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RESEARCH ARTICLE



Implementing Anti-money-laundering Goals: New Technologies or Coordination between Related Agencies?

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ABSTRACT

This paper is to investigate whether anti-money-laundering (AML) improvement in a gaming tourism destination is driven by the integration of new technologies, or by other factors such as financial inclusion and close coordination between companies and related government bodies. The quantitative method of ordinary least squares (OLS) multivariate regression is applied to determine the degree to which money-laundering activities in Macau reduced between 2007 and 2017. This study reveals a strong positive relationship between the number of suspicious transaction reports (STRs) and the amount of private-sector domestic credit as a percentage of GDP. The relationship between investment in IT as a percentage of GDP and the number of STRs is statistically insignificant, but there is a positive association with the number of STRs in the gaming tourism industry. Close coordination between industry players and various AML agencies has also had a positive impact on STR detection. Besides, this study will be of benefit to the gaming tourism destination, showing that casinos can cooperate openly with financial institutions and government bodies to fight money laundering, which will help to ensure that gaming tourism destination maintains a positive image sustainably.

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Gaming tourism; anti-money-laundering; new technologies; financial inclusion; close coordination; suspicious transaction reports

关键词

博彩旅游; 反洗钱; 新技术; 金融包容性; 密切合作; 可疑交易报告

实现反洗钱目标: 新技术还是相关机构之间的协调?

摘要

本文旨在研究博彩旅游目的地反洗钱 (AML) 情况的改善是由新技术的集成或其他因素 (例如金融包容性以及公司与澳门相关政府机构之间的紧密协调) 所推动。研究采用最小二乘多元回归的定量方法来确定2007年至2017年间澳门洗钱活动的减少程度。这项研究揭示了可疑交易报告 (STRs) 的数量与私营部门本地信贷的数量 (占GDP的百分比) 之间存在很强的正相关关系。IT投资占GDP的比重与可疑交易之间的关系不显著, 但是与博彩旅游业可疑交易的数量之间存在正相关关系。行业参与者与各种反洗钱机构之间的密切协调也对可疑交易的检测产生了积极影响。此外, 这项研究将对博彩旅游业有利, 结果表明博彩企业可以与金融机构和政府机构公开合作打击洗钱活动, 这将有助于确保博彩旅游目的地持续保持良好的形象。

Introduction

As a special administrative region (SAR) of China, Macau has become synonymous with tourism and the gaming tourism industry. It is also a free port city, so no quotas or tariffs are imposed, and as a free-market economy, it has minimal taxation and its currency is traded freely on the open market.

According to government statistics, in 2018 Macau's population was 635,000 and its gross revenue from games of fortune was 276.38 billion Macanese pataca (MOP; DSEC, 2018), making it the world's casino capital. Casinos are cash intensive, with a high risk of money laundering. Macao's gaming tourism industry attracts three main types of patron: (1) mass gaming players who are tourists on vacation; (2) junket players who are usually brought in by casino operatives; and (3) high roller premium players who are generally given VIP treatment when they visit Macau (Asia Pacific Group on Money Laundering, 2018). Younger Macau citizens prefer mobile gaming to playing roulette or baccarat on casino tables. The local gaming tourism industry has weathered crises and challenges, not only through its status as a financial and economic hub, but also by improving the scale and quality of its infrastructure, offering world-class professional service standards and operating responsible gaming (Wu & Chen, 2015).

Macau has relied heavily on gaming tourism for economic growth, and has introduced international-standard anti-money-laundering (AML) regulations. According to the Financial Intelligence Office (GIF), in October 2019, the Macau Special Administrative Region (MSAR) became the first member of the Asia Pacific Group on Money Laundering (APG) globally to secure a positive technical compliance rating for all 40 Financial Action Task Force (FATF) recommendations. This marks a key milestone in Macau's AML efforts. Technology is a major aspect of AML, and is required as part of an effective AML compliance framework. Innovative technological tools enable organizations to mitigate the risk of financial crime (Lee, 2016; Yang & Wei, 2010). The primary objective of this paper is to investigate whether AML improvement is driven by the integration of new technologies, or by other factors such as financial inclusion and close coordination between companies and related government bodies.

The FATF expects countries to apply its risk-based approach in their jurisdictions to ensure financial inclusion. Despite its efforts to encourage countries to implement financial inclusion through regulatory models, it remains unclear how this has helped to tackle money laundering for a gaming tourism destination. The FATF has carried out its own studies to explore what a 'low-risk' label actually means in the case of money laundering, in discussion with national regulators and financial institutions (De Koker, 2011). For successful financial inclusion, there must be close coordination between the parties crucial to stamping out money-laundering activities (FATF, 2017). Financial inclusion measures must not allow money-laundering activities by those seeking to use the banking system to hide their illegal gains (Shehu, 2012). Coordination must be mutually agreed by all parties so that their roles and responsibilities are clear and do not overlap. This study seeks to establish how financial inclusion relates to the enforcement of AML regulations in a gaming tourism destination. It also analyzes how successfully local authorities and international authorities have coordinated in fighting money laundering and, more importantly, whether they succeeded in requiring industry players to follow the regulations.

Literature review

Fighting money laundering: Level of compliance in Macau

The Asia Pacific Group on Money Laundering (APGML) is an FATF-style regional body advocating AML regulation. Membership is available to all territories in the Asia-Pacific region that commit to the policy objectives of curbing the problems of money laundering and identifying terrorist financing in member states. Each member undergoes a mutual evaluation to determine its level of compliance with international standards to counter money laundering and terrorist financing. The group cooperates with observer-status countries and allied international organizations (Asia Pacific Group on Money Laundering, 2018).

