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# How anti-corruption policy of mainland China affects Macau gaming industry

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**How anti-corruption policy of mainland China affects Macau gaming industry**

by

**Fanli Zhou**

A thesis submitted to the graduate faculty  
in partial fulfillment of the requirements for the degree of

**MASTER OF SCIENCE**

Major: Hospitality Management

Program of Study Committee:  
Tianshu Zheng, Major Professor  
Ching-Hui Su  
Wen Chang

The student author and the program of study committee are solely responsible for the content of this thesis. The Graduate College will ensure this thesis is globally accessible and will not permit alterations after a degree is conferred.

Iowa State University

Ames, Iowa

2017

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**ABSTRACT**

Macau has grown to become one of the famous gambling centers around the world. However, China's anti-corruption policy challenged Macau and led Macau to a significant gaming revenue decline. This study applied seasonal autoregressive integrated moving average (SARIMA) with intervention analysis to examine Macau's quarterly gross gaming revenue, VIP baccarat revenue, and slot coin-in revenue from the first quarter of 2005 and last quarter of 2016 and determined the Macau gaming industry was affected by the anti-corruption policy. SARIMA models on three-time series were fitted by SAS time series forecasting system. The results showed that gross gaming revenue, VIP baccarat revenue, and slot coin-in revenue were significantly affected by the anti-corruption policy of mainland China. The findings of this study could be an initial empirical study for analyzing and forecasting Macau gaming industry performance when a policy event happened.

Keywords: Macau, gaming industry, time series, SARIMA, intervention analysis, anti-corruption

## **CHAPTER I**

### **INTRODUCTION**

#### **Background**

Gaming history dates back for over three centuries and Macau was eminent as "Monte Carlo of the Orient" and "Las Vegas of the East." The gaming industry became a mainstay of Macau. Macau attracted international business and investment of billions of dollars after it was transferred from a local monopoly of the gaming industry into a foreign competition market in 2001. This converted Macau into one of the world's largest gaming centers. It became the largest gaming city when its gross gaming revenue surpassed Las Vegas, Nevada, USA in June 2007. In 2009, the gaming tax was approximated at more than 70% of Macau's total fiscal revenue. However, anti-corruption action of mainland China caused poor economic performance of Macau. This study will explore how anti-corruption policy affected Macau economic development. The following sections discuss the three stages of the development of the Macau gaming industry.

#### **Early development of the Macau gaming industry before transfer of sovereignty over Macau**

The Macau gaming industry dates from the 16th century when Macau initially opened its harbor to guests. Around this time, gaming was particularly well known among the development laborers emigrated from Mainland China, port coolies, and local temporary workers. Since no gaming rules were carried out, the gambling stalls were developed all over streets and were operated by the bankers themselves. According to Gaming Inspection and

Coordination Bureau of Macau SAR (2016), there were more than two hundred "Fantan" stalls operating in by the 1850's. Gaming industry entered into a flourishing stage in the late nineteenth century and the Macau government regarded gaming tax as the primary income. From then on, Macau started to be famous for its gaming industry and earned the appellation "Monte Carlo of the Orient." In 1937, the Macau gaming industry had sustained a revolutionary enhancement. In that year, the Macau's Portuguese government enacted a Decree Law to incorporate the operations of various games. The gaming monopoly license was awarded to the Tai Heng Company. As one of Tai Heng's hotels, the New Central Hotel, was made into the flagship casino and led Baccarat, a new gambling game which became the most popular game in Macau. Since then, New Central Hotel brought many other games from Western countries. Jaime Silvério Marques, the 119th administrator of Macau, authorized Macau to be a permanent gambling city and low taxation region. Since then, gaming and tourism industries have become a significant economic resource for Macau.

### **New era for Macau gaming industry**

The transfer of sovereignty over Macau from Portugal to the People's Republic of China was placed on December 20, 1999. After that, Macau became the only place where casinos were legal. Macau has expanded quickly over the past decade because of liberalization of the gaming industry since 2002 (Wong, 2011). The government of the Chief Executive Edmund Ho began the process of opening the gaming market rapidly. The historic Law 16/2001 announced that three new gaming concessions would be granted through an international public bidding process (*Regime Jurídico da Exploração de Jogos de Fortuna ou Azar em Casino*, 2001). Three casinos, including Wynn Resorts, a joint venture between Las

Vegas Sands and Hong Kong Galaxy Entertainment, SJM, were authorized gaming concessions by the government of Macau. Since 2002, the government has also empowered three other sub-concessions in three years. One of the sub-concession between Galaxy and Las Vegas Sands was certified in the year of 2002; one from a joint venture between Pansy Ho and the American manager MGM to SJM was approved in the year of 2005; the last from a joint venture between Australian Crown and Hong Kong Melco to Wynn Resorts was confirmed in the year of 2006.

Additionally, there was further support for Macau gaming industry development of mainland China. An 'Individual Visit Scheme' was started in July 2003, whereby visitors from Mainland China became permitted to visit Hong Kong and Macau on an individual basis, and were not required to be part of a tour group. Since then, the numbers of visitors to Macau have grown quite rapidly. Asian customers could enjoy gambling in Macau rather than taking a long flight to Las Vegas, Nevada, USA. Today, Macau's main tourist market is Mainland China.

Since 2010, under the Government of Chief Executive Fernando Chui Sai On, the pace of progress of the gambling industry has again increased, the monthly gaming revenue hit an all-time high in August 2014. The Macau gaming industry enjoyed significant development during this time. Gross gaming revenue approached a historic high of US\$45 billion in 2013, which was seven times that of the Las Vegas Strip based on the data from Macau's Statistics and Census Service. Although there was a global financial tsunami in 2008 and European debt crisis in 2012, the annual growth rate of the gaming industry in Macau was not affected. It reached 18 percent growth between 2003 and 2014. The share of gambling revenue in GDP increased unprecedentedly from 41.73 percent in 2002 to 91.6 percent in 2010.

### **After anti-corruption campaign**

The anti-corruption campaign in China started in late 2012, it focused on officials from the ruling party, government, military, and state-owned companies suspected of corruption in China. From then on, hundreds of officials in Mainland China have been investigated and prosecuted. The anti-corruption policy discourages a distinct part of high rollers and premium mass players to visit Macau, which caused a sustained decrease in VIP gaming revenue.

