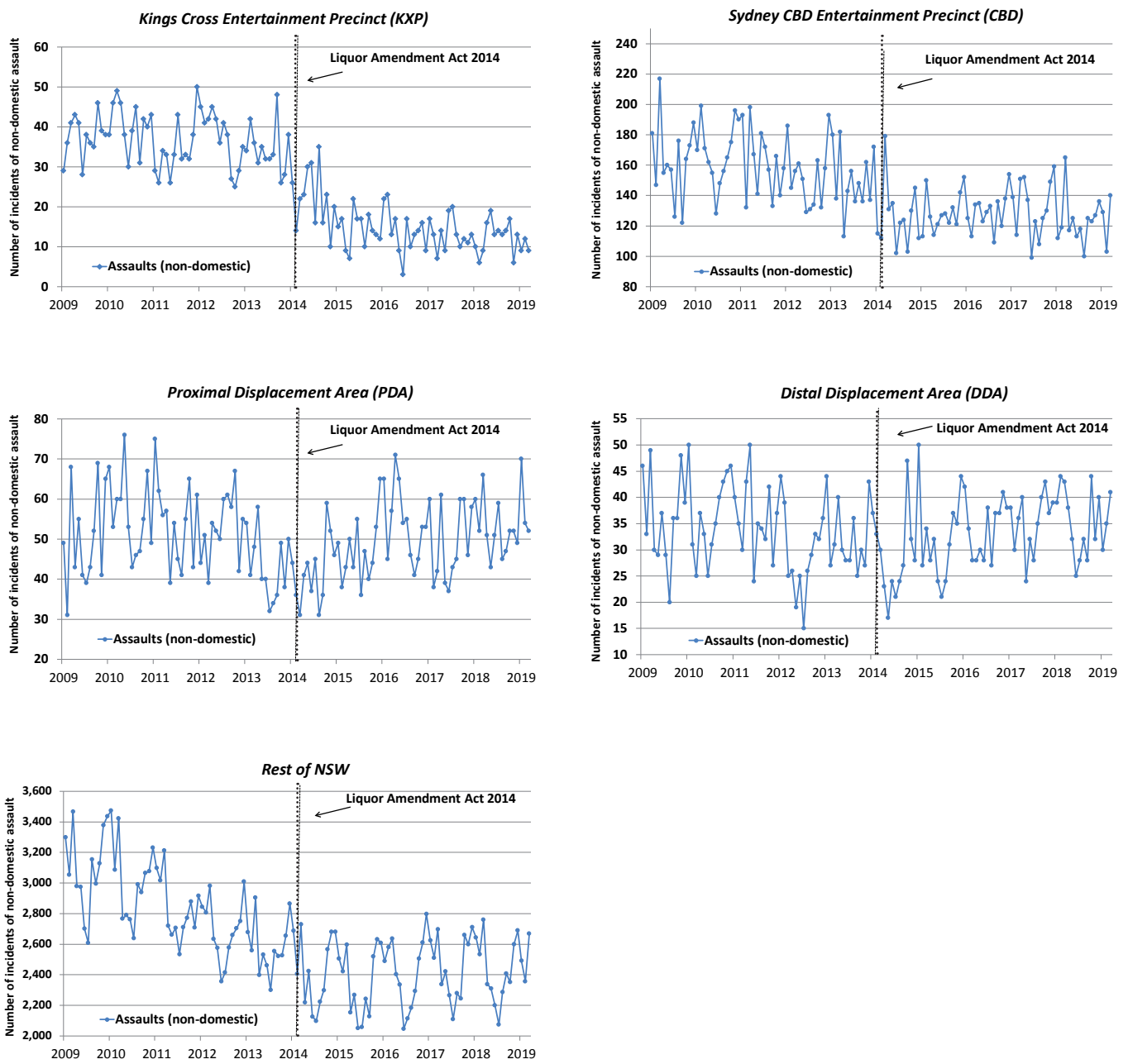
The results from the final time series analyses modelling the monthly number of non-domestic assaults in the target areas, displacement areas and the rest of NSW are shown in Table 1. The rows show the underlying trend in assaults prior to the 2014 reforms, the change in the level of non-domestic assaults after the laws began, the change in the trend post-law reform and the diagnostics associated with each model. The columns show these results for each of the five areas examined.

