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## Regional and global uncertainty and the impacts on the tourism and gambling industry of Macao

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### ABSTRACT

For decades, gambling has been Macao's pillar industry. In 2023, the gambling sector accounted for 38.3% of Macao's total economic output, highlighting its fundamental role in the city's economy. In this study, we employ vector autoregression to examine the impact of regional and global uncertainty on Macao's gambling industry. Our results indicate that both regional and global uncertainties negatively affect Macao's gaming revenue, with global uncertainty exerting a greater influence in the variance decomposition. However, the gambling industry remains highly resilient, as uncertainty—both regional and global—only accounts for approximately 16.7% of the variance decomposition of gaming revenue. Policymakers should consider this relative insensitivity when formulating economic policies in an increasingly uncertain global landscape and when pursuing economic diversification strategies. This paper also suggests that maintaining tourism and gambling as Macao's pillar industry could help the city navigate economic and political uncertainty until a more resilient sector is identified.

### IMPACT STATEMENT

This study examines the sensitivity of Macao's gaming industry to uncertainties. While economic diversification remains a key policy priority, developing sectors that are more vulnerable to uncertainty than gaming could increase the city's exposure to economic fluctuations. The findings reveal that the gaming sector demonstrates notable resilience to both regional and global uncertainties. These results suggest that stakeholders should evaluate the robustness of different sectors before pursuing diversification, prioritizing those with equal or greater resilience to uncertainty.

### ARTICLE HISTORY

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## Introduction

Macao, the second Special Administrative Region of the People's Republic of China, is recognized as the world's leading gambling hub, generating the highest gross gaming revenue globally (Financial Times, 2024). The city's gambling history dates back to the sixteenth century, with the industry formally legalized in 1847 under Portuguese administration. Macao was returned to China in 1999, and following the liberalization of the gaming industry and the introduction of the Individual Visit Scheme for Mainland Chinese tourists, it experienced rapid economic expansion. By 2024, the standard of living—measured by GDP per capita—had reached MOP 587,922 (Macao Statistics and Census Service, 2024).

In the first quarter of 2024, approximately 70,600 people—around 24% of the local labor force—were employed in the gambling industry (Macao Statistics & Census Service, 2024). The sector accounted for 38.3% of the city's economic output in 2023 (Macao Statistics & Census Service, 2024) and contributed approximately 80% of the government's fiscal revenue through gambling tax (Macao Financial Services

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Bureau, 2025). Given the gambling industry's critical role in Macao's economy, assessing its resilience amid global uncertainty is essential for both the city and the country (China).

Economic diversification has been a key policy pursued by the government of Macao in recent decades. This strategy aims to reduce reliance on the gambling industry by fostering the development of other sectors to decrease its relative dominance. However, economic diversification does not inherently enhance an economy's ability to withstand economic and political uncertainty—it depends on the resilience of the industry being developed. If a newly promoted industry proves to be more sensitive to such uncertainties than the gambling sector, its development may be a less optimal strategy, potentially increasing the city's economic vulnerability.

In addition, several studies have examined various forms of uncertainty in relation to Macao. For example, Chen and Zhou (2021) highlighted that the heavy reliance of Macao's gaming sector on the Mainland Chinese economy exposes the city to risks associated with Mainland China. Zhang and Tian (2025) investigated the effects of Mainland China's economic policy uncertainty, finding that increases in such uncertainty lead to declines in Macao's GDP and hotel occupancy rates. Liu et al. (2021) analyzed Macao during the pandemic period, revealing the city's vulnerability under crisis conditions. Wan and Pinheiro (2025) explored the unpredictability of Macao's tourism industry and noted that, in times of uncertainty, measures such as communicative planning were implemented to mitigate impacts. Man Wai Leong et al. (2024) examined the influence of global geopolitical risk, global economic policy uncertainty, and U.S. monetary policy uncertainty on Macao's hospitality sector. However, to the best of my knowledge, no prior study has investigated the impact of regional (Asia-Pacific) uncertainty and global uncertainty specifically on Macao's gaming industry.

The objective of this paper is to examine the resilience of Macao's gambling industry (the current pillar industry of Macao) amid regional and global uncertainty. Future research can apply similar analyses to other industries to identify which sectors demonstrate greater resilience and could serve as potential pillar industries for the city.

In terms of empirical contributions, this paper is the first to examine the impact of Asia-Pacific and global uncertainty on Macao's gaming industry—the only legal gambling hub in China. The findings indicate that the gaming sector exhibits strong resilience to both regional and global uncertainties. Consequently, economic diversification strategies should prioritize the development of sectors that demonstrate even greater robustness to uncertainty. Until such sectors are identified, the gaming industry should remain the cornerstone of Macao's economy; otherwise, shifting focus to more vulnerable sectors could increase the city's exposure to external shocks.