The fast growth seemed unstoppable until May 2014. However, the monthly gaming revenue year-over-year started to drop from June 2014 and continued to decline year-over-year for 28 consecutive months (until October 2016). The gross gaming revenue in 2015 was about US\$28.9 billion, which was down dramatically by 34% year-over-year.

### **Objective**

Political factors in mainland China are the dominant reason for the Macau gaming revenue decrease. The purpose of this study is to examine how the anti-corruption campaign in China impacted the Macau's gaming industry.

### **Practical and Academic Significance of the Study**

Although the economy of Macau has been severely affected by the anti-corruption campaign, no current study focuses on this issue. Therefore, this study aims to quantify the impact of the anti-corruption campaign on the Macau gaming industry. By examining gross gaming revenue, VIP baccarat revenue, and slot coin-in revenue through the anti-corruption campaign, this study could provide the Macau gaming industry with base-line evidence for future action.

## **Organization of the Thesis**

This thesis is presented in three sections. Chapter II presents a review of the literature regarding an introduction to the gaming industry development of Macau and anti-corruption situation of mainland China. The chapter is divided into four parts: 1) background; 2) Macau fragile economy; 3) anti-corruption campaign of mainland China; 4) anti-corruption campaign effect on Macau. Chapter III is devoted to the methodology of identifying the three relevant variables used to examine the Macau gaming performance. Chapter IV reports the study results by using autoregressive integrated moving average with intervention analysis. Chapter V presents a general conclusion based on the results obtained from the autoregressive integrated moving average (ARIMA) analysis and discusses the limitations of this thesis and directions for future research.

## CHAPTER II

### LITERATURE REVIEW

#### Background

As early as the 16th century, Macau was occupied by Portugal and became an important trade center between China and Europe under the administration of the Portuguese. The land area of Macau at that time was less than 10 square kilometers with a population of around 40,000. Macau could not supply its own needs. Therefore, it was necessary to construct economic links with adjacent areas. Macau served as a transfer station for the trade between China and Europe long before the foundation of Hong Kong, which was the major economic basis for the enclave. Since Hong Kong was ceded by China to Britain in 1847, it nearly completely displaced Macau and became an international trade port (Wang & Eadington, 2008).

As a result, Macau had to search for other strategies for survival. One strategy was gambling. At that time, Hong Kong and Guangdong Province of Mainland China were the major gambling markets. Furthermore, the Portuguese government was governing Macau and had made gambling legal as early as the 1840s, while the British government was governing Hong Kong and officially illegalized gambling in the 1870s. This provided a reliable and stable market for the casino industry in Macau. Macau was supported by the Hong Kong market which was large and rich enough at that time. Although the role of Macau as an international trade center was captured by Hong Kong which was increasingly rich, Macau had become its “sin city” so as to support its own economy (Wang & Eadington, 2008).

On December 20<sup>th</sup>, 1999, the sovereignty over Macau was transferred from Portugal to the People's Republic of China and it became one of two special administrative regions of China. In addition to its own currency, Macau also enjoys legislative, executive, and judicial power independent from Beijing. The gaming industry is of great importance in Macau. Macau is often named "Asian Las Vegas" and "The Monte Carlo of the Orient". Not only does Macau have casinos, but also horse racing, greyhound racing, sports betting, and lotteries are all legal there, as is online gambling. Baccarat is the most popular game in Macau, and high rollers all over the world come to Macau to play Baccarat. Together with traditional Chinese game players, baccarat players are the majority of gamblers in Macau. In 2001, the Macau government released regulations to liberalize the gaming industry which was monopolized before (Despacho do Chefe do Executivo no. 217/2001, 2001). Subsequently, the inflow of foreign capital and competition attracted considerable investment in infrastructure and realized unheard-of economic growth in the city. This industry accounted for about 40% of the profits of the entire country. After the introduction of online gambling, this number was enhanced to 50%.

### **World's fastest growing gambling capital**

In 2001, the Legislative Council of Macau set up a regime of legal casino gaming to operate the gaming. It was considered as a new milestone in the development history of Macau. Three gaming concessions were provided in this new legal gambling system and they would be accepted through an international public bidding process (Regime Jurídico da Exploração de Jogos de Fortuna ou Azar em Casino, 2001). Three concessions were awarded to SJM, Wynn Resorts, and a combination of Galaxy Entertainment and Las Vegas Sands.

Due to the liberalization of casino gambling since 2001 and Macau being the only legal place for gambling in China, it has developed rapidly over the past decade.

### **Considerable foreign investment**

With the gambling market opened to the whole world, Macau introduced competition mechanisms and foreign investment. Since then, Macau became a free port without any control over foreign investment. When three companies won the concessions, they directly invested in Macau's gaming industry with more than 15 billion Patacas on 2002 (Macau Statistics and Census Services, 2002). According to the liberal economic doctrine, the Macau government provided a series of measures to facilitate foreign investment, which led to spectacular economic prosperity since 2002. Because of the broader opening, a large overseas investments have been flowing into Macau. While the total inward direct investment was 3,034 million Patacas in 2002, it was brought to 36,169 million Patacas in 2013, and the stock of foreign investment was enhanced to 220,772 million Patacas (Macau Statistics and Census Services, 2002–2013). After seeing the remarkable success of Las Vegas Sands achieved in Macau, casinos were springing up all over the city. Meanwhile, hundreds of visitors come to Macau. There is a total amount of 38 casinos full in Macau at present (Gaming Inspection and Coordination Bureau Macau SAR, 2016). Since 2006, its per capita GDP was up to US\$ 29,755 and surpassed Hong Kong's US\$ 28,224 USD for the first time (World Bank, 2006). What is more, its gross gaming revenue was up to 83,847 million Patacas and exceeded Las Vegas to be the largest gambling center in the world that year. From the beginning of 2012 to the end of 2013, the performance of gambling companies' stock was the best in the Asian market. The

stock price of SJM company doubled, it was tripled for Sands China and was increased by 265% for MGM China (Dimmhy, 2015).

The gaming industry is the backbone of the economy in Macau, and tourist consumption occupies nearly 90% of GDP. More than half of the labor forces work in tourism related sectors and the gaming industry creates about two thirds of the public revenues (Macau Statistics and Census Services, 2009). In 2014, Macau achieved the highest GDP of 442,070 million Patacas (Macau Statistics and Census Services, 2002–2016). With a population of 636,200 and a territory area of 30.3 kilometers, Macau became one the richest economic entities all over the world.