Looking first at column 2 of Table 1 we see that in the KXP the onset of the liquor law reforms was associated with a significant, immediate decline in the level of the series in February 2014 by around 14 non-domestic assaults, dropping from 32 to 18 ($p < .001$). There was no change in the magnitude of the declining trend after the liquor law reforms took effect. Figure 2 shows this sharp drop in assaults when the laws commenced and the continuation of the same downward trend thereafter. Overall, we estimate a 52.8% decline in the number of non-domestic assaults which means that there were 1,021 fewer non-domestic assaults in KXP during the 62-month post-reform period compared with what was forecast from the pre-existing trend.

In the CBD (see column 3 of Table 1) there was a significant step reduction in the level of non-domestic assaults after January 2014 by around 15 per month ($p = .006$). There was, however, also a change to the underlying downward trend ($p = .004$). We estimate that prior to February 2014 the number of non-domestic assaults declined by around 2.7 incidents every 6 months. From February 2014, assaults only declined by 0.4 incidents over the same time interval. This change in non-domestic assaults in the CBD area is shown graphically in Figure 3. After the onset of the lockout and last drinks laws there was an overall decline of 4.0% in the number of non-domestic assaults in the Sydney CBD. This represents around 329 fewer assaults over the 62-month post-reform period than what was expected based on the pre-existing trend.

Column 4 of Table 1 shows the final time series model for non-domestic assaults in the PDA, including *The Star* casino. In the five years prior to the 2014 liquor law reforms non-domestic assaults were falling in the PDA by around one

Figure 1. Time series of the number of non-domestic assaults for Kings Cross Precinct, Sydney Entertainment Precinct, proximal and distal displacement areas and the rest of NSW: January 2009 - March 2019



assault every 6 months. When the restrictions commenced there was a significant change in the trend in non-domestic assaults whereby assaults began to increase by almost one extra incident every 6 months ($p = .004$). The effect is shown in Figure 4. After the legislative reforms there was an 18.4% increase in the number of non-domestic assaults with 479 additional assaults occurring in the PDA (including *The Star* casino) than would have been expected from the pre-liquor law reform forecast.

The ARIMA time series model for non-domestic assaults in the DDA is shown in Column 5 of Table 1. In the years prior to the liquor law reforms non-domestic assaults were in significant decline in the DDA by around one assault every 7 months. The

reforms did not coincide with a significant change in the level of the series. However, there was a change in the trend, with evidence for a statistically significant increase in non-domestic assaults of one extra incident every 9 months ($p < .001$). The estimated trend from this model is displayed in Figure 5. After the new liquor laws commenced we estimate that there was a 30.0% increase in the number of non-domestic assaults in the DDA. This equates to an additional 476 incidents during the 62-month post-reform period than what was forecast from the pre-reform trend.

The time series model for the rest of NSW excluding the target and displacement areas is shown in Column 6 of Table 1. The estimated trend from this model is displayed in Figure 6. Prior to