During the first half of 2018, 1,128 out of 2,187 suspicious transaction reports (STRs) related to games-of-fortune operators. To tighten its control, the Gaming Inspection and Coordination Bureau (DICJ) revised its AML rules on 16 May 2016, but kept the threshold for reporting any suspicious transaction at MOP 500,000 (US\$ 62,500), despite the US State Department insisting that Macau should reduce this threshold to US\$ 3,000 to bring Macau in line with international reporting standards.

In an interconnected world, the smallest of breaches can be exploited for criminal purposes. Although digitalization may be a tool for democratization, it may also be used as a weapon to spread hatred and undertake large-scale money laundering to support terrorism (Balooni, 2017). Legacy systems and traditional ways of conducting transactions in banks and other financial institutions have serious flaws, posing numerous challenges to creating a robust AML system. Banks' large volumes of transaction data are difficult to screen comprehensively. Smurfing, through nefarious structuring of bank accounts, is a common tool used by money launderers. Small amounts of money deposited in multiple accounts over long periods of time may go undetected owing to their small value, and rules-based systems may not identify anomalies. Anonymity, high negotiability, utility of funds and global access to cash through ATMs are major factors that attract money launderers to new methods (Interpol, 2018).

The Macau Anti-Money Laundering Specialist Association (MAMLSA) was established with support from the Association of Certified Anti-Money Laundering Specialists (ACAMS). The participation of relevant professionals in the local banking sector and other players in the local gaming tourism industry was a driving force for the introduction of AML in Macau. Macau maintains coordination mechanisms at a multi-agency level for AML and counter-terrorist financing schemes (AML/CFT), with agencies working on specific issues and operational areas. The AML/CFT Working Group is made up of all relevant agencies. It has proved effective mainly for coordinating policy, producing annual plans, creating the National Risk Assessment (NRA), and organizing various promotion and awareness activities. The authorities access and use a wide range of intelligence-rich information. The GIF uses multi-source intelligence to produce sound analysis. As a result, numerous STRs have been opened for investigation. Law enforcement agencies use STRs, as well as other relevant information on foreign risk and the intelligence value of non-STR information.

Lack of a cross-border disclosure or declaration system is a major intelligence gap for a jurisdiction exposed to high risk from vast numbers of visitors and cash-intensive businesses, particularly casinos and related high-value dealers. The mandatory threshold

for reporting by the gaming tourism sector has helped mitigate this gap. However, there have been only five money-laundering convictions. A shortage of prosecutorial resources in the Public Prosecutions Office, tough evidentiary requirements for third-party money laundering, and a loose policy have impacted negatively on the quantity and quality of money-laundering investigations and prosecutions. This has resulted in a low conviction rate and short sentences, ranging from three to five years for money-laundering offenses (Siu Lam & Greenlees, 2017). In practice, money-laundering investigations fail to match risk profiles, apart from one major corruption case involving up to US\$ 100 million. Confiscations are limited to cash, currency and casino chips, apart from one case in which shares were confiscated, and another in which half of a commercial property was confiscated.

Adequate preventative measures are implemented in Macau's financial sector and casinos. With the exception of notaries and accountants, implementation in other FATF-designated non-financial businesses and professions (DNFBPs) is at an earlier stage. All financial institutions, DNFBPs and other sectors are subject to AML/CFT supervision, with resources devoted to higher risk and more material sectors. Sound risk-based supervision is undertaken in the two most significant sectors: the Gaming Inspection and Coordination Bureau (DICJ) supervises the gaming sector, and the Monetary Authority of Macau (AMCM) supervises the financial sector. This supervisory action has improved compliance to some extent. However, while there is AML/CFT supervision of DNFBPs and other sectors, including pawnshops and dealers in high-value goods such as vehicles, supervision is not entirely risk-based, regular and comprehensive.

One important duty of gaming operators in Macau is reporting transactions. In fact, complex procedures are in place, with two entirely separate criteria for reporting obligations. Suspicion-based and threshold-based reporting are reported to two different agencies: the GIF for suspicious transactions, and the DICJ for transactions above MOP/HKD 500,000 within 24 hours. Suspicious transactions must be reported, regardless of the amount involved. Reports must be made in good faith, and do not normally give rise to liability of any kind. A suspicious transaction is defined as an 'operation relating to the practice of gaming or wagering which, given its nature, unusual character or complexity, may indicate an activity of money laundering or terrorist financing' (Godinho, 2016, p. 16). Threshold-based reporting continues to be unique to Macau's AML law and only applies to the gaming tourism industry. The threshold of MOP/HKD 500,000 set in 2006 remained unchanged following the 2016 regulation, despite international criticism and pressure. It includes multiple transactions exceeding the limit within a 24-hour period.

Gaming (sub-)concessionaires play a key role in relation to gaming promoters, covering various aspects. First, (sub-)concessionaires must report suspected money-laundering activities by gaming promoters. Second, they must exercise 'special control' over STRs prepared by gaming promoters, keep a daily record of the number of STRs filed by promoters, and monitor promoters' compliance with the law. Third, threshold-based reports prepared by promoters must be reviewed and signed by the compliance officer of the (sub-)concessionaire, who must verify compliance with legal duties. These obligations have resulted in a comprehensive set of mechanisms that place gaming promoters in a double relationship, with the government and with the (sub-)concessionaire with whom they work (Godinho, 2016).