### **Significant enhancement of tax from gaming industry**

The opening of the gaming market since 2002 benefited the corresponding tax revenue. The economic situation of Macau was unprecedentedly prosperous. In 2014, the highest tax revenue was 136,710 million Patacas, which was almost seventeen times higher than the tax revenue in 2002, which is the first year when the gaming market was opened in Macau (Macau Statistics and Census Services, 2002–2016). Currently, the tax revenue accounts for two-thirds of the current annual revenue in Macau.

### **Individual visit scheme enlarged gambling tourism market**

The world-class tourism facilities in Macau attracted the attention and curiosity of surrounding regions. The gambling industry was liberalized in Macau since 2002, and some international players threw themselves to this industry. In 2003, there have been individual visit schemes allowing citizens from the selected cities in Chinese mainland to be permitted to

visit Macau without joining a tour. Tourist arrivals increased dramatically since 2002. What is more, Macau's major gaming market has shifted from Hong Kong to Mainland China (Liu, 2016). The highest number of tourist arrivals reached up to 31.5 million in 2014 which could compare with 7.44 million tourist visitors in 1999. As a small part of the total amount of Mainland China visitors, the number of Chinese visitors who were under the individual visit scheme was 7.1 million in 2012, which exceeded the total number of Hong Kong visitors (Macau Statistics and Census Services, 1999–2016).

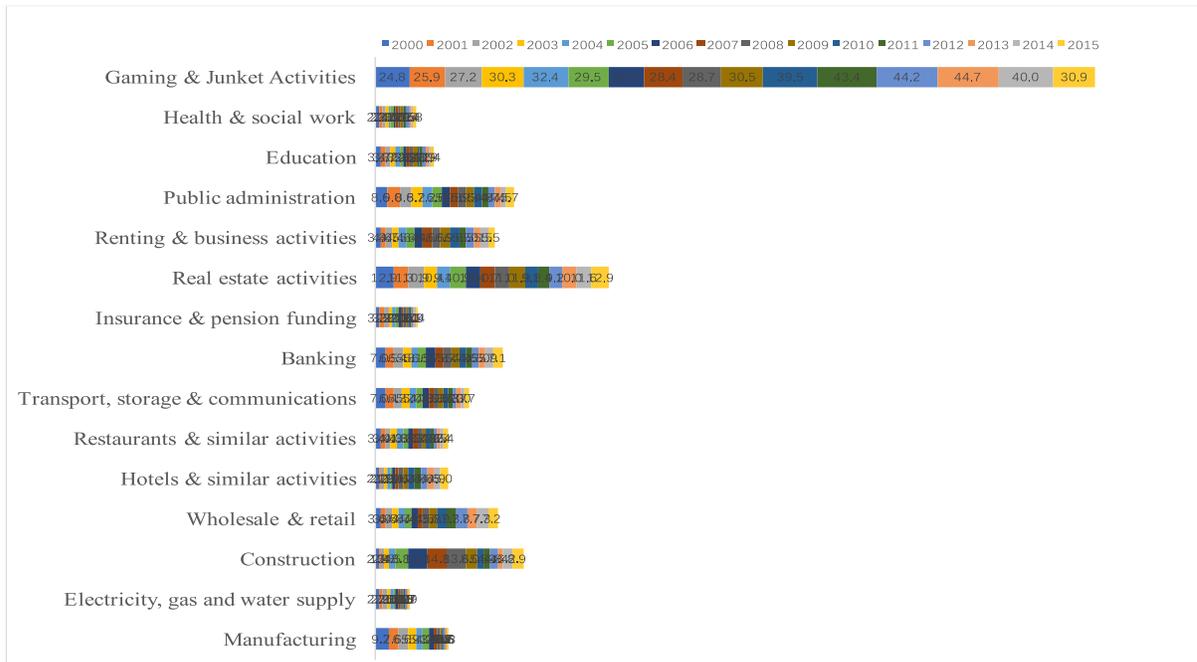
During ten years of liberalization of the Macau gambling industry, the gambling market enlarged ten times as before. Macau became the world's gambling center with the largest gambling market.

### **Macau Fragile Economy**

#### **Macau economic structure**

Due to historical, geographical, social, and political factors, Macau's economic structure has been relatively simple. Since the reunification, Macau government has made some efforts to promote the development of the economy diversity. Other industries besides gambling industry have also developed like tourism, export processing, finance, and insurance, which led to a more diversified industrial system. However, overall, the economy structure is simple. The main reason is that the economy of the gambling industry dependence is serious. As gambling industry is the main financial source of Macau government, the government reduces the emphasis on other industries (Zhang, 2009). Because the industry structure is simple and the economy highly depends on external environment, the economy development is unstable. The fragility of Macau economy is exposed day by day and becomes the biggest

potential problem of sustainable economic development. In the first half of 2003, the outbreak of SARS in surrounding areas affected the Macau economy. In the first quarter, the economic growth rate was 16.5%. In the second quarter, due to the SARS epidemic, the number of visitors dropped dramatically, which caused a 1.3% decrease in the economy.