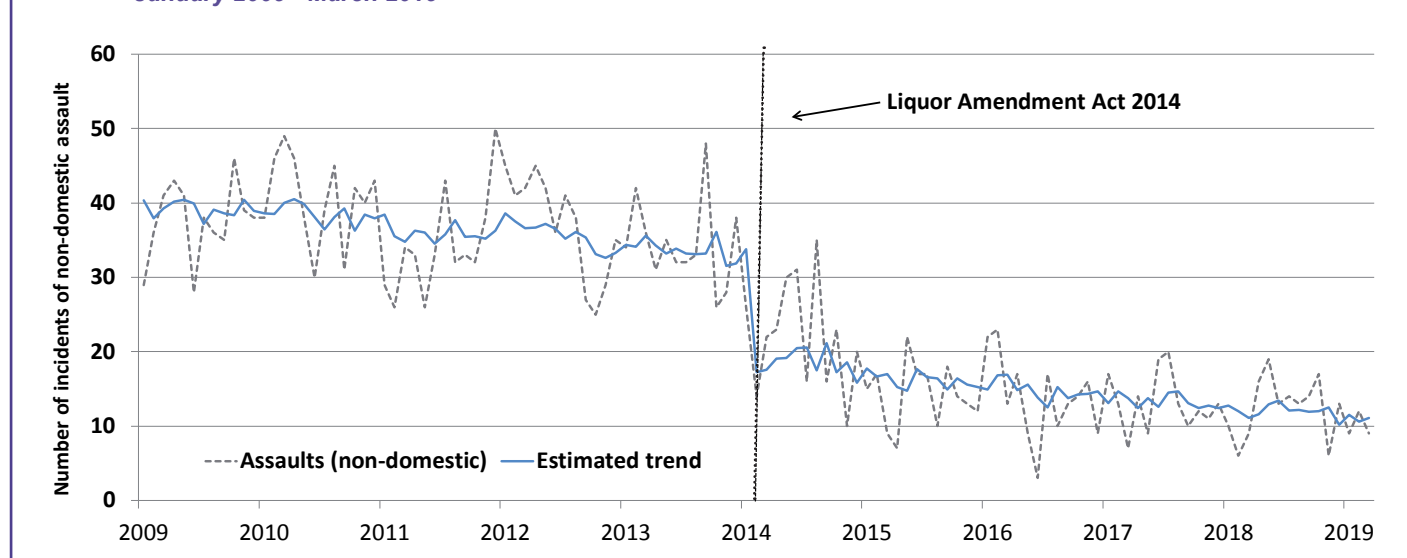
Table 1. Final model estimates of changes in non-domestic assault incidents by area, (January 2009 – March 2019)

	KXP	CBD	PDA	DDA	Rest of NSW
Underlying trend	-0.127 <i>p</i> < .001 ***	-0.457 <i>p</i> < .001 ***	-0.178 <i>p</i> = .006 **	-0.140 <i>p</i> < .001 ***	-11.271 <i>p</i> < .001 ***
Level change	-14.005 <i>p</i> < .001 ***	-15.156 <i>p</i> = .006 **	-	-	-
Trend change	-	0.393 <i>p</i> = .004 ***	0.332 <i>p</i> = .004 **	0.258 <i>p</i> < .001 ***	9.963 <i>p</i> < .001 ***
Ljung-Box test[#]	$\chi^2_{23} = 25.87$ <i>p</i> = .307	$\chi^2_{23} = 30.48$ <i>p</i> = .136	$\chi^2_{23} = 18.59$ <i>p</i> = .725	$\chi^2_{23} = 13.24$ <i>p</i> = .947	$\chi^2_{22} = 27.81$ <i>p</i> = .182
AIC	785.30	1038.38	889.20	797.32	1532.25
Intervention effect type	Level	Level & Trend	Trend	Trend	Trend
Seasonality?	No	Yes	Yes	Yes	Yes

[#] Ljung-Box test based on first 24 autocorrelation lags of the residuals

* *p* < .05, ** *p* < .01, *** *p* < .001

Figure 2. Estimated trend for the number of non-domestic assaults in the Kings Cross Entertainment Precinct (KXP): January 2009 - March 2019



the onset of the liquor law reforms there was a strong declining trend in non-domestic assault incidents of around 11 fewer assaults each month (*p* < .001). After the legislative changes the magnitude of the declining trend reduced significantly to around five incidents every 4 months (*p* < .001). From Figure 6 it can be seen that the overall trend in non-domestic assaults flattened from 2017 onwards. We estimate that there has been an increase in the number of non-domestic assaults during the post-law reform period of 9.5% compared with what was forecast from the pre-intervention period.

Did geographical displacement offset the reductions in non-domestic assault in the target areas?

From these analyses there was a clear reduction in non-domestic assault incidents in KXP and a smaller reduction in the

CBD in the 62 months post-reform. These were the areas which were most affected by the 2014 amendments to the Liquor Act. Notably there were also increases in non-domestic assaults in the two displacement areas (PDA and DDA). We therefore sought to determine whether the increase in violence in the PDA and DDA offset the reductions observed in the target sites.

