Electronic Gambling Machines in New Zealand: A Local Government Policy Analysis

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Abstract:

Problem gambling is a significant public health concern, affecting approximately 11 percent of New Zealanders each year (Department of Internal Affairs, 2008). Class 4 gambling, defined as non-casino electronic gaming machines and commonly referred to as “pokies”, contributes the most harm to New Zealand compared to other types of gambling (Ministry of Health, 2019). We focus on the direct impact of local government policy instruments on the number of electronic gaming machines, venues, and gambling expenditure. Our key finding is that a reduction in access to Class 4 gambling is estimated to reduce gambling expenditure from electronic gaming machines by between 10 and 14 percent, relative to the reference group. Additionally, this research examines the indirect effects of territorial authority policies on crime. We focus specifically on addiction-related crimes involving alcohol and drugs. We find no significant impacts of gambling policies on this narrow subset of criminal offences.

Key Words: sinking lid, problem gambling, electronic gaming machines, harm reduction

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Disclaimer

These results are not official statistics. They have been created for research purposes from the Integrated Data Infrastructure (IDI) which is carefully managed by Stats NZ. For more information about the IDI please visit https://www.stats.govt.nz/integrated-data/.

Attestation of Authorship

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the qualification of any other degree or diploma of a University or other institution of higher learning, except where due acknowledgment is made in the acknowledgments.

Signature Date 29/01/2021

Table of Contents

Tables

Figures

1 Introduction

New Zealand (NZ) has one of the highest per capita expenditures on gambling in the developed world (The Economist, 2014). On a per capita basis, New Zealanders lose more money on gambling than individuals from other similar economies such as Britain and Canada (The Economist, 2017). Problem gambling is a significant public health concern, affecting approximately 11 percent of New Zealanders each year (Department of Internal Affairs, 2008). Gambling addiction has been linked to poor health, psychological distress, financial difficulties, and strained interpersonal relationships. Class 4 gambling, defined as non-casino electronic gaming machines (EGMs) and commonly referred to as "pokies", contributes the most harm to NZ compared to other types of gambling (Ministry of Health, 2019). According to the National Gambling Study of 2014, over half of the total Class 4 gambling expenditure comes from individuals considered to be high risk or problem gamblers (Abbott et al., 2016).

Although Class 4 gaming is common internationally, policy evaluations in this space are rare. This is likely due to a lack of data. To the best of our knowledge, there is only one quasi-experimental study in the literature focusing on the causal effect of EGM availability on EGM expenditure. According to this 2005 study by the South Australian Centre for Economic Studies, placing an absolute cap on EGMs in five "vulnerable communities" in Victoria, Australia did not appear to increase or decrease overall EGM expenditure. It is important to note, however, the study relies on propensity score matching to estimate average treatment effects and is thus susceptible to bias from unobserved community-level characteristics. In terms of relevant NZ literature, there is little evidence regarding the effectiveness of Class 4 gambling policies. In a descriptive analysis of sinking lid policies by the Sapere Research Group in 2018, the authors note that reductions in EGMs are not

strongly correlated with reduced expenditure in high deprivation neighbourhoods, which may be due to the small magnitude of reductions relative to their existing numbers (Rook et al., 2018).

The Gambling Act of 2003 (hereafter, the "Act") made sweeping changes to how NZ regulates non-casino gaming. The Act characterizes problem gambling as any gambling-related activity that creates negative consequences for the individual, their family, or the community. This definition includes those who suffer from pathological gambling, but also individuals whose gambling behaviour is not considered severe enough to register as a psychological condition but is severe enough to cause harm. The Act mandates the baseline set of restrictions regarding the number of EGMs per Class 4 venue. However, many territorial authorities (TAs) have adopted stronger regulations in recent years, including absolute caps on the number of machines, the number of venues, or both; per capita caps on the number of machines, the number of venues, or both; and sinking lid policies restricting the transfer of Class 4 licenses in order to slowly reduce availability over time.

The main aim of this study is to assess the impact of local government responses to problem gambling using quasi-experimental methods. To do this, we use of TA-level Class 4 gambling expenditure data to understand the efficacy of local policies meant to curb problem gambling. We do this by exploiting the presence of both geographical and time variation in policies. We first focus on the direct impact of the aforementioned local government policy instruments on the number of EGMs, venues, and gambling expenditure. We find that all forms of Class 4 gambling policy interventions are effective in reducing venues and EGMs, relative to the reference group of TAs that only employ the baseline restrictions outlined in the Act. Our key finding is that reduction in access to Class 4 gambling is estimated to reduce gambling expenditure from EGMs by between 10 and 14 percent, relative to the reference group.

Additionally, this research examines the indirect effects of TA policies on crime. We use administrative data in the Integrated Data Infrastructure (IDI) to link crime information at the TA level with gambling expenditure data from the Department of Internal Affairs (DIA). We focus specifically on addiction-related crimes involving alcohol and drugs. We find no significant impacts of gambling policies on this narrow subset of criminal offences.

The remainder of this report is organised as follows: Section 2 lays out the legislative background in NZ; the theoretical understanding regarding problem gambling; and a brief summary of the national and international literature. Section 3 illustrates the core data, while Section 4 describes the methodology used. Section 5 reports results of the analysis. Section 6 provides the additional analysis that examines the impact on the use of gambling intervention services and drug and alcohol-related criminal offences. Finally, Section 7 concludes along with outlining some limitations and directions for future research.

2 Background and Existing Literature

This section first lays out the legislative context relating to Class 4 gambling in NZ, followed by the theoretical literature surrounding gambling behaviour, and finally, the existing literature on the effects of limiting access to EGMs.

2.1 Legislative background

Class 4 gambling is defined by the Act as operating EGMs in a non-casino venue, such as in pubs and clubs.[1] Several studies have found that Class 4 gambling is the most common form of gambling associated with pathological or problem gambling behaviour (Dowling, Smith & Thomas, 2005; Abbott, 2006; Storer, Abbott & Stubbs, 2009). Problem gambling has been recognised as a significant issue in NZ since the early 2000s, when the Act significantly changed the industry's regulatory environment and declared gambling to be a public health concern (Adams, Raeburn & De Silva, 2009). The Act has several explicit purposes, including controlling growth in gambling; minimising community harm; clarifying legal versus prohibited gambling; and ensuring that gambling proceeds benefit the community.

Importantly, the Act also clarifies regulatory agency roles. The DIA is responsible for all forms of gambling law enforcement, while the Ministry of Health (MoH) is tasked with organising and funding NZ's approach to addressing problem gambling. As part of their role, the MoH is required to regularly develop strategic plans focused on preventing and minimising gambling harm in NZ. This study is intended to contribute to the scientific

[1] Classes of Gambling, NZ Department of Internal Affairs, online at https://www.dia.govt.nz/diawebsite.nsf/wpg_URL/Services-Casino-and-Non-Casino-Gaming-Classes-of-Gambling (accessed 18 July 2019). Note that although TAB outlets are regulated under TAB policies at the TA level, TABs that operate EGMs are considered Class 4 venues.

research and evaluation requirement of the latest strategic plan. Most relevant to the present analysis, the Act established limits on the number of EGMs that could be licensed within any Class 4 venue. Specifically, the Act limits the number of EGMs to 18 per venue if a gambling license was granted before 17 October 2001, and 9 per venue if a license was granted later. These restrictions provide a baseline level of Class 4 regulations applying to all TAs in NZ. TAs are also required to revisit their Class 4 gambling policies every three years.

Since the introduction of the Act, many TAs have put in place stricter limits on EGMs and Class 4 venues. There are three types of such policies: absolute caps on the number of EGMs or Class 4 venues within a TA; per capita caps on EGMs or Class 4 venues within a TA; and sinking lid policies, wherein EGM licenses are non-transferable, and so Class 4 venue closures or relocations serve to permanently lower the absolute cap on EGMs within the TA. Sinking lid policies are the strictest of these measures.

Consequently, NZ provides a good case study to understand the impact of local government policy responses to problem gambling, as there is both geographical and time variation in policies. This permits the use of quasi-experimental methods to estimate the causal impacts of these policies on the number of Class 4 venues, number of EGMs and machine spending.

2.2 Theoretical framework

There are four main theories that seek to understand gambling behaviour, its harm to the community, and potential interventions to reduce the prevalence of problem gambling. These are: 1) availability theory; 2) adaptation theory; 3) the mental health theory of addiction; and 4) the public health model of problem gambling. These theories have shaped NZ's public policy strategies for minimising harm associated with problem gambling and are detailed below.