Financial inclusion

Gombiro et al.'s (2015) framework may be used to assist in the detection of financial crimes such as money laundering in Macau. This framework consolidates data mining and big data analysis techniques, implementation of the 'Know Your Customers' directives, information culled from databases with extensive histories, and rich information sources. Interrelationships between essential elements of the transaction process are crucial for detecting money laundering. The framework includes monitoring activities such as social network analysis to detect fraud and money laundering, and helps to establish a rule base, explore outlier detection and conduct link analysis. Exclusion lists, customer rankings and outlier detection schemes are specified in the ontological search engine, which also highlights rules for distinguishing between genuine and suspicious transactions.

Financial inclusion refers to enabling greater access to financial services for low-income households and firms (Morgan & Pontines, 2014). It plays an important role alongside banks' AML and anti-terrorist financing regulations globally. Central banks have been urged to take a sensible approach to balancing these activities by issuing clear instructions on due diligence for all customers engaging in bank transactions, applying a more pragmatic definition of 'official' documents, and using alternative reliable and independent source documents, data and information for customer identification and verification (Simser, 2013).

Due diligence is well-practised in Macau's gaming tourism industry. Casinos are obliged to check and record customers' identity for transactions either above MOP 500,000 or deemed to be suspicious. Even for gamblers with whom the casino has 'stable business relations', their identities must still be established, regardless of the amounts issued. Casinos have strict instructions to report suspicious transactions and player lists every month. This makes it harder for punters to remain anonymous, and a new money-laundering law enables the authorities to freeze and seize assets (FTI Consulting, 2013). Casinos have also been instructed to cease all anonymous transactions and to refuse any involvement in transactions where no credible identification is obtained. The regulations cover all transactions pertaining to placing bets and paying winnings, selling and purchasing chips, tickets and tokens, granting and collecting credit for gaming, and promotional activities.

In addition, the gaming tourism industry receives strong support from the financial industry (Simser, 2013). Banks and financial institutions in Macau are encouraged to improve their understanding of customers' backgrounds, especially of exporters and importers through intermediary banks. They are also urged to ask clients' customers for additional supporting documents to justify transactions, and to set limits on remittance transactions performed through online banking, notably cross-border fund flows (Godinho, 2013).

Enhanced due diligence is required in specific situations. The first relates to politically exposed persons (PEPs), which the gaming tourism industry accepts are at higher risk of access to corruption-derived funds. Under the new guidelines, PEPs may be either foreigners from mainland China, Hong Kong and other countries, or domestic gamers from Macau. It is up to the casino operators to determine whether a patron is a PEP. Relationships with PEPs must be authorized by senior management, having

determined the origin of the funds and conducted customer profiling. Second, enhanced due diligence is specifically required in particular high-risk situations, including those where increased risk is identified by government authorities, the FATF, the United Nations or other relevant entities. Third, a new regulation has been introduced on intra-company relations, requiring enhanced due diligence in connection with the transfer of funds or credits, or collections between companies belonging to the same group and their branches, agents and representatives. Gaming companies operate in various jurisdictions where the regulations may vary and the standards may differ from those in Macau. Therefore, Macau's concessionaires must not blindly suppose that due diligence has already been carried out on their gaming companies abroad, and must check that the companies' standards comply with those in Macau. Concessionaires must ensure that they are fully aware of the background of any intra-company transactions and the parties to it by obtaining all necessary documents. When due diligence on customers abroad is found to be lacking, appropriate measures must be adopted. How these new procedures will play out in the future is yet to be determined, but local Macau concessionaires are already aware of their duties and responsibilities.

Another major area of concern is the issuing and handling of cheques and negotiable instruments. These are generally tightly regulated in order to maintain a paper trail. Due diligence on electronic fund transfers has been similarly enhanced. For stable business relations, transfers to the value of MOP 120,000 or more must be identified properly, and for intermittent transactions there is a lower limit of MOP 8,000 (Godinho, 2016).

The FATF is committed to financial inclusion. It believes that applying these measures will allow individuals and businesses, notably those in the low-income bracket and those who are currently unserved or underserved to gain access to and use regulated financial services. As such, it may improve the reach and effectiveness of AML/CFT efforts (Molla Imeny et al., 2021a). Unserved and underserved groups must be included in the legal financial system. Otherwise, they will be forced to conduct their businesses through unregulated channels. As such, it enables them making use of regulated and supervised channels to protect them against fraud especially financial abuse and exploitation (Ige, 2021). It is also advantageous to the FATF due to expanding the scope of traceable transactions, allowing better detection, reporting suspicious transactions. Hence, the risks of money laundering and terrorist financing are minimized accordingly. Financial integrity and financial inclusion are also mutually reinforcing (FATF, 2017). All such activities are further aided by the use of new technologies in the financial system. The adoption of advanced information and communication technologies would identify customers runs parallel with appropriate measures to manage attendant risks (Carballo, 2017; Molla Imeny et al., 2021b).

The FATF requires financial institutions to apply appropriate customer due diligence (CDD) measures. However, one of the main challenges to financial integrity in relation to financial inclusion is lack of reliable identity documentation and data verification for potential customers. In 2014, 18% of adults without financial accounts said that they were unable to provide the documentation required to prove their identity (World Bank, 2014). This problem does not apply to Macau citizens, who must have Macau identity cards.

