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Introduction

Regulating gambling serves the goals of player protection and harm reduction while interacting with fiscal incentives and regional development. I take the perspective of industrial organization and regulatory economics and ask how policy, market structure, and local public finance shape outcomes in practice. I aim to highlight the potential effects of regulatory policies on market structure and behavior in advance, as well as evaluate the implemented rules from competition and welfare perspectives. In doing so, I will draw particular attention to potential negative externalities and discrepancies between well-intentioned regulations and their implementation. I focus on Germany and Europe where federal structures and heterogeneous rules offer useful variation. This dissertation consists of four papers.

The first paper studies the geography of casino locations in Germany. We examine whether observed locations are aligned with the objectives of the State Treaty or with fiscal and strategic incentives at administrative borders. Using county data and a logit framework, I show that border proximity and tourism predict casino presence. The pattern is consistent with a beggar-thy-neighbor logic where benefits are local while part of the costs is shifted to other regions.

The second paper analyzes prosperity and inequality as drivers of participation in the market for gambling machines in Europe. We combine macro sources and estimate fixed effects panel models for EU countries. Higher income inequality is associated with fewer machines, and increases in the disposable income of lower income groups are associated with more machines, while GDP is not a robust driver. The results suggest that the income distribution within countries matters for gambling demand and for regulation.

The third paper turns to municipal licensing of gambling halls in Germany. I study whether local fiscal pressure shapes the number of licenses. Using a balanced municipal panel and a dynamic panel estimator, I find that lagged per capita tax revenue is negatively related to

the number of licenses. The result is consistent with fiscal considerations in licensing and it raises a potential tension with the objectives of the State Treaty. Similar to Chapter 1, this study shows that conflicts of interest can arise due to fiscal incentives and may overshadow the objectives of the State Treaty.

The fourth paper evaluates a targeted regulatory intervention and possible displacement across sub-markets. Hesse introduced a player exclusion program for gambling halls in 2014 while gastronomic establishments were not covered. Using synthetic difference-in-differences on municipal panel data, we find a decline of machines in gambling halls and an offsetting increase in gastronomic establishments. The results highlight that narrow rules can shift activity to less regulated environments.

Taken together, the four papers show how geographic placement, distributional factors, local public finance, and substitution across sub-markets shape locations, number of machines, licensing decisions, and participation. The evidence supports regulation that is clear in its objectives, coordinated across levels of government, and attentive to substitution channels and distributional consequences. With this dissertation, I underline the need for independent, ongoing policy evaluation. The gap between well-intentioned regulation and real-world feasibility should not be ignored. Conflicts of interest and negative externalities should be identified early and limited wherever possible.

Chapter 1

Regulatory Objectives vs Fiscal Interests: Are German Casino Locations Motivated by Beggar-Thy-Neighbor Policy? An Empirical Analysis

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Abstract: In this paper we provide an empirical analysis of German casino locations. Due to the "mercantilistic background" of casinos, we assume that casinos are more likely to be found at borders and in tourist areas. Even though location decisions have been made in the past, we use cross-sectional data at county level to analyze whether the current locations of casinos are consistent with present-day policy objectives. We discuss whether fiscal incentives and/or regulatory objectives to prevent harmful gambling are relevant for today's locations of German casinos. For our empirical analysis we use location and tourism indicators which are both significant factors for the location of German casinos. We find that the likelihood of a casino location increases if a county is located at a state border. We conjecture that border locations are chosen to share negative externalities of gambling with neighboring states while attracting revenues from out-of-state gamblers. This can be viewed as a type of beggar-thy-neighbor policy, which is inconsistent, however, with the objectives of the State Treaty, which is to provide legal gambling opportunities for the population within the state. For better implementation of the objectives, a more balanced distribution of casinos throughout the urbanized regions in Germany is recommended.

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1.1 Introduction

The appropriate regulation of gambling markets is not an uncontroversial topic and it is still being intensively discussed in the literature (Coryn et al., 2008; Carran, 2018; Bühringer, 2018). While parts of the gambling market have long been organized in a legal, regulated framework, other parts of gambling take place in black markets. The reasons for regulation and also partial prohibition include not only various market failures triggered by information asymmetries and external effects, but also by boundedly rational or even the pathological behavior of some gamblers (Coryn et al., 2008). Partly, gambling also has a negative reputation (see, e.g., Yani-de Soriano et al., 2012).

From a regional economic perspective, casinos have positive and also negative effects (Coryn et al., 2008; Walker and Barnett, 1999). Some of the positive effects a casino has on the region include the jobs associated with a casino, the local income generated, possibly also tax revenues, and tourist attraction. On the negative side are possible external effects such as noise, the negative image already mentioned, an increase of gambling addiction, property crimes, and money laundering (Coryn et al., 2008). As Dümmler et al. (2001) explain, the macroeconomic benefit of casinos has a "mercantilistic background": As little as possible should be imported and as much as possible should be exported, so that the largest part of the value creation remains in the domestic market. The bigger the share of labor, investors, and suppliers originating from the region of the casino location, the higher the benefit of a casino for the region. In contrast, the negative effect of the gaming business is ideally exported (i.e., consumed by persons from outside the region in which the casino is located) (Dümmler et al., 2001).

Accordingly, casinos have a certain similarity to so-called NIMBY (Not In My Backyard) goods. In the case of NIMBY goods, significant social costs of production are incurred locally (such as aircraft noise), while the benefits (from an airport) also arise elsewhere, so that, while many welcome the existence (of airports) in principle, they do not welcome it in their neighborhood (Frey et al., 1996; van der Horst, 2007). For casinos, the effects may be somewhat different, but related. From the point of view of a casino location, the social costs (e.g., from gambling addiction) should be exported as much as possible, while the benefits (e.g., from jobs and tax revenues) should remain as local as possible. This can also be viewed as a type of beggar-thy-neighbor policy. In this context, it is surprising that the locations of casinos has not yet been systematically analyzed from the beggar-thy-neighbor

policy perspective. A very good case study for this purpose is Germany since it has the most neighboring states in Europe. In addition, Germany has a federal state system and the individual federal states bear the advantages and disadvantages of a casino location more or less independently. Hence, both state and federal borders should be relevant for the location of casinos. Especially since the responsibility for the location decision rests with the federal state and is, therefore, a public policy decision-making process.

In this paper, we want to analyze whether German casinos are located at borders and in tourist areas to export any potentially negative effects of consumption. The analysis of the location of casinos is important in order to analyze whether current locations are in line with the regulatory objectives of the State Treaty on Gaming (GlüStV) or whether they are more motivated by fiscal objectives. The GlüStV is Germany's regulatory framework with an objective to provide legal gambling opportunities for the German population so as to steer the "natural gambling instinct" of the population into orderly and supervised channels by offering a limited range of games of chance as a suitable alternative to unauthorized gambling, and to counteract the development and spread of unauthorized gambling in black markets.

We use cross-sectional county-level data to analyze whether current casino locations are consistent with official policy objectives.[1] Due to the mercantilistic background of casinos, we conjecture that casinos are more likely to be found at borders and in tourist areas in order to raise revenues from gambling taxes and create jobs, though working all the while to "externalize" the negative effects of gambling. The State Treaty on Gambling, in contrast, has the main objective to provide legal gambling opportunities so that the population abstains from illegal offerings. For that purpose, legal gambling locations should be close to the respective population.

Our paper is structured as follows: First, we present an overview of the gambling regulation in Germany and a literature review. After the data and model section, we report the results. Finally, we discuss model limitations and summarize the findings in the conclusion.

[1] Although the location decision is in the past and a panel regression would cover potential time trends and socioeconomic changes, we still prefer cross-sectional data. On the one hand, our aim is to show whether current locations are still consistent with current regulation. On the other hand, it is not possible to collect all data over the time period of casino openings, as we rely on the availability of data from the Federal Statistical Office.

1.2 Gambling Regulation in Germany

Gambling is only allowed in regulated forms in Germany. The GlüStV is intended to limit the negative effects of gambling. Section 1 Number 1 GlüStV contains the objective of preventing gaming and betting addiction and creating the preconditions for an effective addiction control. Section 1 Number 2 GlüStV is about limiting and channeling the supply of gambling. Dietlein et al. (2012) consider the channeling objective as the most important instrument against gambling and betting addiction. In particular, the second objective aims to combat illegal gambling by channeling the existing gambling demand toward legal gambling activities (Dietlein et al., 2012; Haucap et al., 2017).[2]

The regulation of casinos is at the level of the federal states. Regulation in the respective federal states is composed of the *Spielbankgesetz* and *Spielordnung*. The respective laws regulate who may operate a casino. A distinction is made between a concession model and a state monopoly. In the case of a state monopoly, the location is determined directly by the federal states. In the case of the concession model, the location is determined indirectly by regulation. Even if an operator chooses a location within the regulatory landscape and also meets all other legal criteria for opening a casino, the operator has no legal claim to the granting of a concession (Section 4, Number 2, Sentence 3, GlüStV). Since the operator model represents either a state monopoly or a concession model, the location decision is made by the federal states and should therefore be in line with the objectives of the GlüStV. Hence, the responsibility for the location decision rests with the federal states. For an overview of the operator models and the operators of casinos in the individual federal states, see Table 1.1.

[2]For a more detailed explanation of the objectives of the GlüStV, see Dietlein et al. (2012).

Table 1.1: Overview of the Federal States - Operator Model and Operator

Federal State	Model	Operator	
		State	Private
Baden-Württemberg	Concession Model	X	
Bavaria	State Monopoly	X	
Berlin	Concession Model		X
Brandenburg	State Monopoly	X	
Bremen	State Monopoly	X	
Hamburg	Concession Model		X
Hessen	State Monopoly/Concession Model	X	X
Mecklenburg-Western Pomerania	Concession Model		X
Lower Saxony	Concession Model		X
North Rhine-Westphalia	State Monopoly	X	
Rhineland-Palatinate	Concession Model		X
Saarland	State Monopoly	X	
Saxony	State Monopoly	X	
Saxony-Anhalt	Concession Model		X
Schleswig-Holstein	Concession Model	X	
Thuringia	Concession Model		

Source: Own illustration. Based on Sandhaus and Shirvani (2019).

Other regulations may apply in the respective federal states that affect casinos. However, standardization is achieved with the GlüStV, which was agreed between all 16 federal states. This treaty sets out the framework and includes certain policies relating to casinos (Sandhaus and Shirvani, 2019).[3]

State laws limit the number of casinos and/or the municipalities in which a casino may be located. For example, the number of casinos is limited to a maximum of five in Saxony. A municipality restriction applies in Baden-Württemberg. Only in Baden-Baden, Konstanz, and Stuttgart may casino be operated. In Thuringia, both the number and the municipality are restricted. Only one casino is permitted and this may only be located in Erfurt. For an overview of the municipality restriction in the federal states, see the following Table 1.2.

The gambling market[4] has several different forms of games. Casinos are one of the legal outlets of the gambling market in Germany. In contrast to arcades which only contain machine-based gaming, casinos also contain table games. There are 69 casinos in Germany. These are spread over 15 of the 16 federal states. Only in Thuringia are there no casinos. Of the 69 casinos, 35 are privately operated (BupriS, 2021) and 34 are state-owned (DSbV, 2021).

[3]For an overview of state gaming laws, see Sandhaus and Shirvani (2019).
[4]Additional information about the gambling market can be found in Meyer et al. (2009).

Table 1.2: Overview of the Federal States - Municipal Restriction

State	Municipality Restriction
Baden-Württemberg	Baden-Baden, Konstanz, Stuttgart
Bavarian	Municipalities with state baths, spas or resorts
Berlin	/
Brandenburg	Potsdam, Frankfurt (Oder), Cottbus + bordering Municipalities
Bremen	For each municipality, one casino and branch office
Hamburg	/
Hessen	Bad Homburg, Kassel, Wiesbaden
Mecklenburg-Western Pomerania	/
Lower Saxony	/
North Rhine-Westphalia	/
Rhineland-Palatinate	Bad Neuenahr-Ahrweiler (Branches: Bad Dürkheim und Nürburg), Mainz (Branches: Bad Ems und Trier)
Saarland	/
Saxony	/
Saxony-Anhalt	/
Schleswig-Holstein	/
Thuringia	Erfurt

Source: State laws.

1.3 Literature Review

The location of casinos in Germany has not been analyzed so far. However, there is various literature on the distribution and location of casinos in the US, but the literature is mostly based on the performance (Lambert et al., 2010; Navin and Sullivan, 2007; Wenz, 2008). Lambert et al. (2010) analyze whether the location of casinos has an impact on their success and efficiency. Cookson (2010) analyzed the distribution of Native American casinos with respect to Indian reservations. He concluded that "multiple-state tribes have more than twice the probability [...] of having a casino as do [a] single-state tribe." With regard to non-Native American casinos, Wenz (2008) concludes that they tend to be located beyond state borders.

Regarding the effects of a casino on the local labor market, Humphreys and Marchand (2013) found that employment in Canada increased in both the gaming industry and the hospitality industry. Indeed, increased revenues result from the local gaming industry. In addition, Ishizaka et al. (2013) analyzed a suitable location to construct a new casino in the region of

Greater London. In contrast to our work, Ishizaka et al. (2013) consider new locations for casinos in their analysis. They question the Casino Advisory Panel's (2007) recommendation that casinos should be located in Newham. In their analysis, they state that if profits are to be maximized, Westminster would be a more appropriate location. Westminster is known for generating the highest revenue in the tourism sector. However, if one considers not only profitability but also social criteria, they come to the same conclusion as the Casino Advisory Panel. Based on the work of Ishizaka et al. (2013) and Humphreys and Marchand (2013), we include tourism indicators in our regression. Spas and casinos have a historical connection in Germany. Until the early 1970s, all 12 German casinos were located next to spas. It was not until the mid-1970s that casinos were opened in large German cities or in their immediate neighborhood. This can be explained by the trend toward city tourism, which is especially reflected in the average capacity utilization.

The national border is considered to play a major role in the location of casinos. Assaf et al. (2013, p. 153) study the performance of Slovenian casinos. Their analysis shows that national borders lead to an increased performance of casinos. The idea is that international customers spend more, on average, than domestic customers (Roehl, 1996). Thereby, international customers contribute to mitigating negative consequences for the domestic population (Lee et al., 2010). Based on this literature, we include location indicators in our regression to reflect the border effect and the resulting fiscal benefits[5]. Lambert et al. (2010) also analyze the location of casinos and include a border effect in their regression. Their paper studies the success and efficiency of casinos in the US and finds that border effects are not very important. The authors explain this finding with a small variation of the variable in their sample. Still, they conclude that the most successful locations are in large urban areas near state borders (Lambert et al., 2010). In contrast, we believe that Germany is a better case study for analyzing the location of casinos, especially with respect to border effects, since 86 of 401 counties are located on state borders, which leads to a higher variation. In addition, Germany has the most neighboring countries and the longest border in Europe. Moreover, Germany has a federal system with additional domestic state borders within Germany.

There are social costs associated with casinos. In the literature on the legalization of casinos, among the issues discussed are the associated economic benefits and social costs. Social costs are not directly measurable (Eadington, 1998, p. 55). Strict prohibition or a severely

[5]To control for fiscal benefits at the state border, we would have liked to use a variable that reflects money per patron. Unfortunately, there is no publicly available data of this type.

limited supply of casinos leads to an increase in the demand of illegal gambling (Eadington, 1999, p. 183 f.). If, however, one considers the social costs associated with the presence of a casino, for example, Grinols and Mustard (2004) discuss the extent to which crime rates are influenced by casinos. On the one hand, it is argued that crime is directly reduced because casinos have a direct effect on the labor market and the economy. This is confirmed by the study of Humphreys and Marchand (2013). On the other hand, Grinols and Mustard (2004) suggest a link between crime rates and pathological gambling behavior. As also shown in the study by Strohäker and Becker (2017), the concentration of gamblers with pathological behaviors increases with the presence of a casino. The literature further includes many criteria associated with the social costs of casinos that can be attributed to pathological gambling behavior. Among the criteria, increased insolvency and suicide rates, neighborhood crime, health care costs, and family problems are suspected (Kearney, 2005, p. 285 f.; Eadington, 1999, p. 187; Mallach, 2010, p. 19). As can be seen, the social costs of casinos cover various externalities. Grinols and Mustard (2004, p. 24 f.) estimate, that crime-related social costs in US areas with casinos were about $75 per adult in 2003.

In addition, there is a large body of literature in the area of player barring. Pursuant to § 8 of the GlüStV, operators are obliged to block players who either report themselves or are reported by third parties. There are studies on the effectiveness of the player barring system in Germany. Furthermore, player barring systems are also widespread regulatory instruments internationally. In Canada, the barring system started as early as 1989 (Nowatzki and Williams, 2002), in the USA in 1996 (O'Hare, 2004; Blaszczynski et al., 2007) and in New Zealand in 2003 (Townshend, 2007). In addition, there are barring systems in several countries in Europe and Asia (Strohäker and Becker, 2017, p. 8). The empirical study by Meyer and Hayer (2010) is considered the basis for the evaluation of the barring system in German casinos. Meyer and Hayer (2010) investigated the effectiveness and benefits of player bans over a longer period of time. They used questionnaires from consistent banned players — over a period of time — to evaluate the effectiveness of player barring with regard to pathological gambling behavior. The results of their analysis suggest a positive benefit from player bans. Another analysis is conducted by Strohäker and Becker (2017). They examined the decisive factors for self-exclusion, concluding that the proximity of a casino to the place of residence was a decisive criterion for excluded gamblers. They found that with an increased distance of a casino to the residence, the share of bans decreases. The location of casinos thus directly influences the concentration of pathological gambling behavior. For

these reasons, a different regulatory tool was used in the past to prevent addiction. This was the *Residenzverbot*. Citizens who lived within five kilometers of a casino were not allowed to enter it (Strohäker and Becker, 2017). Fiedler (2015) also evaluated the blocking system in German casinos. Overall, a ban effect is considered positive, as a decrease in gambling participation is observed among banned gamblers. In both the USA and Canada, a barring system was found to reduce the share of pathological gamblers (Ladouceur et al., 2007, p. 91; Nelson et al., 2010, p. 143).

Based on the previous mentioned literature, the location of gambling supply seems to have an impact on pathological gambling behavior. Therefore, it is even more important to analyze current casino locations. Due to the mercantilistic background of casinos, we assume that casinos are more likely to be found at borders and tourist areas. Considering the literature, this does not seem to be in line with the objective of the GlüStV, which is to provide legal gambling opportunities for the population so as to control harmful gambling.

1.4 Data and Model

For our analysis, we created our own data set at the county level. We have included all counties and county-level cities in our data set. Most of the data were taken from the Federal Statistical Office or the statistical offices of the federal states. The individual sources for each variable can be found in Table A.1 in the appendix.

The data set contains 401 observations with 26 missing values related to the variable *average capacity utilization*. The 401 observations are equal to the number of counties in Germany. We included 11 variables in the regression. To counteract the variation in the different regulations of the individual federal states, as can be seen in Table 1.2, dummy variables were included for each of the federal states (*federal state FE*). The dependent variable is *casino*. It represents a dummy variable. The independent variables of the regression are:

- Location indicators: *state border*, *federal state border*, *state border*×*federal state border*
- Tourism indicators: *spa*, *average capacity utilization*
- Control variables
  - Socio-economic indicators: *average age*, *disposable income*, *migration background*
  - Other indicators: *population*, *county-level city*, *federal state FE*

Table 1.3: Variable definition

Variable	Definition
Dependent variable	
casino	Dummy variable equal to 1 if a casino is located in a county.
Location indicators	
state border	Dummy variable equal to 1 if a county contains a state border.
federal state border	Dummy variable equal to 1 if a county contains a federal state border.
state border × federal state border	Dummy variable equal to 1 if a county contains a state or federal state border.
Tourism indicators	
spa	Number of spas that meet the requirements of the German Spas Association.
average capacity utilization	A calculated value (ratio of overnight stays to bed days in percent) that expresses the use of sleeping facilities in a reporting period.
Control variables	
Socioeconomic indicators	
average age	Average age in a county.
disposable income	Disposable income of private households in thousand euros per capita.
migration background	The migration background variable represents the percentage of the population group with a migration background in relation to the total population. Consequently, the variable shows the proportion of people who have immigrated from abroad or are descendants of immigrants.
Other indicators	
population	Number of population in thousands.[6]
county-level city	Dummy variable equal to 1 if a county is a county-level city. According to the data, one third of the population of Germany lives in county-level cities. Therefore, the variable county-level city can be seen as a proxy for big cities.
federal state FE	Dummy variables, which each equal 1 if a county is located in the respective state.

[6]We would have liked to include *population density* in our regression, but there is a high correlation between *population density* and *migration background*. As a proxy, we included the variables *county-level city* and *population* in the regression, since county-level cities tend to be big cities and are thus densely populated.