Time series analyses were conducted on the combined KXP and CBD precincts (see Table A6). Compared with the forecasts from the pre-intervention period there was a 13.3% reduction in non-domestic assaults after the law reforms. In total we estimate that there were 1,350 fewer non-domestic assaults in the KXP and Sydney CBD areas (1,021 + 329). This compares with an estimated increase of 955 assaults in the two displacement areas during the 62-month post-law reform period (479 + 476). This equates to a net benefit of 395 fewer non-domestic assault incidents.²

Figure 3. Estimated trend for the number of non-domestic assaults in the Sydney CBD Entertainment Precinct (CBD): January 2009 - March 2019

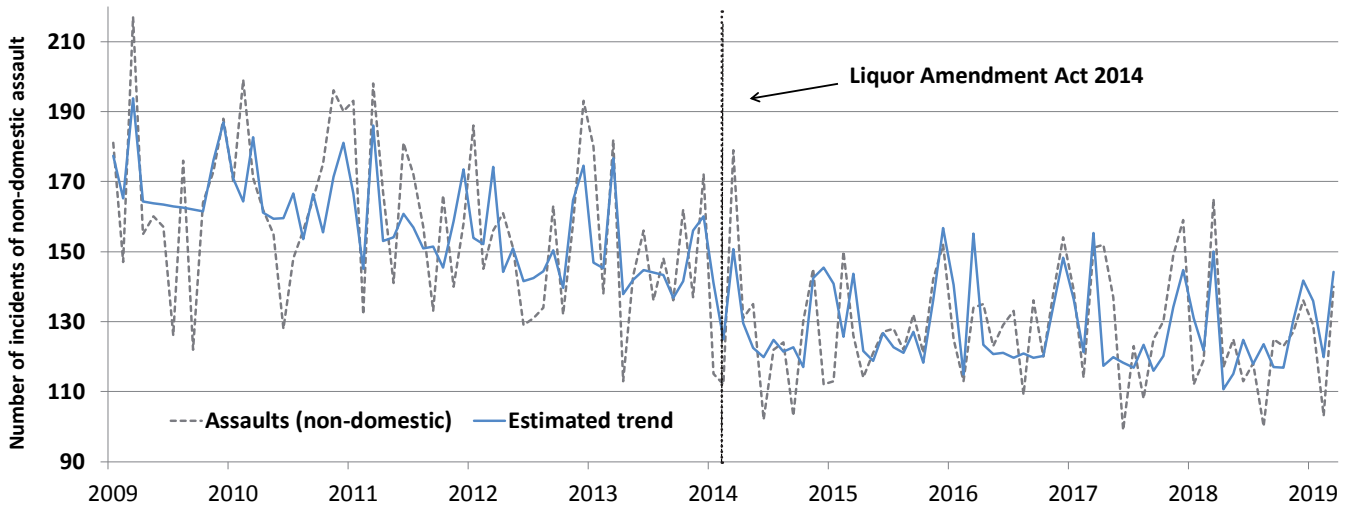


Figure 4. Estimated trend for the number of non-domestic assaults in the Proximal Displacement Area including The Star casino (PDA): January 2009 - March 2019