Theoretical basis

Resource dependence theory (RDT) addresses that organizations depend on contingencies in the external environment (Hillman et al., 2009; Pfeffer & Salancik, 1978). The theory highlights the importance of the interaction between a company and its environment in terms of resources (Zhou et al., 2013). Such as, past literatures have documented evidence to suggest that RDT incorporated with customer-supplier relationships. Regarding money laundering, the situation becomes more complex and high risk primarily arises in industry sectors. The large quantity of the data is '*far beyond what investigators can realistically comprehend and analyzed*' (Lokanan, 2019, p. 753). Therefore, the emergence of technology resource enriches the data mining approach for the financial crimes analysis (Amjad et al., 2021).

Regulatory bodies and authorities are identified as combating crimes in limited resource environments (Chitimira, 2021). Criminals are used more sophisticated methods to avoid detection by advanced technologies. Combatting these crimes would necessitate a 'whole of government approach'. In doing so, various financial crime authorities can create a pool of knowledge and skill to collectively prevent, detect, and enforce these crimes with extra supportive resources (OECD, 2019). Badal-Valero et al. (2018) improved the efficiency of detecting money laundering via employing machine learning algorithms. In response, the study proposes that technologies and financial inclusion are mechanisms that it can apply to combat illegal activities under the framework of RDT. As there are well-established facilities, it believes government is effective in preventing and detecting money laundering.

Use of new technologies to overcome anti-money laundering challenges

New technologies significantly help taking action to detect and deter money laundering and terrorist financing (Demetis, 2018; Salehi & Molla Imeny, 2019). They facilitate record keeping and client identification for financial services providers and those engaged in businesses, professions and activities that are susceptible to being used for criminal purposes. New technologies also support the reporting of suspicious financial transactions and cross-border movements of currency and monetary instruments (Singh & Best, 2019).

Various tools help banks to tackle the threat of money laundering, especially the information and communication technology infrastructure. Advances in computing ability, storage capacity and big data analytics allow cost-effective, real-time screening of large transaction sets. The latest computer chips can process 1.78 trillion instructions per second, enabling banks to conduct rapid authorization checks to deal with increasing numbers of real-time transactions. This fast checking is applied to post facto analysis of historical data, as well as using multiple variables in large data sets (Balooni, 2017; Canhoto, 2020).

Another important analytical advancement is improvement to data visualization tools, enabling compliance teams and senior management to explore comprehensive dashboards presenting large amounts of transaction data with advanced graphical representations. These tools are interactive, facilitating comprehensive data mining and querying capabilities. They also improve visualization and make it easier to identify patterns, such as inter-linkages between accounts that might otherwise be hidden under layers of multiple entities that used to overwhelm the system (Demetis, 2018).

The third technological advancement is in the field of statistical modeling, where tools are aiding banks to proactively pinpoint problematic situations. Clustering techniques make it easier to analyze multidimensional data. For instance, entities in the same locality that at first glance seem unrelated may be found to be linked through proximity analysis. These tools assist banks in red-flagging transactional, demographic and geographical clusters. As more data are fed in and the machine learning improves, response times are further reduced and the system becomes more effective. Sophisticated neural networks and innovative artificial intelligence enrich capabilities by going beyond anomaly identification and helping humans to more accurately judge the probability of transactions being genuine or fraudulent (Rocha-Salazar et al., 2021).

Macau's banking system incorporates face-recognition technology as part of the 'Know Your Customer' campaign being run by central banks worldwide. New cash dispensers scan millions of bank card users at ATMs across the territory as part of a tough initiative by the mainland authorities to tackle capital flight and money laundering. Scanning has so far only been applied to China UnionPay cardholders. This technology was instituted when withdrawals from Macau's ATMs reached HK\$ 10 billion per month, which is a sign of capital flight. Macau's facial recognition system is pioneering the widespread application of this consumer technology. Surprisingly, there has been little public resistance, as privacy concerns are less hotly debated in Macau than in Western countries, and the mainland authorities often ask Chinese consumers to hand over personal information when conducting mobile payments and e-commerce and using food delivery apps (Fraser, 2017).

Therefore the above discussion leads to the following hypothesis H1a:

H1a: Capital investment in information technology is positively correlated with suspicious money transactions reporting in Macau.

Role of domestic credit and real estate in money laundering

Access to finance and the availability of credit are crucial to financial and economic development, with the worldwide growth of financial institutions. Increased investment and resource mobilization are always backed up by private-sector domestic credit. Quick and easy access to Know Your Customer information helps to mitigate risk. If a financial institution suspects a prospective borrower's motives or has reasonable grounds to believe that a fund relates to criminal activities, such suspicions must be reported by law (Gnutzmann et al., 2010).

Numerous private sectors like real estate, art sellers, and luxury retailers are considered as necessary sectors of AML canning (Dobrowolski & Sułkowski, 2020). Such as real estate is considered to be an attractive investment for those seeking to hide the proceeds from crime (Amjad et al., 2021). The US Department of Justice defines money laundering as 'the process by which criminals conceal or disguise the proceeds of their crimes or convert those proceeds into goods and services. It allows criminals to infuse their illegal money into the stream of commerce, thus corrupting financial institutions and the money supply, thereby giving criminals unwarranted economic power' (Federal Bureau of Investigation, 2011). There are three main stages of money laundering (Schneider &

Windischbauer, 2008), the first of which is placement, whereby dirty money is siphoned into the legal financial system. This is the point at which the transaction is most easily revealed. The second stage is layering, when criminals try to hide the source of illegal money by moving the illegal funds around in a speedy and intensive manner through multiple transfers and transactions. Ironically, the presence of diverging jurisdictions investigating money laundering and inefficiencies in the criminal justice system would simplify and facilitate the layering processes (Bande, 2021). Finally, the third stage is integration, when the illegal money is parked in financial investments through stocks, specific deposits and property.