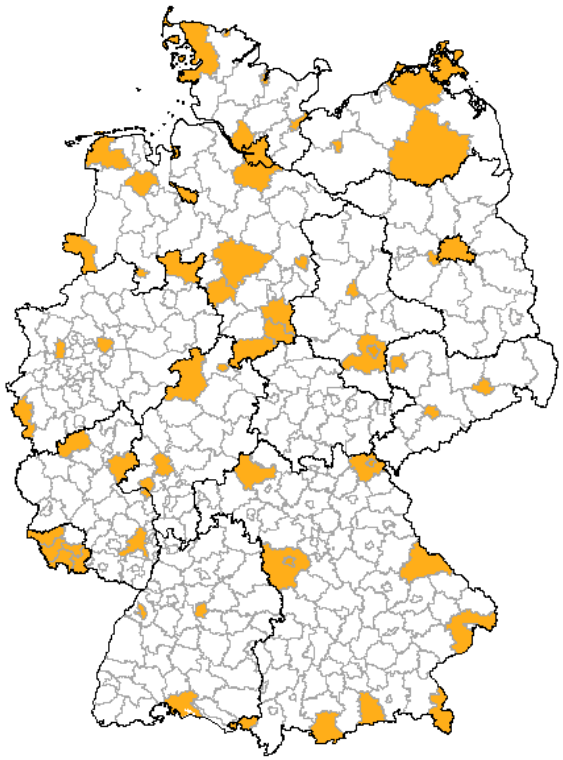

Figure 1.1: Graphical illustration of counties with casinos

Tables 1.4 and 1.5 show the descriptive data and Table 1.6 reflects the pairwise correlation and the variance inflation factor (VIF) of the variables.

Table 1.4: Descriptive data of the dummy variables

Variables	N	Mean	St. Dev.	0 (Abs.)	1 (Abs.)	0 (%)	1 (%)
casino	401	0.15	0.36	341	60	85	15
state border	401	0.21	0.41	315	86	79	21
federal state border	401	0.49	0.50	203	198	51	49
state border × federal state border	401	0.08	0.28	368	33	92	8
county-level city	401	0.27	0.44	294	107	73	27

Table 1.5: Descriptive data of the variables

Variables	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
spa	401	0.97	1.91	0	0	1	16
average capacity utilization	375	35.99	8.39	17.80	30.05	41.00	60.30
average age	401	44.91	1.95	40.20	43.70	46.00	50.50
disposable income	401	22.50	2.61	16.31	20.58	23.95	39.03
migration background	401	16.73	9.49	2	9.8	23.6	50
population	401	207.03	243.88	34.21	103.66	242.16	3,644.83

Table 1.6: Correlation matrix

Var	VIF	1	2	3	4	5	6	7	8	9	10	11
1	-	1										
2	2.95	0.2***	1									
3	2.29	0.1	-0.1**	1								
4	2.29	0.1	0.5***	0.3***	1							
5	1.75	0.1***	0.2***	0.1	0.1	1						
6	2.51	0.2***	0.1*	-0.1***	0.0	0.0	1					
7	2.81	0.0	0.1	0.2***	0.1***	0.2***	-0.3***	1				
8	2.04	-0.1	-0.1	-0.2***	-0.1**	0.0	0.1***	-0.3***	1			
9	6.10	-0.0	-0.1**	-0.2***	-0.1**	-0.2***	0.3***	-0.5***	0.3***	1		
10	1.98	0.1***	-0.0	-0.0	0.0	0.1	0.1***	-0.2***	0.1	0.2***	1	
11	3.57	0.1***	-0.0	-0.2***	-0.1	-0.4***	0.4***	-0.3***	-0.2***	0.4***	-0.1**	1

1 = casino, 2 = state border, 3 = federal state border, 4 = state border × federal state border, 5 = spa, 6 = average capacity utilization, 7 = average age, 8 = disposable income, 9 = migration background, 10 = population, 11 = county-level city

Note: $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$. For the actual p-values of the pairwise correlation test of the variables see Table-A.2.

Only variables with a correlation of less than 0.6 were included in the regression. We also calculated the VIFs of our model. Some of the literature concludes that multicollinearity is a problem with a VIF above 10. Although Wooldridge (2019) only sees a limited use of VIF, he recommends looking at the VIF out of curiosity. Nevertheless, our model does not include VIFs above 10.

For our analysis we use a logit model,[7] which takes the following form:

$$\begin{aligned} &\hat{P}(casino = 1 | state\,border, ..., federal\,state\,FE) \\ &= \wedge(\hat{\beta}_0 + \hat{\beta}_1 state\,border + ... + \hat{\beta}_{11-25} federal\,state\,FE), \end{aligned} \tag{1.1}$$

where $\wedge(z) = exp(z)/[1 + exp(z)]$ is the logit function.

1.5 Results

As shown above, the explanatory variables were divided into location and tourism indicators. The control variables were subdivided into socioeconomic and other indicators. The indicator groups are successively included in the calculation of the regression. Based on this, the explanatory power of each indicator group is to be identified. The results are presented in Table 1.7. We estimated the models with robust standard errors.

[7]Since we have a binary dependent variable, we use the logit and probit model, as these are the most commonly used binary models in applied economics (Greene, 2018). Since our regression results do not differ significantly when using logit or probit (see Table A.3 in the appendix), we keep the logit model. Furthermore, Greene (2018) summarizes that in most cases the choice between logit and probit models does not make much difference.

Table 1.7: Results - Logit model

	Casino			
Variables	Model 1	Model 2	Model 3	Model 4
(Intercept)	-3.5407^{***}	-9.2763^{***}	-8.8676	-13.1141
	(0.7262)	(1.2615)	(6.9908)	(7.9885)
Location indicators				
state border	1.8114^{***}	1.9965^{***}	2.1445^{***}	2.3893^{***}
	(0.4847)	(0.5967)	(0.6156)	(0.6700)
federal state border	0.6748	1.2208^{**}	1.2509^{**}	1.6464^{***}
	(0.4503)	(0.5052)	(0.5019)	(0.5709)
state border × federal state border	-1.2432^{*}	-1.9175^{**}	-1.9379^{**}	-2.1360^{**}
	(0.7384)	(0.9098)	(0.9071)	(0.9514)
Tourism indicators				
spa		0.1597^{**}	0.1703^{*}	0.2081^{*}
		(0.0800)	(0.0949)	(0.1099)
average capacity utilization		0.1229^{***}	0.1161^{***}	0.0892^{**}
		(0.0224)	(0.0291)	(0.0348)
Control variables				
Socioeconomic indicators				
average age			-0.0688	0.0404
			(0.1400)	(0.1566)
disposable income			0.1026	0.1192
			(0.0975)	(0.1162)
migration background			0.0076	-0.0448
			(0.0385)	(0.0486)
Other indicators				
population				0.0031
				(0.0022)
county-level city				1.2317
				(0.7746)
federal state FE	✓	✓	✓	✓
AIC	308.9141	266.8300	271.1409	268.0719
BIC	384.7994	349.2954	365.3871	370.1719
Log Likelihood	-135.4571	-112.4150	-111.5704	-108.0359
Deviance	270.9141	224.8300	223.1409	216.0719
Num. obs.	401	375	375	375
McFadden R^2	0.1996	0.3358	0.3408	0.3617
ROC AUC	0.7803	0.8641	0.8617	0.8805

Note: $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$

As can be seen from models 1 and 2, both location and tourism indicators contribute most of the explanatory power to the variation of the variable *casino*. Accordingly, these indicators should be important for the location of casinos. In models 3 and 4, additional indicator groups were included as control variables.

As logit models are nonlinear, interpretations of the magnitude of the effects are not directly available (Wooldridge, 2019). However, with the help of the Average Partial Effects (APE), an interpretation of the average effects can be made. Here, the mean of the marginal effects

is calculated across all observations. The results are presented in Table 1.8. We estimated the Average Partial Effects of the logit model with robust standard errors.

Table 1.8: Average Partial Effects of the Model 4

Variables	Casino Model 4 APE
Location indicators	
state border	0.2698^{***}
	(0.0762)
federal state border	0.1375^{***}
	(0.0408)
state border × federal state border	-0.1237^{***}
	(0.0328)
Tourism indicators	
spa	0.0182^{*}
	(0.0097)
average capacity utilization	0.0078^{**}
	(0.0030)
Control variables	
Socioeconomic indicators	
average age	0.0035
	(0.0132)
disposable income	0.0104
	(0.0101)
migration background	−0.0039
	(0.0041)
Other indicators	
population	0.0003
	(0.0002)
county-level city	0.1244
	(0.0842)
federal state FE	✓

Note: $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$
For model fit see Model 4 in Table 1.7 and for comparison with the APE of the probit model see Table A.4 in the appendix.

The variables *state border*, *federal state border*, and *state border* × *federal state border* are all significantly different from zero. The null hypotheses can be rejected with a one percent probability of error. Compared to counties without any borders, the likelihood of having a casino increases, on average, by 26.98 percentage points for a county with a state border, but without a federal state border. Likewise, the probability increases by 13.75 percentage points in a county with a federal state border, but without a state border. If a county is located on both a state and federal state border, the likelihood increases by 28.36 percentage points, on average, compared to a county without any borders.

Looking at the tourism indicators, the null hypothesis can be rejected for *spa* with a 10 percent likelihood of error and for *average capacity utilization* with a 5 percent error likelihood. The probability of a casino location increases by an average of 1.82 percentage points when the number of spas increases by one unit and by an average of 0.78 percentage points when the average utilization rate increases by one unit. Our results confirm our hypothesis that casinos are more likely to be found at borders and in tourist areas.

1.6 Discussion

German casinos are significantly located in counties with state borders. One explanation is the mercantilistic background of casinos and the resulting fiscal reasons described earlier. Since it is rather unlikely at the border to steer the home population's natural gambling desire into legal channels, this is inconsistent with official policy objectives.

Considering the results for both indicator groups, our results are consistent with the existing literature. The analysis by Roehl (1996) shows that international customers of casinos spend more on average. Thus, on the one hand, there is an increased demand at state borders by international customers. On the other hand, it is also possible to share the social costs of gambling with the neighboring countries at state borders (Lee et al., 2010). From an economic view, location on the state border is correspondingly advantageous. As long as fiscal interests do not harm the objectives of the GlüStV, economic benefits can be achieved (Haltern, 2004). However, we assume that it is not possible to achieve the objectives of the GlüStV optimally at the state border. The gambling demand has to be channeled nationwide through an urbanized area to prevent the development and spreading of prohibited games on the black market. For that purpose, the distribution of the casinos should be closer to the local population. Assuming that channeling at borders is not optimal, our results are not consistent with the objective of the GlüStV at either the state or federal state border, since the official objective is to channel the own population's gambling demand, not that of foreigners.

The significance of the interaction variable also underlines the relevance of the state and federal state border. A stronger overall effect is observed in counties with both a state and federal state border. Although state variation was included with the *federal state FE* variables, the location indicators are still strongly significant. This illustrates the relevance of the indicator group.

The tourism indicators can be used as a proxy for the number of tourists. The higher the tourism indicators, the higher the potential demand from foreign players. Ishizaka et al. (2013) even use tourism spending as criteria for the profitability of casinos. From an economic point of view, both variables should have a positive effect, since the number of potential customers increases with rising tourism and international customers tend to spend more (Roehl, 1996). In addition, the variable *spa* provides a historical context. Until the early 1970s, all 12 German casinos were located in spas. Casinos were not opened in German cities or in their immediate vicinity until the mid-1970s. The shift to urban areas can be explained by the trend of city tourism (Deutscher Tourismusverband e. V., 2006, p. 6). The low significance of the variable *spa* can be explained with the *federal state FE*. Table 1.2 shows that in some federal states only locations in spas are allowed. If we omit the *federal state FE* variables, the significance of the variable *spa* increases. However, this leads to biased results because the federal states regulate the location decision differently (omitted variable bias). Considering the literature and our results, casinos are more likely to be found in tourist areas. However, based on the objectives of the GlüStV, casinos should address local population instead of tourists.

Moreover, we like the idea of analyzing whether the influence of our explanatory variables differ in explaining the location decisions of early- vs. late-arriving casinos. Unfortunately, only four new casinos have opened in the last 10 years. If we consider the last 15 years, there were still only nine casino openings. Apart from that, old casinos should also be in line with the current policy. In each federal state, the concession of a casino can be either revoked and/or is limited to 10 or 15 years. Since the main objectives of the GlüStV that we consider in our analysis have remained essentially unchanged, locations that do not comply with current policy may already have had their concession revoked or may not be allowed to renew. With this paper, we want to show whether the current locations are still compatible with the current regulation. Our analysis shows that many casino locations should be reviewed for their compatibility with the objectives of the GlüStV.

As shown above, the location decision for both private and state-operated casinos is under the responsibility of the federal states and should thus be in line with the objectives of the GlüStV. Based on our results and the discussion, the implementation of regulation seems to fail here. The significance of the location and tourism indicators rather suggest that fiscal interests dominate in the location of casinos. Haltern (2004) makes clear that fiscal interest should not be considered as the main reason for gambling supply, but only as a positive

side effect. Eadington (1999, p. 184) shows that in the US many regulations intended to protect consumers are usually symbolic in nature. This phenomenon can be transferred to the German gambling market.

1.7 Limitations

The underlying data set covers all counties in Germany and thus 401 observations. Counties, like federal states, administrative districts, and municipalities, represent one of the administrative levels in Germany. However, the municipality level has a smaller subdivision and comprises 10,799 municipalities. Consequently, a data set at the municipality level would entail a significantly higher number of observations. The challenge of the different counties is that they have different sizes in terms of area. This can lead to bias in the variables. For most variables, density or ratio can be included in the data set, which minimizes inaccuracy. However, for dummy variables, the differences in the sizes of counties cannot be taken into account. This can be seen in figure 1.2 as an example of the dummy variable *federal state border*. The figure contrasts the two federal states Mecklenburg-Western Pomerania and Rhineland-Palatinate. Based on the figure, it is clear that the counties in Mecklenburg-Western Pomerania are significantly larger in area than, for example, the counties in Rhineland-Palatinate. The county of Mecklenburgische Seenplatte (yellow) has a federal state border, and so do the cities in the north of the county. In contrast, the county-level city of Neustadt an der Weinstraße (green), for example, has no federal state border. Consequently, there is a certain inaccuracy in counties with large surface areas for dummy variables. Using a data set at the municipality level, there is less inaccuracy. Nevertheless, we deliberately chose the county level because of the coverage of casinos. A casino covers the gambling supply across multiple municipalities, which makes an observation at the county level more meaningful.

(a) Mecklenburg-Western Pomerania (b) Rhineland-Palatinate

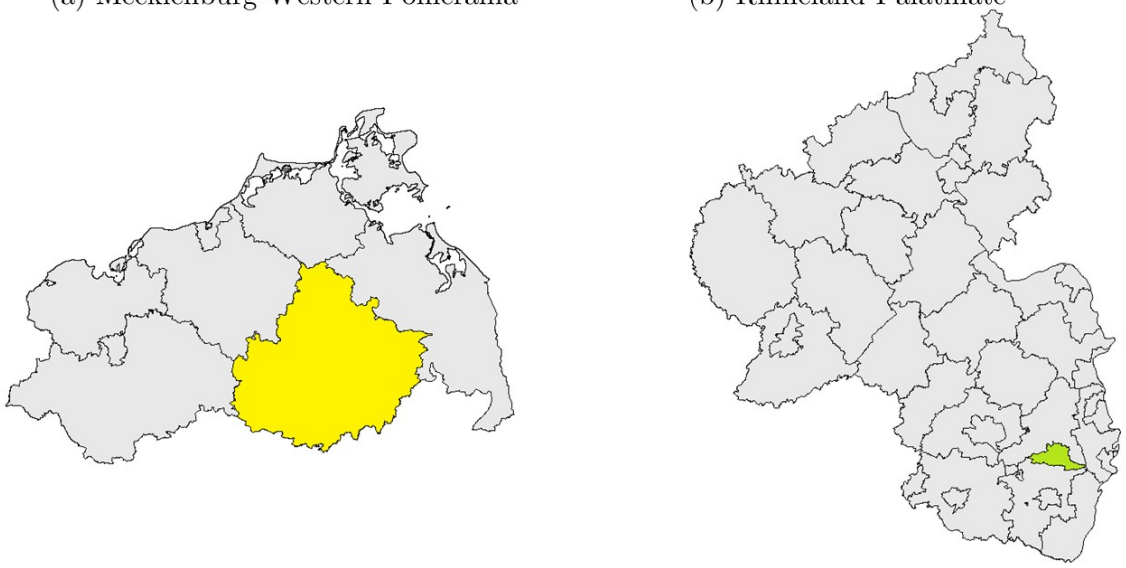

Figure 1.2: Model limitation due to differences in size of counties

Note: yellow = Mecklenburgische Seenplatte, green = Neustadt an der Weinstraße.

1.8 Conclusion

Due to various market failures, triggered by information asymmetries and externalities, but also by boundedly rational or even pathological behavior of some players, regulation is widespread in gambling markets. As assumed above, location decisions for both private and state-operated casinos are the responsibility of the federal states and should thus be in line with their official regulatory objectives. Due to the mercantilistic background of casinos, we conjecture that casinos are more likely to be found at borders and in tourist areas, even though this may contradict regulatory objectives. Considering the literature and our results, the regulation seems to fail here. We can observe casino locations on borders and in tourist areas, disregarding the regulators' objectives to provide legal gambling opportunities for the home population so as to channel their gambling desires into legal and regulated spheres. The significance of the location and tourism indicators rather suggest that fiscal interests dominate in the location of casinos. This finding is also consistent with Calcagno et al. (2010) who find that casino legalization in the USA is motivated by keeping gambling revenues and gambling taxes within the state and to attract tourism or "export" taxes.

For a better implementation of the objectives of the GlüStV, a different distribution of casinos is recommended, away from borders and locations with strong tourism to locations

close to the local population. Thus, channeling local demand comes to the fore and fiscal interests are merely a positive side effect. Above all, placement at the state border entails both increased demand and the sharing of social costs with neighboring countries. The phenomenon of locations of casinos at state borders is not an isolated case, which is why it is difficult to imagine implementation at the national level alone. Looking at the European environment, casinos are also observed at national borders. This is the case in countries such as Austria, Switzerland, the Czech Republic, and Italy. If Germany chose to distance itself from national borders, it bear the social costs of its own casinos as well as those of neighboring countries. Consequently, a Europe-wide approach may be desirable.

Appendix

Table A.1: Overview of the data set and sources

Variable	Source
casino	German casino associations (BupriS; DSbV)
state border	Own determination
federal state border	Own determination
state border × federal state border	Own determination
spa	Ministry of Lower Saxony
average capacity utilization	Federal Statistical Office
average age	Statistical offices of the federal states
disposable income	Statistical offices of the federal states
migration background	Statistical offices of the federal states
population	Federal Statistical Office - GENESIS-Online
county-level city	Federal Statistical Office
federal state FE	Own determination

Table A.2: Significance of the Correlations

Var	1	2	3	4	5	6	7	8	9	10	11
1	–										
2	0.00	–									
3	0.13	0.02	–								
4	0.12	0.00	0.00	–							
5	0.00	0.00	0.33	0.29	–						
6	0.00	0.10	0.01	0.31	0.35	–					
7	0.49	0.14	0.00	0.00	0.00	0.00	–				
8	0.21	0.34	0.00	0.03	0.42	0.01	0.00	–			
9	0.85	0.04	0.00	0.03	0.00	0.00	0.00	0.00	–		
10	0.00	0.21	0.57	0.49	0.63	0.00	0.00	0.41	0.00	–	
11	0.00	0.42	0.01	0.25	0.00	0.00	0.00	0.00	0.00	0.03	–

1 = casino, 2 = state border, 3 = federal state border, 4 = state border × federal state border, 5 = spa, 6 = average capacity utilization, 7 = average age, 8 = disposable income, 9 = migration background, 10 = population, 11 = county-level city

Table A.3: Results - Logit and Probit model

	Logit Model	Probit Model
(Intercept)	-13.1141^{*}	-6.8677^{*}
	(7.3372)	(4.1051)
Location indicators		
state border	2.3893^{***}	1.3024^{***}
	(0.6353)	(0.3381)
federal state border	1.6464^{***}	0.8621^{***}
	(0.5347)	(0.2807)
state border × federal state border	-2.1360^{**}	-1.1381^{**}
	(0.8642)	(0.4686)
Tourism indicators		
spa	0.2081^{**}	0.1181^{**}
	(0.0938)	(0.0533)
average capacity utilization	0.0892^{***}	0.0516^{***}
	(0.0341)	(0.0184)
Control variables		
Socioeconomic indicators		
average age	0.0404	0.0184
	(0.1497)	(0.0837)
disposable income	0.1192	0.0542
	(0.0917)	(0.0509)
migration background	−0.0448	−0.0275
	(0.0461)	(0.0253)
Other indicators		
population	0.0031^{**}	0.0017^{**}
	(0.0014)	(0.0007)
county-level city	1.2317^{*}	0.6860^{*}
	(0.7055)	(0.3873)
federal state FE	✓	✓
AIC	268.0719	266.0181
BIC	370.1719	368.1182
Log Likelihood	−108.0359	−107.0090
Deviance	216.0719	214.0181
Num. obs.	375	375
McFadden R^2	0.3617	0.3677
ROC AUC	0.8805	0.8817

Note: $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$

Table A.4: Average Partial Effects of the logit and probit model

	Logit Model	Probit Model
Location indicators		
state border	0.2698***	0.2581***
	(0.0762)	(0.0708)
federal state border	0.1375***	0.1297***
	(0.0408)	(0.0384)
state border × federal state border	−0.1237***	−0.1196***
	(0.0328)	(0.0320)
Tourism indicators		
spa	0.0182*	0.0183**
	(0.0097)	(0.0089)
average capacity utilization	0.0078**	0.0080***
	(0.0030)	(0.0028)
Control variables		
Socioeconomic indicators		
average age	0.0035	0.0029
	(0.0132)	(0.0129)
disposable income	0.0104	0.0084
	(0.0101)	(0.0097)
migration background	−0.0039	−0.0043
	(0.0041)	(0.0039)
Other indicators		
population	0.0003	0.0003
	(0.0002)	(0.0002)
county-level city	0.1244	0.1221
	(0.0842)	(0.0780)
federal state FE	✓	✓
Num. obs.	375	375
Log Likelihood	−108.0359	−107.0090
Deviance	216.0719	214.0181
AIC	268.0719	266.0181
BIC	370.1719	368.1182

Note: $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$

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Chapter 2

The Effect of Inequality and Prosperity on the European Market for Gambling Machines: A Socioeconomic Panel Analysis

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Abstract: This study examines the potential influence of prosperity and inequality on gambling participation in Europe. We combined data from the Eurostat database, the Global Wealth Report, and the European Casino Association and estimated fixed effects panel regression models. We show that income inequality has a negative effect on the number of gambling machines that flattens for high values, while wealth inequality has a linear negative effect. Moreover, an increase in the disposable income of the lower quintiles leads to significant increases in the number of gambling machines per country. These findings are important for future researchers who relate any kind of economic variable to gambling as well as for policy makers, as our results suggest that the lower-income groups should be given the most attention with regards to gambling regulation.