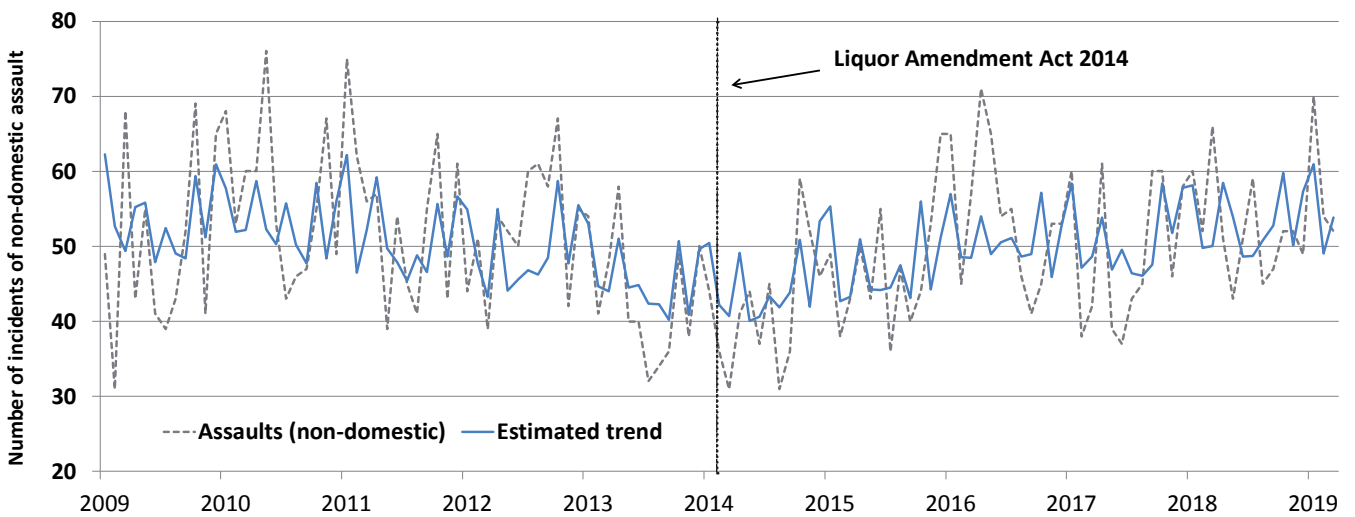


Figure 5. Estimated trend for the number of non-domestic assaults in the Distal Displacement Area (DDA): January 2009 - March 2019

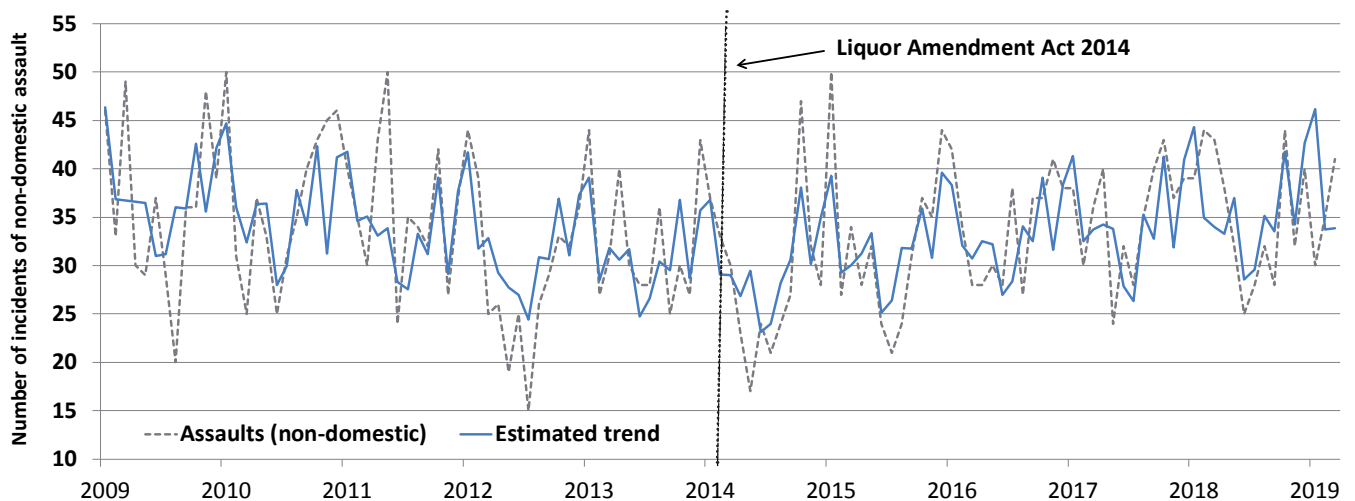
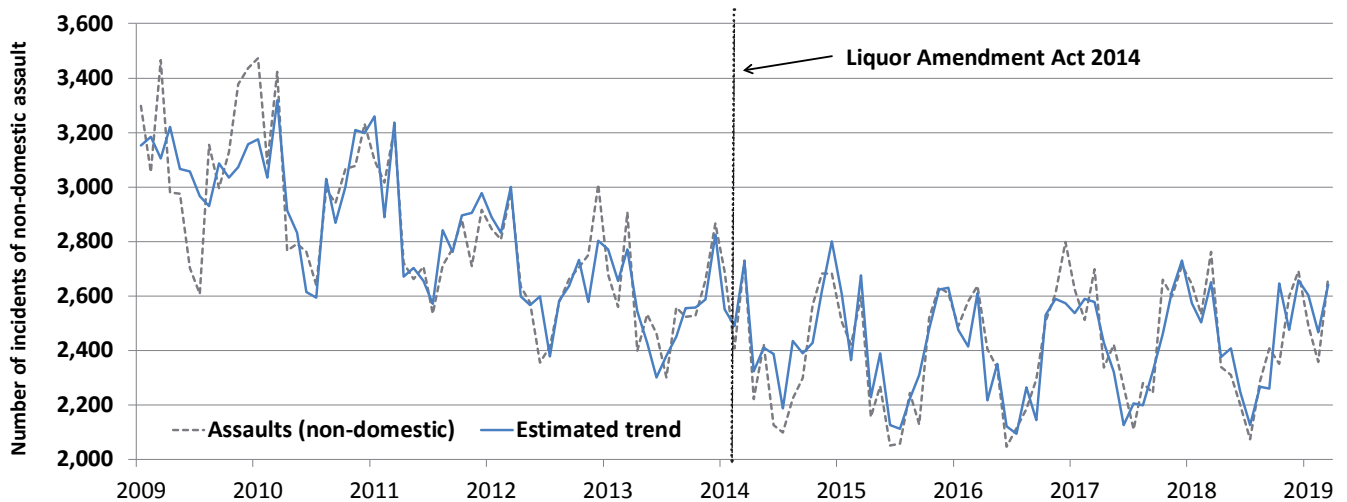