From a theoretical perspective, this research underscores the importance of sectoral robustness—particularly in the gambling industry—when facing uncertainty. The insights suggest that diversification into other industries is not inherently optimal, especially when the dominant sector already demonstrates substantial resilience. In fact, diversification into less robust sectors may heighten the economy's vulnerability to regional and global uncertainties. Policymakers and stakeholders should therefore assess the sensitivity of different sectors to uncertainty before pursuing diversification initiatives.

## Literature review

Macao is a small, open economy that is heavily dependent on the gambling industry, which is classified as part of the city's tourism sector. The impact of global shocks on Macao's hospitality industry has been examined through vector autoregression analysis. Findings indicate that Macao's hospitality sector demonstrates greater resilience to global shocks than traditional hospitality industries, a resilience largely attributable to the distinctive characteristics of its gambling sector (Man Wai Leong et al., 2024). The study suggests that the presence of the gambling industry enhances the overall resilience of Macao's hospitality sector in the face of economic and political uncertainty. Various studies have explored the effects of different risks and uncertainties.

### *Economic policy uncertainty*

Numerous studies have examined the impact of economic policy uncertainty (EPU) on various aspects of the economy. For instance, prior research has explored its effects on stock prices in the tourism industry

(Ersan et al., 2019), investment efficiency (García-Gómez et al., 2023), tourism consumption (Akdağ et al., 2022; Gozgor et al., 2018; Nguyen et al., 2020), and strategies for addressing uncertainty (Wu & Wu, 2021).

In addition, several studies have investigated the phenomenon in different geographical contexts. For example, Payne et al. (2023) examined Europe and Croatia, finding that uncertainty negatively affects international visitor inflows, with Europe's uncertainty exerting a stronger influence than Croatia's. Hailemariam and Ivanovski, (2022) analyzed U.S. tourism exports, demonstrating that heightened uncertainty reduces demand. Işık et al. (2020) studied Mexican and Canadian tourists traveling to the United States, revealing that Canadian tourists are more affected by EPU than their Mexican counterparts. Gozgor and Ongan, (2017) identified a negative relationship between EPU and tourism spending, while Doğan et al. (2023) reported a similar relationship between uncertainty and international tourist arrivals in Malaysia and Singapore. Zhao et al. (2023) found that uncertainty—particularly during the COVID-19 pandemic—had a significant negative impact on international tourist arrivals in Spain, Italy, and the United States.

In summary, existing research has extensively documented the effects of EPU across different sectors and economies. In this study, we focus on Macao—the only city in China where gaming is legally permitted—as a case study to investigate the impact of uncertainty on the gaming industry.

### **Geopolitical risk**

Geopolitical risk is also a significant factor influencing the tourism industry. Numerous studies have examined this issue. For example, Demiralay and Kilincarslan (2019) investigated the impact of geopolitical risk on the stock prices of travel and leisure companies; Demir et al. (2019) analyzed its effects on inbound tourism; and Ghosh (2019) explored its implications for tourism development.

In addition, Drakos and Kutan (2003) examined Greece, Israel, and Turkey to assess the impact of terrorist attacks, revealing spillover effects on nearby destinations. Zhang et al. (2022) used China as a case study to analyze the time-varying impact of geopolitical risk, demonstrating that its influence was particularly pronounced during the global financial crisis.

Geopolitical risk is not confined to specific regions; it can affect people's behavior and visitor arrivals worldwide. The tourism industry is highly sensitive to such risks, as travelers may perceive heightened geopolitical tensions as threats to their personal safety, such as in the case of terrorist attacks.

### **World uncertainty**

Regarding global uncertainty, numerous studies have explored its applications and implications. For instance, Liu and Gao (2022) employed global uncertainty measures to predict U.S. economic growth, whereas Chatterjee (2023) questioned the usefulness of such measures in forecasting U.S. growth when compared with other indicators, such as stock market performance. The contrasting findings of these two studies suggest that the predictive value of the World Uncertainty Index for economic growth may depend on the presence of significant events.

Furthermore, the relationship between uncertainty and foreign direct investment (FDI) has been examined, with evidence indicating that heightened global uncertainty may lead to increased FDI inflows (Canh et al., 2020). Other research has investigated the impact of global uncertainty on tourism, such as Gozgor et al. (2021), who found that rising uncertainty discourages travel, and Lv et al. (2025), who reported varying effects of global uncertainty on tourism in G7 countries.