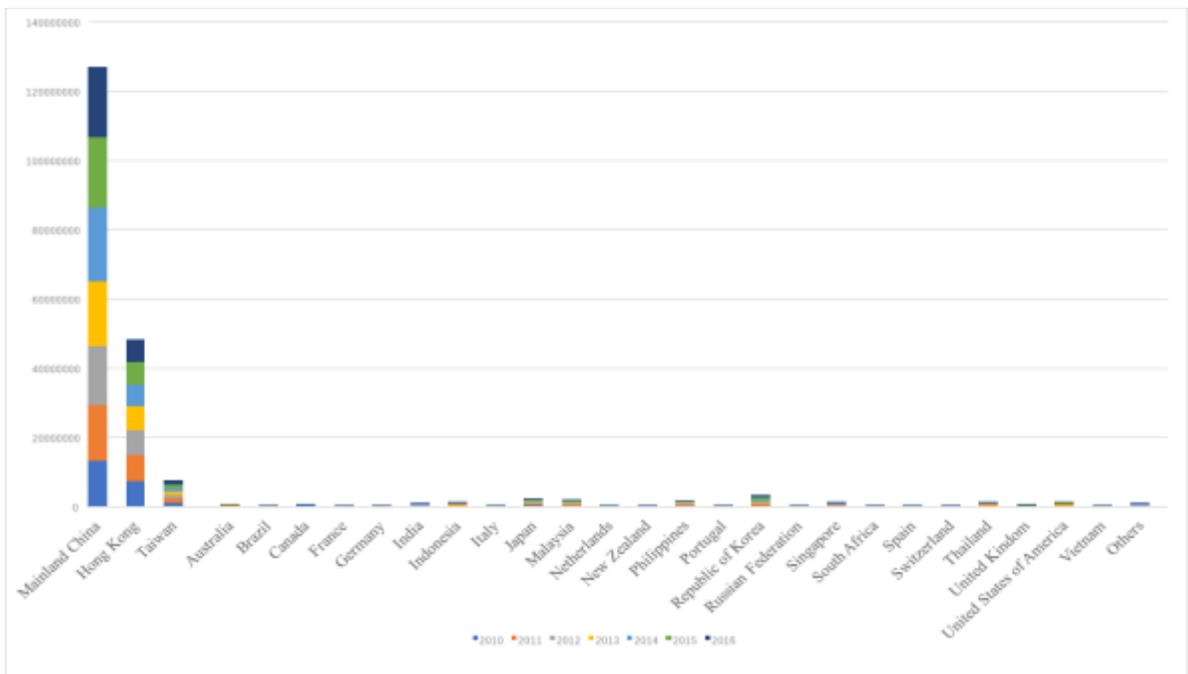
**Figure 1.** Macau Gross Value of Principal Economic Activities by Production Approach (Data source: Macau Statistic and Service: <http://www.dsec.gov.mo>)

From Figure 1, it is clear that the gaming industry contributed the most to Macau economy, which confirmed that Macau depends on gaming industry heavily for its economic development and the Macau government ignored the development of other industries.

**Tourists source highly dependent on Mainland China**

With the implementation of Individual Visit Scheme, the proportion of visitors from mainland China rose and the Macau gambling industry took more parts of the mainland market. The legalization of gambling in Macau conflicted with the prohibition of gambling in the

mainland, which restricted Macau's further development of gambling. One of the purposes of the introduction of foreign investment was to broaden international tourism markets and attract foreign visitors. In this case, the diversification of tourist structures and the tourism volume were promoted (Wang, 2012). Mainland China tourists replaced Hong Kong visitors became the major market for Macau when the gambling market was opened. In 2004, the number of entry passengers in Macau was as high as 16,672 thousand, which was increased up to 40.2% over 2003, the three major tourist sources were Mainland China, Hong Kong, and China Taiwan. Macau relied on Mainland China heavily, but it conflicts with the anti-corruption campaign (Liu, 2016). The following figure shows that the number of tourists visiting Macau from some major countries or areas in the last few years.



**Figure 2.** Macau Tourists from Different Countries, 2010 – 2016 (Data source: Macau Statistic and Service: <http://www.dsec.gov.mo>)

Figure 2 indicates that Mainland China is always the major visitors' source of Macau, which means the economic development of China affects Macau. A good economic

environment brought Macau thousands of visitors from Mainland China. However, if there is an incident that leads to the decrease in tourists from mainland China, Macau's financial performance will be affected accordingly.

### **Anti-corruption Campaign of Mainland China**

The year 2012 witnessed the start of a far-reaching anti-corruption campaign in China after the 5<sup>th</sup> generation Communist leadership of the People's Republic of China took office which came about as a result of the decision of the 18<sup>th</sup> National Congress of the Communist Party of China. Xi Jinping, General Secretary of the Communist Party of China (paramount leader), led the campaign that was considered the biggest and most organized anti-corruption movement throughout the history of China under Communist rule.

Corruption is a long-existing issue within the party since the establishment of the People's Republic of China and indeed even before that. But the majority of corruption appears to rise for a shorter time, according to The New York Times in 2014, it was as early as the 1990s that the crime became wild among party members, due partly to a significant rise in infrastructure investment. More and more opportunities brought by the lucrative contracts for railways, roads, and ports are seized by some officials to fill their own pockets as well as their associates. Investment in real estate, infrastructure, and other fixed assets climbed up from an average of 36% of GDP from 1980-1991 to over 41% from 1992-2011.

The issue has undoubtedly come to the attention of successive administrations that have promised to come up with solutions. Hu Jintao, the former president of China, talked about corruption that "could prove fatal to the party, and even cause the collapse of the party and the fall of the state (Ren and Du, 2008)". Another former president of China, Jiang Zemin warned that "corruption is the cancer in the body of the party and the state. If we let it be, our party,

our political power and our socialist modernization cause will be doomed (Ren and Du, 2008)”. But it wasn’t until the current President Xi Jinping activated the far-reaching anti-corruption campaign in late 2012 that these issues were placed under the microscope to be dealt with seriously.

Macau has noticeably felt the consequence as this initiative has extensively dived into the corruption within the party. The Chinese Communist Party (CCP) remains as one of the biggest organizations in the world and held the title of the biggest political party in the world until 2015. Meanwhile, the CCP is also the official state party. Currently, the CCP holds approximately 88 million seats of members and such a huge amount is bound to sweep key state functions (locally or otherwise) where corruption could be easily located. In 2015, officials being charged and punished for corruption were up to 300,000 and 200,000 of which were found guilty but received ‘light’ punishment while 82,000 of the rest were caught and subjected to severe penalties. There were 100 so-called tigers among these (the once-untouchable elite of the party) were arrested according to International Policy Digest. Regardless if someone is a top ranking official or low-level civil servants, people from almost every corner of the country have been edged out in the campaign (People.cn, 2016).

### **Anti-corruption Campaign Effect on Macau**

An unprecedented anti-corruption campaign was launched by Xi Jinping, the Chinese President and General Secretary of the Communist Party, targeting officials suspected of corruption in military, government, and state-owned companies. The campaign was launched after Xi seized the highest position in late 2012. As he claimed, it was time for China to shift to a ‘new normal’ since the government attempts to reach a balance between the economic reform and more suitable and healthier development (Lopez, 2015).

Hundreds of officials were investigated and prosecuted across the nation in this campaign. Consequently, earnings at Macau's high-rolling VIP lounges were severely impacted due to the crackdown on the corruption (Bolton, 2014).