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2.1 Introduction

While many socioeconomic indicators have been the focus of gambling studies (Barnes et al., 2013; Lutter et al., 2018; Welte et al., 2002), inequality has largely been neglected as an explanatory factor for gambling with only a few exceptions (Barry et al., 2007; Bol et al., 2014; Canale et al., 2017; Pabayo et al., 2023). This omission does not seem to be warranted as studies show that higher (income) inequality leads to more risky behavior in experimental settings (Payne et al., 2017). The idea behind our study is based primarily on a study from Barry et al. (2007, p. 151). They argue that different forms of gambling are likely to be equally attractive for all income groups. In line with Barry et al. (2007, p. 151) we argue that lower-income groups would gamble more if income inequality decreases. These groups have little disposable income and are normally restricted in their ability to gamble. They would be able to act on their gambling inclinations more easily were they to experience an increase in income. We therefore address the question of whether changes in inequality and the disposable income of the lower quintiles are reflected in the number of gambling machines.

Studies show that different forms of gambling are unevenly affected by changes in the economic environment (Barry et al., 2007; Bol et al., 2014; Horváth and Paap, 2012). Horváth and Paap (2012) find that the business cycles affect the relationship between inequality and gambling. Recessions for example seem to affect some forms of gambling more than others. While lotteries are not affected by such economic downturns, the growth in casino revenues seems to stagnate, while revenues for betting games seem to decline (Horváth and Paap, 2012). The few studies that have taken inequality into consideration in the context of gambling (Barry et al., 2007; Bol et al., 2014; Canale et al., 2017), conclude that country-level inequality has variable effects depending on the specific form of gambling that is observed. Canale et al. (2017) also show that the relationship between problem gambling and inequality is dependent on regional differences. We focus on gambling machines in our study since they are the most widespread terrestrial gambling platform and are generally more affordable than other types of gambling such as horse-racing or casino-style games. In the context of our study, this is important because we can only examine the effects of inequality if the gambling opportunity is, in principle, accessible to all people.

Inequality is driven by a multitude of influences such as advances in communication technology (Ali et al., 2019) and general increases in economic complexity (Chu and Hoang, 2020).

Inequality itself is a complex construct that entails more than just a comparison of economic resources (Greve, 2021). While social aspects of inequality are certainly interesting and worth studying (Greve, 2021; Adriaans, 2023), most gambling studies as well as the present study focus primarily on economic measures like income inequality. There are two reasons for this. Firstly, income statistics are readily available for most countries; secondly, the data are usually the most reliable. What differentiates our study from most others is the fact that we include a measure of wealth inequality as well.

Since gambling demand depends in part on purchasing power, we look at inequality and prosperity within countries. It is also possible that prosperity and inequality are related. However, the direction of this effect has been disputed (Barrilleaux and Davis, 2003).

In the present study we analyze the effects of inequality and prosperity on the European market for gambling machines. We also measure the effect of various income groups on gambling expenditure. The study covers 20 EU countries over a timeframe from 2010-2019. For our statistical models, we use fixed effect panel regressions. We show that income inequality has a negative effect on the number of gambling machines in a country. This relationship follows a u-shaped distribution. In our sample, the demand for gambling machines can be explained primarily by changes in income in the lower-income groups. We find no effect of the general level of prosperity on the market for gambling machines in Europe.

2.2 Review

Bol et al. (2014) also analyzed the effect of inequality on gambling. They find that inequality (measured as Gini coefficient) has a positive effect on lottery expenditure and an inverse u-shaped effect on expenditure on pari-mutuel betting (Bol et al., 2014). The authors attribute their finding primarily to "increasing mobility aspirations, availability of resources in the upper part of the distribution, and status anxiety in the lower part of the distribution". Pabayo et al. (2023) find similar effects in relation to online gambling of Canadian students. Sociological literature suggests that people participate in gambling to reduce emotional stress (Devereux, 1980) and rid themselves of feelings of deprivation (Callan et al., 2011). These feelings of "falling behind" in society are known to be related to the level of inequality in a country (Hastings, 2019). However, this relationship might not only depend on the absolute level of inequality, but also on whether the present inequality is perceived as legitimate

(Haack and Sieweke, 2018; Kuhn, 2019; Willis et al., 2015). Unlike other forms of gambling, active playing time can be particularly high on gambling machines[1] and this increases the likelihood of players' interacting with each other. This might affect the subjective perception of inequality. Other studies also show that people do not compare themselves with the whole income or wealth distribution but with other people from the same social strata (Knell and Stix, 2020).

In contrast to the finding from Bol et al. (2014), we expect to see that higher inequality leads to fewer gambling machines in a country. Barry et al. (2007, p. 151) argue that different forms of gambling are likely to be equally attractive for all income groups. In line with them we argue that lower-income groups would gamble more if the income inequality decreased. These groups have little disposable income and are normally restricted in their ability to gamble. They would be able to act on their gambling inclinations more easily were they to experience an increase in income. The Bol et al. (2014) leapfrogging explanation does not hold for the market of gambling machines because winning on a gambling machine does not dramatically change the standard of living of the player.

Wealth is especially interesting in the context of inequality as it is distributed even more unequally than income (Piketty, 2015). Overall levels of wealth are also a large contributor towards inequality but have, compared to income, been neglected in research (Pfeffer and Waitkus, 2021).

H1a: Lower levels of wealth inequality and income inequality lead to an increase in the number of gambling machines in a country. This effect follows a u-shaped distribution.

Inequality however does not explain which group of people in particular has an effect on gambling. We argue that an increased purchasing power of the lower-income groups should lead to more gambling machine play. This is in line with the argument from Barry et al. (2007) that income groups have a similar preferences regarding gambling but lower-income groups are restricted by their disposable income.

H1b: More income in the lower quintiles of the income distribution leads to an increase in the number of gambling machines in a country.

Prosperity is most commonly captured by the GDP of a country, mostly as a proxy for gross national income (Bartelmus, 2018, p. 25). Based on the assumption that greater prosperity

[1]For an analysis of the effect of a reduction in the amount of slot machine gambling see Hansen and Rossow (2012).

at a country level equals greater purchasing power, we assume that expenditure on gambling is also higher in countries with a higher GDP. Other prominent measures of prosperity are income and wealth, which we also include in our analysis. While net worth i.e. the total sum of assets minus any liabilities would be the better measure, even overall wealth figures are hard to obtain on a global scale. There is considerable evidence that prosperity (GDP) is linked more or less directly to well being. Bartelmus (2018, p. 21) says "prosperity is the materialistic side of being better off". Other studies find that well being or happiness is related to inequality (Alesina et al., 2004). Happiness or well being is also related to gambling. Some clinical studies show this relationship (Tang and Oei, 2011; Kabasakal, 2015; Oei and Raylu, 2015) and some show it even for recreational gambling (Blackman et al., 2019; Humphreys et al., 2021). We therefore also include a happiness variable as a proxy for the prosperity in a country in a robustness check.

H2: Greater prosperity leads to an increase in the number of gambling machines in a country.

Fiedler et al. (2019) analyze the concentration of gambling expenditure amongst a small subgroup of the gambling population and suggest that further studies should take a closer look at the relationship between gambling and inequality. Canale et al. (2017) conducted a survey of 15-year-old students and examined the results together with region-level data on income inequality and overall wealth. One of their findings is that students in regions with higher income inequality are more likely to be problem gamblers than students in regions with lower income inequality. Moreover, problem and pathological gamblers account for a large share of gambling machines revenues (Fiedler et al., 2019). It is therefore our view that any paper seeking to provide an explanation for the demand for gambling machines on the macro-level must also discuss how the underlying mechanisms (inequality and prosperity in our case) relate to problem gambling. We briefly address this point and potential implications for policymakers in the discussion section.

2.3 Data and Method

To address our research question, we created a new dataset based on multiple sources. Our final dataset contains data on 20 EU countries over a timeframe from 2010-2019. The gambling-related data on the number of gambling machines were taken from the yearly reports of the Gaming Technologies Association. While we would have preferred actual numbers on gambling machine revenue per country, such numbers are not available for many

of the European countries. The best available option in this regard is tax revenues which are published by the European Commission for most European countries. Unfortunately, the tax rates on gambling machines vary widely by country and type of gambling machine and the reported numbers are often only published as aggregates. Moreover, the basis of taxation also varies from one country to the next. While some countries tax the total revenue from gambling, others only tax the profits. This renders tax revenue largely useless as a proxy for gambling revenue for the purpose of country comparisons. We had to use the number of gambling machines per country as an alternative measure. The number of gambling machines can be used as a proxy as, it depends in part on demand.

We obtained the data for most explanatory variables and all the controls from the Eurostat database. Many of the relevant numbers are also available in purchasing power parity denominations, which allows accurate inter-country comparisons. The descriptive statistics for all variables are set out in Table 2.1.

Table 2.1: Descriptive statistics

Statistic	N	Mean	St. Dev.	Min	Max
Gambling machines (per 1000 inh.)	188	2.62	1.87	0.02	7.66
Gini (share)	188	30.08	4.06	20.90	40.80
Gini wealth (share)	186	69.12	8.65	44.60	90.20
Quintile 1 (share)	188	7.95	1.31	5.10	10.40
Quintile 2 (share)	188	13.35	1.09	11	16
Quintile 3 (share)	188	17.62	0.73	15.20	19.30
Quintile 4 (share)	188	22.94	0.58	21.30	24.60
Quintile 5 (share)	188	38.13	2.91	31.10	47.10
GDP (pc)	188	25,741.52	7,637.83	11,821.76	41,098.84
Median wealth (in 1000 USD)	188	57.68	45.60	10.95	195.21
Foreign-born (share)	188	9.58	5.33	0.92	19.75
Unemployment rate (share)	188	8.70	4.54	2.00	26.10
Low education (share)	188	28.34	13.82	11.08	70.40
Leisure expenditure (share)	188	3.21	0.59	2.00	4.80

Dependent variable

gambling machines (per thousand inhabitants)

We obtained the data on the number of gambling machines from the yearly reports of the Gaming Technologies Association. We use the term gambling machines in a broad sense in our study: the variable includes slot machines, video lottery terminals, video gaming machines and electronic table games.

Table 2.2: Correlation Matrix

	Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Gambling machines (per 1000 inh.)	1	-0.00	-0.06	-0.02	0.03	-0.01	0.07	0.01	0.05	0.09	-0.05	0.06	-0.04	0.15
2	Gini (share)	-0.00	1	-0.06	-0.83	-0.88	-0.71	0.16	0.91	-0.34	-0.26	-0.08	0.20	0.04	-0.24
3	Gini wealth (share)	-0.06	-0.06	1	0.07	0.12	0.05	-0.16	-0.06	0.28	0.09	0.12	-0.17	-0.04	0.08
4	Quintile 1 (share)	-0.02	-0.83	0.07	1	0.76	0.54	-0.29	-0.74	0.31	0.22	0.05	-0.24	-0.04	0.22
5	Quintile 2 (share)	0.03	-0.88	0.12	0.76	1	0.69	-0.21	-0.84	0.37	0.24	0.05	-0.19	-0.05	0.25
6	Quintile 3 (share)	-0.01	-0.71	0.05	0.54	0.69	1	0.09	-0.80	0.37	0.30	0.17	-0.17	0.01	0.26
7	Quintile 4 (share)	0.07	0.16	-0.16	-0.29	-0.21	0.09	1	0.07	-0.09	0.08	0.21	0.21	0.05	-0.03
8	Quintile 5 (share)	0.01	0.91	-0.06	-0.74	-0.84	-0.80	0.07	1	-0.36	-0.27	-0.11	0.18	0.04	-0.26
9	GDP (pc)	0.05	-0.34	0.28	0.31	0.37	0.37	-0.09	-0.36	1	0.59	0.44	-0.34	0.04	0.24
10	Median wealth (in 1000 USD)	0.09	-0.26	0.09	0.22	0.24	0.30	0.08	-0.27	0.59	1	0.41	-0.04	0.33	0.15
11	Foreign-born (share)	-0.05	-0.08	0.12	0.05	0.05	0.17	0.21	-0.11	0.44	0.41	1	-0.06	0.08	0.22
12	Unemployment rate (share)	0.06	0.20	-0.17	-0.24	-0.19	-0.17	0.21	0.18	-0.34	-0.04	-0.06	1	0.14	-0.14
13	Low education (share)	-0.04	0.04	-0.04	-0.04	-0.05	0.01	0.05	0.04	0.04	0.33	0.08	0.14	1	-0.07
14	Leisure expenditure (share)	0.15	-0.24	0.08	0.22	0.25	0.26	-0.03	-0.26	0.24	0.15	0.22	-0.14	-0.07	1

The dependent variable contained some severe outliers for some country/year combinations. It is difficult to check whether these more extreme numbers are a result of misreporting by some authorities or gambling providers or if they are indeed accurate. To make sure that these outliers did not affect our data negatively, we dropped them from some of our analyses as a robustness check (see robustness checks in the results section).

In Figure 2.1 we show the distribution of our dependent variable for all countries in our dataset. For the analysis, we dropped countries with unreasonable changes that might be the result of misreporting or significant changes in the regulatory environment, as well as countries that display no real variation with regards to the number of gambling machines within the timeframe of our analysis. This led to the exclusion of Greece, Ireland, Slovenia, France, Luxembourg, and Finland.

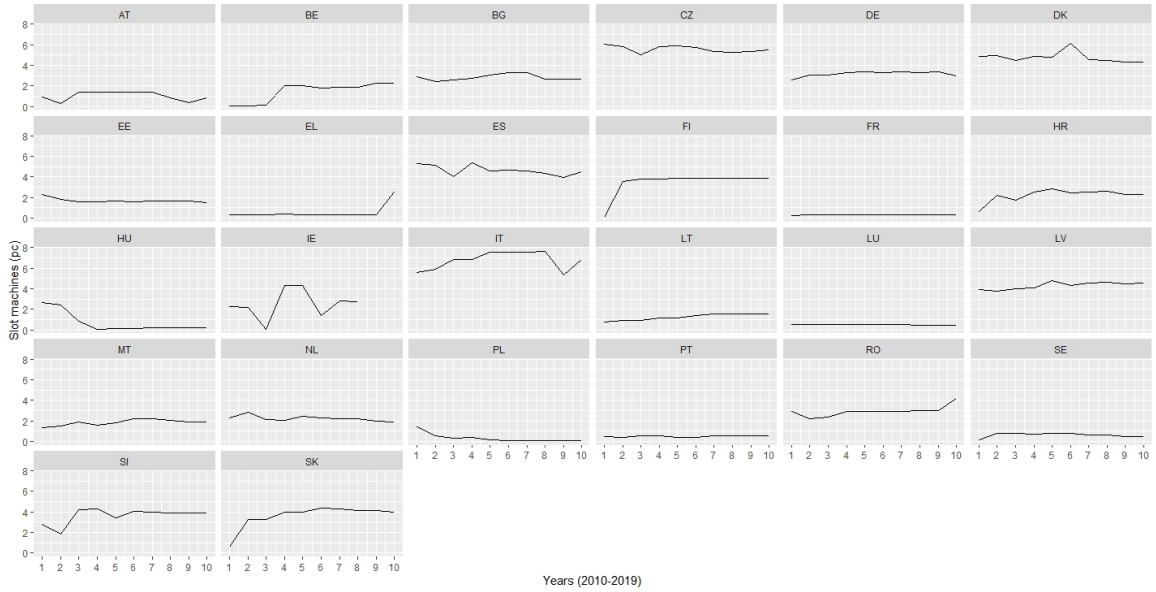

Figure 2.1: Gambling machines per thousand inhabitants

Explanatory variables

Gini coefficient[2]

We use two variants of the Gini-coefficient in our study. We took the Gini coefficient based on the equivalized disposable income from the Eurostat database. We also include the Gini coefficient as a squared term in our models to account for the possibility of a non-linear effect. A second variant of Gini is calculated based on national wealth distribution. We obtained these data from the Global Wealth Report that is issued by Credit Suisse each year. We included this variable because it captures a different aspect of inequality than the income-based Gini coefficient, as the wealth distribution in most countries is much more unequal than the income distribution. These data are based on a combination of official statistics and expert estimates and are therefore less reliable than the data that we use for our income measures. Nevertheless, these reports are valuable in that they give fairly accurate numbers on wealth on a global scale.[3]

Income quintiles

Eurostat divides households into five groups of equal size that are sorted by their equivalized disposable income. The first quintile (quintile 1) is defined as the share of the national

[2]https://ec.europa.eu/eurostat/statistics-explained/index.php?title=EU_statistics_on_income_and_living_conditions_(EU-SILC)_methodology_-_distribution_of_income#Description

[3]For Denmark we identified two unreasonable values in the years 2011 and 2013 with a Gini-coefficient >1. These values have been removed for the purpose of our analysis

disposable income in the lowest income group; the same definition applies accordingly to all other quintiles.[4]

GDP per capita

We include the GDP on a per capita basis as a measure of national prosperity. The value is also adjusted according to the purchasing power "eliminating differences in price levels between countries".[5]

Median wealth

To capture the absolute level of wealth in a country, we include the median wealth from the Global Wealth Reports. We argue that median wealth is a better measure to reflect the prosperity of the average person in a country than the mean value, as since the mean is heavily distorted by the extreme values at the top of the wealth distribution.

Additional prosperity measures

For the purpose of further robustness checks, we also collected data on equivalized household income per capita but these data are highly correlated with GDP. We therefore had to include each measure separately in our models. We also use the happiness measure from the European Social Survey as a proxy for prosperity in a further robustness check.

Controls

Unemployment rate

The rate of unemployment controls for the fact that higher inequality resulting from a larger share of people in the lower part of the income distribution might be affected by unemployment. Studies about gambling show that higher rates of unemployment are associated with higher rates of participation in gambling, but most of the sources are not completely reliable or, with just a few exceptions (Mikesell and Zorn, 1987), provide results only for very specific samples. The idea of falling behind in society that was mentioned in the study by Bol et al. (2014) also relates to unemployment.

[4]https://ec.europa.eu/eurostat/statistics-explained/index.php?title=EU_statistics_on_income_and_living_conditions_(EU-SILC)_methodology_-_distribution_of_income#Description
https://ec.europa.eu/eurostat/statistics-explained/index.php?title=EU_statistics_on_income_and_living_conditions_(EU-SILC)_methodology_-_definition_of_dimensions#Income_quantile
https://ec.europa.eu/eurostat/statistics-explained/index.php?title=EU_statistics_on_income_and_living_conditions_(EU-SILC)_methodology_%E2%80%93_concepts_and_contents#Income_quantile

[5]https://ec.europa.eu/eurostat/databrowser/view/tec00001/default/table?lang=en

Migration

We include the measure "foreign-born" to control for inter-country mobility and the effect that non-native citizens might have on the number of gambling machines. Kastirke et al. (2015) and Schulte et al. (2021) also conclude that people with a migration background might be at higher risk of developing problematic gambling behavior. The variable was obtained from the Eurostat database.

Education

We know that education has a significant influence on prosperity (Pastor et al., 2018; Teulings and van Rens, 2008) and inequality (Glomm and Ravikumar, 2003; Hendel et al., 2005; Sylwester, 2002), and we therefore include it as a control. Preference for certain gambling types also depends on the educational background of the player (Hing et al., 2016). We obtained educational data from the Eurostat Database. The variable itself is categorical and based on the international ISCED classification system consisting of 8 educational levels. Eurostat further categorizes these levels into low (less than primary, primary and secondary education or levels 0-2), medium (upper secondary and post-secondary non-tertiary education i.e. levels 3-4) and high education (tertiary education i.e. levels 5-8). For our analysis, we calculate what percentage of each category is represented by the survey population, which consists of people between the ages of 15 and 74 in each country. Based on previous studies we assume that it is primarily the low education group that is likely to bias our results.

Leisure expenditure

We use the consumption expenditure of private households from EUROSTAT. The variable is split into various subcategories. We only take into account the expenditure for services that are related to spare time and culture. We include this variable because gambling expenditures is most likely regarded as a part of that budget from a household's perspective.

Estimation method

To analyze the effect of our predictors on the number of gambling machines in a country, we estimate fixed effects models based on our imbalanced panel data set. All our models use two-way i.e. unit (country) and time (year) fixed effects. The fixing of the country-level variation removes the influence of potentially unobserved policy changes within a country. The time fixed effects remove unobserved factors such as policy changes within Europe. This allows us to estimate the effect that an increase in a predictor variable has on the number

of gambling machines in our sample irrespective of a specific time or country. Using the independent and dependent variables defined earlier, we obtain the following fixed effects model:

$$\widehat{Gambling\,machines}_{it} = \hat{\beta}_1\, Gini_{it} + ... + \hat{\beta}_8\, ln(Leisure\,expenditure)_{it} + \hat{\alpha}_i + \hat{u}_{it};$$
$$i = Austria, Belgium, ..., Slovakia; \quad t = 2010, 2011, ..., 2019$$

For all statistical models, we use the natural log of all variables to account for skewness of the variables and diminishing marginal effects. For Gini we include the quadratic term instead to test our first hypothesis. For the wealth-based Gini we also estimated a similar model but the quadratic term has no significant effect and we therefore use the natural log of the base value instead.