Although numerous studies have examined the effects of various risks and uncertainties—such as geopolitical risk, economic policy uncertainty, and global uncertainty. To the best of my knowledge, this research represents the first investigation into the impact of regional and global uncertainty on Macao SAR's pillar industry (gambling industry)—the only city in China where gambling is permitted. The subsequent sections will delve into the data, methodology, results, discussions, and conclusions.

While this research paper focuses on Macao, the insights it provides are crucial for understanding the impact of regional and global uncertainty on the gambling industry. Cities and economies can use Macao's case to anticipate changes in their gambling sectors and prepare for uncertainties. The findings of this research demonstrate the resilience of Macao's gaming industry in the face of uncertainties.

Economic diversification should focus on new sectors that exhibit high resilience; otherwise, Macao's economy may remain vulnerable to elevated levels of uncertainty.

## Data and methodology

In this research, we utilize data from the Statistics and Census Service of the Government of Macao SAR and the Economic Research Division of the Federal Reserve Bank of St. Louis. The time series database of the Statistics and Census Service of Macao collects data related to gross gaming revenue, gross domestic product, and the consumer price index. Meanwhile, the database of the Economic Research Division of the Federal Reserve Bank of St. Louis provides data related to the Global World Uncertainty Index (GDP Weighted Average) and the World Uncertainty Index: Asia and the Pacific. We use the Global World Uncertainty Index (GDP Weighted Average) (Ahir et al., 2024) to denote global uncertainty and the World Uncertainty Index: Asia and the Pacific (Federal Reserve Bank of St. Louis 2024) to denote regional uncertainty. All the collected data are quarterly and span from the first quarter of 2003 (the year the gambling industry was liberalized) to the first quarter of 2024. These data are not seasonally adjusted.

Before further analysis, we carry out seasonal adjustment to all variables. We choose the STL decomposition method for seasonal adjustment, which decomposes the time series data into three components: trends, seasonality, and residuals. We will use the seasonally adjusted time series generated by the Eviews software for our analysis.

The World Uncertainty Index is constructed by Furceri, David, Hites, Ahir, and Bloom, from the International Monetary Fund and Stanford University, respectively. The World Uncertainty Index captures economic and political uncertainty using a text mining technique. It covers 143 countries worldwide, utilizing data from the Economist Intelligence Unit and is updated quarterly. A higher value of the World Uncertainty Index indicates a higher level of risk and uncertainty. The index is constructed by counting the occurrences of the word 'uncertainty' and similar terms in reports from different countries, then adjusting these counts based on the total length of the reports. The World Uncertainty Index is available for individual countries as well as on a global scale. The data can be found in the database of the Economic Research Division of the Federal Reserve Bank of St. Louis. The World Uncertainty Index: Asia and the Pacific focuses specifically on the Asia and Pacific region. It is demonstrated that an increase in the World Uncertainty Index leads to a decrease in output (Ahir et al., 2022).

Vector autoregression (VAR) is an econometric technique widely used in empirical research. It identifies the impact of one variable on others over time. Unlike other techniques, such as the autoregressive distributed lag model (ARDL), VAR recognizes mutual impacts and interactions between variables through multiple regressions, allowing us to track how a shock to one variable affects the entire system, influencing the economy and industries.

We will employ the subsequent Vector Autoregression (VAR) model for our analysis.

$$Ay_t = A_1^0 y_{t-1} + \dots + A_p^0 y_{t-p} + Bu_t$$

where

$$y = \begin{bmatrix} \textit{Asia Pacific Uncertainty} \\ \textit{Uncertainty} \\ \textit{D(gaming)} \\ \textit{D(GDP)} \\ \textit{CPI} \end{bmatrix}$$

In addition, matrix A is a lower triangular matrix with elements of '1' inside, while matrix B is an identity matrix. In this context, 'Uncertainty' and 'Asia Pacific Uncertainty' refer to the percentage change in the World Uncertainty Index and the World Uncertainty Index: Asia and the Pacific, respectively. 'D(gaming)' represents the first difference of the percentage change in gaming revenue. 'D(GDP)' denotes the first difference of the percentage change in GDP. 'CPI' signifies the percentage change in the Consumer Price Index.

The dependent variables of the VAR (percentage change of Asia and the Pacific uncertainty, percentage change of world uncertainty, change in gaming revenue growth rate, change in GDP growth rate, percentage change of CPI) are tested for stationarity using the Augmented Dickey-Fuller test. All variables are confirmed to be stationary. Additionally, a cumulative sum (cum sum) plot is used to verify that there are no structural breaks in the dependent variables.