Macau was a perfect place for corrupt party officials and businessmen in China to launder dirty money or gamble it away. Information gathering about these corrupt Chinese officials was costly to local authorities. Macau was once an ideal place to launder the money but now is increasingly doubted as a safe place for this activity (Nobel, 2015).

Gambling industry provided Macau with gaming revenue of more than \$5 billion dollars since 2004. Gaming revenue reached a peak of \$45 billion in 2013, seven times as much as Las Vegas, and the numbers of tourist visitors increased dramatically. In 2015, the number of visitor arrivals was 31.5 million, almost two times the amount as in 2005 (Macau Statistics and Census Services, 2002–2016). However, the Macau gambling industry has become the target of public criticism. The gambling industry in Macau is a primary way wealthy individuals can take enormous sums of money out of China. Since 2013, the anti-corruption campaign influenced thousands of officials and business people. In addition, along with the speed of China's economic slowdown, China's foreign investment developed also became slow, which led the Chinese government to be concerned about outflow of capital. Therefore, the gambling industry was strongly criticized for laundering dirty cash (Nobel & Julie, 2015).

Macau's revenue decreased approximately 3.3% year-over-year to approximately \$28 billion in the entire year of 2016, falling 34.3% in 2015 and 2.6% in 2014. In the June of 2014, Macau's casinos encountered another increase due to the violent efforts of the Chinese Government against the corruption. In response to these efforts, Macau officials had no choice

but to impose stricter rules to halt the siphoning of illegal money. VIP rollers have no longer appeared in the public eye, so major casinos must compete for the mass market (Bolton, 2014).

Macau government has taken some practical measures, such as changing the visa requirements and restricting credit card payments (Nobel & Julie, 2015). For the visitors coming from Mainland China, they could stay in Macau for fourteen days with their passports; however, Macau Public Security Bureau changed that rule on August 1st, 2008 (Zeng, 2015). Entry days were reduced from fourteen days to seven days for visitors coming from Mainland China with their passport. If visitors from the mainland enter Macau with a passport and did not go to any other destination for their initial entry, the re-entry period for their stay time would be reduced from seven days to two days and they wouldn't be allowed to enter Macau until thirty days later. Macau Public Security Bureau tightened the entry policy for the visitors from Mainland China with their passport again on July 1st, 2014 (Zeng, 2015). The entry permit days were reduced from seven days to five days, for a traveler's first entry, if they did not go to any other destination and would not be allowed to re-enter Macau within sixty days, and their permit stay days would be reduced to one day only. For the next sixty days, if mainland China visitors entered Macau again with their passport but did not go to any other countries, they would be refused entry to Macau. Each time Mainland China visitors use the passport to entry Macau without the flight ticket to the third country, their passport would be marked with 'dt' by Macau police officers. Passport with 'dt' mark will be affected by applying visa to other countries.

The Mainland China government also tightened its policy for visitors who were exiting to Macau with their passport after Macau tightened entry policy for five months. Visitors can exit from Mainland China to Macau with a visa of the third country and corresponding flight

tickets in the past days. With the new policy, Chinese border patrol also required a flight ticket with a proof of seat number (Zeng, 2015).

### **Reduction of VIP gamblers**

The mainlanders' dramatic movement to Macau has been slowed by the national anti-graft campaign. It is apparent that Chinese gamblers won't simply visit Macau for gambling only. Xi's government also put gave special attention to the relevant advertisements that promote Macau casinos, sometimes in the form of bother some text messages. Analysts also express that the visa restriction would be tighter and even retail gamblers' money will be tracked by the officials' monitor, Union Pay, which is the only domestic bank card in Mainland China. Considering the pain that Xi's administration has already placed on the casinos in Macau as well as casino companies in the world, the latest announcement goes around and round throughout all these years (Bolton, 2014).

VIP rooms have been the barometer of the Macau gaming industry recently, even though the mass market of the casinos seems exceptionally lively and to always be in full flow. However, as an essential part of Macau gambling industry, VIP rooms-related business languished (Gu & Tam, 2011). Not only did the number of VIP gamblers decreased, the gambling stakes were also significantly reduced. Due to the decrease of rolling chips from VIP rooms, the income of casinos in Macau was affected. In the third-quarter in 2014, the revenue of VIP rooms was decreased by 16% year on year (Macau Statistics and Census Services, 2014). Since then, the poor conditions for VIP rooms do not improve or even become worse. Usually, high-spend wealthy businessman or government officials from Mainland China were the targets of VIP rooms in Macau, and they promoted the VIP room's income a great deal.

However, Macau finance administrative bureau announced that restricted Union Pay bank card from Mainland China and the ban of the use of terminal equipment for Union Pay in the jewelry store and pawnshop from July 1st, 2014. Although this announcement could attack laundering money and maintain the Macau economic order, it limited casino agencies to prepare funds for VIP customers and cut off their channels for accessing more money. The Chinese government took sweeping measures against corruption, such as investigation of the collusion between public officials and wealthy businessman and restricted government officials' visas rigorously. Therefore, the number of officials who could visit Macau reduced significantly. What's more, due to the economic development of Mainland China has been an awkward position, which led business conditions to become seriously deteriorated and the amount of rich businessman visits Macau also reduced (Liu, 2016).

## **CHAPTER III**

### **METHODOLOGY**

#### **Introduction**

The primary purpose of this study was to examine whether the Macau gambling industry was affected by the anti-corruption campaign or not. Data were analyzed by implementing SARIMA with intervention analysis (Box & Tiao, 1975). To develop SARIMA forecasting models for Macau gambling industry and to forecast future quarterly revenue, historical time series of the quarterly gross gaming revenue, slot coin-in revenue, and VIP Baccarat revenue were required. Data were obtained from Macau Statistics and Census Service. The data between the first quarter of 2005 and fourth quarter of 2016 covering 44 quarters were used to establish the forecasting model.

This study attempted to examine whether the anti-corruption campaign of mainland China had a significant impact on any or all the three variables by identifying and measuring significant decreases in value in each time series when the anti-corruption campaign started. To satisfy the purpose of this study, the period started at the first quarter of 2013 was defined as the beginning of anti-corruption campaign under Xi Jinping (People.cn, 2016). This study used SAS 9.4 to analyze the data.