2.4 Results

In Table 2.3 we show seven models. In the main model (1) we include all basic variables and controls. We also include the Gini coefficient as a squared term to account for potential non-linear effects. In the next model (2), we include the wealth-based Gini coefficient instead of the income-based Gini to predict the effect of wealth inequality. The models (3)-(7) each contain one of the quintiles instead of the Gini coefficient. This approach allows us to examine inequality in more detail. All models are based on 188 observations except for the second model, which only has 186 because of two unreasonable values on the Gini wealth variable that were dropped (see footnote 3 on page 38). For those readers interested in specific country-level effects, we also have created a model that includes country dummies (see Table B.1 in the appendix).

In the main model (1), we see that the Gini coefficient as our measure of income inequality explains a significant share of the number of gambling machines per country. This shows that a decrease in inequality seems to lead to an increase in the number of gambling machines. The squared term is also significant in the model and has a positive effect. This indicates a non-linear relationship between inequality and the number of gambling machines. Figure 2.2 shows the relationship between the two variables in a graph. Since the effect of the squared term is relatively small in comparison, the effect of inequality on the number of gambling machines per capita is negative and flattens only for high values. In the second model (2) we consider the effect of wealth inequality instead of income inequality. We see that the

wealth inequality also has a significant negative effect. In summary, these results confirm H1a except for the expected u-shaped distribution.

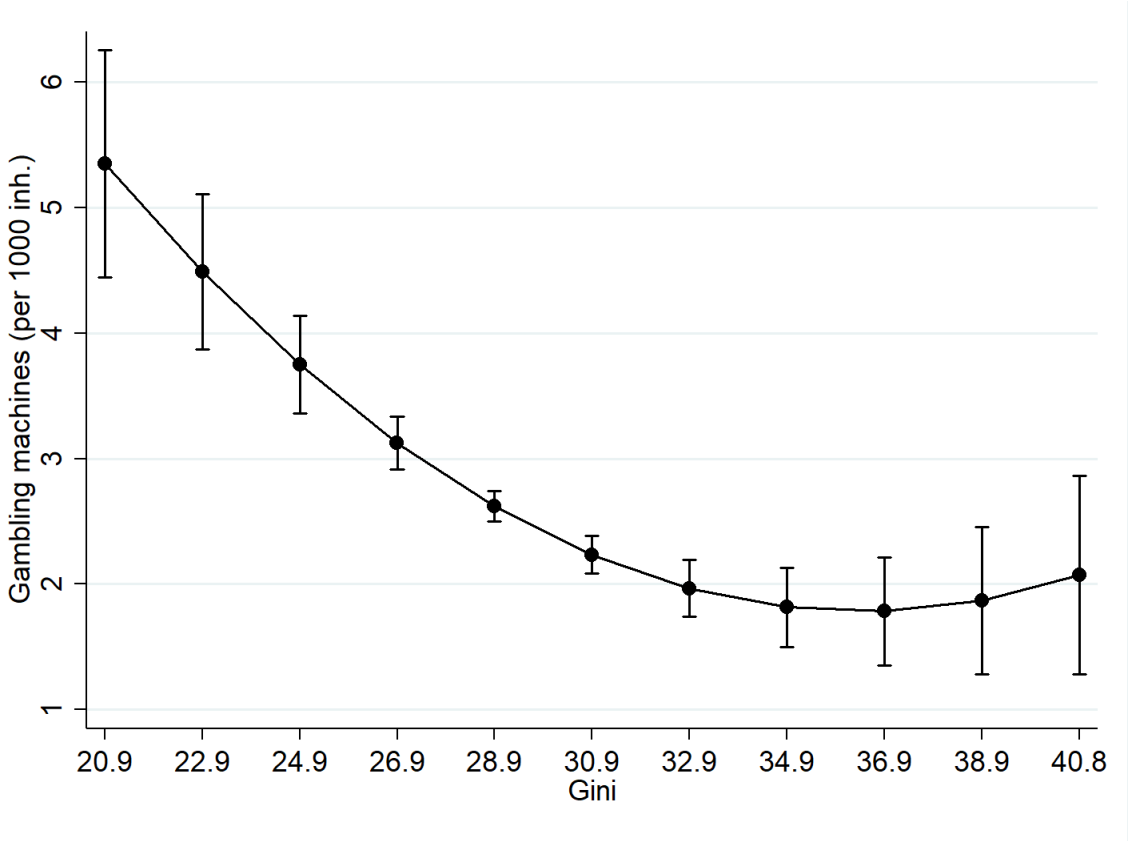

Figure 2.2: Marginal effect of Gini on gambling machines (95% CIs)

Table 2.3: Results of the fixed effects models

	Dependent variable: Gambling machines (per thousand inh.)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Gini	-1.075^{***}						
	(0.227)						
Gini_squared	0.015^{***}						
	(0.004)						
Gini wealth (ln)		-1.452^{**}					
		(0.616)					
Quintile 1 (ln)			2.281^{**}				
			(0.962)				
Quintile 2 (ln)				5.312^{***}			
				(1.699)			
Quintile 3 (ln)					7.445^{***}		
					(2.105)		
Quintile 4 (ln)						6.041^{*}	
						(3.347)	
Quintile 5 (ln)							-6.470^{***}
							(1.547)
GDP (pc, ln)	0.810	-0.232	-0.104	0.370	-0.173	-0.496	0.044
	(1.135)	(1.226)	(1.218)	(1.216)	(1.191)	(1.234)	(1.175)
Median wealth (ln)	0.733^{*}	0.756	0.571	0.562	0.644	0.640	0.659
	(0.438)	(0.485)	(0.475)	(0.469)	(0.466)	(0.480)	(0.459)
Foreign-born (ln)	0.794^{***}	0.740^{***}	1.024^{***}	1.009^{***}	1.160^{***}	1.078^{***}	1.074^{***}
	(0.247)	(0.282)	(0.258)	(0.255)	(0.256)	(0.263)	(0.249)
Unemployment rate (ln)	1.232^{***}	1.076^{***}	0.888^{***}	0.876^{***}	0.848^{***}	0.835^{***}	0.913^{***}
	(0.270)	(0.292)	(0.279)	(0.275)	(0.273)	(0.282)	(0.269)
Low education (ln)	-0.867	-0.701	-0.807	-0.947	-1.238	-1.283	-1.092
	(0.798)	(0.883)	(0.872)	(0.856)	(0.851)	(0.886)	(0.837)
Leisure expenditure (ln)	1.829^{***}	1.902^{***}	2.187^{***}	2.463^{***}	2.240^{***}	2.144^{***}	2.312^{***}
	(0.596)	(0.646)	(0.632)	(0.635)	(0.618)	(0.636)	(0.610)
R^2	0.351	0.235	0.228	0.248	0.261	0.217	0.282
Adj. R^2	0.197	0.056	0.051	0.075	0.090	0.036	0.117
N (countries)	20	20	20	20	20	20	20
N (country-year)	188	186	188	188	188	188	188
F Statistic	10.227^{***}	6.577^{***}	6.425^{***}	7.166^{***}	7.656^{***}	6.003^{***}	8.546^{***}
	(df = 8; 151)	(df = 7; 150)	(df = 7; 152)	(df = 7; 152)	(df = 7; 152)	(df = 7; 152)	(df = 7; 152)

Note: *p<0.1; **p<0.05; ***p<0.01

As the Gini coefficient provides limited information on which group is responsible for the inequality in a country, we use income quintiles to address the provenance of the inequality. In H1b we assume that more income in the lower quintiles leads to more gambling machines in a country. For quintile 1 in model 3 we see a significant positive effect. An increase of one percent in the share of available income in Q1 leads to an increase of 0.02281 gambling machines per thousand inhabitants. This interpretation applies equally to all other quintiles in models 4-7. The effects of quintile 2 in model 4 and quintile 3 in model 5 are significant as well. However, these effects can not be interpreted as straightforwardly as the effect of quintile 1 as we do not know exactly from which quintiles a change in quintile 2 and quintile 3 results. A decline in all other quintiles could lead to an increase in the money supply in quintile 2 or quintile 3 respectively, while for quintile 1 and quintile 5 it is clear that increases always come from the upper or lower quintiles. Together, these models indicate that the supply of gambling machines rises if the income in the lower groups increases. For Q4 we find no significant effect and for quintile 5 (model 7) the effect is in fact negative. This shows that the number of gambling machines per capita decreases if the top earners in society increase their share of the overall income. Both the positive significant coefficient of the lowest income group and the negative significant coefficient of the highest quintile confirm our assumption from H1b.

We can not confirm H2, because the GDP as a measure of prosperity is not significant in all our models (1-7). The same is true for the median wealth variable. We also use other measures of prosperity, which lead to similar results. We explain these robustness checks below.

Robustness checks

As the dependent variable contained some severe outliers for some country/year combinations, we calculated the percentage change in the number of gambling machines from one year to the next for every country/year combination. This enabled us to cut them from the model based on various exclusion criteria. In Table B.2 we see the main model and the reduced models based on our exclusion criteria for outliers. The first model is a full model that is based on a sample of all countries for which we have information on all of the relevant variables (main full). The next model shows the least restrictive case (50% or more deviations) with the model after that being more restrictive (20-% cutoff). The fourth model is the most restrictive, excluding every observation where the number of gambling machines in a country

deviates by more than 10% from one year to the next. Finally, we present our main model that we use for all other analyses in this paper (main). Here, we excluded countries that show no variation with regard to the dependent variable or exhibit unreasonable changes from one year to the next (see Data and Method for detailed information). The exclusion of outliers based on our exclusion criteria led to a meaningful loss of observations compared to the full model (main full) with no reasonable benefit in all three cases. The final model in which we manually excluded countries from the dataset is by far the best in terms of overall explanatory power and therefore offers a reasonable balance between losing too many observations and an improved model fit. We therefore only refer to the main model in the discussion section and all other analysis.

The reports of the Gaming Technologies Association contained an asterisk on some of the reported numbers indicating that data collection had changed in some way. Since this might affect the data quality, we created a new binary variable indicating whether the information for that country/year combination might be less reliable.[6] Table B.3 shows that the data quality variable had no significant effects on our model predictions. We did not therefore retain it for further analysis.

As a robustness check we replicate our main model twice using income per capita and once using happiness instead of GDP per capita. These models are shown in Table B.4. The results are consistent with the models that include GDP as a measure of prosperity.

To check the validity of our results regarding inequality, we use the 80/20 quintile ratio instead of the Gini coefficient. The S80/S20 income quintile share ratio "refers to the ratio of total equalized disposable income received by the 20% of the country's population with the highest equalized disposable income (top quintile) to that received by the 20% of the country's population with the lowest equalized disposable income (lowest quintile)".[7] This ratio reflects the inequality in society in a similar way to the Gini coefficient. The model using the 80/20 ratio instead of Gini is set out in Table B.5 in the appendix. This model does not differ significantly from our main model, indicating the robustness of our analysis.

[6]There was no separate report for the year 2014 available but the numbers for 2014 are also reported in the next year's report, but without information about the data quality. Since we have no information about the data quality for the year 2014, we assume that this number might be unreliable for every country that had any less reliable data in any other year.

[7]https://ec.europa.eu/eurostat/statistics-explained/index.php?title=EU_statistics_on_income_and_living_conditions_(EU-SILC)_methodology_-_distribution_of_income#Description

2.5 Discussion

We show that an increase in income inequality leads to fewer gambling machines within a country. This is in contrast to the findings on lottery play and pari-mutuel betting from the US (Bol et al., 2014) and online gambling in Canada (Pabayo et al., 2023). For lotteries and gambling machines, this difference makes perfect sense regardless of the country/region: Lotteries attract a different audience and, with higher inequality, the desire to leapfrog to a higher social class increases (Friehe and Mechtel, 2017). We argue that pari-mutuel betting is not directly comparable with lotteries or gambling machines. For pari-mutuel betting, the findings from Bol et al. (2014) suggest a positive non-linear effect of income inequality. We attribute the different findings on gambling and inequality to the fact that gambling markets are unevenly affected by economic changes (Barry et al., 2007; Bol et al., 2014; Horváth and Paap, 2012). Even if gambling machines and pari-mutuel betting are similar in some regards, the contrasting findings might be explained by the different mean inequality in Europe and the U.S. If inequality is high, the share of disposable income is significantly higher in the high-income group which is usually not behind expenditure on gambling machines. On the contrary, we assume in H1b that lower income groups may be a determining factor in the demand for gambling machines. We show this relationship in models 3-7 in Table 2.3. If the disposable income of the lower income group increases in relation to the other income groups, the number of gambling machines increases (model 3). If the income of the upper income group increases and the income of the lower income groups decreases accordingly, the number of gambling machines decreases as well (model 7). This shows that our findings support each other. Our results show that the assumption from H1b is correct and highlight the added value of a more specific look at the provenance of inequality.

Our results also extend the findings from a study from Italy that shows that the preference for specific forms of gambling varies by income group (Resce et al., 2019) with regards to gambling machines. Furthermore, Barry et al. (2007, p. 151) assume that lower income groups play less due to their lower income. Our study supports their assumption, as we find that when income increases in lower income groups, the demand for gambling machines increases. We also extend these findings by answering the same question for wealth-inequality. However, it might be possible that the changes in wealth are less sustainable for poorer people because of inefficient saving processes (Karlan et al., 2014). Other studies point to the fact that temporary changes in wealth have no effect on private consumption (Lettau

and Ludvigson, 2001; Lettau and Ludvigson, 2004). Since our dependent variable reflects the number of gambling machines, it is not possible to reflect short-term changes in demand, resulting from changes in wealth inequality: by the time gambling providers can react to a change in wealth inequality, that inequality might already have decreased again. However, we can not test these assumptions with our data since we can not compare the effect size of the quadratic effect of income inequality with the linear effect of wealth inequality.

Our results show that changes in GDP have no effect on the number of gambling machines when inequality is fixed. Other measures of prosperity such as per capita income, median wealth and overall happiness lead to similar results (see Table B.4). An increase in overall prosperity in a country across all income groups benefits everyone, including income groups that are less relevant to demand for gambling machines. This is highlighted in model 6, as the positive effect of the lower income groups offsets the negative effect on gambling expenditure of the highest income group. An increase in prosperity is therefore not a significant predictor for the number of gambling machines.

Limitations

To reflect a country's political intervention, we wanted to include a country's social spending per capita in the regression. However, since this is highly correlated with GDP per capita, we do not include it. The relationship between inequality and gambling might be affected by political interventions, since studies show that welfare policy is related to income inequality (Moene and Wallerstein, 2003; Scruggs and Hayes, 2017). Countries with a more liberal stance towards welfare policy are more likely to see higher levels of inequality than countries with a more social democratic stance (Schneider and Soskice, 2009).

We used the number of gambling machines in a country as a proxy for gambling expenditure. While the number of gambling machines should be a good and reliable alternative, it may not capture certain demand shocks directly as it responds to them more slowly than gambling expenditure. Another point of criticism could be the fact that our dependent variable is skewed between countries. However, the fixed effects model solves this problem because it only considers the variation within a country.

The studies by Freund and Morris (2005, 2006) support the notion that gambling might cause inequality. This, however, indicates that both inequality and gambling might not be exogenous. Bol et al. (2014) have identified this problem before. They tried to resolve it by including a time lag on their measure of inequality (Bol et al., 2014, p. 67). Recently,

this procedure has however been criticized as a generally applicable method to address endogeneity problems (Bellemare et al., 2017). According to Bellemare et al. (2017) this statistical solution is only valid if a few assumptions are met. Most importantly, the unobserved variables have to be time-invariant. This assumption is not likely to be true for most large-scale macro data, for which it is difficult to state all the unobserved factors in the first place. Regardless, we do not see a major problem with endogeneity, at least for gambling machines. We find no theoretical explanation for a direct effect of gambling machines on inequality. Expenditure on gambling machines does not directly change the distribution of income among the income groups. We only see the possibility of an indirect effect in the event employment is affected in cases of problematic or pathological gambling. Only then is a change in income reflected in our measure of inequality (Gini). Since the target groups of the different forms of gambling differ, the causal direction of the effect between inequality and gambling is not generalizable. We therefore believe that the specific form of gambling must be considered individually in relation to inequality.

According to Canale et al. (2017), inequality can influence problem gambling behavior, but our model does not allow us to draw any conclusions in this regard. However, we suspect that price elasticity diverges strongly between problem gamblers and casual gamblers. Although we can assume a decrease in gambling with higher inequality, this might have less of an impact on problem gamblers. Consequently, this should be considered, especially in the taxation of gambling machines. Although taxation would lead to fewer gambling machines, the question arises as to what extent problem gambling behavior would be affected. In future studies, the relationship between problem gambling and inequality should be investigated more closely in the context of regulation.

2.6 Conclusion

Based on previous studies (Barry et al., 2007; Bol et al., 2014; Canale et al., 2017; Resce et al., 2019; Pabayo et al., 2023) we argue that national prosperity and income inequality at a country level are useful measures to predict the size of the gambling market at a national level. We test these assumptions with the available data on gambling machines in EU countries.

We found that prosperity has no effect on gambling machines in a country while income inequality has a negative effect that flattens for high values and wealth inequality has a

significant negative influence. Demand decreases with increased inequality. Based on this, we took a closer look at inequality by including each of the income quintiles in our analysis. It is particularly interesting to note that when disposable income increases proportionately in the lower quintiles, demand for gambling machines increases. With respect to the negative nonlinear effect of inequality, we differ from previous findings in the literature. It should be noted, however, that comparability is only possible to a limited extent, as the motivation to gamble can differ greatly between the various different forms of gambling. Moreover, the average inequality in Europe is not comparable to the average inequality in the U.S., on which previous studies are based. In summary, our findings suggest that redistribution is an important macroeconomic driver for demand for gambling machines.

Since we only analyzed gambling machines, we encourage the study of further forms of gambling in order to check whether our findings apply to different forms of gambling and across different regions. As we focus on the economic impact of inequality, we use a fairly strict economic definition with the Gini-coefficient. While this allows us to draw on reliable data and keep the research endeavor manageable, it also restricts the scope of our findings with regard to inequality. Further studies should therefore take a closer look at other aspects of inequality in the context of gambling.

Although our study is mainly intended to extend the scientific discussion on inequality and gambling, it is also relevant in terms of policy decisions since we show that the income of the lower income groups in a country drives the demand for gambling machines. Consequently, taxation of gambling machines is more likely to impact the lower income groups. Higher taxation reduces demand, but it is questionable whether this reduces pathological gambling behavior to the same extent.

Appendix

Table B.1: Individual country effects

	Dependent variable:
	Gambling machines (per thousand inh.)
Gini	−1.075***
	(0.227)
Gini_squared	0.015***
	(0.004)
GDP (pc, ln)	0.810
	(1.135)
Median wealth (ln)	0.733*
	(0.438)
Foreign-born (ln)	0.794***
	(0.247)
Unemployment rate (ln)	1.232***
	(0.270)
Low education (ln)	−0.867
	(0.798)
Leisure expenditure (ln)	1.829***
	(0.596)
Belgium	−0.151
	(0.629)
Bulgaria	6.698***
	(1.156)
Czechia	6.073***
	(0.877)
Germany	3.781***
	(0.404)
Denmark	3.484***
	(0.404)
Estonia	2.719***
	(0.715)
Spain	4.072***
	(0.776)
Croatia	2.758***
	(0.717)
Hungary	2.292***
	(0.753)
Italy	7.376***
	(0.780)
Lithuania	3.277***
	(0.900)
Latvia	4.726***
	(0.868)
Malta	2.204***
	(0.706)
Netherlands	1.321***
	(0.429)
Poland	2.988***
	(0.931)
Portugal	2.519***
	(0.893)
Romania	7.588***
	(1.012)
Sweden	−1.044***
	(0.250)
Slovakia	2.863***
	(0.786)
R^2	0.955
Adj. R^2	0.944
N	188
F Statistic	79.089*** (df = 31; 210)

Note: *p<0.1; **p<0.05; ***p<0.01
Austria is the reference category and therefore excluded from the model.

Table B.2: Removal of outliers based on the dependent variable at 50%, 20% and 10% deviation.