The percentage change in Asia-Pacific uncertainty, the percentage change in world uncertainty, the change in GDP growth rate, and the percentage change in the Consumer Price Index (CPI) are selected as key variables because they align with the focus of this research. The change in the gaming revenue growth rate is also included; however, since the percentage change in gaming revenue is non-stationary, its first difference is taken to ensure stationarity. In other words, only one variable in the model is non-stationary, making vector autoregression (VAR) an appropriate modelling approach for this study.

In the VAR model, the two sources of uncertainty—Asia-Pacific uncertainty and world uncertainty—are incorporated, with gaming revenue as the third dependent variable, reflecting the possibility that spending on gambling activities may fluctuate during periods of uncertainty. GDP is included because changes in gaming revenue directly affect nominal GDP, and variations in nominal GDP may, in turn, influence the price level, justifying the inclusion of CPI. This reasoning is consistent with economic growth theory: when the main sector of an economy expands, overall economic growth occurs, often accompanied by price changes. In the case of Macao, where the gambling sector is the dominant industry, its expansion drives economic growth and may trigger price adjustments. These price changes can subsequently affect gaming revenue in later periods, as both local residents and tourists participate in gambling activities.

Uncertainty is a key factor influencing human behavior. In Keynesian economics, the theory of animal spirits emphasizes that emotions and other psychological factors significantly affect decision-making. When uncertainty is high, rational consideration and precise calculation may become difficult, and consumers tend to adopt a more cautious approach to spending, which in turn reduces aggregate demand. Similarly, in behavioral economics, emotions and cognitive biases are frequently cited as determinants of decision-making, with individuals generally exhibiting risk aversion and a dislike for uncertainty. An increase in uncertainty can shape the behavior of economic agents by, for example, delaying investment decisions and discouraging consumer purchases, as people tend to prefer familiar and predictable situations over unknown or unfamiliar ones. These theoretical perspectives provide the foundation for the derivation of the vector autoregression model employed in this study.

Given the significant impact of the COVID-19 pandemic on Macao's gaming sector, a subsample analysis is conducted for the period from the first quarter of 2003 to the fourth quarter of 2019. This approach isolates the pandemic's effects from the empirical results. During COVID-19, travel restrictions severely reduced visitor flows to Macao; for example, tourists were often required to undergo quarantine before entry, which naturally depressed gaming activity. In the second quarter of 2020, Macao's gross gaming revenue was approximately MOP 3.3 billion, compared with about MOP 72 billion in the fourth quarter of 2019 and MOP 30 billion in the first quarter of 2020 (Macao Statistics & Census Service, 2024).

Moreover, the research satisfies the ethical requirement of the study country or region.

## Results

Table 1 presents the descriptive statistics of the variables, including their mean, median, maximum, minimum, and standard deviation values. The variables are seasonally adjusted, and percentages are calculated accordingly. For example, GDP figures are seasonally adjusted, and the percentage change is measured on a quarter-to-quarter basis. Regarding the descriptive statistics for the Asia-Pacific Uncertainty percentage change, there is a substantial difference between the mean and the median. This suggests that, although there are periods of significant increases in risk within Asia, the level of risk tends to remain moderate for most of the time. In contrast, for the other variables, the mean and median values are relatively close, indicating that extreme events are less frequent and therefore do not cause large discrepancies between these two measures. Figure 1 illustrates the time-series plots of the variables.

**Table 1.** Descriptive statistics.

	Asia pacific uncertainty	Uncertainty	D(gaming)	D(GDP)	CPI
Mean	17.66	4.99	0.16	0.19	0.81
Median	1.59	-0.29	-0.38	-0.17	0.82
Max	287.30	109.04	207.71	50.19	3.38
Min	-85.81	-58.50	-239.16	-52.81	-0.74
Standard Deviation	71.70	35.06	52.92	16.98	0.72

Note: The original dataset contains 85 observations. The variables Asia Pacific Uncertainty, Uncertainty, Gaming, GDP, and CPI are expressed as percentages derived from these 85 observations in the raw dataset. The variables D(Gaming) and D(GDP) contain 83 observations due to the loss of data point resulting from the first-difference transformation.

Source: Macao Statistics and Census Service; Federal Reserve Bank of St. Louis.