#### **Time Series Analysis**

Autoregressive Integrated Moving Average (ARIMA), an analysis model of time series, was developed by Box and Jenkins (2008). AR (autoregressive) refers to a weighted average calculation adopted to evaluate values of time series through previous data and “p” stands for

autoregressive order  $p$ . In this process, the previously associated data is contained. Moving average (MA) is the procedure of evaluating values of time series on the basis of weight average about previous observations' error estimation and "q" means moving average order  $q$ . The data related to previous observations' error estimation is included herein. Integrated (I) represents the various steps to realize stability and "d" refers to the different orders for changing stability. The ARIMA model could be represented in the form of  $(p, d, q)$ .

By considering estimation error residuals and lag, the process created by Box and Jenkins desired to match more accurate models (Box, Reinsel, and Jenkins, 2008). The process was welcomed in numerous industries, like related studies of Hospitality and Tourism. Song, Witt, and Li (2009) summarized that ARIMA process was applied in most research after 1990 associated with the analysis of time series in travel demands. For instance, Lu and Lai (2005) conducted an analysis of the impact on demand for travel by air. Moreover, Box-Jenkins process can be adopted as well in predicting and surveying tourism (Du, Preez, and Witt, 2003).

### **ARIMA with Intervention Analysis**

Social events, such as policy transformation, marketing activities, and economic depression, will frequently influence time series and consequently result in notable structural transformation and mean concentration fluctuations in time series before or after the event. The technology of intervention analysis can quantitatively evaluate the effect caused by a social event (Bowerman, Koehler, and Connell 2005). To be more specific, analysis of intervention refers to adding a variable into the present ARIMA model to find out whether an external event influenced time series and calculated the magnitude of the impact.

Previous scholars applied time series analysis with intervention analysis in various of fields to confirm and estimate the effect of events, including scheduling and simulating systems (Ip, 1999; Ip, Fung, and Keung, 1999), predicting economic elements (Chung et al., 2008), the fiscal crisis of manufacture industry in China (Chung et al., 2009), requirements of telephone marketing center (Bianchi, Jarrett, & Hanumara, 1998). Many scholars have analyzed the hospitality industry related event by ARIMA with intervention analysis. Murphy, Lucas, Bernhard, and Eisendrath (2008) measured the effect of the 911 terrorist attack on the gaming industry performance in Las Vegas. Zheng, Farrish, Lee, and Yu (2013) calculated the influence of the economic depression on the gaming industry in Iowa and estimated the tendency of the development of gaming industry. Zheng, Farrish, and Kitterlin (2015) measured the weekly stock index of hotels and casino compared with the S&P 500 index.

### **Data Collection**

Gross gaming revenue, slot coin-in revenue, and VIP Baccarat revenue were analyzed in this study. These three variables were obtained from the Macau Statistics and Census Service.

#### **Gross gaming revenue**

Gross gaming revenue is the total number of net wins received on all games minus the winnings paid out (Kuuluvainen et al., 2012). In this study, gross gaming revenue is analyzed to determine the performance of the gross gaming revenue after the anti-corruption campaign.

### Slot coin-in revenue

Slot coin-in revenue was considered the total amount of money casino guests spent on slot machines. According to Lucas and Santos (2003), slot coin-in is the purest index for gaming volume. Zheng (2013) used this variable as one of the three variables in his study to examine the performance of the Iowa gaming industry during the economic recession.

### VIP baccarat revenue

Since baccarat is the only gambling game in Macau VIP rooms and VIP baccarat revenue have been a primary source of the income for the Macau gambling industry for a long time. Therefore, VIP baccarat revenue could reflect a general situation of the Macau gaming industry development. In Table 1, it is clear that VIP baccarat revenue has been an important part of gross gaming revenue and usually accounts for more than fifty percent of gaming revenue.

**Table 1.** The Ratio of VIP Baccarat Revenue to Gross Gaming Revenue

	Gross Gaming Revenue	VIP Baccarat Revenue	Ratio
2005	47,134	28,864	61.24%
2006	57,521	36,783	63.95%
2007	83,847	55,762	66.50%
2008	109,826	73,772	67.17%
2009	120,383	79,834	66.32%
2010	189,588	135,648	71.55%
2011	269,058	196,126	72.89%
2012	305,235	210,850	69.08%
2013	361,866	238,524	65.92%
2014	352,714	212,535	60.26%
2015	231,811	127,818	55.14%
2016	224,128	118,960	53.08%
	Million Patacas	Million Patacas	Percent

## CHAPTER IV

### RESULTS OF STUDY

#### Introduction

According to Bowerman, Koehler, and Connell (2005), this study applied the three-step process to fit an accurate SARIMA model: identification, estimation, and diagnostics. In this study, three quarterly time series were fitted by the SARIMA model. To identify and estimate the potentially significant effect of anti-corruption policy had on the Macau gambling industry and the lag time of the influence of this policy. Each of the three SARIMA models implemented intervention analysis by SAS Time Series Forecasting System. The time series combined data from the first quarter of 2005 to the last quarter of 2016 was used for identifying impact.

#### SARIMA with Intervention Analysis

There are many series that include seasonal effect. To confirm the accuracy of analysis, the ARIMA model was developed to contain seasonality by adding seasonal autoregressive terms and seasonal moving average terms in the time series by Box and Jenkins (2008). Therefore, the seasonal autoregressive integrated moving average (SARIMA) model was identified. The seasonal autoregressive integrated moving average model could be represented as  $(p, d, q) (P, D, Q)_s$ ,  $s$  stands for the number of a time period in a seasonal series. In this study,  $s$  was equal to 4 due to the quarterly seasonal time series. The process for modeling SARIMA should follow the same procedure for modeling ARIMA.

An intervention event may affect time series' performance, and consequently influences the evaluation of the ARIMA model parameters and the model's framework (Box, Reinsel, and Jenkins, 2008). Because this study attempted to identify the possible significant impact the anti-corruption campaign had on quarterly gross gaming revenue, slot coin-in revenue, and VIP baccarat revenue, the SARIMA model with intervention analysis was performed on three quarterly time series.

To confirm the suitable model for forecasting and interpreting the effectiveness, there are three procedures in SARIMA modeling. First, it was necessary to determine the order of difference. This initial process is important to generate a stationary time series model for identification. Observation of the plots of quarterly time series data indicated that none of the three-time series were stationary. The Augmented Dickey-Fuller test was used for determining the order of the differencing in SARIMA modeling. This model suggested that the time series for variable gross gaming revenue and VIP baccarat revenue appeared to be stationary when accounting for second order differencing and the time series for variable slot coin-in revenue appeared to be stationary when accounting for first order differencing.