The earliest theory of gambling behaviour is known as "availability theory" or as the "availability hypothesis". This theory holds that problem gambling is positively linked to exposure. Early research examining the state-level legalisation of several new types of gambling in the United States during the 1980s and 1990s supported this hypothesis (Volberg, 1994). As the opportunity to gamble increases, rates of pathological gambling also increase. Availability theory therefore predicts that restrictions with Class 4 gambling, a reduction in venues and/or EGMs (on a per capita basis) will indefinitely decrease rates of problem gambling and associated harms. This theory drives our hypothesis that Class 4 gambling policies that lower or restrict the number of gaming machines will ultimately lower the rates of problem gambling in the affected community.

However, research in NZ suggests other mechanisms are also at work (Abbott, 2006; Abbott, 2017). Abbott notes that three new types of gambling were legalised in NZ in the late 1980s: a national lottery, instant lotteries (commonly known as scratch tickets), and EGMs. Data suggests that availability of new venues and forms of gambling was associated with increased participation in gambling initially. However, this increase only continued for up to two years, after which gambling participation declined, coinciding with a decrease in problem gambling. This finding is consistent with the "adaptation theory" or the "adaptation hypothesis". This theory argues that gambling behaviour is influenced by several psychosocial and economic factors beyond availability, and that problem gambling behaviour may be influenced by public health interventions (Abbott, 2006).[2]

Abbott (2017) further notes that since 2000, gambling participation in NZ has continued to decrease, but rates of problem gambling have remained relatively constant. The author

[2] Abbott (2006) studies EGM prevalence in Australia, noting that the positive relationship between the prevalence of EGMs and gambling participation appears to break down between six and ten EGMs per 1,000 adults. He also finds that caps on EGMs and a reduction in EGMs have no effect on gambling participation. Problem gambling associated with an increase in EGMs appears to be short-term in nature.

speculates that observed declines in gambling participation paired with steady rates of problem gambling may be driven by accumulation of the stock of problem gamblers over time, many of whom are at high risk of relapse. Abbott concludes that since the 1980s, patterns of gambling and problem gambling in NZ are at odds with features of both the availability and adaptation hypotheses. The implication is that reducing EGMs or venues will not be enough to prevent problem gambling and gambling related harms associated with EGMs, and other policy responses may also be necessary.

The third and fourth theories of gambling—the mental health and public health models, respectively—are also important drivers of public intervention strategies. With the publication of the Diagnostic and Statistical Model of Mental Disorder (DSM III) in 1980, the American Psychiatric Association first recognised "pathological gambling as a disorder of impulse control" (Lesieur & Rosenthal, 1991; American Psychiatric Association, 2013). Since then, this theory has become widely recognised as a successful approach to diagnosing and treating pathological gambling. While the mental health theory of addiction has been a useful lens through which to examine pathological gambling, it is not without its criticisms, due the fact that it ignores those other than the individual affected by problem gambling, such as friends, family, and the broader community.

The public health model of gambling, first described by Korn and Shaffer (1999), recognises the importance of the mental health model, but seeks to offer a more holistic approach, including harm minimisation. This model targets the individual (problem gambler), the activity (gambling), the mechanism (EGMs) and the relevant environment (family, community and society, among others) which contribute or could abate problem gambling and its related harms (Abbott et al., 2017).

The broad scope of the public health model directly informed the MoH's NZ Strategy to Prevent and Minimise Gambling Harm 2016/17 and 2018/19.[3] The model also permits policy makers to approach problem gambling minimisation from multiple levels. For instance, by creating policies that help individual problem gamblers and by implementing community-wide policies and programmes. The Class 4 gambling policies, enacted at the TA-level, are a community approach to minimising gambling related harm associated with pokies.

2.3 New Zealand literature

In terms of relevant NZ literature, there is little evidence regarding the effectiveness of Class 4 gambling policies. As mentioned earlier, in a descriptive analysis of sinking lid policies by the Sapere Research Group in 2018, the authors note that reductions in EGMs are not strongly correlated with reduced expenditure in high deprivation neighbourhoods (Rook et al., 2018). The authors plot the change in EGMs against the change in gambling expenditure for each TA over fiscal years 2014 to 2017. Although some TAs showed reductions in both EGMs and gambling expenditure, many did not. In fact, many TAs (especially those with high levels of deprivation) exhibited increased gambling expenditure despite a reduction in EGMs.

In another study of Class 4 venues and EGMs, Cox and Hurren (2017) investigate why nominal gross gaming machine proceeds suddenly increased in late-2013 after a steady decline since the Act came into force. The authors use time series models that predict machine spending based on lagged values of machine spending, personal income, venue numbers, gross domestic product (GDP), population, and tourism visitor numbers.

[3] Strategy to Prevent and Minimise Gambling Harm 2016/17 to 2018/19, Ministry of Health, online at https://www.health.govt.nz/publication/strategy-prevent-and-minimise-gambling-harm-2016-17-2018-19 (access 24 July 2019).

Additional lags of the right-hand side variables are also included in the model as covariates. Models were not successful in predicting gaming machine proceeds. The authors stated that promising avenues for future research include consideration of micro-level data, which directly highlights our main contribution to this literature.

One final study to highlight is Storer et al. (2009). This meta-analysis used data from 34 surveys on availability of EGMs and prevalence of gambling activity across Australia and NZ. One of their key findings was that each additional EGM introduced into an area was associated with 0.8 new problem gamblers, on average. This finding concurs with the availability hypothesis, which posits that increased exposure to EGMs is associated with an increase in gambling activity.

2.4 International literature

Many international jurisdictions implement policies that limit access to EGMs. These restrictions vary in both intensity and reach. Regulatory coverage can be at the national-level, such as in Norway, or at the regional-level, such as in Canada. In Canada, regulations vary provincially, while they vary at the state-level in the U.S. and Australia. In this section we provide an overview of common policies utilised internationally and a summary of relevant policy evaluations. [4]

[4] Most policies referred to in this section are with respect to EGMs outside of casinos, given the focus of our analysis. A few relate to the combined group of casino and non-casino EGMs.

2.4.1 Common policies that limit access to EGMs

Policies limiting access to EGMs cover a broad range, from the extreme (e.g., total bans) to those that are lower coverage in nature (e.g., age restrictions).[5] Table 1 presents a brief overview of the most common policy categories internationally.

Table 1. Common policies that limit access to EGMs

Policies	Definitions
Bans	
Blanket ban	No EGMs allowed to operate anywhere in the jurisdiction.
Venue ban	EGMs permitted in specific venues types only. [6]
Caps	
Per capita caps	A cap on number of EGMs and / or venues on a per capita basis within a jurisdiction.
Absolute caps	A cap on number of EGMs and / or venues within a jurisdiction.
Per venue caps	A cap on number of EGMs per venue within a jurisdiction.
Sinking lid	A limit on number of EGMs and venues within a jurisdiction that is permanently lowered with each reduction of EGMs or venues.
Individuals	
Age restrictions	Minimum gambling age.
Intoxication	Individuals banned from using machines while intoxicated.

Bans

By far the most extreme policies limiting access to EGMs are blanket bans. Although rare, blanket bans have been implemented in several jurisdictions, including NZ where EGMs were banned until their legalisation in 1988 (Abbott, 2017). In 2007, in response to rising concern regarding the harm caused by problem gambling, Norway banned all EGMs (Lund, 2009). Before the ban, EGM revenue had risen substantially from NOK 9 billion in 2001 to NOK 27 billion in 2005 and EGMs were available in a wide range of locations, including shopping centres and train stations (Norsk Tipping, 2010). While new EGMs were reintroduced into Norway in 2009, the new machines are under the control of a government

[5] Note that not all jurisdictions use the term 'EGM'. For example, gaming machines are referred to as VLTs (Video Lottery Terminals) in Canada. We use the collective term of EGMs to encompass gambling machines internationally.

[6] One variant of bans is a temporal restriction with respect to access hours. For example, regulation restricting opening hours.

operator and have particular features aimed at making them less harmful, including mandatory play breaks, lower prizes, limits on gambling amount, and the inability to play using cash (Engebø, 2010). Other examples include blanket bans in Alaska, Hawaii, and Utah (Friedl, 2020), and bans on EGMs in Hungary and Western Australia, apart from those within casinos (Szczyrba, Fiedor & Smolová 2016; Stevens & Livingston, 2019).