	Dependent variable:				
	Gambling machines (per thousand inh.				
	(Main full)	(50%)	(20%)	(10%)	(Main)
Gini	-0.807^{***}	-0.494^{**}	-0.640^{***}	-0.662^{***}	-1.075^{***}
	(0.270)	(0.207)	(0.186)	(0.207)	(0.227)
Gini_squared	0.011^{**}	0.007^{**}	0.010^{***}	0.010^{***}	0.015^{***}
	(0.004)	(0.003)	(0.003)	(0.003)	(0.004)
GDP (pc, ln)	−0.879	1.144	0.868	0.150	0.810
	(1.075)	(0.946)	(0.870)	(0.998)	(1.135)
Median wealth (ln)	0.337	0.309	0.513	0.871^{**}	0.733^{*}
	(0.472)	(0.356)	(0.337)	(0.399)	(0.438)
Foreign-born (ln)	0.962^{***}	0.204	−0.033	−0.321	0.794^{***}
	(0.298)	(0.271)	(0.266)	(0.333)	(0.247)
Unemployment rate (ln)	0.619^{**}	0.657^{***}	0.769^{***}	0.878^{***}	1.232^{***}
	(0.290)	(0.238)	(0.216)	(0.243)	(0.270)
Low education (ln)	-1.901^{**}	−0.784	−0.761	−0.700	−0.867
	(0.884)	(0.639)	(0.571)	(0.685)	(0.798)
Leisure expenditure (ln)	1.181^{*}	0.491	0.116	0.065	1.829^{***}
	(0.602)	(0.488)	(0.467)	(0.574)	(0.596)
R^2	0.180	0.089	0.134	0.161	0.351
Adj. R^2	0.010	−0.142	−0.132	−0.170	0.197
N (countries)	26	26	26	26	20
N (country-year)	246	204	176	146	188
F Statistic	5.553^{***}	1.968^{*}	2.582^{**}	2.486^{**}	10.227^{***}
	(df = 8; 203)	(df = 8; 162)	(df = 8; 134)	(df = 8; 104)	(df = 8; 151)

Note: *p<0.1; **p<0.05; ***p<0.01

Table B.3: Data quality

	Dependent variable:	
	Gambling machines (per thousand inh.)	
	(Main)	(Quality)
Gini	−1.075***	−1.044***
	(0.227)	(0.226)
Gini_squared	0.015***	0.014***
	(0.004)	(0.004)
GDP (pc, ln)	0.810	0.676
	(1.135)	(1.133)
Median wealth (ln)	0.733*	0.755*
	(0.438)	(0.436)
Foreign-born (ln)	0.794***	0.739***
	(0.247)	(0.248)
Unemployment rate (ln)	1.232***	1.245***
	(0.270)	(0.268)
Low education (ln)	−0.867	−0.803
	(0.798)	(0.795)
Leisure expenditure (ln)	1.829***	1.787***
	(0.596)	(0.593)
Data quality		0.271
		(0.169)
R^2	0.351	0.362
Adj. R^2	0.197	0.205
N (countries)	20	20
N (country-year)	188	188
F Statistic	10.227*** (df = 8; 151)	9.472*** (df = 9; 150)
Note:		*p<0.1; **p<0.05; ***p<0.01

Table B.4: Replication of all models with income and happiness instead of GDP

	Dependent variable:		
	Gambling machines (per thousand inh.)		
	(Main)	(Income)	(Happiness)
GDP (pc, ln)	0.810		
	(1.135)		
Income (pc, ln)		0.685	
		(1.069)	
Happiness (ln)			−0.327
			(2.416)
Gini	−1.075***	−1.102***	−0.959***
	(0.227)	(0.251)	(0.287)
Gini_squared	0.015***	0.015***	0.013***
	(0.004)	(0.004)	(0.005)
Median wealth (ln)	0.733*	0.743	1.032**
	(0.438)	(0.458)	(0.512)
Foreign-born (ln)	0.794***	0.837***	1.128***
	(0.247)	(0.275)	(0.408)
Unemployment rate (ln)	1.232***	1.230***	1.424***
	(0.270)	(0.267)	(0.314)
Low education (ln)	−0.867	−1.021	−0.643
	(0.798)	(0.803)	(0.924)
Leisure expenditure (ln)	1.829***	1.858***	3.074***
	(0.596)	(0.640)	(0.713)
R^2	0.351	0.360	0.457
Adj. R^2	0.197	0.200	0.274
N (countries)	20	19	18
N (country-year)	188	176	132
F Statistic	10.227***	9.851***	10.311***
	(df = 8; 151)	(df = 8; 140)	(df = 8; 98)
Note:			*p<0.1; **p<0.05; ***p<0.01

Table B.5: Replication of the main model with S80/S20 ratio instead of Gini

	Dependent variable:	
	Gambling machines (per thousand inh.)	
	(Main)	(Ratio)
Gini	-1.075^{***}	
	(0.227)	
Gini_squared	0.015^{***}	
	(0.004)	
S80/S20 ratio		-2.353^{***}
		(0.601)
S80/S20 ratio_squared		0.167^{***}
		(0.048)
GDP (pc, ln)	0.810	0.424
	(1.135)	(1.183)
Median wealth (ln)	0.733^{*}	0.621
	(0.438)	(0.458)
Foreign-born (ln)	0.794^{***}	0.938^{***}
	(0.247)	(0.252)
Unemployment rate (ln)	1.232^{***}	1.052^{***}
	(0.270)	(0.275)
Low education (ln)	-0.867	-0.755
	(0.798)	(0.837)
Leisure expenditure (ln)	1.829^{***}	2.030^{***}
	(0.596)	(0.617)
R^2	0.351	0.290
Adj. R^2	0.197	0.121
N (countries)	20	20
N (country-year)	188	188
F Statistic (df = 8; 151)	10.227^{***}	7.709^{***}
Note:		*p<0.1; **p<0.05; ***p<0.01

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Chapter 3

Municipal Tax Revenue and Gambling Hall Licensing: Dynamic Panel Maximum Likelihood Estimation

Abstract: In this paper, I examine the German gambling hall market with regard to licensing policies. I assume that municipalities with lower previous period tax revenues are more likely to tolerate or grant licenses. For this I use a balanced panel of 983 municipalities in Germany from 2002 to 2020. A dynamic panel model with a Maximum Likelihood estimation is used to analyze the effect of lagged tax revenues on the number of licenses in a municipality. The lagged tax revenue has a significantly negative impact on the number of gambling hall licenses in a municipality. This indicates that municipalities with lower prior tax revenues tend to tolerate or approve a higher number of licenses. The results suggest that fiscal interests influence the licensing process, as amusement taxes remain at the municipal level. However, this may be incompatible with the objectives of the State Treaty on Gambling. The licensing process could create a conflict of interest within Germany's federal system. More licenses in already structurally weaker municipalities can lead to an exacerbation of socioeconomic inequalities due to the regressive nature of gambling. Possible reforms could include centralized licensing at state level or a nationwide redistribution of gambling tax revenues. This could mitigate the conflict between the fiscal interests of municipalities and the regulatory objectives of the State Treaty.

Acknowledgement: I thank the Arbeitskreis gegen Spielsucht e.V. for providing municipality-level data on gambling, in particular from the 15th updated and expanded edition of the study *Angebotsstruktur der Spielhallen und Geldspielgeräte in Deutschland* (Trümper and Heimann, 2020). This continuous and independent data collection has been essential to my project. I gratefully remember the long-time managing director Jürgen Trümper, whose dedicated work significantly shaped the foundation of this dataset.

3.1 Introduction

Conflicts of interest occur in many different contexts. They can arise between regulators and the regulated industry, across different levels of government, or between fiscal and social policy objectives. The German gambling hall market provides an ideal case study of such tensions. In Germany, the regulation of the gambling hall market rests with the federal states and is coordinated through the State Treaty on Gambling. However, municipalities are responsible for the enforcement of issuing gambling hall licenses, although the amusement tax of those establishments remain at municipal level. This dual responsibility, combined with fiscal benefits for municipalities, could lead to a conflict of interest between municipalities and federal states. Against this backdrop, the present study analyzes the number of gambling hall licenses issued at the municipal level.

I assume that municipalities with a previously lower tax revenue are more likely to tolerate or grant gambling hall licenses. Germany provides an ideal context for this analysis due to its federal structure. Since amusement tax remains at the municipal level, while regulation rests at state and federal levels, municipalities could face potential budgetary losses from stricter regulations, creating conflicting incentives. As tax revenues affect the budget with a time lag, I use lagged values to reflect more realistic reactions.

This study aims to contribute to the effective implementation of consumer-oriented regulations, ensuring they do not merely serve symbolic purposes. Eadington (1999) has already shown that many regulations introduced in the United States to protect consumers were largely symbolic. When designing and implementing regulations, decision-makers should therefore carefully assess potential conflicts of interest and the risk of regulatory ineffectiveness. To analyze the effect of lagged tax revenues on the number of licenses in a municipality, I employ a dynamic panel model with a Maximum Likelihood estimation following Williams et al. (2018) and Moral-Benito et al. (2019).

3.2 Review

The literature contains studies on the relationship between gambling and the household level of a municipality or state. However, these studies focus primarily on the US and mostly examine the motives for legalizing gambling. Still their findings are equally interesting for this study, as the motives in legalization may be similar to those in increasing the number of

gambling licenses (Furlong, 1998; Calcagno et al., 2010; Toossi and Zhang, 2019; Yaskewich, 2021).

The analysis by Yaskewich (2021) shows that lower levels of household income leads to a higher likelihood of a casino in a community. However, Yaskewich (2021) argues that economic reasons are not the only motive for gambling expansion, but also factors such as proximity to borders and urban areas are also important for an increased gambling supply. This is supported by the findings of Calcagno et al. (2010), which show that US states tend to retain gambling revenues within the state and export the negative externalities by attracting tourists from neighboring states. Furthermore, Haucap et al. (2023) found that in Germany, the main factors influencing the probability of a casino in a county are proximity to borders, urbanization, and tourism. In contrast to Yaskewich (2021), however, Haucap et al. (2023) also justify this with an economic interest, as this leads to increased gambling revenue and thus to higher gambling taxes.

A large strand of research examines gambling as a source of public revenue. Glickman and Painter (2004) found that US states with tax and expenditure restrictions are more likely to legalize lotteries, suggesting that gambling functions as an alternative revenue source. Similarly, Pickernell et al. (2004) observed that gambling taxes can substitute general taxation revenue. Walker (2007) mentions that gambling is often seen as a fiscal policy tool. Legalizing gambling, for example by opening new casinos, can be seen as such a tool as politicians seek "to generate tax revenue in a relatively painless way" (Walker, 2007, p. 10). Considering the literature, I assume that in Germany municipalities with higher tax revenues have more financial flexibility and may not need to rely on gambling revenues. Vice versa gambling could be used as a kind of tax increase. To account for the hypothesis I include the variable *lagged tax revenue* in the regression.

However, we should not overlook the fact that gambling is a form of regressive taxation that disproportionately affects low-income groups (Borg and Mason, 1988; Borg et al., 1991; Smith, 2000; Schissel, 2001; Pickernell et al., 2004; Forrest, 2008). Regressivity has been displayed through various gambling forms, such as lotteries and casinos (Borg and Mason, 1988; Borg et al., 1991; Pickernell et al., 2004). Gambling taxes are more often than not marketed as money for "good causes" but they may be a substitution of general taxation revenue (Pickernell et al., 2004). Regressive taxation can have varying degrees of impact on a region. This can depend, for example, on socio-economic factors, as in the literature it

has been shown that the worst effect has been on areas with a more deprived population (Schissel, 2001; Pickernell et al., 2004). This issue is particularly relevant to my research. If the hypothesis holds, municipalities with lower tax revenues are more likely to permit gambling. However, this could exacerbate existing socioeconomic inequalities due to the regressive nature of gambling.

Another key area of the gambling literature deals with the relationship between individual financial conditions and gambling. As previously mentioned, the results of Yaskewich (2021) suggest that weak communities tend to legalize casinos. This can also be transferred to the individual level. People experiencing financial difficulties are more willing to gamble (Olason et al., 2017). One proposed explanation is the lack of financial mobility, as some people perceive gambling as a potential path to financial independence (Tabri et al., 2015). Additionally, stress is also a significant factor. Some individuals use gambling as an escape from stress (Buchanan et al., 2020; Edgerton et al., 2018). Other than that, problem gambling is associated with poverty and issues like unemployment (Hahmann et al., 2021; Syvertsen et al., 2024). The literature shows that problem gamblers account for the majority of gambling turnover (Williams and Wood, 2004, 2007; Grönroos et al., 2021). Since unemployment leads to higher problem gambling and problem gamblers account for the majority of gambling turnover, I assume that employment influences the demand for gambling. Other than that, higher employment rates can also be associated with better economic conditions, which might reduce the need for municipalities to seek alternative revenue sources like gambling. With controlling for individual financial conditions in the regression model it is possible to isolate the effect of tax revenue on gambling licenses from the broader economic context. Accordingly, I control for employment and long-term unemployment in the regression to distinguish between short-term financial instability and chronic financial distress.

There is also literature that deals with the relationship between age and gambling (Welte et al., 2011; Dellosa and Browne, 2024). Dellosa and Browne (2024) examine different age groups and divide participation in gambling into three categories. Whereas the age group 18 to 35-year-old showed a 1.51 times higher likelihood of reporting problem gambling compared to the middle age group (Dellosa and Browne, 2024). Since problem gamblers account for the majority of gambling turnover (Williams and Wood, 2004, 2007; Grönroos et al., 2021), I assume that the previous mentioned age group influences the gambling demand. To account for that I control for the share of young population between 18 and 30 years old and the average age of the municipality.

3.3 Data

For the analysis, I assemble the dataset from multiple sources. The dataset is based on municipal level. Gambling market information is sourced from the "Arbeitskreis gegen Spielsucht." Every two years, the working group collects gambling data from all German municipalities with over 10,000 inhabitants,[1] such as the number of gambling hall licenses, the number of gambling hall locations, the number of devices in gambling halls, the number of devices in gastronomic establishments and population size. The working group's panel follows 1,663 German municipalities in two-year intervals across 2000 to 2020 (Trümper and Heimann, 2020). Accordingly, the data set is limited to the municipalities surveyed by the working group. All other data is taken from the INKAR database. The INKAR database includes data from the statistical offices of the federal states and the federal statistical office provided by the Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR) (2025).

The final dataset was restricted to observations from 2002 onwards. Since there is a substantial amount of missing data observed in earlier years. Furthermore, municipalities with missing values in the variables were identified and removed. This procedure was implemented to ensure that each group was complete and that the analyses were based on robust and reliable data. Ensuring a balanced panel is crucial for the robustness of the Dynamic Panel Maximum Likelihood estimation shown by Williams et al. (2018) and Moral-Benito et al. (2019). Thus, the panel takes into account 983 municipalities from the years 2002 to 2020, i.e., 10 time periods.

Dependent Variable

Gambling hall licenses (y_{it})

The number of gambling hall licenses per municipality represents the dependent variable in this study. The variable *gambling hall license* is collected by the working group. The data is based on the municipality level in Germany. The data was collected every two years for all municipalities with 10,000 inhabitants and more. Licenses for gambling halls are granted by municipalities. In addition, in the case of hardship applications, the municipalities decide whether the regulation actually provide for a closure. Accordingly, the license represents a proxy for the effect of the municipality on the gambling offer.

[1] For North Rhine-Westphalia and Saarland, the working group surveys every municipality, not only those above 10,000 inhabitants.

As the licenses from the previous period are generally also present in the current period, I assume a dynamic model. Because of that, the lagged number of licenses is also an independent variable in the regression.

Independent Variables

Lagged tax revenue (TR_{it-1})

The tax revenue variable represents the tax revenue of the municipalities in euros per inhabitant. The tax revenue of a municipality includes the following types of tax: property tax A and B, trade tax, municipal share of income tax, municipal share of sales tax, tax-like levies. Tax revenue is a key factor in determining a municipality's financial room for action and provides information on the economic strength or structural weakness of a municipality. Tax revenue represents the core of the municipal budget. Accordingly, budget restrictions for economic, ecological, and social areas are based on the development of tax revenue (Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR), 2025). As tax revenues affect the budget with a time lag, I use lagged values to reflect more realistic reactions.

Controls

Employment and long-term unemployment

The employment rate represents the ratio of employees between the ages of 15 to 64 to all 15 to 64 year olds in the municipality as a percentage. Only employees subject to social security contributions are taken into account. Long-term unemployment is defined as the share of all unemployed who have been without an employment for at least twelve months. Those two variables help to isolate the effect of tax revenue on gambling licenses from the broader economic context and to distinguish between short-term financial instability and chronic economic distress.

Young population and average age

The variable young population denotes the fraction of population aged 18–30 in a municipality. I want to control for potential differences in the demand for gambling within the young age group. As Welte et al. (2011) show, different age groups participate in gambling at different rates. I also control for the average age in a municipality. This reflects the arithmetic mean of the age of the population in a municipality. With those two variables I aim to isolate the effect of age on the demand of gambling.

Table 3.1 provides the descriptive statistics for all variables. Table 3.2 reflects the pairwise correlation of the variables.

Table 3.1: Descriptive statistics

Variable	N	Mean	St. Dev.	Min	Max
gambling hall license	9,830	8.47	18.10	0	250
lagged tax revenue	9,830	904.39	551.92	238.15	16966.43
employment	9,830	54.44	6.44	30.05	82.14
long-term unemployment	9,830	31.77	9.10	0.52	63.35
young population	9,830	13.33	1.88	8.38	30.71
average age	9,830	42.92	2.10	33.19	51.74

Table 3.2: Correlation matrix

	Variable	(1)	(2)	(3)	(4)	(5)	(6)
(1)	gambling hall license	1.00					
(2)	lagged tax revenue	0.13***	1.00				
		(0.00)					
(3)	employment	-0.12***	0.34***	1.00			
		(0.00)	(0.00)				
(4)	long-term unemployment	0.21***	-0.09***	-0.24***	1.00		
		(0.00)	(0.00)	(0.00)			
(5)	young population	0.35***	0.05***	-0.13***	-0.01	1.00	
		(0.00)	(0.00)	(0.00)	(0.15)		
(6)	average age	0.00	0.21***	0.39***	0.09***	-0.40***	1.00
		(0.99)	(0.00)	(0.00)	(0.00)	(0.00)	

Note: $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.

3.4 Method

Since the dependent variable is the number of gambling hall licenses, I assume that prior values of the dependent variable could have a strong impact on present gambling hall licenses. This requires including a lagged endogenous regressor in the estimation, which would lead to estimation difficulties. To solve this problem, I use a dynamic panel model. In the literature several methods are used, such as lagged instrumental variables together with the Generalized Method of Moments (GMM) (Arellano and Bond, 1991; Arellano and Bover, 1995) or Maximum Likelihood (ML) estimation (Allison et al., 2017; Williams et al., 2018; Moral-Benito et al., 2019).

I rely on the dynamic panel model with ML estimation. Following Moral-Benito et al. (2019) and Williams et al. (2018), the method is well suited for panels with a small to moderate time dimension. It also accommodates both fixed and random effects specifications and permits the inclusion of lagged dependent variables without relying on differencing or instrumental variable approaches (Williams et al., 2018). Moral-Benito et al. (2019) demonstrate that ML estimators can serve as a more efficient alternative to GMM under standard assumptions. In contrast to GMM, ML estimation does not rely on instruments and is therefore not subject to weak-instrument bias and can yield more reliable results in dynamic panel data settings. Based on these advantages, I use a dynamic panel model with ML for the estimation.

The model takes the following form:

$$y_{it} = \lambda y_{it-1} + \beta TR_{it-1} + \gamma \omega_{it} + \alpha_i + \xi_t + \nu_{it} \tag{3.1}$$

where y_{it} is the number of gambling hall licenses in municipality i at time t. y_{it-1} is the lagged number of gambling hall licenses. TR_{it-1} represents the lagged tax revenue per capita (treated as predetermined). ω_{it} refers to a set of control variables (employment, long-term unemployment, young population, and average age). α_i captures municipality-specific heterogeneity potentially correlated with the regressors that are time-invariant. ξ_t captures unobserved time-specific effects that are constant across units within each period but may vary over time. ν_{it} is the error term which is specified to be robust to heteroscedasticity and serial correlation,

and

$$E\left(\nu_{it}\middle|y_i^{t-1}, TR_i^{t-1}, \alpha_i\right) = 0 \quad (t = 1, \ldots, T)\,(i = 1, \ldots, N) \tag{3.2}$$

where (TR_i^{t-1}) denotes a vector of the lagged tax revenue per capita accumulated up to $(t-1)$ and (y_i^{t-1}) denotes a vector of the values of the number of gambling hall licenses accumulated up to $(t-1)$. This condition (2) is the only assumption required for consistency and asymptotic normality (Moral-Benito et al., 2019; Williams et al., 2018). This means that previous gambling hall licenses and the tax revenue from the previous year remain uncorrelated with the current error term. I classify the lagged tax revenue TR_{it-1} in the model as predetermined since I assume that prior values of the dependent variable can affect the lagged tax revenue.

3.5 Results

The study examines the effect of a change in the lagged tax revenue on the number of gambling hall licenses in a municipality. For this purpose a dynamic panel model with ML estimation is used. Table 3.3 shows the main estimation results. The central hypothesis, that the lagged tax revenue of the municipality has an impact on the number of gambling hall licenses, is confirmed by the significantly negative coefficient. If the lagged tax revenue decreases by 100 euro per capita, the number of licenses in a municipality increases by 0.22. Figure 3.1 visualizes the partial effect of lagged municipal tax revenue on licenses. Another significant result is the positive effect of the number of licenses in the previous period, which underlines the persistence of gambling hall licenses. With the lagged number of licenses and the lagged tax revenue, we can calculate the long run effect of a change in the previous period's tax revenue on the number of licenses in a municipality. Using the estimates in Table 3.3 ($\hat{\lambda} = 0.945$, $\hat{\beta} = -0.0022$), the implied long run effect ($\frac{\beta}{1-\lambda}$) equals -0.040 per euro, i.e., about $+4.0$ licenses for a 100 euro decrease in TR_{t-1} (see Figure C.1 in the Appendix). The long run effect reflects that high persistence amplifies responses over time and is also consistent with the short-run effect of $+0.22$ licenses for a 100 euro decrease in TR_{t-1}. Finally, the results show that municipalities with previously lower tax revenues tend to tolerate or approve more licenses.

Other than that, the average age also shows a significant positive effect of 0.3363, while the proportion of young people has no significant influence. This indicates that municipalities with a higher average age tend to issue more gambling licenses.