In the SARIMA model,  $p$  represents the autoregressive part,  $P$  represents the autoregressive part at seasonal level,  $q$  stands for the moving average component of the model, and  $Q$  represents the moving average component of the model at the seasonal level. Therefore,  $p$ ,  $P$ ,  $q$ , and  $Q$  were calculated and parameters were evaluated in the estimation procedure of SARIMA model fitting. The best fitting SARIMA model for variables gross gaming revenue and VIP baccarat revenue was  $(2, 2, 4) (0, 2, 0)_4$  and for variable slot coin-in revenue was  $(0, 1, 4) (0, 1, 0)_4$ . Table 2 lists the parameters estimates.

**Table 2.** Summary of Estimates of Model Parameters

Parameters	Estimate	Std. Error	<i>t</i> -statistic	<i>p</i> -value
<i>Quarterly Gross Gaming Revenue: SARIMA (2, 2, 4) (0, 2, 0)<sub>4</sub></i>				
AR <sub>1</sub>	0.5493	0.1368	4.02	0.0003
MA <sub>1</sub>	1.0000	0.3162	3.16	0.003
<i>Quarterly VIP Baccarat Revenue: SARIMA (2, 2, 4) (0, 2, 0)<sub>4</sub></i>				
AR <sub>1</sub>	0.5458	0.1427	3.83	0.0004
MA <sub>1</sub>	0.0998	0.3168	3.16	0.003
<i>Quarterly Slot Revenue: SARIMA (0, 1, 4) (0, 1, 0)<sub>4</sub></i>				
MA <sub>1</sub>	0.9999	0.3086	3.24	0.0023

According to Bowerman, Koehler, and Connell (2005), residuals acquired from the model were examined to guarantee all SARIMA models fit the data sufficiently in the last procedure of diagnosing. A Ljung-Box test was conducted on each SARIMA model to test whether the autocorrelations at lags 6, 12, 18, or 24 of the residuals were different from zero.

Table 3 shows that *p*-values were higher than 0.05 for most  $\chi^2$  statistics, which means autocorrelations were not different from zero, it suggested an adequate model fit. The results from the Ljung-Box test indicated that the models of the three quarterly time series were identified and formed by the Box-Jenkins procedure and all three SARIMA models fit the data adequately.

**Table 3.** Summary of Ljung-Box Chi-Square Statistic

<b>Lag</b>	<b><math>\chi^2</math></b>	<b>Df</b>	<b><i>p</i>-value</b>
<i>Gross Gaming Revenue</i>			
6	23.63	4	<.0001
12	24.8	10	0.0057
18	27.33	16	0.0379
24	43.38	22	0.0042
<i>VIP Baccarat Revenue</i>			
6	15.8	4	0.0033
12	16.04	10	0.0986
18	20.34	16	0.2055
24	32.55	22	0.0685
<i>Slot Coin-in Revenue</i>			
6	6.24	5	0.2831
12	8.13	11	0.7012
18	11.29	17	0.8413
24	13.44	23	0.9417

When the SARIMA model was fitted the three quarterly time series, an intervention analysis was applied to each model to figure out the potential significant influence by analyzing whether there was a significant decrease or increase in any time series. Due to the beginning time of anti-corruption was the end of 2012 (People.cn, 2016), this study performed an intervention analysis on each of the three-time series models from the first quarter of 2013. External events always influence time series with lagged feature. Therefore, failure to figure out a significant effect in the first quarter of 2013 does not mean the anti-corruption policy had no impact on the Macau gaming industry. This study applied an iterative method and

performed intervention analyses repeatedly on each time series until a significant decrease effect was determined or until the last quarter of 2016 as suggested in Chang, Tiao, and Chen (1998) and Chen and Liu (1993). The intervention analysis performed on three-time series started at the first quarter of 2013, the first quarter after anti-corruption campaign, and repeated in the second quarter of 2014 and the following quarters.

### Results of Analyses

The results of analysis listed in Table 4, Table 5, and Table 6 indicated that the impact was identified in the form of a significant decrease in estimated value in three-time series for gross gaming revenue, slot coin-in revenue, and VIP baccarat revenue respectively of -14625.1 million Patacas, -11457.1 million Patacas and -318.4879 million Patacas, respectively, starting in the first quarter of 2014.

**Table 4.** Impact of Gross Gaming Revenue Identified

Parameters	Estimate	Std. Error	<i>t</i> -statistic	<i>p</i> -value
<i>Quarterly Gross Gaming Revenue</i>				
AR <sub>1</sub>	0.7322	0.1642	4.46	<0.0001
MA <sub>1</sub>	1.0000	0.1643	6.09	<0.0001
First quarter of 2014	-14625.1000	4281.9	-3.42	0.0016
(Million Patacas)				

**Table 5.** Impact of VIP Baccarat Revenue Identified

Parameters	Estimate	Std. Error	<i>t</i> -statistic	<i>p</i> -value
<i>Quarterly VIP Baccarat Revenue</i>				
AR <sub>1</sub>	0.6571	0.1567	4.19	0.0002
MA <sub>1</sub>	1.0000	0.1485	6.73	<0.0001
First quarter of 2014	-11457.1000	3083.9	-3.72	0.0007

(Million Patacas)

**Table 6.** Impact of Slot Coin-in Revenue Identified

Parameters	Estimate	Std. Error	<i>t</i> -statistic	<i>p</i> -value
<i>Slot Coin-in Revenue</i>				
MA <sub>1</sub>	1.0000	0.0877	11.39	<0.0001
First quarter of 2014	-318.4879	170.8843	-1.86	0.0701