Venue bans are a more common policy. For instance, in 2015, Poland banned EGMs in convenience locations, restricting them to casinos and gaming halls (Sulkunen et al., 2018). Similarly, in the Canadian province of British Columbia, EGMs are only permitted in casinos, gaming centres, and co-located racetrack casinos (Gaming Policy and Enforcement Branch, 2019).

Caps

A less intensive way of restricting access to EGMs, compared to bans, involves capping EGMs and / or venues in some form. Australia is a good example on this front. Each Australian state sets some form of cap on EGMs (Livingstone et al, 2019). This is similar to the reference policy in NZ that was created by the Act, whereby each TA faces a cap on number of EGMs per venue. The point of difference is that this base policy is the same across all TAs in NZ, whereas the base cap in Australia is state-specific. Moreover, and again in a similar fashion to NZ, Australian states can undertake additional regulation. For instance, in the state of Victoria, in 2000, a per capita cap was introduced (over and above the base cap of 27 500 non-casino EGMs). [7] The cap was specifically targeted at disadvantaged communities and was 11.7 EGMs per 1,000 adults (McMillen, J. & Doran, B., 2006). Municipalities within Victoria that did not meet this threshold were given three years to become compliant.

[7] See Australian Productivity Commission (2010).

Other selected examples of per venue caps which illustrate differing regulations dependent on the type of venue include the following: hotels in Australian's Northern Territory are permitted up to 20 EGMs, while clubs in the same state may have up to 55 (Livingston et al., 2019); most non-casino venues in Alberta (Canada) are permitted up to 14 EGMs, while gaming entertainment centres in the same province may have up to 49 (AGLC, 2020); and in Nevada, up to 7 EGMs are allowed in each convenience store, with a limit of 4 EGMs in liquor stores, with other venue types assessed individually (Nevada Gaming Commission & Nevada Gaming Control Board, 2020).

Finally, to the best of our knowledge, NZ is the only jurisdiction employing a sinking lid policy. As indicated earlier, a sinking lid policy prohibits transferring EGM licenses. As such, venue closures serve to permanently lower the number of non-casino EGMs within the TA.

Individuals

Most jurisdictions have a minimum gambling age, usually varying between 18 - 21 years, with limits often depending on the form of gambling (Sulkunen et al., 2018).[8] In many jurisdictions, the minimum gambling age is set with reference to the minimum drinking age, especially since most gambling venues are often liquor-licenced. In Canada, for example, gambling and alcohol consumption are regulated under the same legislation, the Gaming, Liquor and Cannabis Act. While access to EGMs and liquor are often co-located, jurisdictions often regulate against intoxicated individuals gambling. Using another example from Canada (from the province of Alberta), individuals who "appear to be intoxicated" are not allowed to engage with EGMs (AGLC, 2020).[9] In Europe, the most common gambling

[8] There are few exceptions to this age range. For example, according to section 48 of the UK Gambling Act 2005, 16-year olds can participate in the lottery, football pools, and use Category D gaming machines (UK Gambling Act, 2005).

[9] The penalty options for violating AGLC policies and guidelines include termination of the Video Lottery Agreement by AGLC, as well as suspension of the venue's ability to operate the EGM equipment (AGLC, 2020).

age is 18. Across much of the U.S., the gambling age is 21, although it is set at 18 in several states for casino gambling (American Gambling Association, 2020). In NZ, the gambling age is 20 for casinos, and 18 for EGMs outside of casinos.

2.4.2 International literature findings

Policy evaluations in this space are scant. This is likely due to lack of relevant data, and a small number of quasi-experimental settings to draw from. As such, many of the studies referred to in this sub-section refer to cross-sectional analysis. Table 2 presents a summary of selected studies.[10]

[10] Given the focus of this research, we do not delve into the vast literature on the impact of availability of casinos.

Table 2. Summary of selected international studies

Region	Availability change	Year	Key findings
Australia			
Queensland	Allowed EGMs in hotels	1991	The increase in EGM availability was associated with an increase in problem gambling (Australian Institute for Gambling Research, 1995).[11]
Victoria	Absolute cap of 27,500 EGMs	1995	The decrease in EGM availability did not decrease EGM expenditure (South Australian Centre for Economic Studies, 2005).
Victoria	Per capita cap of 11.7 EGMs per 1,000 adults	2000	The reduction in the number of EGMs had no impact on gambling expenditure and little impact on the spatial distribution of gambling expenditure (McMillen & Doran, 2006).[12]
U.S.			
Louisiana	Allowed EGMs in parishes	1992	The increase in EGM availability increased participation in gamblers anonymous groups (Campbell & Lester, 1999).
South Dakota	Blanket ban	1995	The reduction in EGMs reduced demand for problem gambling treatment services (Carr et al., 1996).[13]
South Carolina	Blanket ban	2000	The reduction in the number of EGMs was reduced participation in gambling anonymous groups and reduced the long-term demand for problem gambling help (Bridwell & Quinn 2002, Williams, West & Simpson 2012).
Others			
Switzerland	Venue ban – no EGMs permitted outside casinos	2005	The reduction in EGMs was associated with no change in problem gambling, but a clear drop in problem gamblers with probable alcohol problems (Bondolfi et al. 2008).[14]
Norway	Blanket ban	2007	The reduction in EGMs did not increase participation in other forms of gambling by either high- or low-intensity EGM players (Lund, 2009).
Nova Scotia (Canada)	Reduction in EGM venue opening hours	2005	The decrease in EGM availability reduced gambling revenue and spending by problem gamblers by 5 – 9% and 18%, respectively (Nova Scotia Gaming Corporations, 2005).

[11] Measured by expenditure as a percentage of total income.
[12] One area had an increase in the number of EGMs during the study period, the hotspot in that locality also experienced a decline in relative gambling intensity.
[13] The ban lasted only 3 months.
[14] It is notable that while non-casino EGM numbers decreased as a result of the ban, the number of casino licences increased by 19, possibly confounding the results.

As shown in Table 2, there are two main types of results regarding a change in EGM availability and the resulting impact on gambling behaviour. First, there are a number of studies that find a positive association, and thus align with the availability hypothesis put forward in the theoretical framework. For example, evidence points to a rise in problem gambling following EGMs being permitted in hotels in Queensland (Australia) in 1991. Further, past research also shows a drop in availability in the U.S. states of South Dakota and South Carolina, as well as Nova Scotia in Canada, decreased gambling activity. Here it is important to note the range of measures employed to proxy for gambling behaviour: in South Dakota and South Carolina, the outcome of interest was the demand for problem gambling help services—in Nova Scotia it was spending by problem gamblers and gambling revenue.

The second type of result in Table 2 is that of no impact. For instance, both the absolute cap in 1995 and the per capita cap in 2000 introduced in Victoria (Australia) were not found to be associated with any changes in gambling outcomes as measured by EGM expenditure. Similarly, in Switzerland, the drop in EGM availability was not empirically linked to a change in problem gambling. However, Bondolfi et al. (2008) did find the policy change in Switzerland was associated with a drop in the number of problem gamblers with alcohol problems.

There are a range of arguments put forward to explain finding no impact. The South Australian Centre of Economic Studies (2005) argued that there was likely poor enforcement of the policy changes to reduce EGM availability in Victoria. It was also noted that, in the case of Australia, the machines which were removed were the least profitable and least popular (Vasiliadis et al., 2013) indicating another potential reason for finding no impact in some Australian studies.

3 Data

3.1 Data source and descriptives

Data are sourced from the DIA, Stats NZ, and each local government body. We first sourced TA-level statistics on the outcome variables of interest—the number of Class 4 venues, the number of EGMs, and gaming machine proceeds (GMP) from the DIA.[15] The data are quarterly and span the period Q2 2010 to Q4 2018. We collapsed this information to produce annual figures at the TA-level for the outcome variables, specifically the annual mean values for number of Class 4 venues and number of EGMs, and the annual sum of GMP. This was so we could include covariates which we felt were important to control for, but were not available at a quarterly level. We also adjusted the venue and EGM indicators for population by dividing the annual mean values per 100,000 population. Furthermore, we adjusted the annual GMP figures for population and inflation to derive the real GMP per capita at the TA level, in 2019 dollars.

