Impacts of smoking ban policies on billiard halls sales in South Korea using objective sales information of a credit card company: A quasi-experimental study

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Abstract

Background: Smoking ban policy (SBP) is a potent health intervention and offers the potential to influence anti-smoking behavior. The Korean government completely has prohibited smoking in indoor sports facilities, including billiard halls, since the government revised the National Health Promotion Act in December 2017.

Objective: This study aimed to examine the impact of the SBP on indoor sports facilities on billiard halls' economic outcomes.

Methods: This study used credit card sales data of the biggest card company in South Korea. Data are from January 2017 to December 2018. We examined monthly sales data in 28 administrative neighborhoods in Seoul, capital city of South Korea. We conducted the interrupted time series model using the fixed effects model and the linear regression with panel corrected standard errors (PCSE).

Results: Billiard halls' sales and transactions were not significantly changed after the introduction of the smoking ban in the full PCSE models. R-squared of the full PCSE model was 0.967 for sales and 0.981 for transactions.

Conclusions: SBP had no substantial economic gains or losses in the sales and transactions in billiard halls. Health policy makers can actively expand the application of SBP and make effort to enhance the social awareness of the need and benefits for public SBP in both the smokers and the owners of hospitality facilities. Clinical Trial: N/ASmoking ban policy; indoor sports facility; South Korea; Economics

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Abstract

Background: Smoking ban policy (SBP) is a potent health intervention and offers the potential to influence anti-smoking behavior. The Korean government completely prohibited smoking in indoor sports facilities, including billiard halls, since the government revised the National Health Promotion Act in December 2017.
Objective: This study aimed to examine the impact of the SBP on the economic outcomes of indoor sports facilities, particularly billiard halls.
Methods: This study used credit card sales data of the largest card company in South Korea. Data are from January 2017 to December 2018. Monthly sales data were examined across 23 administrative neighborhoods in Seoul, the capital city of South Korea. We conducted the interrupted time series model using the fixed effects model and the linear regression with panel corrected standard errors (PCSE).
Results: The sales and transactions of billiard halls were not significantly changed after the introduction of the smoking ban in the full PCSE models. R-squared of the full PCSE model was 0.967 for sales and 0.981 for transactions.
Conclusions: SBP had no substantial economic gains or losses in the sales in billiard halls. In addition to existing price-based policies, the enhanced SBP in public-use facilities, such as billiard halls, can have a positive synergistic effect on reducing smoking prevalence and preventing secondhand smoke. Health policy makers can actively expand the application of SBP and make effort to enhance the social awareness regarding the necessity and benefits of public SBPs for both the smokers and the owners of hospitality facilities.

Keywords: Smoking ban policy; indoor sports facility; South Korea; Economics

Introduction

Background

It is well-known that exposure to secondhand smoke causes death, and illness. The WHO has estimated that tobacco smoking kills seven million people per year globally, of which 890,000 are due to secondhand smoke [1]. In the USA, the prevalence of secondhand smoke exposure among nonsmokers diminished during 1988–2014, from 87.5% to 25.2%. However, there was no change in exposure between 2011-2012 and 2013-1014, and about one in four nonsmokers was still exposed to secondhand smoke during 2013–2014 [2].

Prior studies reported that Korea belongs to countries with high prevalence of tobacco smoking [3,4], and the prevalence of smokers had decreased markedly by 2021 [5]. However, it is still high compared to other Organization for Economic Cooperation and Development (OECD) countries [6], which means that people are considerably exposed to health threats and risks of secondhand smoke.

Between 2007 and 2018, the exposure rate to secondhand smoke among Korean adults decreased by 10.7 %, and the exposure rate to secondhand smoke in indoor working areas decreased by 34.5% [6]. The reduction in the exposure rates to secondhand smoke in indoor working areas and the public regions was especially prominent after 2012, most probably due to the continuous expansion of the non-smoking zones [7].

Smoking ban policy (SBP) is a potent health intervention and offers the potential to influence anti-smoking behavior. There has been an increase in the number of SBP in countries globally, including Australia, England, and the USA, aligning with an increase of knowledge on the risk of secondhand smoke [8]. Indeed, with the introduction of SBP, it leads to a decrease in exposure to secondhand smoke, improves indoor air quality, protects workers, reduces adult and youth smoking level, decreases hospitalizations of acute myocardial infractions, and promotes respiratory health [9-

11]. Notwithstanding the benefits of SBP, the owners of hospitality facilities, including restaurants, bars, and billiard halls, have vigorously opposed the policy to curb smoking in the places, arguing that the SBP will result in economic hardship for them. This argument suggests that a complete ban on smoking in the places would discourage people from dining out, negatively affecting sales. However, there are many evidences from the USA, Korea, Australia, and European countries indicating that economic performance did not be affected by the SBP [12-15].