Table 3.3: Maximum likelihood estimator (ML)

	gambling hall license
Variables	ML Model
lagged gambling hall license	0.9450***
	(0.023)
young population	-0.0510
	(0.042)
average age	0.3363***
	(0.069)
employment	-0.0383*
	(0.020)
long-term unemployment	0.0045
	(0.003)
lagged tax revenue	-0.0022***
	(0.001)
AIC	254784.75
BIC	258565.19
SRMR	0.021
Number of periods	10
Number of units	983
Number of observations	9830

Standard errors in parentheses (Satorra–Bentler)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

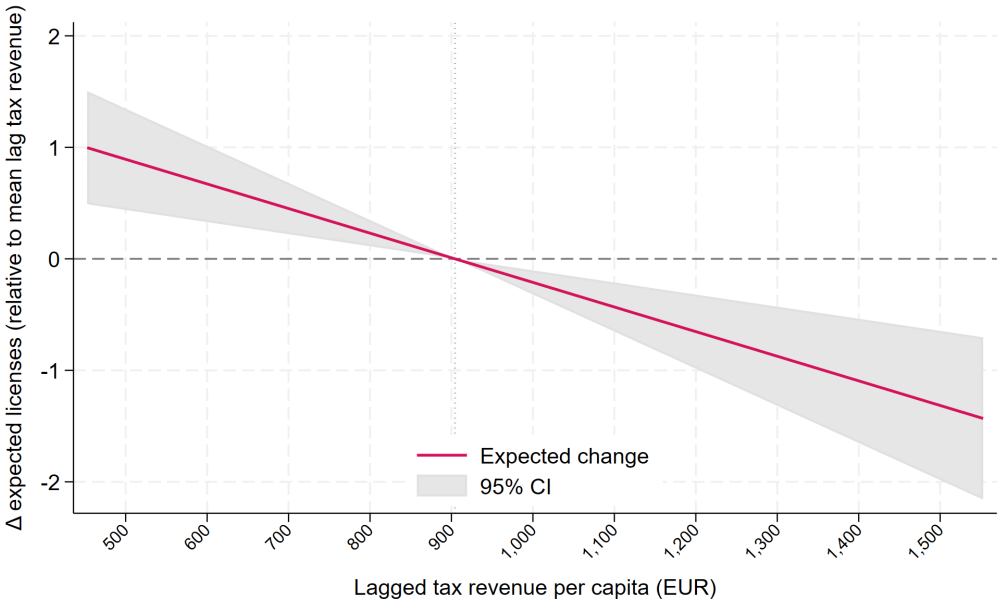

Figure 3.1: Marginal effects of lagged tax revenue

In the main ML Model standard errors are Satorra–Bentler robust. As a further robustness check, I also estimate the model with municipality clustered standard errors and with robust standard errors according to Huber-White. The main effects remain stable (see Table C.1 in the Appendix), which further emphasizes the robustness of the results.

As an additional placebo test, I replace the lagged tax revenue TR_{it-1} in (3.1) with the *lead* TR_{it+1} and *lead* TR_{it+2} respectively, and estimate

$$y_{it} = \lambda y_{it-1} + \beta TR_{it+1} + \gamma \omega_{it} + \alpha_i + \xi_t + \nu_{it} \tag{3.3}$$

and

$$y_{it} = \lambda y_{it-1} + \beta TR_{it+2} + \gamma \omega_{it} + \alpha_i + \xi_t + \nu_{it} \tag{3.4}$$

This follows the common panel-data practice of using leads as a diagnostic to detect anticipation or feedback as can be seen in Wooldridge (2010). Both coefficients are small and statistically insignificant (see Figure 3.2 and for the detailed results see Table C.2 in the Appendix). Thus, future tax revenues do not explain the current number of licenses, which supports the assumption that the main results are not driven by reverse causality or anticipation.

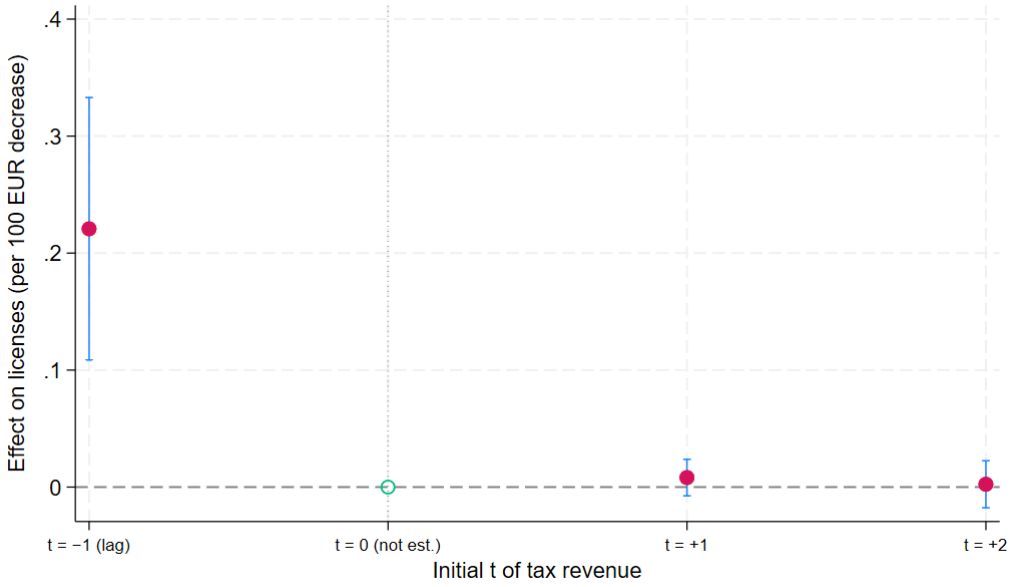

Figure 3.2: Lagged tax revenue and lead placebo tax revenue effects

As another robustness check, I replace the dependent variable with the number of gambling hall locations (Table 3.4). Again, the lagged tax revenue remains negative and significant, suggesting that the core results do not depend on the exact definition of the dependent variable. The negative impact of the tax revenue slightly have decreased, which is consistent with the fact that the number of licenses generally exceeds the number of locations.

Table 3.4: Robustness check with other dependent variables

	gambling hall location
Variables	ML Model
lagged gambling hall location	0.9665***
	(0.026)
young population	-0.0071
	(0.027)
average age	0.1729***
	(0.037)
employment	-0.0089
	(0.013)
long-term unemployment	0.0034
	(0.003)
lagged tax revenue	-0.0008**
	(0.000)
AIC	246140.83
BIC	249862.59
SRMR	0.008
Number of periods	10
Number of units	983
Number of observations	9830

Standard errors in parentheses (Satorra–Bentler)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

To substantiate the robustness of the results, I also use the first-difference GMM method (Table 3.5). The coefficients show a similar pattern, in particular the negative effect of the lagged tax revenue remains negative and significant and even increases slightly. In addition, the high persistence of gambling licenses remains. The coefficient for average age increases, while other control variables maintain a similar direction as in the ML model. This again underlines the robustness of the results.

Table 3.5: First-differenced GMM estimator (AB)

Variables	gambling hall license GMM Model
lagged gambling hall license	0.8383***
	(0.044)
young population	0.1485
	(0.141)
average age	0.6802***
	(0.142)
employment	-0.0432
	(0.046)
long-term unemployment	0.0000
	(0.006)
lagged tax revenue	-0.0039**
	(0.002)
Test for AR (1)	p-value: 0.0001
Test for AR (2)	p-value: 0.1494
Number of instruments	40
Number of periods	8
Number of units	983
Number of observations	7864

Standard errors in parentheses (WC robust)
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

3.6 Discussion

This study examines the link between municipal fiscal health and the licensing of gambling halls in Germany. The results show a significant negative effect of lagged municipal tax revenues on the number of licenses. If the lagged tax revenue of a municipality decreases, the number of licenses in a municipality increases. The results are consistent with those of Yaskewich (2021). Although his study cautions that gambling expansion is driven not only by fiscal motives but also by proximity to borders and urban areas, the question arises as to whether these factors are also due to indirect fiscal interests. The findings of Haucap et al. (2023) support this idea, showing an increased likelihood of gambling offer near borders, in urban, and in tourist areas. Unlike Yaskewich (2021), Haucap et al. (2023) however, justify this with indirect fiscal interests as proximity to the border and tourism also lead to increased demand for gambling. The results also show considerable persistence. Once

licenses are granted, they tend to remain.

The findings are also consistent with the argument that gambling can be used as a substitute for tax revenue (Pickernell et al., 2004). Walker (2007) already argued that the increase in tax revenues with the expansion of gambling causes less resistance than an increase in general taxation. This is especially true for financially weaker regions. The results suggest that municipalities with lower financial revenues may use gambling as a means of financial compensation. This is consistent with the findings of Glickman and Painter (2004), who show that states with tax and spending constraints are more likely to rely on lottery revenues. The robustness checks further validated this relationship, demonstrating consistent results across different measures of an alternative dependent variable (*gambling hall location*).

Financially weaker municipalities may exhibit greater interest in increasing gambling revenues. This could lead to a concentration of gambling locations, particularly in already structurally weak municipalities that are dependent on additional revenue. Especially with the regressive nature of gambling this can lead to a negative trend and strengthen socioeconomic inequalities (Borg and Mason, 1988; Borg et al., 1991; Smith, 2000; Schissel, 2001; Pickernell et al., 2004; Forrest, 2008). In the short term, more gambling licenses might be advantageous because of increased tax revenues and employment. However, in the long term, gambling causes negative externalities for the population and municipality.

Taken together, the evidence from the discussed literature and our results raise concerns about whether all objectives of the State Treaty on Gambling are being fulfilled in the context of gambling hall licenses. Any fiscal benefits should be no more than positive side effects (Haltern, 2004). However, the results indicate fiscal interest. Gambling hall licenses are regulated at the federal and state level, whereas the implementation of this regulation is the responsibility of the municipalities. However, as the amusement tax on gambling machines remains with the municipality, a conflict of interest can arise. In the case of financially weaker municipalities, one could assume that the conflict of interest is even more pronounced. Similar fiscal conflicts of interest in the German gambling market have already been discussed in previous studies (Haucap et al., 2023).

A common view in the literature is that problem gamblers account for the majority of gambling expenditure (Williams and Wood, 2004, 2007; Grönroos et al., 2021). In addition to that, the highest prevalence of problem gamblers is among 18-35 year olds, as shown by Dellosa and Browne (2024). Therefore, one assumption could be that the variable young

population with the share of 18 to 30 year olds has a significant effect in our regression model. In contrast, the average age is positive and statistically significant, although the mean of the variable *average age* across the observations is 42.92. One possible explanation could be that problem gambling in Germany is more prevalent among older age groups than among those aged 18 to 30, especially in relation to the gambling hall market. Besides the possible higher demand for gambling among older people another argument could be that municipalities with an older population exhibit less regulatory resistance to gambling expansion. This could also be similar to the argument of Walker (2007) where he claims that an increase in gambling offer is less controversial than an increase in general taxation. This change in the gambling offer may be less controversial or noticeable to the older population.

As shown above, the decision to grant gambling licenses is the responsibility of the municipalities, but should in principle be in line with the objectives of the State Treaty on Gambling. Based on the findings and the discussion, however, it is clear that regulation does not always comply with these requirements in practice. In particular, the importance of fiscal factors suggests that financial interests have a significant influence on the granting of licenses. Haucap et al. (2023) show that fiscal interest may play a central role in the location decision for casinos in Germany. This indicates that regulatory objectives, such as player protection, could be overridden by fiscal considerations. Haltern (2004) makes it clear that fiscal interests should not be the main reason for offering gambling, but should at most be seen as a positive side effect. Similarly, Eadington (1999) argues that in the USA, many of the regulations introduced to protect consumers are often rather symbolic in nature. If structurally weak municipalities grant more licenses for gambling halls with primarily financial reasons without taking into account the objectives of the State Treaty, the regulatory framework may become largely symbolic in practice.

Limitations

However, there are some limitations. First, the sample is restricted to municipalities with at least 10,000 inhabitants. This may omit smaller municipalities whose fiscal constraints and revenue dependence differ systematically. However, one could expect that conflicts of interest and thus the fiscal interest are more pronounced in smaller municipalities. Extending the analysis below the threshold would show whether the estimated relationships carry over.

Second, while the dynamic panel approach addresses endogeneity and unit heterogeneity, it cannot include the administrative logic behind license decisions. Complementary qualitative

work such as interviews with treasurers, licensing officers, and mayors, or focused case studies around policy changes could provide a richer understanding of the factors influencing gambling policies at a local level.

A remaining concern is feedback from licensing to municipal tax revenues. I mitigate this by lagging tax revenues and treating TR_{it-1} as predetermined rather than strictly exogenous, i.e. I assume $E\left(\nu_{it}\middle|y_i^{t-1}, TR_i^{t-1}, \alpha_i\right) = 0$. This allows earlier numbers of licenses y_{it-2} to affect later revenues TR_{it-1}, while ruling out correlation between TR_{it-1} and the current error term ν_{it}. However, this condition may be violated if there are persistent unobserved shocks, anticipatory policy responses or within-period budget feedback that jointly influence revenues and licensing. To minimize this, municipality α_i and time ξ_t fixed effects were included. Furthermore, the results are robust across different models and the placebo falsification tests also argue against anticipatory behavior and reverse causality.

3.7 Conclusion

In this study, I have examined the relationship between municipal tax revenues and the number of gambling hall licenses in German municipalities. The results confirm the hypothesis, showing a significant negative relationship between lagged tax revenues and the number of gambling hall licenses. In addition, the results show that licenses exhibit strong persistence. Once established, licenses are difficult to reduce. I also found that municipalities with a higher average age approve more gambling hall licenses. Besides the possible higher demand for gambling among older people another argument could be that municipalities with an older population exhibit less regulatory resistance to gambling expansion.

Two of the main objectives of the State Treaty on Gambling are the player protection and the channeling of the own population. The results suggest that already structurally weak municipalities that are dependent on additional revenue tend to grant more licenses and thus fiscal motives could influence the decision regarding gambling hall licenses. This could potentially be in conflict with the objectives of the State Treaty especially in terms of the regressive nature of gambling. This could lead to more negative trends and an exacerbation of socioeconomic inequalities.

Possible reforms could include centralized licensing at state level or a nationwide redistribution of gambling tax revenues that are specifically invested in prevention and support measures for gambling addiction. This could defuse the conflict between the fiscal interests of individual

municipalities and the regulatory objectives of the State Treaty. Future research could include smaller municipalities in the analysis, as they may have different fiscal dynamics, which could lead to an even more pronounced result. In addition, qualitative methods, such as interviews with municipal decision-makers, could provide more detailed insights into the complex decision-making processes and thus furthermore deepen the findings of this study. In summary, while gambling hall licenses offer short-term fiscal benefits, they could come with significant social and economic risks.

Appendix

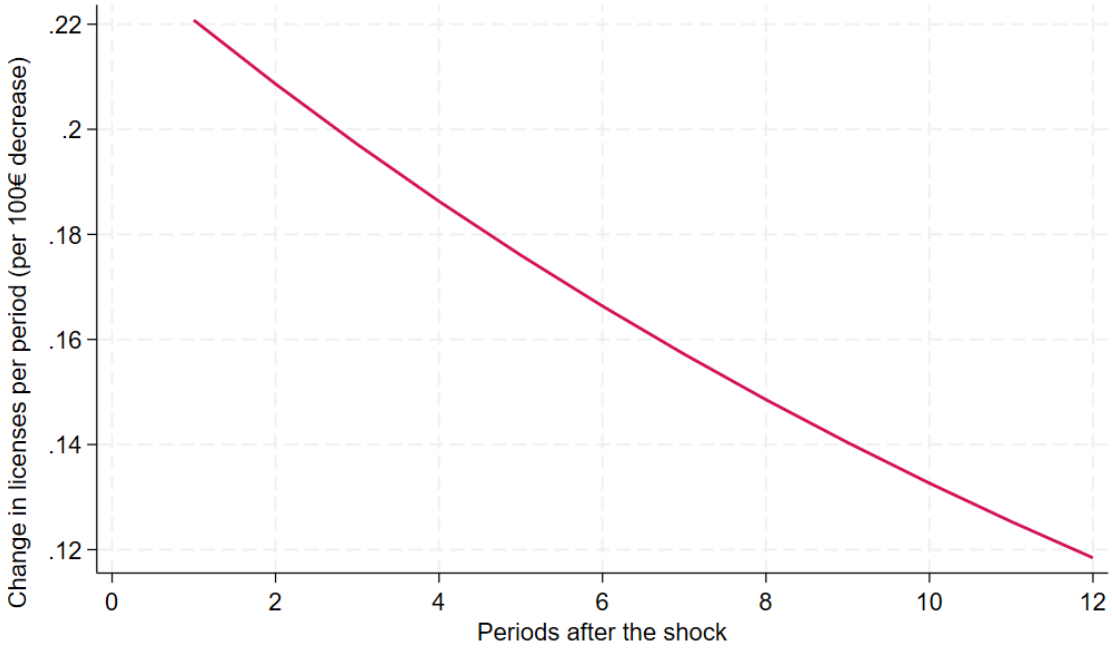

Figure C.1: Persistence: response to a one-time 100 Euro decrease in lagged tax revenue

Note: The long-run *total* effect equals the sum (i.e., the area under the curve) across all periods and is about +4 licenses for a 100 euro decrease.

Table C.1: Robustness check clustered and robust

	gambling hall license	
Variables	Clustered Model	Robust Model
lagged gambling hall license	0.9450***	0.9450***
	(0.075)	(0.075)
young population	-0.0510	-0.0510
	(0.056)	(0.056)
average age	0.3363*	0.3363*
	(0.199)	(0.199)
employment	-0.0383	-0.0383
	(0.024)	(0.024)
long-term unemployment	0.0045	0.0045
	(0.003)	(0.003)
lagged tax revenue	-0.0022**	-0.0022**
	(0.001)	(0.001)
AIC	254092.75	254092.75
BIC	256181.04	256181.04
SRMR	0.021	0.021
Number of periods	10	10
Number of units	983	983
Number of observations	9830	9830

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table C.2: Robustness check Lead-Placebo (Falsification)

Variables	gambling hall license	
lagged gambling hall license	0.8864***	0.8658***
	(0.021)	(0.025)
young population	-0.0126	0.0015
	(0.037)	(0.039)
average age	0.2726***	0.1419**
	(0.057)	(0.056)
employment	-0.0387**	-0.0438**
	(0.017)	(0.019)
long-term unemployment	0.0051*	0.0043
	(0.003)	(0.003)
lead tax revenue (t+1)	-0.0001	
	(0.000)	
lead tax revenue (t+2)		-0.0000
		(0.000)
AIC	258925.96	233521.82
BIC	262290.70	236358.37
SRMR	0.006	0.005
Number of periods	10	9
Number of units	983	983
Number of observations	9830	8847

Standard errors in parentheses (Satorra–Bentler)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: The lead test (3.3) does not reduce the sample as the data on tax revenue is available until 2022. Only the lead test (3.4) reduces the sample by the last period.

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Chapter 4

Player Exclusion and Sub-Market Substitution: Synthetic DiD Evidence from Germany's Gambling Machine Market

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Abstract: This study examines the effects of the introduction of an exclusion program on the distribution of gambling machines between gambling halls and gastronomic establishments. We use the German federal state of Hesse as a case study. Hesse introduced an exclusion program in 2014 for gambling halls. Since gastronomic establishments with gambling machines were not covered by the program, we assume a distributional shift to the less regulated sub-market. Using a synthetic difference-in-differences approach, we analyze municipal-level panel data for the period 2002 to 2020. Our results show a clear shift. The number of machines in gambling halls fell by 8.17 per municipality on average while it increased by 11.11 in gastronomic establishments. This displacement poses a challenge for regulation. Besides the nationwide exclusion program introduced in 2021, we recommend an EU-wide exclusion program to strengthen player protection and channeling, especially in countries like Germany with extensive land borders. Future research should examine how this displacement affects vulnerable groups.

Acknowledgement: We thank the Arbeitskreis gegen Spielsucht e.V. for providing municipality-level data on gambling, in particular from the 15th updated and expanded edition of the study *Angebotsstruktur der Spielhallen und Geldspielgeräte in Deutschland* (Trümper and Heimann, 2020). This continuous and independent data collection has been essential to our project. We gratefully remember the long-time managing director Jürgen Trümper, whose dedicated work significantly shaped the foundation of this dataset.

4.1 Introduction

The gambling market is an example of an industry where the extent and effectiveness of regulation remain actively debated in the literature (Nower and Blaszczynski, 2006; Ladouceur et al., 2007; Nelson et al., 2010; Gainsbury, 2014; Drawson et al., 2017; Motka et al., 2018; Kotter et al., 2019; Kraus et al., 2022). Discussing the effectiveness of regulation is important since suboptimal regulation can generate significant negative externalities, especially in the form of pathological gambling (Coryn et al., 2008; Carran, 2018; Bühringer, 2018). Furthermore, suboptimal regulation could neglect the objectives of the German State Treaty on Gambling. One of the central aims of the gambling regulation in Germany is to reduce the social and economic harm associated with problem gambling, while at the same time directing gambling activities into controlled and supervised environments. Despite the objectives of the State Treaty, studies show challenges in implementation regulation, particularly in establishments that are economically dependent on gamblers (Meyer et al., 2015; Hayer et al., 2020). With its federal system, Germany offers ideal conditions for investigating the effectiveness of different regulatory approaches in the gambling sector. In particular, the early introduction of a nationwide player exclusion program for gambling machines in gambling halls in Hesse in 2014 is an excellent case study. While other federal states only began to implement comparable measures in 2021 due to the State Treaty on Gambling, and in practice even later, Hesse's early adoption provides an opportunity for a robust analysis of the long-term impacts of such regulatory interventions.