To this end, H1b can be generated as follow:

H1b: Increased domestic credit to the private sector is positively correlated with suspicious money transactions reporting in Macau.

New technologies and AML in the gaming tourism industry in Macao

As mentioned in the theoretical section, improving the technical conditions for anti-money laundering of financial institutions is a powerful guarantee against combating money laundering crimes. In response to the new characteristics and trends of existing money laundering crimes, it is necessary to vigorously improve the technological investment and invest more resources to enrich technological monitoring capabilities to detect more transactions (Rusanov & Pudovochkin, 2021; Sousa Lima et al., 2022).

Macau is one of the starting points of the Maritime Silk Road. To a certain extent, it has played a vital role in the historical evolution process. It still maintains economic and trade exchanges with various countries along the Maritime Silk Road. It is now an important node of the 'Belt and Road Initiative' (Jin & Yu, 2019). In addition, Macau is one of the world's largest gaming tourism markets. In this sense, the industry directly or indirectly dominates Macau's economy over the past few decades (Wang, 2020). From a historical perspective, casinos have been described as a cash-intensive industry. So, they always faced a high-risk level of money laundering. The money laundering risks faced by the gaming tourism industry in Macau mainly arisen from illegal foreign gains (i.e., corruption, fraud, and bribery). However, the assessment team also believes that Macau not only a channel or a 'transshipment port' for the transfer of criminal proceeds to overseas (Siu Lam & Greenlees, 2017), but also the destination of the stolen money chosen by criminals. Under such circumstances, technological investment and integration become more critical to control the money laundering activities.

By linking up the above discussions in relation to the property and gaming tourism industry, further hypotheses can be developed as follow:

H2: Capital investment in information technology is positively correlated with the number of suspicious transactions being detected in the property market in Macau.

H3: Capital investment in information technology is positively correlated with the number of suspicious money transaction being reported from games-of-fortune operators in Macau

Methodology

Research design

Both quantitative and empirical methods were used to investigate the research problems addressed in this study. The quantitative method of ordinary least squares (OLS) multi-variate regression was used to determine the degree to which money-laundering activities in Macau reduced between 2007 and 2017.

Three models were applied using different dependent variables (Table 1). The first and second models used private-sector domestic credit and new investment in information technology (IT), both as percentages of GDP, as independent variables, and the number of crimes as a control variable. The dependent variable in the first model was the number of STRs in Macau over the period under investigation, and the dependent variable in the second model was the number of purchases of building units and parking spaces in Macau over the same period. The independent variable in the third model was new investment in IT as a percentage of GDP and, as in the other models, the number of crimes was used as a control variable. Since Macau's economy relies on gaming, the dependent variable was narrowed down to the number of STRs from games-of-fortune operators in Macau over the same period. These three models were used to determine how new technologies and financial inclusion practices affected the money-laundering activities of unscrupulous individuals.

Model specification

The number of STRs is affected by levels of investment in IT and domestic credit to the private sector. New technologies facilitate the identification of money laundering. In the discussion of the findings in Section 4, two factors are examined to clarify this process: investment in IT as a percentage of GDP, and domestic credit to the private sector as a percentage of GDP. The models reveal how these factors are related.

As massive profiles and real-time information cannot be handled manually, Model 1 was built to test whether investment in IT as a percentage of GDP may enable simplified operational processes with more detailed but less costly analytics, resulting in a rise in the number of STRs (see H1a). This model also uses domestic credit as a percentage of GDP, as a proxy for the size and depth of the financial sector. As financial institutions increase their provision of banking services, such as mortgages and personal loans, greater financial inclusion is achieved. This model tests whether more money in economic markets leads to more STRs (see H1b).

Model 2 is designed to determine the drivers of purchases and sales of building units and parking spaces in Macau from 2007 to 2017. According to the three stages of money laundering (Schneider & Windischbauer, 2008), the property market is often used to launder dirty money. This model tests whether investing in IT helps tackle dirty money flows into the property market (see H2). In this model, domestic credit as a percentage of GDP is used to measure the scale of the financial sector.

Finally, following the rapid growth of Macau's gaming tourism industry in recent decades, this study seeks to establish whether investing in IT helps to flag up suspicious transactions in casinos. In 2017, 67% of STRs came from casinos, and model 3 tests the impact of IT investment on these activities (see H3).

Table 1. Models and variables.

Model:	
(1)	$STR = f (ITINVEST\%, DOMESCR\%, CRIME, Ut)$
(2)	$STREXGAM = f (UNIT_PARK, ITINVEST\%, DOMESCR\%, CRIME, Ut)$
(3)	$STR_GAM = f (ITINVEST\%, DOMESCR\%, CRIME, Ut)$
Variables:	
STR	number of suspicious transaction reports in Macau
UNIT_PARK	number of purchase and sales of building units and parking spaces
STR_GAM	number of suspicious transaction reports from games of fortune operators in Macau
STREXGAM	number of suspicious transaction reports in Macau exclude those from gaming sector
ITINVEST%	investment in information technology, % of GDP
DOMESCR%	domestic credit of private sector, % of GDP
Ut	stochastic term
CRIME	number of crimes

This study also investigates whether appropriate coordination is undertaken between casinos, banks and Macau’s financial regulatory commissions relevant to AML activities. Primary data were collected through analysis of public reports released by relevant authorities, and secondary data were gathered from the official websites of the GIF and DSEC.