In accordance with the global trends of implementing SBP, indoor sports facilities (e.g., billiard halls) in South Korea were regulated by the SBP as completely non-smoking areas, since the Korean government revised the National Health Promotion Act (NHPA) to prohibit smoking in all indoor spaces in December 2017 [16]. This change in SBP has led owners of indoor sports facilities to feel that the policy may influence their economic profit negatively, despite no significant change in sales. Indeed, the effectiveness of SBP has been evaluated by studies in other countries demonstrating whether SBP affects economic profit. Previous works have consistently highlighted the effect of SBP on sales in various indoor places such as restaurants and bars. For example, a prior study that included a sample of all 88 counties in the state of Ohio demonstrated that there was no significant difference in bar and restaurant sales following a statewide SBP between border regions in Ohio and non-border areas [17]. The SBP in Ohio did not differentially influence the sales revenue for bars and restaurants located in counties where the border is shared with five other non-smoke-free states, compared to those non-border counties. Another study supported evidence that the SBP did not significantly affect facility sales, as the overall impact on sales in bars was negligible [18]. The SBP was related to an increase in sales in medium to large bars in the rural region of Ireland and a small reduction in sales among large bars in the urban. These findings from prior works support evidence for justification of the continued use of SBP to prevent the general public from exposure to secondhand smoke. Yet, there is a lack of evidence of the effects on business revenues in indoor sports facilities between amended ban policy, even though many studies have been steadily involved

in such research based on other indoor places. Moreover, it is crucial to assess the effect of the SBP, whether it resulted in a positive or negative economic impact. The results of the economic impact are important to give evidence to visitors and owners of indoor sports facility.

Objective and Hypotheses

To date, there has been a little study for changes in business revenues of indoor sports facilities, especially billiards halls, since the SBP was introduced in South Korea. This study aimed to examine the impact of the SBP on indoor sports facilities on billiard halls' economic outcomes using actual revenue data from the largest card company in South Korea. Thus, based on the evidence that hospitality facilities' sales were not affected by SBP [14,19,20], we hypothesized that the introduction of the SBP does not significantly affect billiard halls' sales.

Methods

Data

This study used sales data from Shinhan Card Big Data Center. The data included Shinhan credit, debit, and check card sales information from January 2017 to December 2018. Shinhan Card holders were 12 million in 2015, 44.6% of the economically active population in South Korea [21,22]. Shinhan Card has the largest market share (21.7%) in Korea, 2017 [23]. In 2016, 80% of all private consumption in South Korea was made by card payment. A payment method survey in South Korea reported 94% of Seoul citizen had one or more credit cards and 98% of Seoul citizen had one or more debit/check cards in 2013 [24]. The cash transactions were not included in out data, but the correlation between sales information provided by Shinhan Card data and retail sales information of Statistics Korea was 0.92 [25]. The correlation between the sales information from all card companies in Korea and the data of Shinhan Card was 0.97 [25]. Our data is suitable to assess the effect of the policy.

Three districts in Seoul were selected for this analysis; Nowon district (533,498 population in

2019, 35.44 km^2), Secho district (430,697 population in 2019, 46.98 km^2), and Songpa district (675,843 population in 2019, 33.88 km^2). Population in Seoul is 9,729,107 in 2019, the three districts account for 16.9% of Seoul population, and 19.2% of Seoul area. Regional experts at the Seoul Institute selected the districts with considering the percentage of aged 20-59, health behaviors (smoking, drinking, and obesity), income level, environmental factors (park space per capita, number of smoking areas), and similarity of z-score per each factor with the average of Seoul.

A unit of analysis was neighborhood-month. Neighborhood in Korea is ‘dong’, a sub-municipal level administrative unit of a city. We aggregated the individual billiard hall data into the neighborhood level. As the unit of analysis is not a human subject, this study does not require approval from an institutional review board.

Ethical considerations

This research used aggregated sales data from billiard halls by region. It is not subject to ethical considerations.