Achieving an effective balance between regulatory stringency and a liberal market structure constitutes a complex interdisciplinary challenge for regulatory policy. Before implementing regulation, it may also be useful to consider alternative relevant markets. Gastronomic establishments, for example, have the same types of gambling machines as gambling halls and thus are a close substitutes. The main difference is the permitted number of machines. Accordingly, a regulation that aims to protect players should regulate not the establishment but the machines across sub-markets. If regulation is not implemented effectively, it risks being perceived and functioning as a symbolic measure that primarily serves to reassure the public. Eadington (1999) argues that many consumer oriented regulations in the USA tend to be more symbolic in nature.

With this study, we investigate whether the introduction of the exclusion program in gambling halls in Hesse has led to a shift toward the less regulated sub-market of gastronomic

establishments. If the regulation does indeed lead to such a shift, the effectiveness of the State Treaty on Gambling in achieving its goal of channeling gambling activities into controlled environments and to protect the players would be called into question. Moreover, less regulated and controlled markets could potentially increase the risk of players migrating toward illegal gambling options or pathological gambling behavior. Our hypothesis therefore specifically assumes a migration of gambling activities from gambling halls to less regulated gastronomic establishments.

Although the literature to date has intensively investigated the effectiveness of gambling exclusion programs (Ladouceur et al., 2007; Nelson et al., 2010; Meyer et al., 2015; Fiedler, 2015; Hayer et al., 2020), there is a lack of studies on possible displacement effects, particularly in the market for gastronomic establishments. Our study addresses this empirical gap by providing new evidence on whether regulatory interventions, if unevenly enforced, can lead to unintended shifts in the gambling market across sub-markets. Using municipal-level panel data, our empirical strategy primarily relies on the synthetic difference-in-differences (SDiD) method. By constructing a synthetic control group, we are able to compare the post-treatment trend in Hesse with a case in the absence of the regulation. Additionally, we employ difference-in-differences (DiD) and synthetic control method (SCM) as robustness checks.

4.2 Review

According to Section 8 of the State Treaty on Gambling, operators are obliged to ban players who either report themselves or are reported by third parties. At first, the gambling exclusion program in Germany only applied to casinos, sports betting, and lotteries. In 2021, a centralized gambling exclusion program was then introduced nationwide. Hesse had already introduced the gambling exclusion program for gambling halls in 2014.

Self-exclusion programs are also a widespread international regulatory instrument. Canada introduced such a program in 1989 (Nowatzki and Williams, 2002), the United States followed in 1996 (Blaszczynski et al., 2007), and New Zealand in 2003 (Townshend, 2007). Considering the effectiveness and benefits of an exclusion program in Germany, we can find a study by Meyer and Hayer (2010). Their analysis indicated beneficial effects of exclusion programs. Evidence from the United States and Canada likewise shows that exclusion programs reduce the proportion of pathological gamblers (Ladouceur et al., 2007; Nelson et al., 2010).

However, this raises the question of whether the decline in gambling is only related to the legal sector. It is therefore important for our research to observe whether an exclusion program in general leads to less gambling offer or a migration toward other sub-markets such as gastronomic establishments. The worst-case scenario associated with the exclusion program in gambling halls is a potential shift toward the gray or black market. As an example for this Trümper and Heimann (2020) have already documented the so-called "sham gambling halls" in Germany. These establishments present themselves as gastronomic establishments but in practice operate in a manner indistinguishable from licensed gambling halls. By doing so, operators are able to avoid the strict regulations that apply to gambling halls in contrast to gastronomic establishments. In our study, we assume that the introduction of the gambling exclusion program in Hesse will at least lead to a shift in gambling offer to gastronomic establishments.

Considering the effectiveness of self exclusion programs, those have already been discussed extensively in the literature by several studies (Nower and Blaszczynski, 2006; Ladouceur et al., 2007; Nelson et al., 2010) and reviews (Gainsbury, 2014; Drawson et al., 2017; Motka et al., 2018; Kotter et al., 2019; Kraus et al., 2022). Further insights into the demographic profile of self-excluders reveal substantial differences between online and terrestrial gamblers. As shown by Motka et al. (2018), online self-excluders are, on average, 10 years younger and more often male compared to terrestrial self-excluders. These differences point to a need for targeted communication strategies tailored to high-risk groups depending on the gambling format. Additionally, the review highlights administrative complexity, insufficient venue staff support, and lack of cross-venue coverage as common barriers that undermine the broader utilization and effectiveness of self-exclusion programs (Motka et al., 2018). A qualitative study from Italy highlights that measures aiming to restrict gambling availability – similar to exclusion programs – are often undermined by the argument that they drive problematic gamblers toward illegal or less regulated forms of gambling (Rolando et al., 2020). Fiedler (2015) evaluates the exclusion program in German casinos. Although an exclusion program is classified as positive (Meyer and Hayer, 2010), Fiedler (2015) points out that casinos hardly fulfill their legal obligations regarding the exclusion of at-risk gamblers, with only 0.4% of gamblers with a severe gambling disorder being banned by the operators themselves. This underlines that a thorough evaluation of existing regulations is essential in order to design effective and consumer-oriented gambling policies. Also, as mentioned before, finding the right balance between regulation and a liberal market structure is important for achieving

the objectives of the State Treaty on Gambling.

Weaknesses in regulation or in the implementation of regulation could allow consumers to circumvent the exclusion program. Online gambling in particular tends to be more challenging with the implementation of an exclusion program. The individuals described in Drawson et al. (2017) could easily avoid the exclusion program if the implementation is not sufficient. Studies suggest that such circumventions are not the exception, but rather the rule. For example, a study by Nelson et al. (2010) found that only 13% of participants in a lifelong self-exclusion program had completely abstained from gambling for an average period of 6.1 years. Also, Hayer et al. (2020) provided evidence of compliance problems with the exclusion program in Hesse. Approximately 28.1% of gaming halls allowed excluded individuals to play. In the systematic review by Kotter et al. (2019), they examine various studies on self-exclusion programs. Although the authors emphasize the positive effects of self-exclusion, the results of the studies examined vary considerably. Numerous participants continued to gamble despite the exclusion. The authors emphasize an extension of exclusion programs to other sub-markets of gambling (Kotter et al., 2019). This once again underlines the relevance of the correct implementation of regulation.

General regulatory theory, as emphasized by Stigler (1971) and Peltzman (1976), suggests that regulation is often constrained by institutional limits and shaped by organized interests. Acemoglu and Robinson (2013) also highlight how political power and institutional structures fundamentally shape economic and regulatory outcomes. As a result, even well-intentioned efforts can be ineffective. In this context, our hypothesis is based on the relevance between regulatory instruments and successful channeling. We assume that the exclusion program misses the channeling target and the player protection, as we assume a shift from gambling halls to gastronomic establishments. This does not necessarily mean that the exclusion program is not suitable as an instrument per se, but rather that the implementation and enforcement is not sufficiently successful, as already pointed out by Hayer et al. (2020).

It is not sufficient to just offer a state-run or licensed gambling option to channel consumers to the regulated market. To be effective, the regulated offer must also be competitive and attractive to players. At the same time, access to unregulated alternatives should be restricted or, ideally, eliminated. As Kairouz et al. (2017) demonstrate, merely introducing a state-run online gambling service is insufficient to achieve successful channeling. Despite its introduction, a significant proportion of consumers continued to engage with the unregulated

market. In theory, all types of regulatory instruments should be carefully analyzed and evaluated with respect to their intended purpose in order to ensure effectiveness and avoid symbolic regulation. Marionneau et al. (2025) for example showed in their study that the tax rate is not a valid instrument for channeling, as no correlation was found between tax level and channeling success.

4.3 Data

For this research, we compiled a large-scale dataset from a variety of sources. Our analysis is based on the municipal level in Germany. We only consider municipalities with at least 10,000 inhabitants. We obtain part of our data from the "Arbeitskreis gegen Spielsucht." The working group collects detailed data biennially from all German municipalities with more than 10,000 inhabitants.[1] Their dataset includes critical metrics, such as the number of gambling hall concessions, the number of gambling halls, the number of gambling machines in gambling halls, the number of gambling machines in gastronomic establishments, and the overall municipal population size. The original panel provided by the working group comprises 1,663 municipalities observed biennially from 2000 to 2020 (Trümper and Heimann, 2020). Further sociodemographic variables were accessed via the INKAR database, which is maintained by the Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR) (2025). The large extent of missing data in the early years of the panel has led us to restrict our analysis to observations from 2002 onwards. This limitation is necessary to maintain the validity and consistency of our data.

In order to make a robust estimation, we preferred a balanced panel. Municipalities with missing data from 2002 onwards were removed from the dataset to ensure that each group had complete data. Following this procedure, our final dataset contains balanced panel observations for 983 municipalities, respectively 749 for gastronomic establishments, from 2002 through 2020, spanning 10 biennial periods.

Dependent Variable

Number of gambling machines in gambling halls (Y_{it}^{GH}) and gastronomic establishments (Y_{it}^{GE})

The dependent variable in our analysis is the number of gambling machines in gambling halls and the number of gambling machines in gastronomic establishments per municipality.

[1] In North Rhine-Westphalia and Saarland, the working group includes all municipalities.

The data were collected every two years at the municipal level by the previously mentioned working group. The variables can be seen as a proxy for the gambling offer.

Control Variables

Employment rate and long-term unemployment

We include the employment rate, defined as the percentage of individuals aged 15 to 64 employed subject to social security contributions, and long-term unemployment rate, capturing the proportion of unemployed persons without employment for a year or longer relative to total unemployment. These variables help to control for economic conditions within municipalities and to distinguish the effects of short-term and long-term unemployment on the gambling market.

Young population and average age

In our regression we include two demographic variables to control for age-related variations on gambling. The young population variable measures the percentage of population aged 18-30, controlling for potential differences in gambling preferences among the younger population. The average age variable represents the mean age within each municipality.

Table 4.1 presents the descriptive statistics for all variables used in our analyses of the gambling hall market. Table 4.2 displays the corresponding pairwise correlations. The same structure applies to the dataset on gambling machines in gastronomic establishments, with descriptive statistics shown in Table 4.3 and correlations in Table 4.4.

Table 4.1: Descriptive statistics - Gambling Halls

Variable	Mean	Std. Dev.	Variance	Min	Max	Obs
Gambling machines	83.88	178.42	31832.49	0	2614	9830
Employment rate	54.44	6.44	41.50	30.05	82.14	9830
Long-term unemployment	31.77	9.10	82.83	0.52	63.35	9830
Young population	13.33	1.88	3.54	8.38	30.71	9830
Average age	42.92	2.10	4.42	33.19	51.74	9830

Table 4.2: Correlation matrix with significance levels - Gambling Halls

	(1)	(2)	(3)	(4)	(5)
(1) Gambling machines	1.00				
	(0.00)				
(2) Employment rate	−0.09***	1.00			
	(0.00)				
(3) Long-term unemployment	0.20***	−0.24***	1.00		
	(0.00)	(0.00)			
(4) Young population	0.36***	−0.13***	−0.01	1.00	
	(0.00)	(0.00)	(0.15)		
(5) Average age	0.01	0.39***	0.09***	−0.40***	1.00
	(0.17)	(0.00)	(0.00)	(0.00)	

Notes: Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 4.3: Descriptive statistics - Gastronomic Establishments

Variable	Mean	Std. Dev.	Variance	Min	Max	Obs
Gambling machines	44.72	124.28	15445.82	0	2298	7490
Employment rate	54.10	6.37	40.61	30.05	82.14	7490
Long-term unemployment	32.84	8.86	78.54	0.52	63.35	7490
Young population	13.25	1.86	3.47	8.38	30.71	7490
Average age	42.88	2.15	4.61	33.19	51.74	7490

Table 4.4: Correlation matrix with significance levels - Gastronomic Establishments

	(1)	(2)	(3)	(4)	(5)
(1) Gambling machines	1.00				
	(0.00)				
(2) Employment rate	−0.12***	1.00			
	(0.00)				
(3) Long-term unemployment	0.15***	−0.19***	1.00		
	(0.00)	(0.00)			
(4) Young population	0.29***	−0.15***	0.05***	1.00	
	(0.00)	(0.00)	(0.00)		
(5) Average age	−0.07***	0.42***	0.12***	−0.41***	1.00
	(0.00)	(0.00)	(0.00)	(0.00)	

Notes: Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4.4 Method

Our aim in this paper is to estimate the treatment effect of player exclusion on the number of gambling machines. For our analysis, we mainly use the SDiD approach. To test for robustness, we use both the classical DiD approach (Angrist and Pischke, 2009) and the SCM developed by Abadie and Gardeazabal (2003) and further extended by Abadie et al. (2010, 2015).

The SDiD approach combines the strengths of classical DiD and SCM (Arkhangelsky et al., 2021). It uses the DiD's temporal comparison with the SCM's optimized weighting of control units to construct a more accurate counterfactual comparison group. Weighting optimized across groups and time can reduce biases and improve the reliability of estimates (Arkhangelsky et al., 2021). The SDiD method thus estimates the average treatment effect on the treated (ATT), providing a credible measure of the policy intervention's causal effect.

Formally, we estimate the ATT using the following optimization:

$$(\hat{\tau}_{sdid}, \hat{\mu}, \hat{\alpha}, \hat{\beta}) = \arg\min_{\tau,\mu,\alpha,\beta} \left\{ \sum_{i=1}^{N} \sum_{t=1}^{T} (Y_{it} - \mu - \alpha_i - \beta_t - W_{it}\tau)^2 \hat{\omega}_i^{sdid} \hat{\lambda}_t^{sdid} \right\} \tag{4.1}$$

Here, the outcome variable Y_{it} measures the number of gambling machines in gambling

halls (Y_{it}^{GH})/gastronomic establishments (Y_{it}^{GE})[2] i at time period t. To jointly capture both sub-markets in a single measure, we also use the difference in the number of machines between gambling halls and gastronomic establishments per municipality as outcome variable ($Y_{it}^{\Delta} = Y_{it}^{\text{GH}} - Y_{it}^{\text{GE}}$). We estimate the same SDiD as above with the same treatment indicator. The ATT on Y_{it}^{Δ} summarizes the two sub-market specific effects in one parameter and serves as a robustness check. The binary treatment indicator W_{it} equals 1 if the municipality i is subject to the player exclusion regulation at time t, and 0 otherwise. The estimation includes several critical components. The global intercept μ captures the overall average level of gambling machines. The unit fixed effects α_i control for municipality-specific, time-invariant characteristics, while the time fixed effects β_t control for temporal shocks common across municipalities. The estimated parameter τ measures the causal impact of implementing player exclusion policies. To ensure robust estimation, the SDiD approach applies optimized unit weights $\hat{\omega}_i^{sdid}$, constructing an ideal synthetic control that closely mirrors treated units based on pre-treatment dynamics. Similarly, optimized time weights $\hat{\lambda}_t^{sdid}$ ensure that the time periods which are most informative for establishing the counterfactual scenario receive higher weights. To account for observed time-varying confounders (i.e. *employment rate*, *long-term unemployment rate*, *young population*, *average age*), we implement SDiD with covariate adjustment and estimate the ATT on a residualized outcome $Y_{it}^{\text{res}} = Y_{it} - X_{it}'\hat{\beta}$, where $\hat{\beta}$ is obtained from a two-way fixed-effects regression of Y_{it} on the covariates (Arkhangelsky et al., 2021). For a more stable implementation of the covariate adjustment, we are using untreated observations, as explained by Kranz (2022).

In contrast, the traditional DiD estimator employs a similar fixed effects structure but applies equal weights across all units and periods:

$$(\hat{\tau}_{did}, \hat{\mu}, \hat{\alpha}, \hat{\beta}) = \arg\min_{\tau,\mu,\alpha,\beta} \left\{ \sum_{i=1}^{N} \sum_{t=1}^{T} (Y_{it} - \mu - \alpha_i - \beta_t - W_{it}\tau)^2 \right\} \tag{4.2}$$

The SCM optimally selects only unit-specific weights, omitting both optimized time weights and unit fixed effects:

$$(\hat{\tau}_{sc}, \hat{\mu}, \hat{\beta}) = \arg\min_{\tau,\mu,\beta} \left\{ \sum_{i=1}^{N} \sum_{t=1}^{T} (Y_{it} - \mu - \beta_t - W_{it}\tau)^2 \hat{\omega}_i^{sc} \right\} \tag{4.3}$$

[2]GH: Gambling halls, GE: Gastronomic establishments

4.5 Results

As outlined above, the analysis is composed of two primary regressions. Our study examines the impact of the exclusion program in Hesse on gambling machines on two different sub-markets, those located in gambling halls and those located in gastronomic establishments. We use the second regression to assess whether the gambling offer moves from markets with stricter regulation to markets with less stringent regulation. Furthermore, an analysis of the development in gastronomic establishments also serves as a robustness check.

Table 4.5 contains the results for the SDiD estimate in gambling halls and those for the SDiD estimate in gastronomic establishments. The estimated average treatment effect on the treated (ATT) is significant in both regressions. As treatment is assigned to a single group (all municipalities in Hesse), we assess the significance of our estimates using placebo inference with 500 iterations. In each iteration, the treatment is randomly reassigned to a similarly sized group of untreated municipalities. In both regressions the ATT is strongly significant. The introduction of the exclusion program in Hesse therefore leads to an average decrease of 8.17 machines in gambling halls per municipality relative to a synthetic control group without intervention. In gastronomic establishments, by contrast, there is a significant average increase of 11.11 machines. These findings supports the hypothesis that the gambling offer shifts toward the less regulated sub-market when enforcement in gambling halls tightens. As a validation of the sub-market results, we also estimate the ATT on the difference in machines between gambling halls and gastronomic establishments per municipality. The ATT is -18.48 (see Table 4.5). This indicates that, after 2014, the gap in Hesse shrinks by 18.48 machines per municipality relative to the synthetic control. This is consistent with the separate estimates of -8.17 for gambling halls and +11.11 for gastronomic establishments, which together imply a difference of approximately -19.28. Figure 4.1 visualizes the SDiD point estimates with 95% confidence intervals of the results of Table 4.5.

Table 4.5: SDiD results for gambling machines

Outcome	ATT	Std. Error	95% CI
Hesse X 2014 (Y_{it}^{GH})	-8.17^{***}	2.97	$[-14.00, -2.34]$
Hesse X 2014 (Y_{it}^{GE})	$+11.11^{***}$	1.87	[7.45, 14.78]
Hesse X 2014 ($Y_{it}^{\Delta} = Y_{it}^{\text{GH}} - Y_{it}^{\text{GE}}$)	-18.48^{***}	3.01	$[-24.39, -12.58]$

Note: *** p<0.01, ** p<0.05, * p<0.1.

GH: Gambling halls, GE: Gastronomic establishments.

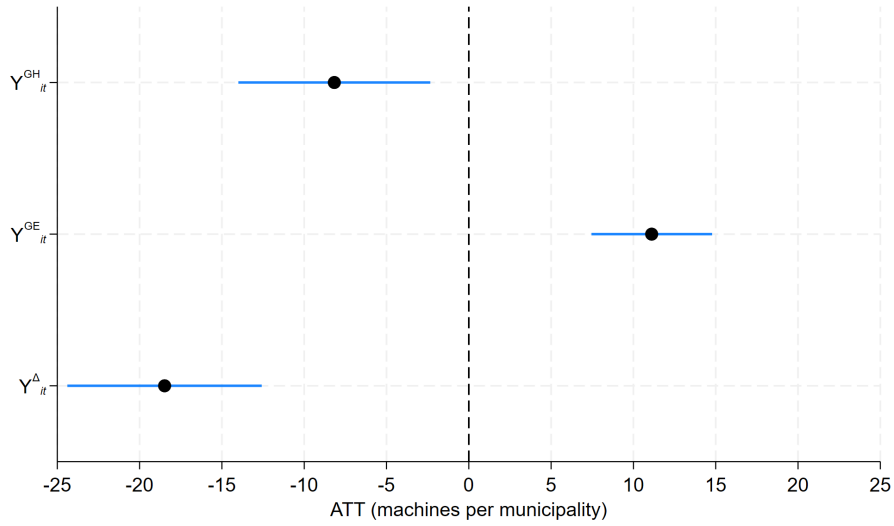
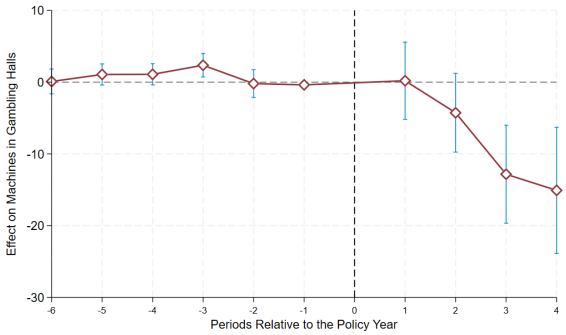
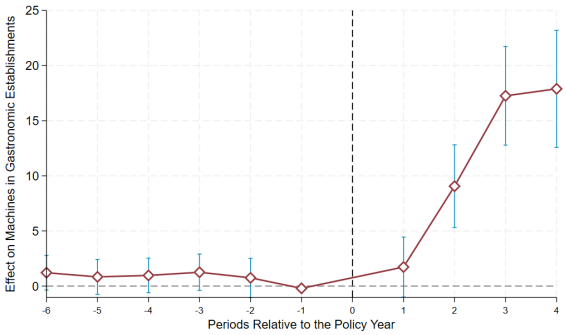


Figure 4.1: Point estimates and 95% confidence intervals for SDiD ATTs.