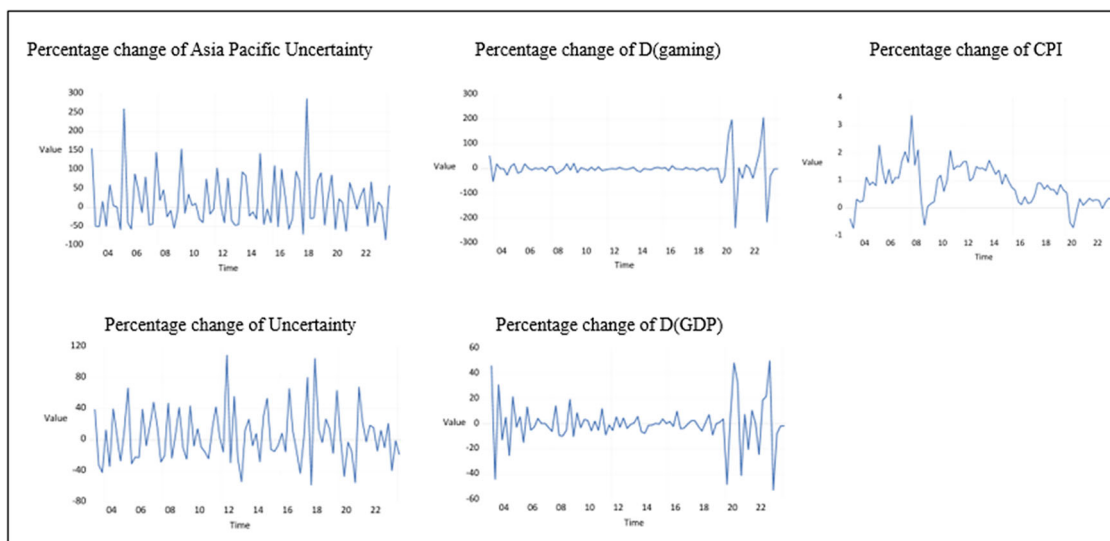
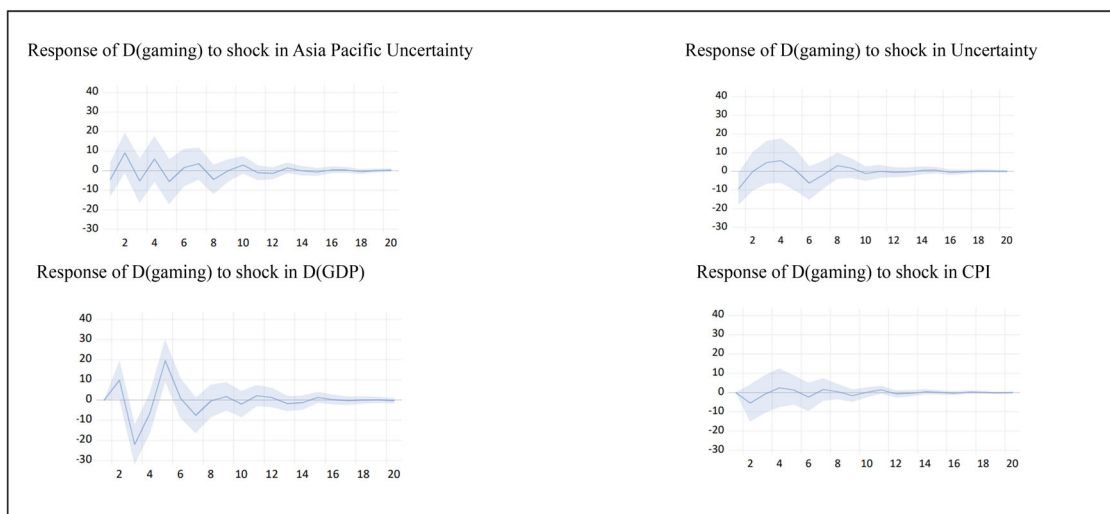
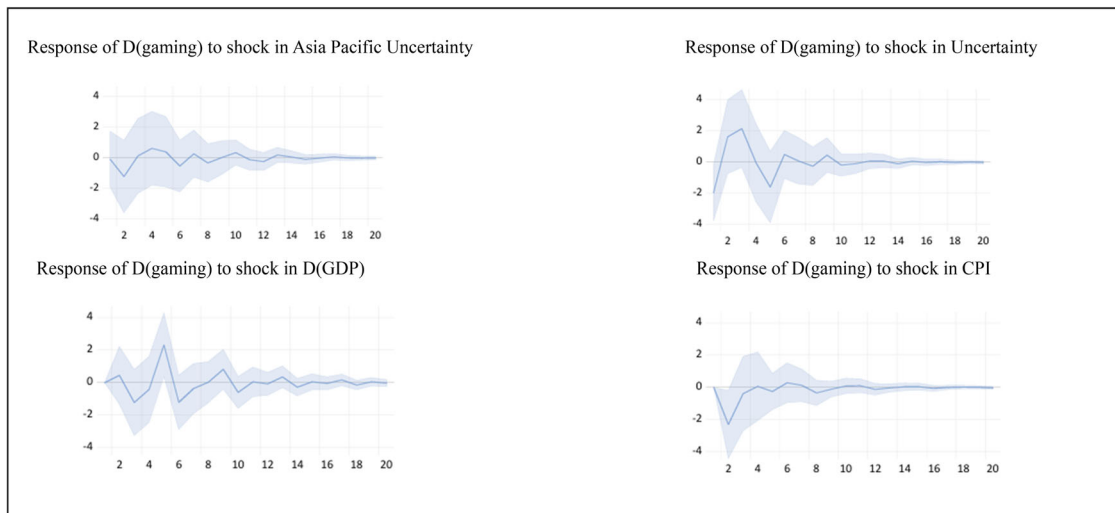
**Figure 1.** Time-series plots of the variables.**Figure 2.** Impulse response functions for full sample period (Response to Cholesky One S.D. (d.f. adjusted) innovations, 95% CI using analytic asymptotic S.E.s).