Over the sample period of 2010 to 2018, we found the average annual EGMs and venues per 100,000 population decrease by 28.7 percent and 26.5 percent respectively; while machine spending (measured in terms of real GMP per capita) decreases by 13.1 percent. Average real GMP expenditure per capita over the sample was $186 NZD. The trend in EGM spending is displayed in Figure 1. The strong seasonal nature of Class 4 gambling in NZ is clear—Class 4 gambling is most popular in last quarter of each year and then abruptly drops in the first quarter of the next year. Figure 2 presents the average number of EGMs, per 100,000 population, over time. As expected, there is little evidence of a seasonal component to the stock of EGMs, and declines are gradual over the sample period.

[15] GMP is all the money that goes into an EGM, less winnings paid out; therefore, it can be thought of as player losses.

Figure 1. Real gross machine spending per capita, 2010 to 2018

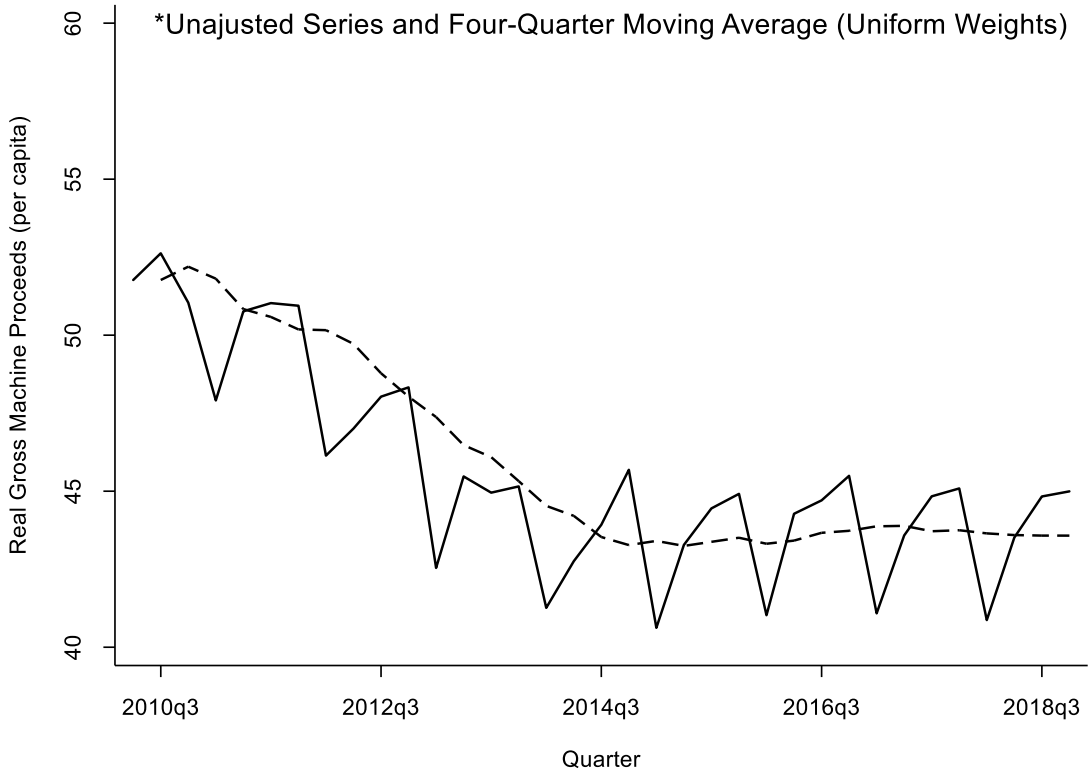
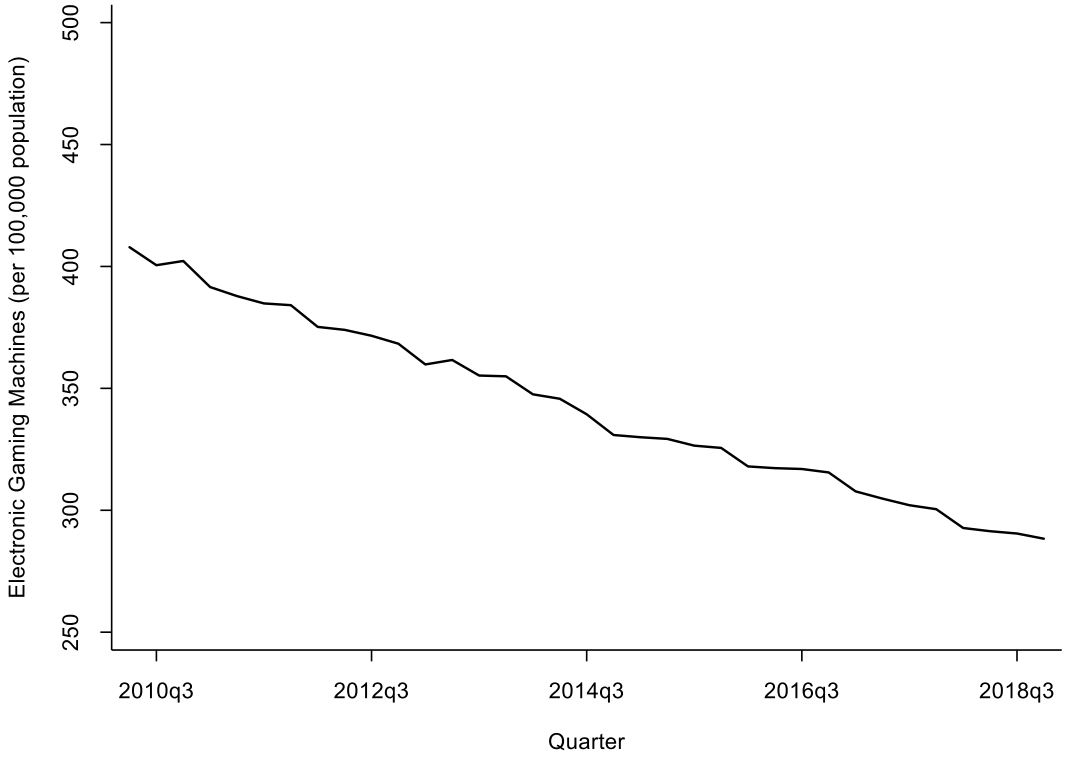


Figure 2. Electronic gaming machines per 100,000 TA population, 2010 to 2018



We next sourced data on the type of Class 4 gambling policies adopted by TAs over time by contacting each of NZ's 67 TAs under the authority of the Official Information Act (OIA). Responses were used to construct a novel panel of TA-level Class 4 gambling policy types over the period 2004 to 2019. This unique dataset also includes information on the specific number of EGMs and venues allowed within the TA over time, on a quarterly basis. We collapsed this information to produce annual policy indicators based on the first quarter of available information for each year. Therefore, gambling policies were sourced from Q1 for the years 2011 to 2018, and Q2 for the year 2010.

We control for the age, gender and ethnicity distributions in each TA using data from Stats NZ.[16] Ethnicity by age cohort is not generally available at the TA-level outside of census years. Therefore, to estimate ethnicity by age cohort for each TA, for each age cohort, we first construct the proportion of five ethnic groups—Asian, European, Maori, MELAA (Middle Eastern/Latin American/African) and Pacific Peoples—for each census year 2006, 2013, and 2018. With these rates, we use spline functions to interpolate ethnicity rates. We then apply these rates to available population levels available for each TA by year to obtain annual estimates of population by ethnicity, for each age cohort across TAs.

We also include annual information on the deprivation level of each TA. The NZ Deprivation index is constructed by the University of Otago, and is based on several items, including the rate of persons within a geographic region buying cheap food, enduring low temperatures to avoid heating costs, being unemployed, receiving government benefits, and going without fresh fruits or vegetables, among others. TAs are categorized into deciles, with the most deprived placed in the top decile (Ward, Trowland & Bracewell, 2019). Deprivation scores are interpolated between census years using spline functions in similar fashion to

[16] Dataset: Subnational population estimates (TA), by age and sex (using 2019 boundaries).

demographic indicators. Our final covariate included is estimated annual GDP growth rate for each TA, based on TA-level GDP estimates produced by the Ministry of Business, Innovation and Employment (MBIE). This allows us to control for broad economic conditions at the local level, which we suspect are positively correlated with EGM spending. Our resulting sample, which merges information from the above sources, is annual in nature, cover the 67 TAs in NZ, and spans years 2010 to 2018.[17] Table 3 provides definitions for our outcome variables, key policy indicators, and control variables. All descriptives in Table 3 are unweighted TA-year means.