Figure 6. Estimated trend for the number of non-domestic assaults in the rest of NSW which excludes target and displacement areas: January 2009 - March 2019



Discussion

This brief set out to examine the long term impact of the 2014 NSW liquor law amendments on non-domestic assaults in Kings Cross, the Sydney CBD and surrounding areas. The study applies the same interrupted time-series approach used by Donnelly et al. (2017) in their earlier evaluation of the lockout and last drinks laws but nearly doubles the post-intervention follow-up period from 32 months (to September 2016) to 62 months (to March 2019).

As in previous studies, we found significant reductions in non-domestic assaults in the Kings Cross and Sydney CBD precincts. Over the 62-month follow-up period we estimate the intervention delivered a 53% reduction in non-domestic assaults in the Kings Cross Precinct and a 4% decline in the Sydney CBD Entertainment Precinct. Given only around one half of all assaults are reported to police (Australian Bureau of Statistics, 2018) the number of violent incidents prevented would be even greater than these figures suggest.

We can be confident from the interrupted time-series analysis that the decline in violence in Kings Cross and Sydney CBD was not due to pre-existing downward trends or seasonal influences. The relatively stable trend in assaults across the rest of NSW also suggests that the reduction is not due to some other unmeasured factor that coincided with the commencement of the licensing restrictions. However, it is difficult to isolate the causal mechanism underpinning the drop in assaults using a time-series approach. The restrictions on alcohol availability are one likely contributor given that previous studies have shown that the decrease in violence in the precinct areas was greater at the times of day when the lockout and last drinks applied (i.e. 1:30am and 3:00am); although this effect was more apparent in the Sydney CBD area than Kings Cross (see for example Menéndez et al., 2017). Systematic reviews of the literature have found that while trading hours independently predict alcohol-

related harms there has not been convincing evidence for the effects of lockouts by themselves (Miller, Curtis, Chikritzhs, & Toumbourou, 2015; Nepal, Kypry, Pursey, Attia, Chikritzhs, & Miller, 2018). Future evaluations could compare the 1:30am-3:00am time of day with the 3:00am-6:00am time of day in an attempt to delineate the effects of the lockout component versus the cessation of alcohol service at 3:00am.

On the other hand there is evidence that reduced visitor numbers in the Kings Cross precinct is also partly responsible for the effect. Analysing transport data from 2013 to 2014, Menéndez et al. (2015) show that train patronage declined significantly in Kings Cross after the restrictions commenced but increased in all other inner Sydney rail stations. The much larger and sustained reductions in violence in the Kings Cross (cf. the Sydney CBD) may also be attributable to the property boom and subsequent 'gentrification' of the area from 2014 onwards, as well as the closure of a number of high profile licensed venues (Callinan, 2016). Replication of the time-of-day analysis undertaken by Menéndez and her colleagues using a longer follow-up period would provide further insight here.

Combining the two target precincts we estimate there was an overall decline in non-domestic assaults of 13.3% in the 62 months after the lockout and last drink restrictions came into effect. This equates to a drop of 1,350 assaults in the target sites after the intervention or around 22 fewer assaults each month. This reduction is smaller than was reported in our previous analysis (Donnelly et al. 2017). The earlier study, which relied on a 32-month follow-up period to September 2016, estimated an overall reduction of 16.1% (891 fewer assaults) in the combined target precincts.