Figure 2 illustrates the impulse response functions of the first difference in the percentage change of gaming revenue to the shocks. The results indicate that increases in regional and global uncertainty lead to an immediate decrease in the first difference of gaming revenue (implying a decrease in gaming revenue). However, gaming revenue rebounds sharply in the subsequent period. The impact of



**Figure 3.** Impulse response functions for the subsample period (Response to Cholesky One S.D. (d.f. adjusted) innovations, 95% CI using analytic asymptotic S.E.s).

**Table 2.** Variance decomposition for the full sample period.

Period	S.E.	Asia pacific uncertainty	Uncertainty	D(gaming)	D(gDP)	CPI
1	39.20	1.37	5.61	93.01	0.00	0.00
2	43.27	5.57	4.61	82.99	5.27	1.57
3	49.77	5.31	4.42	65.57	23.49	1.21
4	51.58	6.27	5.35	63.64	23.38	1.36
5	55.83	6.37	4.60	55.53	32.29	1.21
6	56.32	6.34	5.75	54.79	31.77	1.36
7	57.04	6.57	5.71	53.59	32.73	1.40
8	57.34	7.12	5.93	53.16	32.40	1.39
9	57.44	7.09	5.99	53.08	32.38	1.46
10	57.58	7.31	6.01	52.88	32.34	1.45
11	57.70	7.32	5.98	52.82	32.36	1.51
12	57.74	7.37	5.98	52.76	32.36	1.53
13	57.79	7.42	5.97	52.68	32.40	1.53
14	57.81	7.41	5.98	52.66	32.42	1.53
15	57.84	7.42	5.98	52.62	32.45	1.53
16	57.84	7.42	5.99	52.61	32.45	1.53
17	57.85	7.43	5.99	52.60	32.45	1.54
18	57.85	7.43	5.99	52.60	32.44	1.54
19	57.85	7.43	5.99	52.60	32.44	1.54
20	57.85	7.43	5.99	52.60	32.44	1.54

uncertainty shocks gradually phases out over an extended period (approximately 14 quarters, or more than 3 years for regional uncertainty; approximately 10 quarters, or more than 2 years for global uncertainty).

Figure 3 presents the impulse response function results for the sample period from the first quarter of 2003 to the fourth quarter of 2019. Overall, the results are broadly consistent with those obtained for the full sample (first quarter of 2003 to the first quarter of 2024), except for the effect of Asia-Pacific uncertainty on gaming revenue. In the full sample, gaming revenue tends to increase after the second quarter following a shock to Asia-Pacific uncertainty. In contrast, in the subsample, Asia-Pacific uncertainty exerts a negative effect on gaming revenue after the second quarter.

Table 2 presents the variance decomposition of the first difference in the percentage change of gaming revenue to the shocks. Approximately 7.43% and 5.99% of the standard deviation of the first difference in the percentage change of gaming revenue can be attributed to regional and global uncertainty, respectively. Meanwhile, the first difference in the percentage change of GDP and the percentage change of CPI account for approximately 32.44% and 1.53%, respectively. Notably, approximately 13.43% of the standard deviation can be attributed to uncertainty, encompassing both regional and global factors, while the remaining proportion is influenced by other variables.