It should be noted that our main outcome of interest, GMP, or real player losses from Class 4 gambling, is a strong indication of overall problem gambling in NZ. According to the literature, the vast majority of Class 4 gambling expenditure is problem gambling expenditure. For example, according to the NZ National Gambling Study, the proportion of self-reported problem gamblers that chose Class 4 gambling as their preferred gambling mode increased from 12 percent 1991 to 78 percent in 2002 (Abbott and Volberg, 1991; Paton-Simpson et al., 2003). Further, problem gambling intervention service use data from the MOH show that over the period 2010 to 2018, 55 percent of individuals that received problem gambling services chose Class 4 gambling as their primary mode, while 64 percent listed Class 4 gambling as one of their top five modes of gaming.

Over half of all Class 4 gambling expenditures come from individuals considered to be high risk or problem gamblers (Abbott et al., 2016). As such, problem gamblers are disproportionately represented by player losses. Additionally, NZ survey data has consistently indicated that Class 4 gambling is the mode associated with the most harm

[17] The annual nature of the dataset is due to our available demographic information from Stats NZ being annual. Nonetheless, when we estimate the empirical models using quarterly data and omitting demographic covariates, our findings are qualitatively similar.

relative to other forms of gambling (Rossen, 2015; Tu & Puthipiroj, 2015; Holland et al., 2017; Thimasarn-Anwar et al. 2017).

Table 3. Descriptive statistics for gambling policy evaluation

Variables	Definitions	Mean
Gambling policy[18]		
Reference group	A policy which re-states the minimum standards in the Gambling Act 2003 (i.e., a limit on the number of EGMs to 18 per venue if a gambling license was granted before 17 October 2001, and nine per venue if granted later).	0.18
Absolute cap	A cap on number of machines and / or venues within a TA.	0.35
Per capita cap	A cap on number of machines and / or venues on a per capita basis within a TA.	0.13
Sinking lid	A limit on number of EGMs and venues within a TA that is permanently lowered with each reduction of EGM or venue.	0.34
Outcome variables		
Machine spending	Gross money spent on EGM gambling, less wins paid out (real 2019 $), per capita of each TA. May also be thought of as player losses.	185.91 (56.82)
EGMs	Number of EGMs per 100,000 population of TA.	449.27 (167.48)
Venues	Number of Class 4 venues per 100,000 population of TA.	40.77 (21.49)
Control variables		
Female (%)	The percentage of the population that is female.	50.80
Aged 15 - 39 (%)	The percentage of the population aged between 15 and 39.	27.85
Aged 40 - 64 (%)	The percentage of the population aged between 40 and 64.	39.09
Aged 65+ (%)	The percentage of the population aged 65 or more.	18.60
NZ European (%)	The percentage of the population whose prioritised ethnicity is NZ European.	74.56
Māori (%)	The percentage of the population whose prioritised ethnicity is Māori.	17.67
Pasifika (%)	The percentage of the population whose prioritised ethnicity is Pasifika.	3.04
Asian (%)	The percentage of the population whose prioritised ethnicity is Asian.	4.19
MELAA (%)	The percentage of the population whose prioritised ethnicity is Middle Eastern, Latin American, or African.	0.54
Deprivation	The weighted average per TA of meshblock deprivation deciles using the usual resident population within each meshblock.[19] Deprivation is an ordinal scale ranging from 1 (least deprived) to 10 (most deprived).	5.88 (1.44)
GDP growth rate	Annual GDP growth rate.[20]	4.31 (6.67)
Observations		**536**

Notes: Data cover the 67 TAs in NZ from 2010 to 2018. The machine spending variable used in the regression is the natural log of the variable defined in this table. All descriptives are unweighted TA-year means. Standard deviations are shown in parentheses.

[18] The means for the four gambling policy groups represent the proportion of each group in the sample.
[19] Meshblocks are the smallest area unit used for data collection by Stats NZ, find out more here https://datafinder.stats.govt.nz/layer/92197-meshblock-2018-generalised/. We follow the aggregation process recommended by Atkinson et al. (2019).
[20] Derived from modelled TA-level GDP estimates at https://www.mbie.govt.nz/business-and-employment/economic-development/regional-economic-development/modelled-territorial-authority-gross-domestic-product/

3.2 Class 4 gambling policies

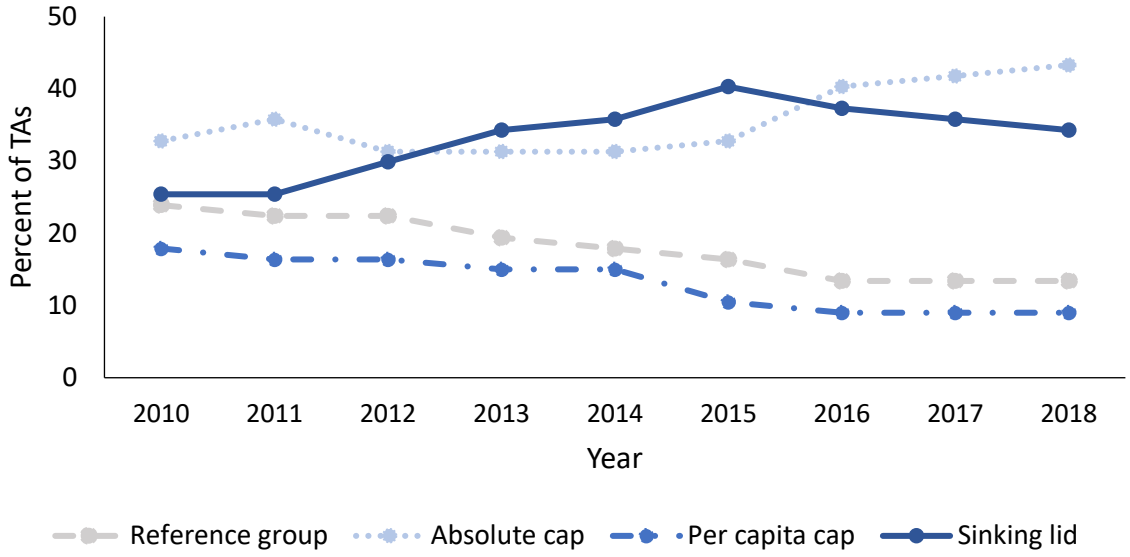
Since 2004, all TAs have been required to adopt a Class 4 gambling policy. At a minimum, they could restate the venue and EGM thresholds provided in the Act. These are 9 gaming machines per Class 4 venue, and 18 if the EGM license was issued before October 2001. As indicated earlier, many TAs have adopted policy interventions that have stricter regulations in addition to those provisioned by the Act.

We analyse three distinct policy interventions. The first policy intervention is a simple absolute cap on the number of either EGMs or Class 4 venues the TA will allow in the district. It is understood that, in practice, TAs have not set caps below the number of EGMs or venues that were in the district at the time the policy was passed. Therefore, a cap is an instrument used to keep the number of machines or venues relatively constant. The second policy intervention is a per capita cap on the number of either EGMs or Class 4 venues. This type of cap aims to keep EGM or venue numbers proportional to the resident population in the TA. The third and strictest policy intervention, is the sinking lid policy. This is a cap on the number of EGMs or Class 4 venues allowed in the TA, which sinks as venues lose their licenses. This means that no new licenses are granted in the TA and any licences lost cannot be reallocated to a new venue or used to expand an existing venue's EGM capacity. Potentially, some TAs may use a sinking lid policy to reduce the number of EGMs, before adopting an absolute or per capita cap. TAs which have none of the three policy interventions form the reference group in the following analysis.

There is substantial geographic variation in Class 4 gambling policies over time. As illustrated by Figure 3, the number of TAs in our reference group is just over 25 percent in 2010; decreasing steadily over time to 14 percent in 2016. TAs adopting absolute caps vary considerably over time. The numbers are lowest in 2012 and 2013 at just over 31 percent, and

peak in 2018 just over 43 percent. The number of TAs adopting per capita caps drops considerably between 2010 (just under 18 percent) and 2016 (just under 9 percent). Finally, the number of TAs adopting a sinking lid policy grows from 2011 to 2015 (25 to 40 percent) and then dips to 34 percent by 2018.