Moreover, we find that the rise in non-domestic assaults in areas proximal to and within easy reach of Kings Cross or the Sydney CBD is now much larger than previously reported. The current study estimates an 18% increase in non-domestic assaults

(an additional 479 incidents) in the Proximal Displacement Area (including *The Star* casino) in the 62 months after the restrictions commenced. In the Distal Displacement Area we estimate a 30% increase in non-domestic assaults (an additional 476 incidents) in the 62 months from February 2014 to March 2019. This compares with a 12% increase in assaults in the Proximal Displacement Area and a 17% increase in the Distal Displacement Area in the 32-month follow-up period to September 2016. We might expect that geographical displacement would take some time to materialise as more patrons modify their behaviour and new businesses emerge, however the continued growth in assaults in areas outside of the lockout zones, particularly the DDA, is of concern. Whether this rise in violence is wholly attributable to the law reforms or is driven (at least in part) by other factors cannot be determined from the work presented here but should be the subject of further investigation.

While the drop in non-domestic assaults in Kings Cross and the Sydney CBD after the lockout and last drinks restrictions remains greater than the increase observed in the displacement sites (by around 395 assaults), this latest analysis suggests that the net benefit of the reforms could be diminishing over time. These diminishing returns are driven both by smaller effect sizes observed in the Sydney CBD and more displacement to surrounding neighbourhoods. The reason(s) for this are not clear but the latest results underscore the need for ongoing monitoring and evaluation of the 2014 reforms to assess whether they continue to achieve a net benefit to the community over the longer term.

Acknowledgements

We would like to thank Stephanie Ramsay, Nicole Mahoney and Derek Goh for providing the recorded crime data. Nicole Mahoney is also acknowledged for providing spatial expertise about the location of the non-domestic assault incidents.

Notes

1. Analyses were also conducted using the old area definitions for KXP and CBD which contained spatial overlap between the two areas. For King Cross Entertainment Precinct (KXP) similar time series results were found for the spatial overlap and non-spatial overlap areas with a significant reduction to the level of non-domestic assaults. The time series model for the spatial overlap area predicted there would be 1,110 fewer non-domestic assaults in KXP during the 62 month follow-up period, a reduction of 52.5%. For Sydney CBD Entertainment Precinct (CBD) the time series model for the spatial overlap area again found that there was a significant decline in the level of series with the underlying downward trend attenuating during the 62 month follow-up period. One difference was that the magnitude of the reduction in the level of non-domestic

assaults was greater for the spatial overlap CBD area compared with the non-spatial overlap CBD area (23 versus 15 less non-domestic assaults). As a result it predicted that there would be 849 fewer non-domestic assaults in the CBD, a reduction of 9.4%.

2. Time series analyses were conducted on the combined KXP and CBD precincts (see Table A6 in the Appendix). Compared with the forecasts from the pre-intervention period there was a 13.3% reduction in non-domestic assaults after the law reforms.

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Appendix

Final ARIMA time series models for each area

Table A1. ARIMA time series model of non-domestic assaults in the Kings Cross Entertainment Precinct (KXP), January 2009 - March 2019

	Estimate	Standard Error	p value
Constant	40.472	1.457	< .001 ***
Underlying trend in assaults	-0.127	0.036	< .001 ***
Liquor law reforms: Level change	-14.005	2.563	< .001 ***
Autoregressive (lag 1)	0.201	0.090	= .026 *

AIC = 785.30; Ljung-Box test: $\chi^2_{23} = 25.87, p = .307$

* $p < .05$, ** $p < .01$, *** $p < .001$

Table A2. ARIMA time series model of non-domestic assaults in the Sydney CBD Entertainment Precinct (CBD), January 2009 - March 2019

	Estimate	Standard Error	p value
Constant	166.122	3.675	< .001 ***
Underlying trend in assaults	-0.457	0.105	< .001 ***
Liquor law reforms: Level change	-15.156	5.464	= .006 **
Liquor law reforms: Trend change	0.393	0.137	= .004 **
January	11.638	3.873	= .003 **
March	29.109	3.864	< .001 ***
November	15.059	4.052	< .001 ***
December	26.259	4.059	< .001 ***
Moving Average Seasonal (lag 12)	0.266	0.097	= .006 **