Variables

The dependent variables were sales per neighborhood-month and transactions per neighborhood-month. The total sales information was aggregated from credit, debit, and check card use. 1,100 Korean won (KRW) was exchanged for one US dollar (USD).

Based on the previous studies for retail sales [14,26,27], following factors were considered as the independent variables; socioeconomic factors of customers and region, seasonal factor, weather factor, employee factor, overall economic status. The data consisted of neighborhood-month, so it was impossible to consider the characteristics of individual customer and specifics of the store. Therefore, regional socioeconomic factors, seasonal factor, and economic factor were included as the independent variables in our study. The research model and control variables are shown in Figure 1 (Figure 1).

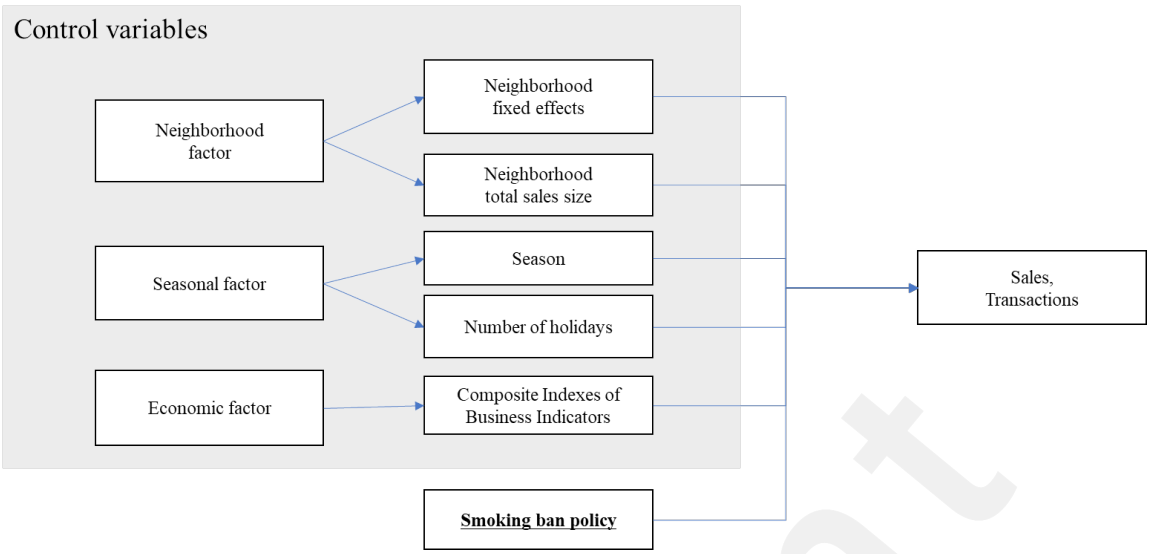

Figure 1. Research model and control variables of this study

Neighborhood total sales size represented overall economic size of neighborhood. Neighborhood total sales size summarized all monthly credit, debit, and check card use in all business type except for online shopping, university tuition, insurance fee, taxes, and utility bills. As revenue is largely influenced by the total sales size of the neighborhood, it is an important covariate to analyze billiard hall's sales. Season and number of holidays per month were included as seasonal factors. Seasons were classified into spring, summer, fall, and winter. It represented that customers prefer to visit indoor facilities during summer and winter. Some billiard halls close on holidays; on the other hand, others are crowded on holidays. Composite Index of Business Indicator (CI) was included to adjust overall economic condition in Korea [28].

Statistical Analysis

Wilcoxon signed-rank test was used to assess the mean difference between before and after introducing the policy. Our data were balanced panel data. Data constituted Time-series-cross-section (TSCS) data, consisting of 24 months and 23 panels. While the fixed-effects (FE) model is commonly applied to analyze TSCS data, the assumptions of independence and identical distribution

(i.i.d.) are prone to violation due to panel heteroskedasticity, contemporaneous correlation, serial correlation, and non-stationarity [29]. To identify these violations, we employed various tests: the Wooldridge test for serial correlation, the Pesaran cross-sectional dependence test for contemporaneous correlation, and the likelihood ratio test using Wiggins and Poi's method for panel heteroskedasticity [30]. With the results of these tests, panel heteroskedasticity, serial correlation, and contemporaneous correlation were significantly observed.