Figure 3. Class 4 gambling policy types, by year



Notes: Data sourced from TAs through individual OIA requests. Percentages represent the TAs policy as of the second quarter in each calendar year.

4 Method

We evaluate the effectiveness of TA-level interventions using variation in geography and policy timing. We focus on Class 4 gambling, of which there are three distinct policy interventions: absolute venue and/or EGM caps (AC); per capita venue and/or EGM caps (PC); and sinking lid policies (SL). Policy interventions are captured by dummy variables equal to one if the policy was in place in the TA in a particular year, and zero otherwise. The reference group are TAs that did not impose any additional restrictions on Class 4 gambling beyond baseline restrictions set forth in the Act. To capture the impact of varying policy interventions at the TA-level, we use a difference-in-differences approach.

The econometric model may be expressed as:

$$y_{it} = \beta_0 + \beta_1 AC_{i,t} + \beta_2 AC_{i,t-1} + \beta_3 PC_{i,t} + \beta_4 PC_{i,t-1} + \beta_5 SL_{i,t} + \beta_6 SL_{i,t-1} + \boldsymbol{X\theta} + \delta_t + \delta_i + \varepsilon_{it} \quad (1)$$

where y_{it} is an outcome for TA *i* in year *t*. Three direct outcomes of interest are examined—the number of Class 4 venues; the number of EGMs; and machine spending. **X** is a vector of demographic controls which includes ethnicity, age, and gender composition. **X** also includes the deprivation level over the sample period to help capture socio-economic status at the TA-level, as well as annual GDP growth rates at the TA-level. One-year lags are included to estimate the delayed effect of policies on outcomes. Summing the contemporaneous and lagged impacts of each policy intervention provides an estimate of the cumulative impact in the first two years. TA and year fixed effects remove time-invariant factors which affect gambling behaviour within each TA. An idiosyncratic error term, ε_{it}, captures all other factors which are not taken account of in the model.

Because data are naturally clustered into TAs, ignoring this feature will result in standard errors that are misleadingly small and confidence intervals that are too narrow. As a result, estimates would appear more precise than they are. To obtain the correct standard errors we conduct inference using bootstrapped clustering (see Cameron and Miller, 2015, and MacKinnon, 2019, for details).

The identifying assumption in any difference-in-differences approach is that pre-treatment trends are similar across treatment and control groups, also known as the parallel trends assumption. This is typically verified by visual inspection, or empirically using methods akin to event study models which check for placebo treatment effects before policy changes occur. In our case, due to having multiple treatment types enacted in different time periods, it is not clear how to visually inspect the parallel trends assumption. Instead, we empirically inspect this assumption by predicting our outcomes while including two leading policy indicators for each treatment type—one and two years prior to the actual policy change-alongside treatment dummy variables in levels and two lagged policy indicators. We refrain from adding additional leads/lags as it would leave us for too few observations for meaningful hypothesis testing. We examine the coefficients on leading indicators for each of our three main outcomes. Any coefficient statistically different from zero on leading indicators suggests that the parallel trends assumption does not hold.

Finally, Goodman-Bacon (2018) showed that two-way fixed effects difference-in-difference models are a weighted average of results using three different groups as the control: timing groups, or groups that are treated at different times which can serve as other's control groups in different time periods (e.g., groups treated later in the sample period can serve as controls for groups that are treated earlier on); always treated, the group that was treated before the sample period; and the never treated group. In order to better understand what is driving our results, we conduct Goodman-Bacon decomposition, as discussed in Section 5.

5 Results

Table 4 presents estimates for our three outcomes of interest. There is evidence of effectiveness across all three forms of policy intervention (i.e., absolute cap, per capita cap, and sinking lid) of reducing venues and EGMs relative to the reference group. For example, as shown in column (1) of Table 4, the impact of an absolute cap policy (relative to the reference group) is a drop of 67 EGMs and approximately 7 venues (per 100,000 population) over one year. This equates to a 15 percent drop in EGMs and a 16.9 percent drop in venues, per 100,000 population. In terms of magnitude, numbers are marginally larger for the per capita cap policy (85 machines and 8 venues respectively), and lower for the sinking lid policy (36 machines and 4 venues respectively). As shown in Table 4, the direct impact on the number of venues and EGMs are contemporaneous in nature, with no significant impacts in the following year.

Table 4. Impact of gambling policies on EGMs, Venues and Machine spending.

Variable	(1) EGMs	(2) Venues	(3) Machine spending
Outcome variables			
Absolute cap	-67.18**	-6.88**	-0.10**
	(26.84)	(3.43)	(0.04)
Lagged absolute cap	6.14	-0.07	-0.03
	(21.93)	(2.08)	(0.02)
Per capita cap	-84.64**	-8.01**	-0.14***
	(33.29)	(3.94)	(0.05)
Lagged per capita cap	8.28	-1.08	-0.03
	(24.74)	(2.53)	(0.03)
Sinking lid	-36.21*	-4.47*	-0.08***
	(19.65)	(2.61)	(0.03)
Lagged sinking lid	-11.53	-0.36	-0.05***
	(19.78)	(1.83)	(0.02)
Control variables			
Female (%)	117.71	2.95	-0.02
	(72.29)	(2.64)	(0.03)
Aged 15 - 39 (%)	50.59***	3.49**	0.05*
	(17.93)	(1.52)	(0.02)
Aged 40 - 64 (%)	69.09***	6.09***	0.09***
	(25.20)	(1.93)	(0.03)
Aged 65+ (%)	42.35***	4.17**	0.05*
	(14.53)	(1.63)	(0.03)
Maori (%)	11.08	2.27*	0.03*
	(9.74)	(1.26)	(0.02)
Pasifika (%)	65.50*	3.90*	0.01
	(35.40)	(2.31)	(0.03)
Asian (%)	16.84**	2.78***	0.01
	(8.05)	(0.82)	(0.01)
MELAA (%)	11.33	0.23	0.004
	(45.05)	(5.19)	(0.06)
Deprivation	-32.39**	0.72	0.0001
	(15.89)	(1.80)	(0.03)
GDP growth rate (%)	0.063	0.00003	0.0007
	(0.28)	(0.03)	(0.0005)
Observations	536	536	536
R-squared	0.69	0.68	0.58

Notes: Machine spending is the natural logarithm of real GMP per capita, reported in 2019 dollars. TA and year fixed effects included. Bootstrapped clustered standard errors are shown in parentheses. ***, **, and * denote statistical significance at the one, five, and ten percent-levels, respectively.

The impact on gambling expenditure is of key importance and is shown in column (3) of Table 4. This variable is measured as the natural logarithm of machine spending in real 2019 dollars. Regression coefficients are therefore interpreted as a percentage change. For example, a coefficient of -0.10 for an absolute cap indicates that, compared to the reference group, this policy intervention resulted in a 10 percent decline in gambling expenditure.

When assessing the cumulative impact of policy interventions (sum of both contemporaneous and lagged effects), it appears that per capita caps and sinking lids are the most effective in reducing gambling expenditure. Compared to the reference group, either of these policy interventions has the cumulative impact of reducing gambling expenditure by an estimated 13 to 14 percent. We find that absolute caps reduce overall gambling expenditure by 10 percent. Sinking lid policies appear to be the only policy intervention with evidence of both contemporaneous and lagged negative impacts on gambling expenditure. We tested the sensitivity of our findings by replicating the regression model with weights based on the TA-level population statistics. Our results remain qualitatively similar, thus providing a reassuring signal of robustness of findings.

Lastly, we appeal to decomposition methods proposed by Goodman-Bacon (2018) to better understand what is driving our results. We present the results of the Goodman-Bacon decomposition in Table 5.

Table 5. Goodman-Bacon decomposition

	(1) EGMs	(2) Venues	(3) Machine spending	Weight
Timing Groups	-41.18	-5.93	-.048	3.48%
Always Treated	-25.55	-4.58	-.122	82.04%
Never Treated	-34.13	-1.04	-.106	14.78%
Weighted Average	-27.34	-4.11	-.117***	
	(25.16)	(3.05)	(.028)	
Observations	603	603	603	

Decomposition indicates that over 80 percent of results are driven by TAs that adopted regulations beyond the Act before the sample period began in 2010. Reassuringly, all estimates using the three control groups are negative for each outcome. Notably, the Goodman-Bacon decomposition requires a single binary treatment indicator and does not allow for controls. Thus, the decomposition is also an exercise in whether results are similar when assuming homogeneous treatment (i.e., absolute caps are identical to per capita caps and sinking lids) and no lagged treatment effects. Although point estimates for models of EGMs and Class 4 venues are now not statistically different from zero, the simplified model estimates an 11.7 percent decline in player losses upon enacting any Class 4 gambling policy beyond the Act.