Results and findings

For the variables included in the individual models, correlation tests show that STRs are significantly positively related to YEAR, ITINVEST%, DOMESCR%, and CRIME, while STR_GAM is positively correlated with YEAR, DOMESCR% and ITINVEST% (see, Table 2). Table 3 shows the regression results from the three models. Models 1 and 2 exhibit linear relationships, with multiple R values of 0.83 and 0.88, respectively, which are close to 1. The adjusted R squared values are 55% and 68%, indicating that more than

Table 2. Correlation Matrix.

	STRs	YEAR	STR_GAM	DOMESCR%	ITINVEST%	CRIME	UNIT_PARK
STRs	1						
YEAR	0.917***	1					
STR_GAM	0.988***	0.928***	1				
DOMESCR%	0.804***	0.889***	0.762**	1			
ITINVEST%	0.567*	0.496	0.554*	0.685**	1		
CRIME	0.551*	0.656**	0.519	0.673**	0.764***	1	
UNIT_PARK	-0.476	-0.653**	-0.472	-0.758**	-0.477	-0.765***	1

Table 3. Regression Results.

	Model 1	Model 2	Model 3
	Dependent variable		
	STRs	UNIT_PARK	STR_GAM
DOMESCR%	0.538**	-0.539**	-
ITINVEST%	0.246	0.238	0.502*
CRIME	0.456	-0.163	-0.151
YEAR	0.611***	-0.717***	0.679***
R Square	0.826	0.880	0.516
Adj R Square	0.546	0.678	0.272
F value	18.403***	53.031***	16.361***

Notes: *, **and ***denote significant at the 10%, 5% and 1% levels, respectively

half of the values of the observed variables fit the model. However, for Model 3, there is a hazy linear relationship between the variables, as the multiple R value is only 0.52, with an adjusted R squared of 0.27.

In model 1, domestic credit as a percentage of GDP (DOMESCR%) is the only significant variable, with a p-value of less than 0.05. This result shows that an increase in domestic credit leads to an increase in the number of STRs. However, investment in IT (ITINVEST%) does not affect the number of STRs, with a p-value of 0.92. The results of Model 1 support H1b and reject H1a. As domestic credit as a percentage of GDP is used to measure the scale of the financial sector, a positive correlation implies that a larger financial sector will induce more suspicious transactions.

In Model 1, domestic credit as a percentage of GDP is a proxy for the size and depth of the financial sector. An increase in the number of individuals obtaining mortgages, personal loans or other types of borrowing indicates that the size of financial institutions is becoming larger and more accessible. As a result, investment, resource mobilization and financial inclusion will also increase. The economic size of a country seems to be an obvious determinant of varying STR levels, as a larger financial sector may trigger more STRs. The number of STRs is positively correlated with the size of an economy (Braun et al., 2016). If a financial institution suspects a borrower's purpose or has reasonable grounds for believing that a fund relates to criminal activities, it is legally required to report those suspicions. Thus, a substantial increase in the number of STRs may signal defensive over-reporting where high penalties are imposed for noncompliance. This may adversely affect the efficiency and effectiveness of the reporting mechanism, slowing down the pace of AML because more resources are required to distinguish genuinely suspicious cases.

In Model 2, domestic credit as a percentage of GDP (DOMESCR%) is significant at the 5% level. However, it has a statistically significant negative effect on purchases of building units and parking spaces. This result indicates that an increase in domestic credit leads to a reduction in purchases of real estate. On the other hand, IT investment as a percentage of GDP (ITINVEST%) does not significantly influence the purchase of building units and parking spaces, with a p-value of 0.12. Therefore, H2 is rejected. A negative correlation between DOMESCR% and UNIT_PARK implies that a larger financial sector will decrease transactions in building units and parking spaces in Macau.

Criminals tend to avoid pouring their illegal money into property markets, which are well-known hotbeds of money laundering, in order to avoid attracting the attention of financial intelligence units. This is a potential reason for the identified negative relationship. However, an alternative explanation is that it may have been caused by the sharp increase in property prices in Macau during the period under observation. Between 2007 and 2017, the average market price of building units tripled from MOP 24,567 to MOP 100,822 per square meter (DSEC, 2017). A decrease in the number of units sold was possibly due to their high price. Therefore, it cannot be concluded that people stopped laundering dirty money in the property market. In addition to rocketing prices, the Macau government imposed a special stamp duty of 10% of the property's value for nonpermanent Macau residents, which also significantly reduced demand for real estate.

Model 3 focuses on the number of STRs filed by game-of-fortune operators. The result for this variable has the expected positive sign, indicating that ITINVEST% has a positive impact on STR_GAM, although the significance level is relatively low. This suggests that investment in IT may help to fight money laundering, but its impact is limited and there is potential for resources to be used more efficiently and effectively.

Macau's economy has relied on the gaming tourism industry over recent decades. This industry has been affected by the Chinese government's crackdown on corruption in its leadership ranks since 2014, as a result of which various Chinese government officials have stopped their gambling activities. High rollers, especially with connections to officials from mainland China, have had to reel in their activities to avoid Beijing's anti-corruption drive. Nevertheless, IT investment may have had an impact on the number of STRs.

Owing to the large volume of data and complex procedures, it is almost impossible for casino staff to handle transaction data manually and detect suspicious transactions and patterns of money laundering without the help of technology. Apart from the quality of detection systems and reports generated, administrative capacity is crucial for detecting and prosecuting money-laundering activities. Qualified personnel facilitate monitoring, and reporting quality can be improved through ongoing training to enhance awareness.