**Table 3.** Variance decomposition for the subsample period.

Period	S.E.	Asia pacific uncertainty	Uncertainty	D(gaming)	D(gDP)	CPI
1	7.41	0.01	7.02	92.97	0.00	0.00
2	8.83	1.92	8.30	82.70	0.26	6.82
3	9.35	1.73	12.73	77.32	1.95	6.27
4	9.40	2.15	12.58	76.94	2.13	6.20
5	9.86	2.11	14.09	70.58	7.51	5.71
6	9.97	2.36	14.02	69.12	8.84	5.67
7	9.98	2.42	13.98	68.99	8.94	5.66
8	10.00	2.52	13.99	68.83	8.91	5.76
9	10.05	2.50	14.07	68.22	9.50	5.72
10	10.08	2.60	14.03	67.87	9.81	5.70
11	10.08	2.61	14.03	67.86	9.80	5.70
12	10.08	2.67	14.02	67.81	9.79	5.71
13	10.09	2.70	14.00	67.70	9.90	5.70
14	10.10	2.70	14.00	67.64	9.97	5.70
15	10.10	2.71	14.00	67.63	9.97	5.70
16	10.10	2.71	14.00	67.63	9.97	5.70
17	10.10	2.71	13.99	67.61	9.99	5.70
18	10.10	2.71	13.99	67.59	10.01	5.70
19	10.10	2.71	13.99	67.59	10.01	5.70
20	10.10	2.71	13.99	67.59	10.01	5.70

For the subsample, Asia-Pacific uncertainty and world uncertainty account for 2.71% and 13.99% of the total variance in gaming revenue, respectively, while GDP and CPI contribute 10.01% and 5.70%. In total, approximately 16.70% of the variance in gaming revenue is explained by Asia-Pacific and world uncertainties combined. The results are reported in [Table 3](#).

## Discussion and conclusion

Macao, a small city in southern China, is renowned for its monopoly on China's gambling industry, which is part of the world's second-largest economy by nominal GDP (USD). As a monopoly, Macao has generated substantial economic profits, improving the well-being and standard of living for local citizens. Gaming tax revenue was utilized to support the economy in the city during the pandemic (McCartney et al., 2021). In 2023, Macao became the global leader in the gambling industry, achieving the highest gross gaming revenue in the world (Financial Times, 2024). However, research into the sensitivity of the city's gaming revenue to uncertainty is limited. Our findings indicate that regional and global uncertainty can influence gaming revenue, meaning changes in political and economic uncertainty will have a corresponding impact on gaming revenue. Thus, Macao's gambling industry is not isolated from the outside world. The reasons for this include.

The gambling industry in Macao relies heavily on visitors from outside the Macao SAR, whose behaviors and expenditures are influenced by regional and global factors, such as economic and political uncertainty. Mainland China, Hong Kong, Taiwan, South Korea, and Japan are the top five sources of visitors to Macao, all located in East Asia. Any economic and political uncertainty specific to the Asia Pacific region will impact these major source markets, subsequently affecting Macao's gambling industry. Uncertainty and instability in economic performance and political factors can negatively impact tourism (Akdağ et al., 2022; Demir et al., 2019; Doğan et al., 2023; García-Gómez et al., 2023; Ghosh, 2019; Gozgor et al., 2021; Gozgor et al., 2018; Gozgor & Ongan, 2017; Hailemariam & Ivanovski, 2022; Işık et al., 2020; Lv et al., 2025). Nguyen et al., 2020, 2022; Payne et al., 2023; Wu & Wu, 2021; Zhao et al., 2023).

Before the outbreak of the COVID-19 pandemic in 2020, Macao's gaming industry was more sensitive to global uncertainty than to Asia-Pacific uncertainty. One possible explanation lies in the economic conditions of visitors' home economies. For instance, in Mainland China, the ratio of net exports to GDP was generally higher in the pre-pandemic period (World Bank, 2024), indicating greater exposure to external shocks at that time. Any global shock affecting the income of visitors from Mainland China would therefore have a corresponding impact on Macao's gaming revenue. Although the top five sources of visitors to Macao are all located in Asia, global uncertainty still exerts an influence on the city's gambling revenue. Visitors from Asia are not insulated from global events; changes in global uncertainty can affect their income and wealth, indirectly influencing their travel spending (Akdağ et al., 2022;

Nguyen et al., 2020; Gozgor & Ongan, 2017). Consequently, the amount of money spent on gambling activities while visiting Macao will be affected, leading to fluctuations in the city's gambling revenue.

However, the impacts of both regional and global uncertainty are not critically significant to Macao's pillar industry. The city's gambling sector exhibits strong resilience against economic and political instability at both regional and global levels. Maintaining gambling as Macao's pillar industry can help stabilize the city's economy amid growing global risks and uncertainties.