Finally, as previously mentioned, it is important to test whether pre-treatment trends are similar across treatment and control groups. We test this since the untreated TAs in the difference-in-differences model are used as our counterfactual. That is, they are assumed to capture the trajectory in outcomes in the absence of any policies going beyond the Act. In order for the untreated TAs to form a convincing counterfactual, the two groups must have been following parallel trends before the treated TAs switched policies. The results of the parallel-trends assumption test are shown in Table 6. We find little evidence that there are any significant differences in pre-treatment trends in outcomes. Out of the 18 t-tests we conduct, in only one case do we find a coefficient on a pre-treatment policy indicator that is

statistically different from zero. Specifically, we estimate a ten percent decrease in player losses in the year prior to implementing a per capita cap. Although this effect is statistically significant, it is not unusual to detect a statistically significant coefficient when testing so many hypotheses (in our case the likelihood of detecting at least one false negative at the five percent significance level is 1 - 0.9518 = .603).

Table 6. Tests of the parallel trends assumption

	(1)	(2)	(3)
Variables	EGMs	Venues	Machine spending
Absolute cap(*t-2*)	-1.22	.578	-.008
	(19.90)	(2.22)	(.046)
Absolute cap(*t-1*)	-25.95	-1.62	-.053
	(27.95)	(2.20)	(0.33)
F-statistic (p-value)	.286	.751	.123
Per capita cap(*t-2*)	-6.82	.876	-0.100
	(34.25)	(3.81)	(.086)
Per capita cap(*t-1*)	-33.98	-1.96	-0.100***
	(29.69)	(2.79)	(.036)
F-statistic (p-value)	.478	.718	.010
Sinking lid(*t-2*)	11.20	.783	-.001
	(25.27)	(3.44)	(.064)
Sinking lid(*t-1*)	-27.05	-1.20	-.051
	(29.91)	(2.63)	(.040)
F-statistic (p-value)	.646	.696	.446
Overall F-statistic (p-value)	.509	.992	.087
Observations	335	335	335

6 Impact of gambling policies on drug and alcohol-related crime

A 2005 NZ study found that 10 percent of problem gamblers admitted to experiencing problems with the police as a consequence of their gambling behaviour (Abbott et al., 2005). Similarly, the Australian Productivity Commission (1999) found that 11 percent of problem gamblers admitted to committing illegal acts as a consequence of their gambling. Of individuals who have identified their gambling as a problem and have sought help, two thirds have admitted to committing an offence (Blaszczynski and McConaghy 1994a).

As the public health model of gambling suggests, it is important to identify other areas in the relevant environment (family, community and society, among others) impacted by problem gambling (Korn and Shaffer, 1999; Abbott et al., 2017). We therefore focus on crime rates as an area that may be impacted following a change in the level of gambling activity.

This section is structured as follows: Section 6.1 discusses the relevant literature, while Section 6.2 describes the data used in this sub-analysis as well as the methodology, before Section 6.3 presents the results.

6.1 Existing Literature

Many studies have revealed a positive relationship between crime and gambling disorders (Blaszczynski and McConaghy, 1994b; Meyer and Stadler, 1999; Perrone, Jansons and Morrison, 2013). According to a 2003 study of gambling in Sothern Nevada, roughly 50 percent of problem gamblers commit crimes (Schwer, Thompson and Nakamuro, 2003).

Problem gamblers are likely to experience the social costs of gambling, known to include depression, breakdowns of interpersonal relationships, reduced productivity, unemployment,

bankruptcy and crime (Adolphne, et. al, 2019). Additionally, the literature points to co-morbidity between gambling and mental health disorders including compulsive and criminal behaviour (Shelp, n.d.).

Perrone, Jasons and Morrison (2013) suggest three potential ways that gambling disorders and crime may be linked: first, the relationship could be coincidental with no systemic link underneath it; second, it could be co-symptomatic (or endogenous), with an unobserved endogenous variable causing both gambling problems and criminal behaviour; finally, there may be a causal connection where gambling causes crime.

This association is drawn out in the literature by studies focusing on one of three populations: criminal offenders serving prison sentences, problem gamblers who seek help through various support groups, and individuals who seek help for drug and/or alcohol problems. This body of research is complimented by population-wide studies which estimate the number of problem gamblers in society at large. A comparison of the results can give us an indication of the potential relationship between problem gambling and crime.

Table 7, sourced from Ramanauskas (2020), gives an overview of some of the international findings of problem gambler populations found within prisons. The findings show that between 34 and 12 percent of prison populations internationally are made up of problem gamblers. Among other things, this variation could be due to the varying screening tools used to measure problem gambling in each population. By comparison, using the Problem Gambling Severity Index (PGSI)[21] screening tool, Armstrong and Carroll (2017) found that only about 1 percent of Australians are problem gamblers. Also using PGSI in the UK, the reported problem gambling rate in the population is 0.8 percent (Gambling Commission,

[21] PGSI, is the most commonly used problem gambling screening tool (Ramanauskas, 2020). This screening tool is readily available online here: https://www.gamblingcommission.gov.uk/news-action-and-statistics/Statistics-and-research/Problem-gambling-screens.aspx

2020). Similarly, Malatest and Associates Ltd (2014) reported a 0.6 percent prevalence of problem gamblers in the Canadian province of British Columbia, with Williams and Volberg (2013) reporting a 1 percent rate for the province of Ontario. The fact that problem gamblers appear to make up a significantly larger proportion of prison populations internationally, compared to the average population, suggests a positive association between problem gambling and criminal activity.

Table 7. Problem gambling prison population analyses from different jurisdictions

Jurisdiction	Population	Prevalence	Source
Australia	Australian Capital Territory corrections facilities	34 percent reported as problem gamblers, of which 15.7 percent classed as "severe".	Lahn and Grabosky (2003)
England	One male prison, one female prison	Using PGSI, a prevalence of 28 percent was reported among the male sample, and 18 percent among the female sample.	May-Chahal et al. (2012)
England & Scotland	Prison and electronic tags	Using PGSI, reported as 12 percent problem gamblers (compared to 0.7 percent of the UK population).	May-Chahal et al. (2016)
USA (Nevada)	Medium security prison	Using SOGS,[22] 23 percent reported some experience of problem gambling, and 26 percent were classed as being likely "pathological".	Templer, Kaiser and Siscoe (1993)

Source: Ramanauskas (2020), page 14.

A systematic review of 21 research papers by Adolphe et al. (2019) concludes that most crimes related to problem gambling are non-violent and are most likely to be financially motivated. However, this does not explain all gambling-related crimes. Violent crimes also appear to be more prevalent for gamblers than non-gamblers (Rudd and Thomas 2016; Laursen et al. 2016; Turner et al. 2009). This suggests that other mechanisms beyond financial losses from problem gambling are at play (Adolphe et al., 2019).

[22] The South Oaks Gambling Score (SOGS), is a 20-item questionnaire based on DSM-III criteria for pathological gambling. For further information, see: https://www.greo.ca/en/topics/sogs.aspx

There is a known link between problem gambling and drug and alcohol abuse (Steinberg et al., 1992, Zimmerman, Chelminski and Young, 2006; Bellringer et al., 2009). Zimmerman, Chelminski and Young (2006) found that problem gamblers have a higher chance of being diagnosed with a substance use disorder, particularly alcohol abuse or dependence, than non-gamblers and non-problem gamblers. Additionally, according to Bellringer et al. (2009), between 45 percent and 46 percent of help-seeking gamblers suffered from alcohol dependence or abuse. According to a NZ study, 27 percent of individuals seeking help for their gambling, had committed a drug-related criminal offence (Bellringer et al., 2009). Of individuals who struggle with substance abuse, 10 to 20 percent report that they also experience gambling problems (Ferentzy, Skinner and Matheson, 2013). Also, when looking specifically at cocaine abusers, Steinberg et al. (1992) found that 15 percent of participants were also pathological gamblers, as compared to roughly 1.5 percent of the general population they surveyed.