Therefore, A regression model with panel corrected standard errors (PCSE) was the most suitable approach for our data [31]. The PCSE model is known to provide robust estimation for TSCS data when T>=15. Since the number of panel and the number of time points are almost the same, we conducted a fixed effects (FE) model with robust standard errors to assess the robustness although there was contemporaneous correlation.

The full regression model would be as follows. The interrupted time series (ITS) model, a quasi-experimental analysis, was applied in the analysis [32]. ITS is a well-known method to analysis the effects of policies. It provides a policy effect by comparing the actual outcome with the potential outcome assuming that the baseline trend would be extended if the policy were not introduced [33].

$$Y_{it} = \beta_0 + \beta_1 month_t + \beta_2 policy_t + \beta_3 month_{¿t} + \beta_4 neighborhood\ total\ sales ¿¿ it + \beta_5 season_t + \beta_6 holidays_t + \beta_7 CI$$

Y: dependent variable; *t*: time period (month); *policy*: an indicator for the introduction of the policy introduced (0: before the introduction of the policy and 1: after the introduction of the policy); *D*: dummy variables for neighborhood fixed effects.; and ε: error term. β_2 and β_3 represents the effects of the policy. β_2 represents the level change due to the policy, β_3 represents the trend change after the policy introduced, compared to the baseline time trend (β_1¿. The effects of policy can be calculated with considering both β_2 and β_3 after the time point when the policy is introduced. For

example, the one-year effect of SBP is calculated as $\beta_2+\beta_3\times 12$.

Results

General characteristics of the study data are shown in Table 1. The changes of sales information and neighborhood total sales size of billiard halls were insignificant in all three districts. Only the transaction of billiard halls in Secho district was significant. It implies a decrease in the number of card payments. Since the sales in Secho district did not change significantly, customers might be paying more per visit (Table 1).

Table 1. General characteristics of the study data by districts

Variables		Nowon (N=5)			Secho (N=6)			Songpa (N=12)		
		Before	After	p-value	Before	After	p-value	Before	After	p-value
Billiard halls	Log (sales per neighborhood-month) (100 USD)	5.7±1.1	5.7±1.2	0.999	5.9±1.3	5.7±1.7	0.063	5.4±0.9	5.4±0.9	0.301
	Log (transactions per neighborhood-month)	7.9±1.2	7.9±1.2	0.313	7.9±1.3	7.7±1.6	0.031	7.5±0.8	7.4±0.9	0.110
Log (neighborhood total sales size) (1 million USD)		7.3±0.7	7.2±0.7	0.438	7.7±1.3	7.6±1.7	0.688	7±0.7	7.1±0.8	0.027

N: the number of neighborhoods.

Figure 2 shows the monthly trends of sales of districts. The trends of billiard halls monthly sales in three districts were almost flat (Figure 2).

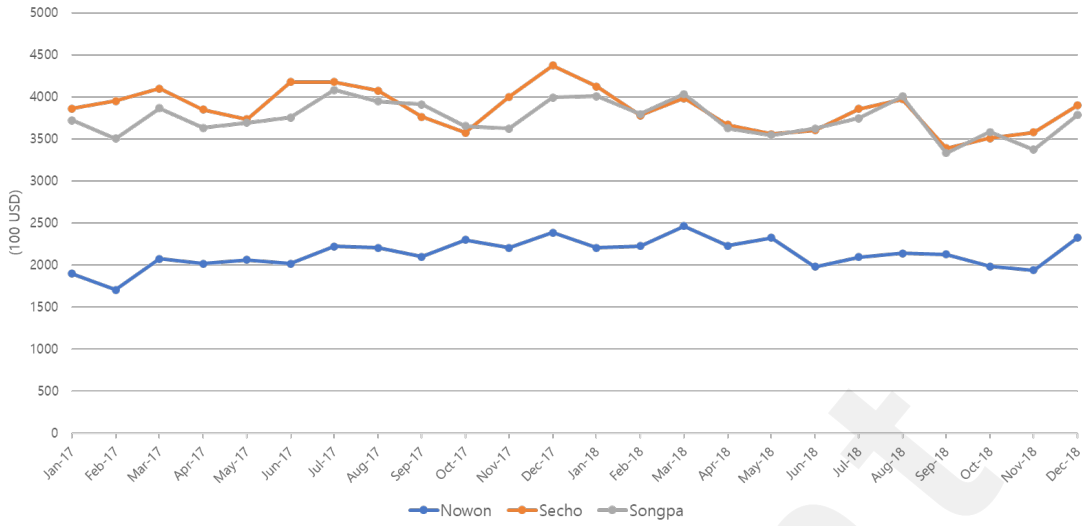

Figure 2. The trends of the monthly sales of billiard halls.