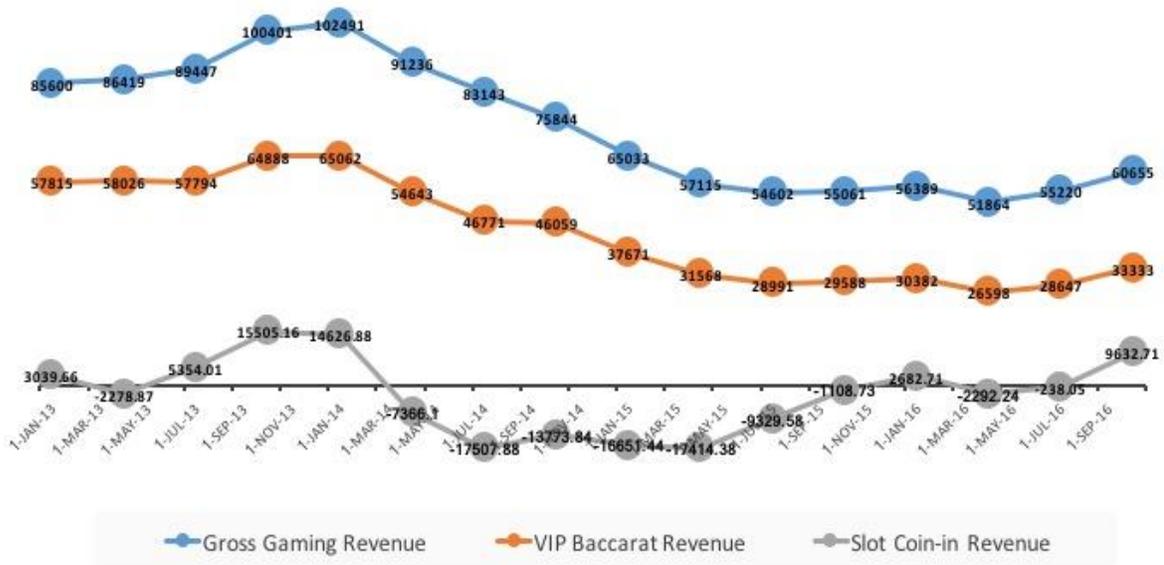
(Million Patacas)

CHAPTER V

IMPLICATIONS AND CONCLUSIONS

Summary of the Study

The results of the SARIMA with intervention analyses listed in Table 4, Table 5 and Table 6 indicate that three variables showed significant decrease starting at the first quarter of 2014. In other words, all three variables were significantly affected by the policy event of mainland China. Figure 3 indicates that the actual value of all three variables appeared to significantly decrease after the first quarter of 2014 and experience sharp decreases in the following quarters, which indicates the anti-corruption policy had a negative and far-reaching impact on the Macau gaming industry.



**Figure 3.** Tendency for the Development of Actual Value (Data source: Macau Statistic and Service: <http://www.dsec.gov.mo>)

## Discussion and Implication

In the history of the Chinese gaming industry, the Chinese prefer table games than other games in casinos. Especially baccarat, the most popular table game among Chinese gamblers (Lam, 2005). The reason why Chinese people like baccarat the most is that they enjoy high risk, social value, and the exciting environment in baccarat gaming. Chinese gamblers are less likely to learn the gaming rules of automatic gaming machines, such as slot machines. They believe that the new knowledge for learning slot machines does not seem likely to be more lucrative than baccarat gaming does. Furthermore, they enjoy controlling the win or lose on the table games but slot games could not provide them a sense of control (Lam, 2005). According to the Gaming Inspection and Coordination Bureau Macau SAR (2016), there were 13,826 slot machines versus 6,287 tables in the Macau gaming industry, the ratio for slot machines to table games in Macau was 2.2. Compared to Las Vegas Strip, where, according to the Nevada Gaming Commission and State Gaming Control Board) there were 145,813 slot machines versus 5,569 table games, the ratio for slot machine to table games was 26.18. There are many kinds of table games in Macau's casino, such as baccarat, Makccarat, black jack, Mahjong Paikao, and Fantan. However, the revenue for baccarat and VIP baccarat tends to be the majority of the Macau gross gaming revenue. According to Macau Statistic and Census Service, the highest ratio of baccarat (including VIP baccarat) to gross gaming revenue was 91.23% in 2013 and the lowest ratio of baccarat (including VIP baccarat) to gross gaming revenue was 81.1% in 2002.

To make a conclusion, the reduction of gaming revenue was caused by the change of VIP baccarat revenue. The development of the Macau gaming industry relied heavily on baccarat gamblers, especially VIP baccarat customers. These gamblers seriously affected the

Macau gaming industry. This was due to the fact that most VIP baccarat gamblers were officials and wealthy businessman from Mainland China and fear of the anti-corruption policy is high currently, which results in less possibility for people to come to Macau for high stake gaming. The Macau gaming industry needs to find a new method for avoiding the single segment of the gaming market (customers playing baccarat or VIP baccarat).

Since no known study has been identified concerning the Macau gaming industry and the affect by the anti-corruption campaign under Xi Jinping, the findings of this study will provide the Macau gaming industry with initial evidence. As for practical meaning, the revenue from VIP baccarat customers was shown to have been significantly affected by policy events from Mainland China, and caused the dramatic decrease in performance for the Macau gross gaming revenue. Slot coin-in revenue was affected slightly by anti-corruption policy from the results of this study. Not only was slot machine gaming is not as popular as baccarat, but the target audience of slot machines were mass market customers, they were not influenced by Mainland China policy as VIP customers were. Because Macau is losing its VIP room target customer, it could shift its target market to mass market customers. Such as building more new attractions to appeal to more visitors. Also, Macau could decide to rethink the economic structure due to these findings. To reduced its economic dependence on the gaming industry, Macau could learn from Las Vegas about how to transfer a gambling center into a famous tourist city.

### **Key Limitations and Suggestions**

Limitations of this study could be data selection. To apply with the time serious analysis, data need to include a long-time period for forecasting and estimation. Since data provided by

Macau Statistics and Census Services were limited in time periods, there were not very suitable data with long periods could be used as the most accurate data to be analyzed and satisfy the purpose of this study. Such as variable gross gaming revenue, it is not a purist factor of the real volume of the gaming business. Because gross gaming revenue is not the actual profit, it can include chips, coupons, and any further deductions. Therefore, gross gaming revenue should not be the most accurate variable for analyzing the real volume of the gaming business. In this study, it was used as a factor to interpret the general performance of Macau gaming industry before and after the anti-corruption campaign. As for a suggestion for future study, it could be useful to explore and analyze more certain variables. The measure of forecasting time series data used in this study was found to be reliable. It established the prediction model based on the accurate and statistical method. Future researchers should use a similar method when attempting to analyze whether a current situation would be affected by another event.

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