Yet, the link between problem gambling and drug and alcohol-related crime has never been investigated from a gambling policy perspective. A study of prison populations in England concluded that criminal offending could be reduced by an estimated 5 percent if there was an effective prevention of gambling problems (May-Chahal et al, 2015). This paper adds to the literature by investigating whether effective gambling policies can reduce drug and alcohol-related crime by restricting access to EGMs in the community.

6.2 Data

We use several data sources within the Stats NZ framework of the IDI. The IDI is a large research database containing microdata about individuals and households in NZ. It has a wealth of administrative data from a range of government agencies, providing population-

level information on outcomes related to employment, health, criminal justice, and public benefit receipt, for example. It also includes numerous Stats NZ surveys, as well as data derived from non-government agencies.

For the purposes of this research, we focus on justice events (prevalence of criminal offending) sourced from the NZ Police's Recorded Crime Offenders Statistics (RCOS). We are interested in all addiction-related (alcohol and drug) criminal offences committed by individuals who may have been affected by a TA's gambling policy (i.e., individuals who had legal access to Class 4 gambling venues and EGMs).

The starting point for the empirical analysis is the number of offences recorded in the offenders data, committed during our sample period Q2 2010 to Q4 2018, by TA.[23] We begin with all drug and alcohol-related crimes, but then drop crimes committed by individuals who were below 18 years old in the year the crime was committed, since they could not legally access EGMs. We also drop all individuals with missing birth year data, and/or missing TA data. We are left with a sample of just under 400,000 offences, 58 percent of which are alcohol-related, while the remaining 42 percent are drug-related offences. Table 8 defines the outcomes of interest for this analysis. All descriptives in Table 8 are unweighted TA-year means.

Table 8. Descriptive statistics of crime variables

Variables	Definitions	Mean
All drug and alcohol offences	Number of drug and alcohol-related offences per 100,000 population of TA.	936.41 (520.58)
Drug offences	Number of drug-related offences per 100,000 population of TA.	438.45 (335.68)
Alcohol offences	Number of alcohol-related offences per 100,000 population of TA.	498.79 (282.48)
Observations		528

Notes: Data cover the 66 TAs in NZ from Q2 2010 to Q4 2018. Data on the TA of Chatham Islands was unavailable. All descriptives are unweighted TA-year means. Standard deviations are shown in parentheses.

[23] We note that there is a lack of criminal offence data for the TA of the Chatham Islands. We therefore omit this TA from this sub-analysis.

For all outcomes described in Table 8, we employ the same difference-in-difference framework portrayed in Section 4 to examine the impact of policy interventions on the number of drug and alcohol-related offences.

6.3 Results

The results in Table 9 show no statistically significant changes in drug and alcohol-related offences as a result of any of the three Class 4 gambling policies.

Table 9. Impact of gambling policies on drug and alcohol related crimes

	(1)	(2)	(3)
Variable	Drug & alcohol	Drug	Alcohol
Absolute cap	14.51	0.77	6.81
	(118.44)	(85.35)	(73.31)
Lagged absolute cap	-95.94	-80.95	-4.99
	(139.79)	(122.28)	(36.61)
Per capita cap	-72.21	28.91	-107.36
	(156.15)	(128.40)	(108.66)
Lagged per capita cap	106.12	96.07	19.41
	(143.72)	(142.92)	(78.33)
Sinking lid	147.84	96.89	44.47
	(120.99)	(112.52)	(62.85)
Lagged sinking lid	-123.73	-156.43	41.52
	(142.89)	(136.71)	(42.11)
Observations	528	528	528
R-squared	0.43	0.18	0.63

Notes: The control variables described in Table 3 are included in these regressions, but not included here for the sake of brevity. TA and year fixed effects included. Bootstrapped clustered standard errors are shown in parentheses. ***, **, and * denote statistical significance at the one, five, and ten percent-levels, respectively.

This result could be driven by several different factors. For example, we are not sure of the spill-over effects of one addictive behaviour to another. On one hand, a problem gambler may be more likely to commit other addiction-related offences, leaning more heavily on other drug or alcohol addictions, when the supply of EGMs is reduced. Conversely, it could be that

less exposure to EGMs, due to their reduced availability, leads to less exposure to other addictive behavioural triggers. For example, since Class 4 venues generally serve alcohol, individuals may no longer go to these venues, therefore reducing their exposure to alcohol and, as such, their probability of committing an alcohol-related offence. It could be that these competing forces cancel each other out, increasing drug and alcohol-related offending for some problem gamblers and reducing it for others, such that the overall effect of the gambling policies appear to be zero.

One additional factor is time. It is possible that Class 4 gambling policies need more time in order to have an indirect effect on drug and alcohol-related offences. A data set with additional observations could, in future, test this theory with the use of additional lags.

There are some other key limitations to this data, namely that we cannot account for individuals that have committed a crime in a TA they do not reside in, which has a different gambling policy. We rely here on the assumption that this is a rare occurrence and any instances that may exist in the data are too small to affect our results.

We also cannot account for any spill-over effects into other types of gambling. Although the literature is quite clear on the link between problem gambling and crime, we do not yet know if a specific type of gambling is more correlated with crime than others. Therefore, we may not see a drop in crime rates even if EGM use has decreased, because individuals may substitute other types of gambling such as casino, lottery, sports betting or online gambling.

As a result, although our analysis does not draw out a statistically significant impact, this is not necessarily indicative of no link between Class 4 gaming and drug and alcohol-related crime.

7 Conclusions

This research aim of this paper is to understand the impact of public policy interventions on problem gambling. To conduct our empirical analysis, we gathered information on Class 4 gambling policies from all 67 TAs in NZ. This allowed us to construct a novel panel data set of TA-level Class 4 gambling policy types over time. In each year, a TA either had the baseline policy mandated by the Act or had more stringent regulation in the form of either an absolute cap on number of EGMs and / or venues; a per capita cap on number of EGMs and / or venues; or a sinking lid policy. We combined this policy information with data on machine spending from the DIA and demographic and economic indicators from Stats NZ and MBIE. A quasi-experimental difference-in-differences identification strategy relying on geographic and time variation in gambling policy is used to estimate the causal impact of Class 4 gambling policies on the number of venues, EGMs, and machine spending. Our analysis is at the TA-level and the sample period of interest is 2010 to 2018.

We found that all three forms of policy intervention prevalent in NZ are effective in reducing Class 4 venues and EGMs relative to the reference group (i.e. TAs with no restrictions beyond those in the Act). For example, absolute caps are estimated to reduce the number of EGMs by 67 (14.7 percent) and the number of venues by 7 (16.6 percent) on a per 100,000 population basis over one year. Estimated reductions are marginally larger for the per capita cap policy and lower for the sinking lid policy.

In terms of reducing machine spending, sinking lids and per capita caps appear the most effective. Compared to the reference group, these policies are associated with a cumulative reduction (sum of contemporaneous and lagged effects) in machine spending of between 13 – 14 percent. Absolute caps were shown to reduce cumulative expenditure by 10 percent, relative to the reference group. Furthermore, sinking lids are the only policy estimated to

reduce gambling expenditure in both contemporaneous and lagged years (again, relative to the reference group).

Our research also explored the impact of Class 4 gambling policies on crime. We found no statistically significant changes in drug and alcohol-related offences as a result of any of the three gambling policies.

One limitation worth pointing out is that we do not know the source of reduction in gambling expenditure. More specifically, we cannot ascertain what proportion of the drop in spending is from casual gamblers compared to problem gamblers. Another limitation to note is that we don't have information on other forms of gambling activity. Therefore, we don't know if the drop in machine spending created spill-over effects, such as a rise in online gambling activity.[24] We also don't have information on additional measures (perhaps more informal in nature) undertaken by TAs to try and curb problem gambling. Although, we can potentially assume that the policy intervention employed (whether absolute cap, per capita cap or sinking lid) is not only a signal of the level of commitment a TA has towards trying to reduce problem gambling, but also a proxy for the likely level of other informal activities aimed at this goal.

[24] Note that TA fixed effects will capture one of the alternative gambling opportunities – casinos, as they don't vary with respect to location over time. Also note, that while we don't have information on other types of opportunities such as Lotto and TAB outlets for our sample period, if these numbers do not vary substantially over time, they will also be picked up by the TA fixed effects.

8 References

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