In the gaming tourism industry, the concept of conflict of interests adopted in AML has drawn considerable attention from industry players. Tighter due diligence checks on high rollers lead to a reduction in the number of gamblers and size of revenues. Casino operators must adequately investigate sources of funds, and must apply enhanced due diligence to gamblers from high-profile jurisdictions. They must also investigate other situations that present a higher risk of money laundering, such as increases in the frequency or amount of spending.

In addition to the main models, lead-lag effects were also considered in this study. The three models were retested. For Models 1 and 3, the significance of each variable remained the same after considering the lead-lag effect, indicating that the regression result already reflects the impact in the current year. For Model 2, after using the lead-lag effect, the independent variable DOMESCR% became insignificant. This implies that the number of loans granted had little impact on the number of transactions in the property market, and borrowers may have chosen to use the loans for other purposes.

Coordination among anti-money laundering agencies

This section assesses the level of coordination between the various AML agencies in Macau and seeks to determine how successful they have been in requiring casinos to follow the regulations, based on analysis of the annual reports of Macau's financial authorities.

As Macau is a free port, it is critical to monitor people who cross its borders and who may be bringing in large amounts of cash or bearer negotiable instruments (BNIs). This is because cash and BNIs are anonymous and lack audit trails. They are widely used for money laundering, enabling criminals to easily transfer criminal proceeds to other jurisdictions. Hence, it is necessary to prohibit criminals from laundering criminal proceeds through physical cross-border transportation of cash, for which Macau is an ideal conduit.

Within the requirements set out in the FATF's 40 recommendations for combatting money laundering and terrorist financing, Recommendation 32 requires jurisdictions to establish proactive measures to detect and prevent the physical cross-border transportation of cash and BNIs. As a key member of the APG, Macau must comply with this requirement. As a result, the Macau government has established a law for the 'Control of the Cross-border Transportation of Cash and Bearer Negotiable Instruments'. This states that passengers arriving in Macau carrying cash or BNIs such as travelers' cheques, cheques, bank drafts, payment orders and promissory notes with a total value of MOP 120,000 or more, or the foreign currency equivalent, must pass through the red channel at immigration and complete a customs declaration form. Passengers leaving Macau must also disclose the amount of cash or BNIs they are carrying, if asked by a customs officer. This law is not intended to restrict, hinder or prohibit the transfer of legal proceeds from or to Macau. Any traveler going from or to Macau and any Macau resident, including minors and incapacitated people, are obliged to declare cash or BNIs exceeding the limit (Law, 2017). Travelers taking layovers in Macau in transit to other destinations are not required to complete declarations.

Any person who has an obligation to declare but fails to fill in the declaration form, or who provides incomplete information or false statements, is committing an administrative offense punishable by the Macau Customs Service, liable to a fine of between 1% and 5% of the value exceeding the designated amount of MOP 120,000 or equivalent. The minimum fine is MOP 1,000 and the maximum MOP 500,000. This administrative offense does not exclude the potential for criminal liability for money laundering or terrorist financing. In order to inform travelers and citizens of this new law, the Macau Customs Service has cooperated with the transportation industry to launch a series of promotional campaigns and public awareness programmes. These include short videos, posters and flyers placed on ferries and coaches, and in the pre-boarding lounges and departure and arrival halls of the international airport and other entry and exit sites.

Bringing in large amounts of cash deposits, especially in foreign currencies, with no reasonable support for the source of funds is identified as a red flag for money laundering. The person handling the case must also confirm the background of the subject being checked. Financial institutions must proactively obtain documents from their clients on sources of funding. If this information cannot be obtained from customers, the financial institution must consider turning down the transaction immediately. Attempted suspicious transactions must also be reported to the GIF, regardless of the amount involved.

Another activity similar to due diligence is matching personal data with all possible aliases, using established matching criteria. Identification information contained in public databases can be matched with identification data on individuals or entities subject to freezing measures, using criteria such as names, any aliases, nationality, passport or ID card number, or matching names with places, dates and registration number. Reporting entities should try to obtain any missing information to confirm whether there is a match. If an exact match is found, the person in charge must implement freezing action, and immediately cease making the assets available or providing financial services. Reports on freezing actions must be made to the Commission within two days, using a standard form.

In a case study presented to the authorities, nationality and passport information on a person suspected of engaging in suspicious transactions were fully matched with basic information about a person on the sanctions list, but the order of the person's names differed. In this example, the suspect's nationality, passport and ID information matched exactly, and other information such as date and place of birth, and address were the same as for the person on the sanctions list. Therefore, this was considered to be the same person. In another example, although nationality and passport information were missing from the sanctions list, the name and ID, date and place of birth, and address were fully matched with information on the suspect, who was therefore considered to be the same person. Similarly, if a suspect's name and ID information are fully matched with basic information on a person on the sanctions list, including date and place of birth and address, even though nationality information is unavailable, this should nevertheless be considered to be the same person.

The establishment of new technologies and implementation of the financial inclusion directives clearly contribute to AML activities in Macau, as evidenced by the dramatic increase in STRs (see, [Table 4](#)). It is therefore recommended that Macau's financial authorities should continue to strengthen their technical abilities and their knowledge on the ground. These two steps have been instrumental in improving the identification of money-laundering activities. More diverse and innovative approaches to financial inclusion should be adopted to eliminate the underground economy, and new account openers who have no solid business activities in the territory should be questioned more thoroughly.