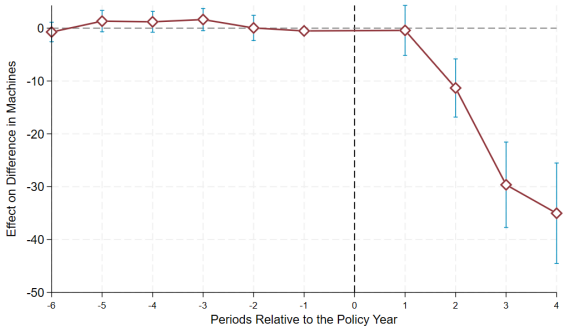
As a complement to the ATT in Table 4.5, Figure 4.2 shows the SDiD event-time dynamics relative to the policy year 2014 ($k = 0$) with baseline $k = -1$, using placebo inference with 500 iterations. These dynamic effects illustrate how the impact of the policy evolves across individual time periods before and after its introduction. While the ATT summarizes the average effect over all post-policy periods, the event-time coefficients also reveal whether and how the effect changes immediately after the introduction and whether it strengthens or weakens over time. It also serves as a diagnostic for the parallel-trends assumption since pre-policy coefficients close to zero suggest that there are no systematic differences before the treatment that could bias the results. As can be seen in Figure 4.2 the pre-treatment coefficients for our models are close to zero. After the introduction of the exclusion program, we observe a sustained decline in gambling hall machines and a pronounced increase in gastronomic establishments. While the increase in machines in gastronomic establishments sets in almost immediately after the policy change, the decline in gambling halls shows a more gradual pattern. One possible explanation is that individuals who would have opened a gambling hall decided to open gastronomic establishments once the new restrictions became binding, leading to a fast increase in that segment. By contrast, the delayed decline in gambling halls may be driven by the high persistence of existing licenses. This could explain the observed lagged adjustment in gambling halls compared to the immediate response in gastronomic establishments. This is consistent with the delayed effect on the difference in machines Y^{Δ}_{it} (see Figure 4.2c).



(a) Gambling halls (Y_{it}^{GH})



(b) Gastronomic establishments (Y_{it}^{GE})

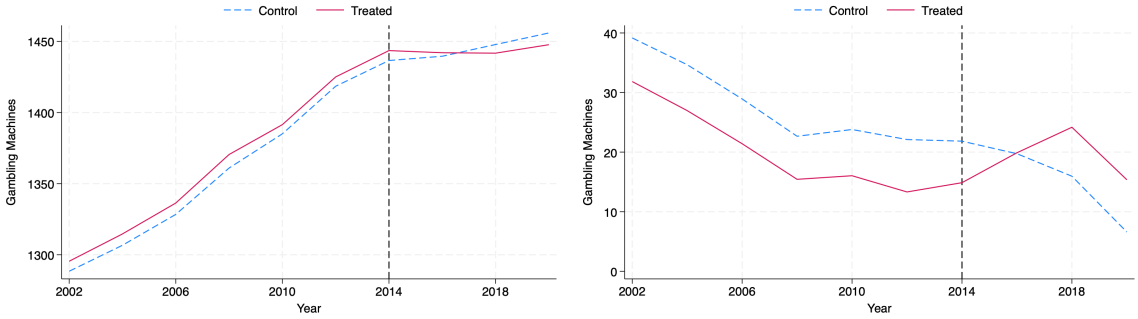


(c) Difference in machines (Y_{it}^{Δ})

Figure 4.2: SDiD Event-Time dynamic effects of exclusion program in Hesse

Figure 4.3a shows the development of the number of machines in gambling halls in the treated municipalities, i.e., those that are in Hesse, compared to the synthetic control group. Similarly, Figure 4.3b shows the development of machines in gastronomic establishments.[3] The vertical line marks the introduction of the exclusion program in 2014. Both graphs clearly show that the trends are close and approximately parallel in the pre-treatment period, suggesting a good pre-treatment fit and supporting a causal interpretation of the results. After the implementation of the exclusion program, the trend of the curves changes significantly. This can be seen for both the gambling machines in gastronomic establishments and those in gambling halls. Accordingly, our graphical results (Figure 4.2 and Figure 4.3) support the previously estimated ATT and underline the plausibility of a causal relationship between the exclusion program and the assumed migration to the less regulated sub-market.

[3]For the plot of Y_{it}^{Δ} see Figure D.1 in the Appendix



(a) Gambling halls **(b)** Gastronomic establishments

Figure 4.3: SDiD Plot - Hesse vs. Synthetic Control

Although estimating effects for both sub-markets and estimating the difference already provides a form of robustness, we additionally validate our findings using alternative econometric approaches. We implement two other robustness checks to validate the consistency of our main results. First, we replicate our analysis using the SCM. Second, we perform a classical DiD analysis as an additional verification. The robustness checks allow us to evaluate the reliability of our main findings across alternative empirical methods. Table 4.6 summarizes these results. Both the SCM and the DiD model show significant results in both regressions and are therefore consistent with the results shown above. Accordingly, our results are consistent across all methods applied.

Table 4.6: Robustness check using DiD and SCM

	Gastronomic Establishments			Gambling Halls		
Method	ATT	Std. Error	95% CI	ATT	Std. Error	95% CI
DiD	$+7.50^{***}$	2.64	[2.32, 12.68]	-17.86^{***}	6.09	[−29.79, −5.93]
SCM	$+12.61^{***}$	2.78	[7.18, 18.05]	-34.46^{**}	16.58	[−66.95, −1.97]

Note: *** p<0.01, ** p<0.05, * p<0.1.

Finally, we restrict the sample to observations through 2018 as another robustness check. Considering Figures 4.3a and 4.3b, a change can be observed from 2018 to 2020. This can be explained by the policy change from three to two machines in gastronomic establishments. Accordingly, Figure 4.3b shows a decline in the number of machines in gastronomic establishments and Figure 4.3a shows a minimal increase in machines in gambling halls. Despite the policy change, our results still show an increase in the number of machines in gastronomic establishments (+11.11). Nevertheless, we have estimated an additional robustness check to rule out possible bias. We restrict the sample to observations through 2018. The results remain statistically significant (see Table D.1 in the Appendix).

4.6 Discussion

Our results show a significant decline in the number of gambling machines in gambling halls following the introduction of the exclusion program in Hesse. Equivalent to the decrease in gambling halls, our results also show a significant increase in gastronomic establishments. This is also confirmed by our estimation of the difference between machines in gambling halls and gastronomic establishments. This pattern suggests that there has been a regulation-induced substitution effect. This finding raises questions about the effectiveness of the State Treaty on Gambling in achieving its objectives of channeling gambling into regulated environments and protecting players.

The results show an ambivalent picture of regulatory effectiveness. On the one hand, they illustrate the intended effect of the exclusion program in terms of a reduction in the number of gambling machines in gambling halls. On the other hand, they suggest a significant shift to less monitored and regulated sub-markets. The observed decline in the number of gambling machines in gambling halls can be interpreted as a success in terms of the objectives of the State Treaty on Gambling. The State Treaty primarily aims to channel gambling offers into regulated, controllable environments and to prevent problematic gambling behavior. The exclusion program is a key instrument for limiting vulnerable groups' access to gambling. Earlier studies like Meyer and Hayer (2010) were able to show that gambling exclusion can reduce the gambling behavior of pathological gamblers. These findings are also supported by Ladouceur et al. (2007) and Nelson et al. (2010).

At first glance, the introduction of the exclusion program in Hesse in 2014 might be viewed as a success concerning the goals of the State Treaty on Gambling. However, given the notable increase in gambling machines in the gastronomic sector, it is clear that gambling activity shifted to another sub-market that was not subject to an exclusion program at the time. Further support for this interpretation comes from the legal reduction in the number of machines permitted in gastronomic establishments. Even though since 2019, gastronomic establishments have been legally allowed to operate only two rather than three machines, our results show a stronger increase in the number of machines in gastronomic establishments.

Gastronomic establishments exceeding two machines fall into the illegal market. An example of illegal activity is provided by the sham gambling halls described by Trümper and Heimann (2020). These establishments present themselves as gastronomic establishments, but in

practice they operate in a manner indistinguishable from licensed gambling halls. By doing so, operators are able to avoid the strict regulations that apply to gambling halls in contrast to gastronomic establishments. The migration toward less regulated sub-markets, including the gastronomic sector and the black market, contradicts the primary objectives of the State Treaty on Gambling.

Such evasive reactions have also been observed in other gambling markets. Rolando et al. (2020) show that in Italy, industry often argue that supply restrictions could lead to a shift toward illegal or informal markets. Kairouz et al. (2017) highlight that even the existence of a state online supply does not guarantee channelization if the unregulated supply remains more attractive from the user's perspective. Our results suggest that a comparable mechanism also applies to the terrestrial market in Germany. If gastronomic establishments are subject to less systematic control and regulation, this market segment represents an obvious escape valve for providers and players.

In this context, it is important to examine whether the introduction of the nationwide exclusion program in 2021 aligns with the objectives of the State Treaty on Gambling. Positively, it must be emphasized that the nationwide regulation established the first comprehensive exclusion program across all gambling forms. This makes the previously observed evasion into unregulated or less regulated sub-markets more difficult and thus increases the overall effectiveness of player protection. Additionally, uniform nationwide implementation is beneficial from a regulatory standpoint. Divergent state-level regulations not only create regulatory inconsistencies but can also promote so-called border effects. Haucap et al. (2023), for example, show a significant likelihood for casinos near state and federal borders. In this way, it is possible to capture cross-border demand and share potential social costs with neighboring states. However, such practices conflict with the core objectives of the State Treaty on Gambling. According to Haltern (2004), fiscal motives should not be the main reason for gambling offer, but should rather serve at most as a positive side effect. Furthermore, the State Treaty is not intended to specifically channel foreign players. Especially in Germany, there is high potential for border effects if there is different regulation across 16 federal states. If individual federal states implement stricter regulations, such as a gambling exclusion programs, with neighboring federal states which maintain fewer regulations or none at all, regulatory fragmentation can result. Operators may deliberately position themselves near borders to benefit from less stringent regulations while attracting players from neighboring areas with more stringent regulations. This

behavior would undermine the State Treaty's objectives. Therefore, consistent nationwide regulation are even more important for effective player protection and preventing regulatory arbitrage. The introduction of the nationwide exclusion program established in 2021 is already an important and appropriate step toward meeting the objectives of the State Treaty on Gambling. An EU-wide solution could help achieve these goals even more effectively. Border effects also exist at the state level. Consumers who are banned in Germany can easily continue to play in neighboring states. Germany in particular would benefit from an EU-wide solution, as it borders more EU states than any other member state and has the longest land border, stretching 3,714 kilometers.

Despite our general support for the nationwide exclusion program, it must be acknowledged that the effectiveness of this regulation greatly depends on practical implementation. Significant shortcomings are already evident within regulated gambling halls. For instance, Hayer et al. (2020) document that, despite legal obligations, a notable proportion of banned individuals continued to access gambling halls in Hesse. Same issues are shown by the results of Meyer et al. (2015) and Nelson et al. (2010). This implementation gap represents a fundamental weakness in the regulation. The situation in gastronomic establishments with gambling machines appears even more problematic. Ensuring enforcement with exclusion programs is likely even more challenging in gastronomic establishments. Unlike gambling halls, many gastronomic establishments lack specially trained staff for their gambling offers, greatly reducing the feasibility of effective enforcement. This is consistent with findings by Motka et al. (2018), who emphasize that many terrestrial exclusion programs suffer from complex enrollment procedures, lack of trained staff, and insufficient informational outreach. In addition, Trümper and Heimann (2020) argue that supervisory authorities are already overwhelmed by the precise monitoring of gambling machine numbers in gastronomic establishments. These structural control deficiencies underscore that consistent enforcement of the gambling exclusion program in gastronomic establishments seems highly unrealistic. This not only undermines player protection, but also creates false incentives for providers and players to withdraw into less controlled sub-markets. Hayer et al. (2020) show that banned players specifically look for opportunities to continue their gambling activities, a behavior that might be encouraged by insufficiently controlled gastronomic establishments. Moreover, Nelson et al. (2010) found that only 13% of participants in a lifelong exclusion program abstained from gambling over a longer period of time and 50% of self-excluded players were able to bypass the exclusion program.

Consequently, it is necessary to question whether the current implementation of player exclusion effectively achieves two of the primary goals of the State Treaty on Gambling, channeling gambling activity into legal and controlled environments and to protect the players. Our analysis suggests that only establishing regulatory instruments is insufficient. The practical implementation and monitoring of the regulation is at least as important. Neglecting these aspects risks symbolic regulation with potentially even negative effects. Effects, such as the strengthening of black or less regulated markets. Finally there is a fundamental challenge in regulatory economics. If a market segment is over-regulated, the incentive to shift to gray or informal segments could increase. If there is too little regulation, there is a risk of social costs. An effective regulatory framework should therefore be characterized by coherence, equal treatment, and practicable enforcement otherwise there is a risk of only formal but ultimately ineffective symbolic policy.

Limitations

In our analysis, we use the number of gambling machines as a proxy for the gambling offer. While this provides a reasonable approximation of the availability of gambling opportunities, it does not capture the overall demand. A more precise measure would be gambling turnover, since the demand of gambling can be better explained by the intensity of use of the gambling machines. For example, locations with few but heavily used machines may contribute more to local gambling activity than locations with many machines that are only used sporadically. As Trümper and Heimann (2020) correctly note, the revenue generated by gambling machines in gastronomic establishments already matches or even surpasses that of gambling halls. However, turnover data at the level of individual establishments is not available at the municipal level. Despite this limitation, the number of gambling machines represents a realistic and consistent proxy for gambling offer in both gambling halls and gastronomic establishments.

Another important point is that informal, unlicensed, or illegal gambling activities are not captured in the data we use. Our analysis reflects only the legal market. Sham gambling halls are not included in official statistics. According to Trümper and Heimann (2020), such establishments are increasingly gaining market relevance. Reliable data on these sham gambling halls, as well as on entirely illegal gambling operations in the black market, are difficult to collect systematically. Yet these segments are particularly important for a comprehensive assessment of the State Treaty's effectiveness, particularly in terms of player

protection and channeling. As a result, our findings may underestimate the degree to which players are shifting to less regulated markets. To fully understand market dynamics, further qualitative fieldwork and targeted investigations into unregistered gambling establishments would be necessary.

Also the question of the extent to which the shift will affect the actual gambling behavior of vulnerable player groups remains unanswered. As our analysis is based on aggregated machine data, individual usage patterns, risk behavior or violations of exclusion programs cannot be shown. It would therefore be ideal to further investigate the effects of regulation at micro level, for example, through player surveys, individual data on gambling behavior or qualitative case studies on sham gambling halls.

4.7 Conclusion

The aim of this study was to investigate whether the introduction of the exclusion program in Hesse has led to a shift of gambling offers from regulated gambling halls to less controlled sub-markets, in particular gastronomic establishments. The focus relies on the question of whether the regulatory measure has caused unintended alternative reactions that could counteract the channeling objective of the State Treaty on Gambling. Our question is particularly relevant with regard to the nationwide introduction of the exclusion program. With the nationwide introduction of the exclusion program as part of the State Treaty on Gambling, the long-term effects observed in our study take on a possible forward-looking character. They provide initial empirical indications of possible structural shifts that could also be expected nationwide.

Our empirical analyses based on an SDiD approach consistently and significantly show that the introduction of the exclusion program in Hesse leads to an average decrease of 8.17 machines in gambling halls in a municipality compared to a synthetically constructed control group without intervention. In gastronomic establishments, on the other hand, there is a significant increase of 11.11 machines on average. These results are also confirmed by our estimation of the difference between machines in gambling halls and gastronomic establishments, with a shrinking gap of 18.48. This finding provides strong support for the hypothesis that gambling activities shift to less regulated sub-markets following stricter enforcement in gambling halls. Less regulated and controlled markets could potentially increase the risk of players migrating toward illegal gambling options or pathological gambling behavior. Our findings suggest

that the effectiveness of the regulatory intervention in complying with the player protection and market channeling goals of the State Treaty remains limited under current enforcement conditions. Although studies such as Ladouceur et al. (2007), Meyer and Hayer (2010) and Nelson et al. (2010) show the effectiveness of exclusion programs in reducing problematic gambling behavior, our analysis indicates that a non-market-wide implementation can lead to a shift to less controlled markets, thus undermining the central objectives of the State Treaty.

With the introduction of the nationwide exclusion program across all forms of gambling from 2021, an important step has been taken toward coherent and effective player protection, particularly in comparison to the exclusion program analyzed in this study. Nevertheless, our analysis shows that the mere existence of regulatory instruments is not enough. Effective gambling regulation requires consistent, practicable implementation and monitoring, especially in areas that are difficult to control, such as gastronomic establishments. Otherwise, there is a risk of regulatory arbitrage and a shift to less regulated markets, which would undermine the objectives of the State Treaty on Gambling and result in symbolic rather than effective policy. Despite the nationwide exclusion program, we suggest an EU-wide exclusion program to achieve the goals even more effectively. This is particularly relevant for Germany, as it borders more EU states than any other member state and has the longest land border.

Effective regulation requires not only clear legal requirements and their practicable implementation, but also a continuous and independent evaluation of their effectiveness. In order to further develop regulatory instruments in a targeted manner and identify unintended side effects at an early stage, the effectiveness of regulation should be regularly reviewed through independent research. It is important that there are no conflicts of interest, for example through third-party funding from industry, as both political decision-making processes and scientific analyses are potentially susceptible to lobbyist influence. If regulation is not objectively scrutinized and further developed, there is a risk that it will degenerate into symbolic policy or even a negative impact for the population and fail to achieve its actual protective purpose.

Appendix

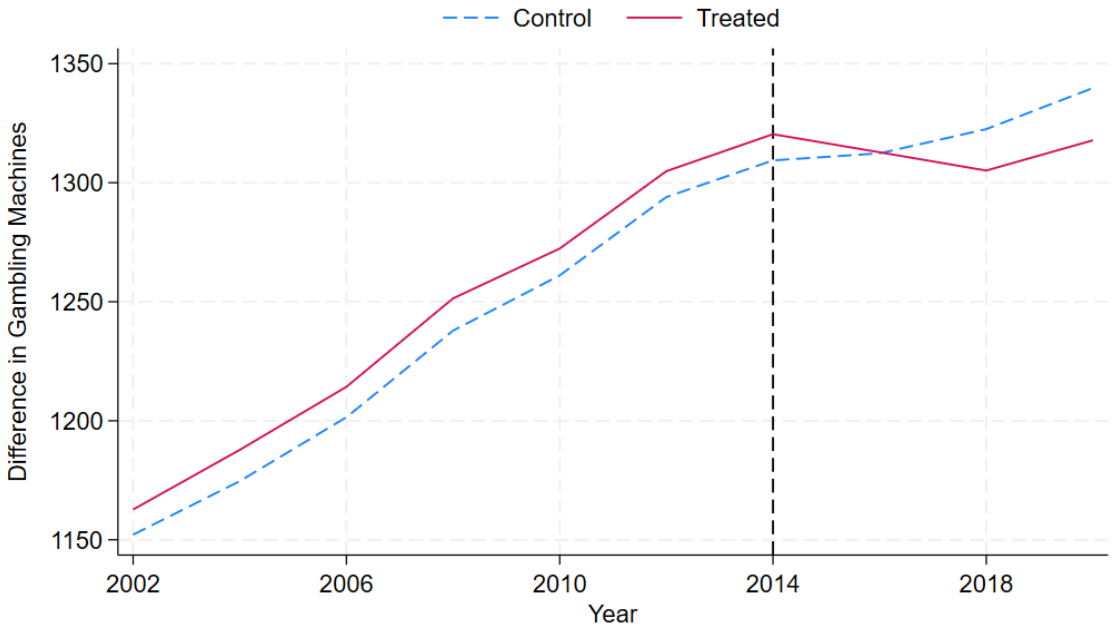


Figure D.1: SDiD Plot: Difference in machines of gambling halls and gastronomic establishments

Table D.1: Results of SDiD with restricted data

Venue Type	ATT	Std. Error	95% CI
Gambling Halls	-6.67^{**}	2.95	$[-12.46, -0.89]$
Gastronomic Establishments	$+8.37^{***}$	1.89	[4.66, 12.07]

Note: *** p<0.01, ** p<0.05, * p<0.1.

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Eidesstattliche Versicherung

Ich, Herr Talha Şimşek, versichere an Eides statt, dass die vorliegende Dissertation von mir selbstständig und ohne unzulässige fremde Hilfe unter Beachtung der „Grundsätze zur Sicherung guter wissenschaftlicher Praxis an der Heinrich-Heine-Universität Düsseldorf“erstellt worden ist.

Köln, der 2. Oktober 2025 Unterschrift: _____

Statements of Contribution

Statement of Contribution

My co-authors Justus Haucap and Radivoje Nedic contributed to the chapter

> "Regulatory Objectives vs Fiscal Interests: Are German Casino Locations Motivated by Beggar-Thy-Neighbor Policy? An Empirical Analysis"

of my dissertation

> "Four Essays in Industrial Organization and Public Policy."

All authors contributed *equally* to this chapter.

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> "Four Essays in Industrial Organization and Public Policy."

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of my dissertation

> "Four Essays in Industrial Organization and Public Policy."

All authors contributed *equally* to this chapter.

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Statement of Contribution

My co-author Radivoje Nedic contributed to the chapter

> "Player Exclusion and Sub-Market Substitution: Synthetic DiD Evidence from Germany's Gambling Machine Market"

of my dissertation

> "Four Essays in Industrial Organization and Public Policy."

All authors contributed *equally* to this chapter.

Signature of Radivoje Nedic: _____