Table 2 shows the results of FE and PCSE regressions. PCSE regression with fixed effect term and control variables showed the highest R-squared in both sales and transactions model. Our interesting variables were SBP and month after the policy. In the model 5, the highest R-squared model, the SBP's coefficient (β_2 was 0.0767. It represented the dependent variable was increased by 0.0767 constantly after SBP. The month after the policy (β_3 was -0.0123. It showed the dependent variables decreased by 0.0123 every month since the policy was introduced. However, both variables were not significant in all models for sales. Month after the policy variables in transaction models were significant in FE model and PCSE only with regional fixed effects model, but they were not significant in the full PCSE model. There were little evidence that the sales were affected by the SBP in billiard halls.

Composite Index of Business Indicator was not significant for both sales and transactions, but it shows the positive relationship. It might be there were no significant macro-economic issues from 2017 to 2018. Log (neighborhood total sales size) was significant for both sales and transactions; it represents the billiard hall business was strongly affected by the economic status of its location. Compared to spring, only sales in winter were significantly higher. However, transactions were not

significant in winter, compared to spring. It meant that people are likely to visit billiard halls and stay longer in winter season. Transactions in summer was significantly higher than spring (p-value=0.049). Number of holidays was not significant for both sales and transactions.

Table 2. Effects of the smoking ban policy on log (monthly sales) and log (monthly transactions) of billiard halls.

	Log (monthly sales)					Log (monthly transactions)				
	Model 1 FE	Model 2 FE	Model 3 PCSE	Model 4 PCSE	Model 5 PCSE	Model 1 FE	Model 2 FE	Model 3 PCSE	Model 4 PCSE	Model 5 PCSE
Month (β_1)	0.0038	-0.0041	0.0054	0.0040	-0.0008	0.00697	-0.0002	0.0114	0.0083	0.0041
	(0.455)	(0.534)	(0.780)	(0.578)	(0.911)	(0.147)	(0.973)	(0.587)	(0.266)	(0.506)
Smoking ban policy (β_2)	0.0289	0.0977	-0.0034	0.0092	0.0767	-0.00611	0.0520	-0.0575	-0.0364	0.0237
	(0.539)	(0.060)	(0.967)	(0.887)	(0.221)	(0.866)	(0.134)	(0.478)	(0.574)	(0.647)
Month after the policy (β_3)	-0.0233	-0.0150	-0.0121	-0.0197	-0.0123	-0.0288*	-0.0233	-0.0208	-0.0258*	-0.0191
	(0.068)	(0.076)	(0.697)	(0.069)	(0.405)	(0.020)	(<.001)	(0.519)	(0.023)	(0.119)
CI		0.0197			0.0561		-0.0035			0.0501
		(0.768)			(0.657)		(0.935)			(0.630)
Log (neighborhood total sales size)		1.1220			1.0210		0.9971			0.9012
		(<.001)			(<.001)		(<.001)			(<.001)
Summer		0.0452			0.0633		0.0450			0.0577
		(0.065)			(0.073)		(0.066)			(0.049)
Fall		0.0308			0.0239		0.0024			-0.0040
		(0.297)			(0.565)		(0.931)			(0.907)
Winter		0.0944			0.108		0.0488			0.0685
		(0.017)			(0.039)		(0.128)			(0.108)
Number of holidays		-0.0045			-0.0055		-0.0017			-0.0028
		(0.319)			(0.344)		(0.605)			(0.552)
Adjusting Regional Fixed Effect	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Yes
N	552	552	552	552	552	552	552	552	552	552
R^2	0.059	0.581	0.679	0.936	0.967	0.118	0.650	0.791	0.959	0.981

p-values in parentheses
CI: Composite Index of Business Indicator

Discussion

Principal Findings

Despite the concerns of many people about negative impacts of the SBPs on sales of indoor

working areas [14,34], this study found that the sales and transactions in billiard halls were not affected by the SBP in 2017. This finding supports previous research demonstrating that smoking ban policies had no negative economic impacts on sales of restaurants and bars in South Korea and other countries [14,34,35].