In conclusion, despite the small size of Macao's economy, it is not isolated from the rest of the world. As the monopoly of China's gambling industry, the city's gaming revenue is subject to regional and global uncertainties, including economic and political factors. The gambling industry in Macao relies on visitors from outside the city, and their behaviors may be affected by these uncertainties. Furthermore, in terms of the source of variance in gaming revenue, global uncertainty outweighs regional uncertainty before pandemic. Moreover, the resilience of Macao's gambling industry remains strong under both economic and political uncertainty. Continuing to position the gambling industry as the city's economic backbone can help maintain stability in the face of rising uncertainty. The insights presented in this paper align with prior research by Man Wai Leong et al. (2024), which found that Macao's hospitality sector is less sensitive to global risks and uncertainties compared to traditional hospitality industries, largely due to the presence of the gambling industry. However, their study did not employ statistical or econometric modeling to assess the resilience of the gambling industry amid uncertainty. This research bridges that gap by empirically demonstrating the industry's strong resilience. By combining the findings of this study with those of Man Wai Leong et al. (2024), it becomes evident that integrating the gambling industry within Macao's tourism sector enhances the overall resilience of the city's tourism and hospitality industry.

Economic diversification has been a key policy of the Macao government. However, careful consideration should be given to the sensitivity of different industries compared to the gambling sector. If the gambling industry demonstrates high resilience to uncertainty, maintaining it as Macao's gambling industry could be a viable strategy for stabilizing the economy. Additionally, resilience to uncertainty can serve as a key criterion for the government when selecting industries for development, as it contributes to economic stability amid increasing global economic and political uncertainty.

Although this paper focuses on Macao, a special administrative region of China, its insights are relevant to economies that rely on or plan to develop a gambling sector. Policymakers and stakeholders should carefully assess the sensitivity of different industries compared to gambling. If alternative industries prove more vulnerable to uncertainty, prioritizing their development may be less optimal, as heightened economic volatility could disrupt macroeconomic performance, including growth and employment. Stakeholders—both within Macao and in other economies—can leverage the findings of this research to formulate more effective responses to evolving economic conditions.

In comparison with other studies, this paper differs in several important aspects. Chen and Zhou (2021) examined the impact of a political event in Mainland China on Macao's gaming sector, finding a substantial effect. While their research focused exclusively on Mainland China, the present study considers events related not only to Mainland China but also to other economies. Zhang and Tian (2025) investigated the effects of economic policy uncertainty in Mainland China, Hong Kong, and Macao on the energy consumption of Macao's tourism industry, concluding that an increase in Mainland China's economic policy uncertainty reduces energy consumption. By contrast, our research examines the impact of uncertainties originating not only from these three economies but also from other regions. Furthermore, whereas their study focuses on energy consumption in the tourism industry, our analysis targets gaming revenue. Given these differences in scope and dependent variables, it is unsurprising that the two studies yield different conclusions regarding the effects of uncertainty. Man Wai Leong et al. (2024) explored the influence of global economic policy uncertainty, global geopolitical risk, and U.S. monetary policy uncertainty on Macao's hospitality sector. In contrast, this paper investigates the effects of regional (Asia-Pacific) and global uncertainty on the city's gaming industry. A notable similarity, however, is that both studies find the hospitality and gaming sectors of Macao to be relatively insensitive to such shocks. Liu et al. (2021) assessed the performance of Macao's economy and tourism during the pandemic, highlighting that over-reliance on tourism increases the city's vulnerability. In contrast, our findings suggest that reliance on the gaming sector may make the city less vulnerable to regional and global

uncertainties. Moreover, diversifying the economy by developing other industries could increase vulnerability—particularly if the newly developed sectors are more sensitive to uncertainty.

Like all research, this study has certain limitations. Future data could be incorporated to assess whether the relationships and insights identified here remain valid over time. Moreover, given the unique economic context of Macao—being the only city within the world’s second-largest economy where gambling is legally permitted—the findings may not be directly generalizable to other economies, and to evaluate the robustness of these results, similar studies should be undertaken in different economic contexts to determine whether the conclusions hold across regions.

## Ethical approval

The data utilized in this research were sourced from the Statistics and Census Service database of Macao SAR and the Federal Reserve Bank of St. Louis. As the study relied entirely on secondary data, no human participants were involved in any aspect of the experiment or research.

## Remarks

This research was edited with the assistance of AI.

## Author contributions

CRedit: **ChiChong Tang**: Conceptualization, Formal analysis, Investigation, Project administration, Resources, Supervision, Writing – original draft.

## Disclosure statement

No potential conflict of interest was reported by the author(s).

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## Data availability statement

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

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