AIC = 1038.38; Ljung-Box test: $\chi^2_{23} = 30.48, p = .136$

* $p < .05$, ** $p < .01$, *** $p < .001$

Table A3. ARIMA time series model of non-domestic assaults in the Proximal Displacement Area including The Star casino (PDA), January 2009 - March 2019

	Estimate	Standard Error	p value
Constant	53.028	2.762	< .001 ***
Underlying trend in assaults	-0.178	0.065	= .006 **
Liquor law reforms: Trend change	0.332	0.114	= .004 **
January	9.381	2.645	< .001 ***
April	7.982	2.764	= .004 **
October	10.175	2.886	< .001 ***
December	8.228	2.873	= .004 **
Autoregressive (lag 2)	0.235	0.091	= .010 *

AIC = 889.20; Ljung-Box test: $\chi^2_{23} = 18.59, p = .725$

* $p < .05$, ** $p < .01$, *** $p < .001$

Table A4. ARIMA time series model of non-domestic assaults in the Distal Displacement Area (DDA), January 2009 - March 2019

	Estimate	Standard Error	p value
Constant	37.147	1.297	< .001 ***
Underlying trend in assaults	-0.140	0.030	< .001 ***
Liquor law reforms: Trend change	0.258	0.053	< .001 ***
January	9.315	1.539	< .001 ***
June	-5.309	1.598	< .001 ***
July	-4.998	1.597	= .002 **
October	6.850	1.598	< .001 ***
December	6.693	1.599	< .001 ***
Moving Average Seasonal (lag 12)	0.227	0.101	= .024 *

AIC = 797.32; Ljung-Box test: $\chi^2_{23} = 13.24, p = .947$

* $p < .05$, ** $p < .01$, *** $p < .001$

Table A5. ARIMA time series model of non-domestic assaults in the rest of NSW, January 2009 - March 2019

	Estimate	Standard Error	p value
Constant	3,163.900	83.724	< .001 ***
Underlying trend in assaults	-11.271	1.578	< .001 ***
Liquor law reforms: Trend change	9.963	2.538	< .001 ***
Autoregressive (lag 1)	0.302	0.084	< .001 ***
Autoregressive Seasonal (lag 12)	0.825	0.045	< .001 ***

AIC = 1532.25; Ljung-Box test: $\chi^2_{22} = 27.81, p = .182$

* $p < .05$, ** $p < .01$, *** $p < .001$

Table A6. ARIMA time series model of non-domestic assaults in the combined Kings Cross and Sydney CBD Entertainment Precincts (KXP & CBD), January 2009 - March 2019

	Estimate	Standard Error	p value
Constant	205.194	3.370	< .001 ***
Underlying trend in assaults	-0.518	0.096	< .001 ***
Liquor law reforms: Level change	-31.833	5.006	< .001 ***
Liquor law reforms: Trend change	0.325	0.123	= .008 **
January	10.094	4.292	= .019 *
March	28.651	4.228	< .001 ***
November	11.818	4.426	= .008 **
December	28.383	4.478	< .001 ***
Autoregressive (lag 4)	-0.231	0.092	= .012 *
Moving Average Seasonal (lag 12)	0.258	0.097	= .008 **

AIC = 1058.48; Ljung-Box test: $\chi^2_{22} = 30.42, p = .109$

* $p < .05$, ** $p < .01$, *** $p < .001$

Time series analyses were also conducted where the KXP and CBD areas were combined. The results from the ARIMA analysis are shown in Table A6. There was a significant reduction in the level of the series after the law reforms commenced where there were on average 32 less non-domestic assaults per month ($p < .001$). There was a reduction in the magnitude of the declining trend in non-domestic assaults in the combined KXP and CBD area post liquor law reforms. Prior to 2014 the trend

was one less assault every 2 months while after the reforms it was only declining by around one less assault every 5 months ($p = .008$). Compared with the forecasts from the pre-intervention period there was a 13.3% reduction in non-domestic assaults after the law reforms. In total there were 1,360 fewer assaults in the combined KXP and CBD areas which is very similar to the 1,350 fewer assaults which was found when adding the results from the distinct KXP and CBD analyses together.