The first of the three reasons for no negative economic impacts on sales of billiard halls is that the social awareness of the need for public SBPs to prevent the harms of secondhand smoke has been increased due to mass media campaigns among both smokers and non-smokers [36-39]. As smoking in public places becomes increasingly stigmatized, smokers may increasingly become aware that non-smokers have the right to object to exposure to harmful passive smoking [36,40,41].

The second reason may be due to changes in the smoking population and increased preferences for no smoking areas. The smoking prevalence among Korean adults aged 19 or older decreased from 27.5% in 2010 to 20.6% in 2020. [42] Smoking prevalence among men aged 30-50 who were the dominant population of smokers decreased especially after 2015, when tobacco prices were raised from KRW 2500 (USD 2.1) to KRW 4500 (USD 3.8) as well as indoor smoking was banned in all businesses and restaurants [42-44]. A study found that Korean smokers in 2016 reported more positive perceptions of the effectiveness of expanded smoking bans and smoke-free policies compared to smokers in 2010 [40]. Therefore, smokers who may complain regarding SBP in the billiard halls decreased, and smokers who prefer smoke-free environments may visit the billiard hall despite knowing that it is a non-smoking area.

The third reason may be related to the indoor smoking room. According to a study conducted between 2018 and 2019, eighty-seven percent of billiard halls have indoor smoking rooms [41]. Based on the NHPA in Korea, smoking rooms can be installed inside and outside of facilities, even the facilities are smoking-free area. Most smokers could use indoor smoking rooms despite the SBP in billiard halls, which may lead to no change in sales of billiard halls. Or, if there is no indoor smoking rooms or rooms are far away from where you're playing, smokers may give up smoking and

focus on playing pool. The Ministry of Health and Welfare in South Korea reported nonsmokers are more likely to be exposed to secondhand smoke in indoor public places with indoor smoking rooms and recommends closing indoor smoking rooms in all public facilities by 2025 [45]. Future research should examine the economic impact in indoor facilities and the consequences of secondhand smoke following the closure of indoor smoking rooms.

There are several additional benefits related to the SBP in billiard halls. First, SBP reduces exposure to secondhand smoke and improve health outcomes and reduce mortality due to smoking-related illnesses of both smokers and non-smokers [36,46,47]. Second, smoking restrictions influenced changes in smoking behavior among smokers because smokers should spend additional time to smoke due to SBPs, which lead to an increase in quit attempts [47]. Third, the Smoking Ban Policies in billiard halls lead to enhanced positive perceptions of the effectiveness of expanded smoking-free areas. A study found that past smokers and non-smokers among owners, worker, and users in billiards and indoor golf clubs were more favorable to smoke-free area after SBP in 2017 compared to before SBP [46].

Previous studies stressed price-based policy as the most effective means of reducing the consumption of tobacco [38,44], but the level of price increase in 2015 was insufficient to lead to a noticeable difference in South Korea [44,48]. Therefore, SBPs in public facilities such as billiard halls with the price-based policy have positive synergistic effects in reducing smoking prevalence and preventing secondhand smoke [35,38,40,46]. This study has the strength of examining the impact of the SBP on billiard halls' economic outcomes using actual revenue data from the largest card company in South Korea to provide a basis for enhanced the SBP.

However, there are some concerns in interpreting this study finding. First, this study could not adjust the presence of indoor smoking rooms in billiard halls, which may be related to sales and transactions in billiard halls. Future studies could compare sales between the billiard halls with and without indoor smoking rooms, or, in the case of closing indoor smoking rooms, compare sales

before and after closure to provide a more robust evidence base for smoke-free policies. Also, the inability to control for individual preferences and accessibility to the indoor smoking rooms is one of the limitations of this study. Smokers could prefer to play pool than they prefer to smoke even though they are aware of the ban in the billiard halls. Or smokers may not be aware of the existence of an indoor smoking area, or even if they are, they may not want to go to it while playing pool. Therefore, future studies should include individual preferences and adherence to smoking and smoke-free areas, as well as environmental constraints such as the presence and accessibility of indoor smoking rooms, in their analyses to determine if smoke-free policies have an impact on sales.

Conclusions

This study examines the effects of the SBP in indoor sports facilities on billiard halls' economic outcomes. Despite the worries of the owners of hospitality facilities, the SBP does not affect billiard halls' sales. In addition to existing price-based policies, enhancing SBP in public use facilities such as billiard halls can have a positive synergistic effect on reducing smoking prevalence and preventing secondhand smoke. Based on this finding, health policy makers can actively expand the application of SBP and make effort to enhance the social awareness of the need and benefits for public SBP among both the smokers and the owners of hospitality facilities.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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We used the generative AI tool ChatGPT only to correct English grammar.

Conflicts of Interest

None declared.

Abbreviations

FE: Fixed Effects

PCSE: Panel Corrected Standard Errors

SBP: Smoking Ban Policy

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Supplementary Files

Figures

Research model and control variables of this study.

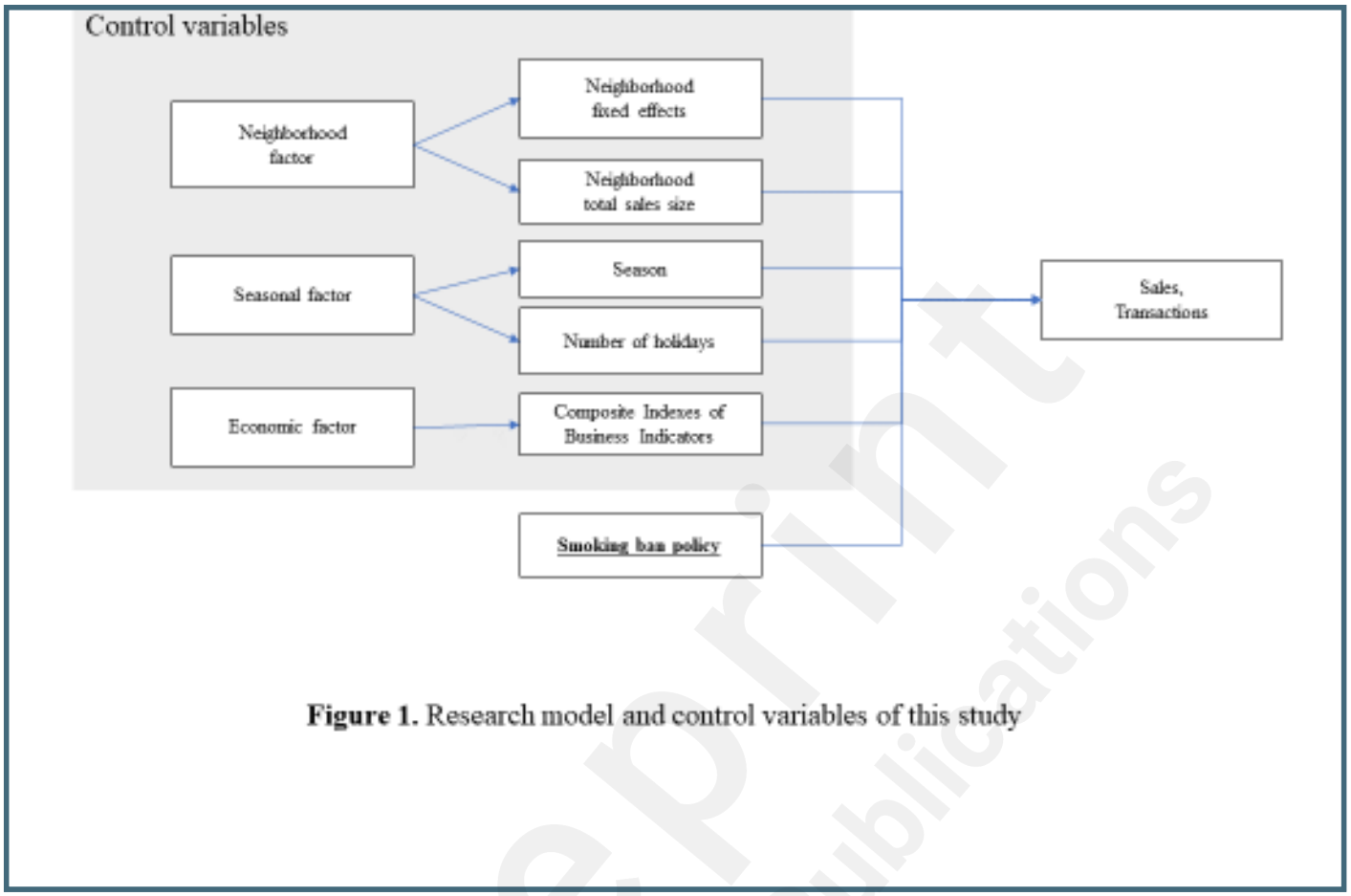

Figure 1. Research model and control variables of this study

The trends of the monthly sales of billiard halls.

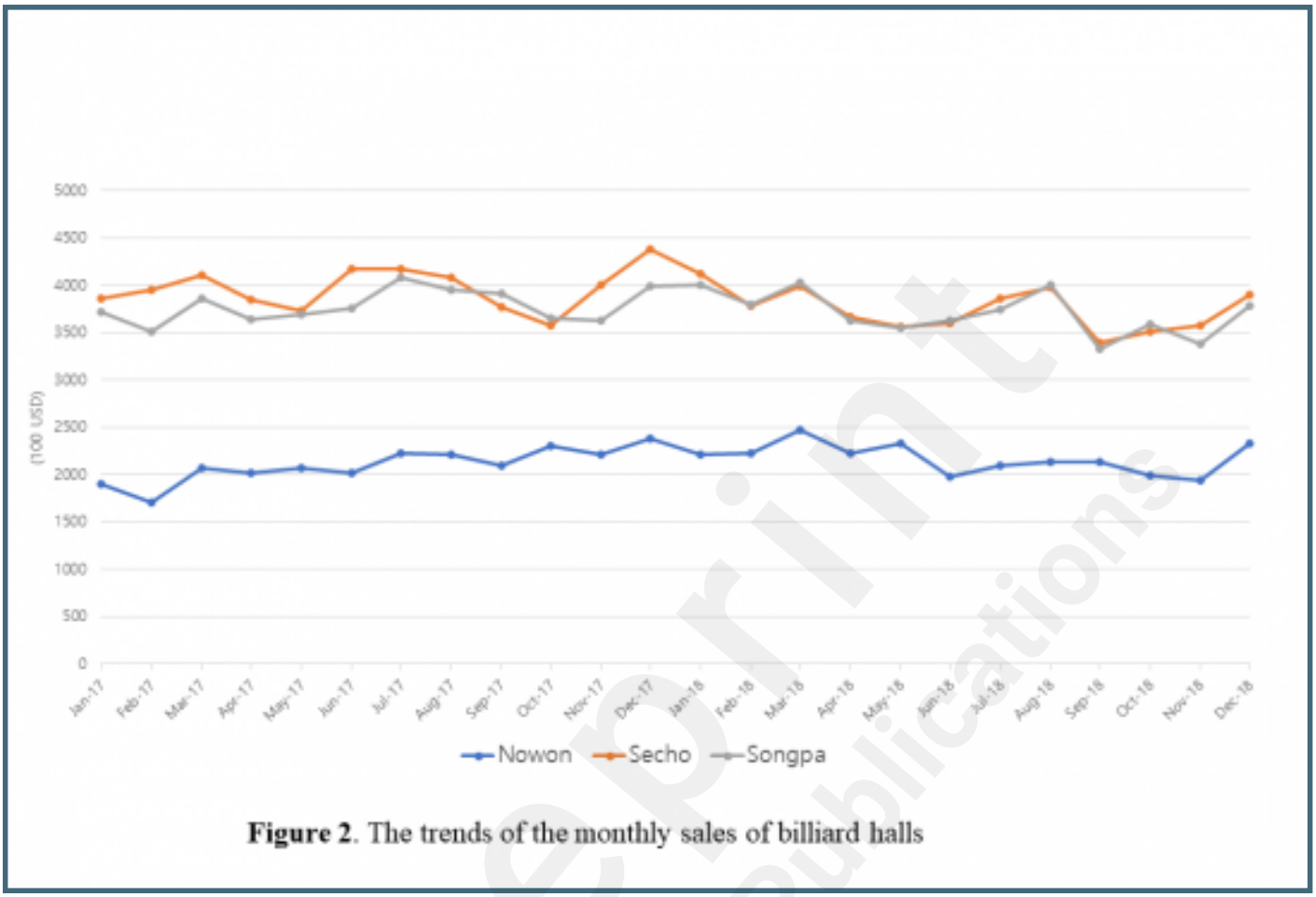

Figure 2. The trends of the monthly sales of billiard halls