As the world of technology is embracing new technological concepts such as blockchain, the Internet of things (IoT) and artificial intelligence, the AML authorities in Macau should also synchronize their technology know-how to ensure that their reporting of money-laundering activities is in line with other jurisdictions around the world. Data sharing has had a very significant effect in tracking down criminal activities that overlap jurisdictions, and this approach should also be adopted by AML authorities.

Few financial penalties have been imposed on financial institutions. It is suggested that the effectiveness of supervisory policy with respect to STR compliance should be reinforced, given the current tools at the authorities' disposal and the joint liability between concessionaires/sub-concessionaires and junket promoters. In addition, it is necessary to improve public awareness of the urgency of AML measures by organizing seminars and using social media channels.

Table 4. Number of STRs.

YEAR	STRs	STR_GAM
2008	838	443
2009	1156	767
2010	1220	814
2011	1563	1082
2012	1840	1328
2013	1595	1138
2014	1812	1370
2015	1801	1247
2016	2321	1546
2017	3085	2074

Source: Financial Intelligence Office, Macau SAR

Triangulation

To ensure the validity and provide a more comprehensive understanding of the research findings, three interviews were conducted with main stakeholders from different fields to triangulate the results generated from the applied model. The three main interviewees were 1) a representative from Macao gaming tourism association; 2) a member of Legislative Council, Macao SAR; and 3) a representative from Macao financial industry association. The average duration was around 20 minutes. The interviews were conducted with the following open-ended questions: 1) Do you think the AML improvement in Macao is driven by the integration of new technologies? Please explain in details. 2) What is(are) the other factor(s) for driving the AML improvement in Macao? 3) In what aspects that Macao needs to improve continuously?

The responses from the interviewees echoed with the result of the quantitative research in this study. According to the representative from the financial industry association, the Monetary Authority of Macao continues to manage risks based on the ‘risk-based’ principle. As expected, it assists the industry in improving Macao’s anti-money laundering capabilities. Such as the implementation of ‘KYC ATM’ points out that using technology to confirm personal identities. In addition to adopting technological means to optimize financial services, the industry can use more effective regulatory technologies to strengthen the defense against risks and maintain efficient compliance capabilities. Industry operators are encouraged to jointly promote the development of Macao’s financial technology, perform an excellent job in anti-money laundering work, and sustain the safety of Macao’s financial system.

The representative from the association of gaming tourism industry addressed The Gaming Inspection and Coordination Bureau has continuously enhanced the risk management of the gaming industry. Also, the Bureau has taken the necessary anti-money laundering measures covering various relevant parties: for instance, the supervision of junket operators and their partners, and the companies introduce business through junket operators. The customer should go through the rigorous procedures for minimizing potential risks. International organizations also affirmed the anti-money laundering work of Macao’s gaming industry. Anti-money laundering is a long-lasting task. With the ever-changing in technology and the macro environment, continuous training and learning are required to improve the professionalism in this area. In doing so, the local associations and operators are encouraged to organize a series of activities, gather knowledge exchanges between industries, learn about international cutting-edge technologies, and jointly promote anti-money laundering work in Macao.

The member of Legislative Council emphasized Macao may need to strengthen the close cooperation among local law enforcement, regulatory authorities, and the industry. In the past two years, the COVID-19 epidemic has swept across the world. While bringing new challenges to anti-money laundering work, it introduced more innovative and creative at work in the financial industry. The global economy is showing new development patterns and new industrial models. In doing so, online financial transactions have become more frequently. Financial transactions are conducted in a more concealed manner, as well as traditional ‘Know Your Customer’ (KYC) policies, due diligence, and transaction tracking measures have gradually shown shortcomings. Globally involved scams and cyber crimes in the pandemic are showing an upward trend. In the meantime, we also observed that financial institutions and gaming operators

incline toward proactive attitude toward improving the effectiveness of anti-money laundering work. Through strengthening digital access and simplifying due diligence, the identification of financial crimes and suspicious transactions are reinforced to effectively prevent criminals from resorting to non-traditional transactions.

Discussion and Conclusion

This study reveals a strong positive relationship between the number of STRs and the amount of private-sector domestic credit as a percentage of GDP. The data show that in Macau, domestic credit as a percentage of GDP has increased steadily. This implies that Macau's economy is in a favorable condition, and that Macau residents have the confidence to apply for loans from financial institutions. An increase in STRs may also indicate a higher level of illegal activities. Therefore, banks and financial institutions may need to bolster their due diligence practices and Know Your Customer campaigns.

This study also reveals that, contrary to expectations, the increase in domestic credit as a percentage of GDP in Macau had led to a decrease in purchases of building units and parking spaces. Individuals (especially tourists) may have stopped laundering their dirty money through the property market in order to avoid excessive exposure to financial institutions. However, steep rises in the selling prices of units may also have driven the decrease in units sold, but not demand for housing.

Furthermore, the relationship between investment in IT as a percentage of GDP and the number of STRs is statistically insignificant, but there is a weak positive association with the number of STRs in the gaming tourism industry. This result suggests that massive profiles and real-time information are difficult to handle manually, so it has been necessary to take advantage of technology to enable simplified operational processes with more detailed but less costly analytics. It is concluded that close coordination and supervision of financial intelligence units like AMCM, GIF and other entities, together with the benefits of financial inclusion, have enabled Macau to obtain outstanding results through technical compliance with the legal framework and effective implementation of measures to counter money laundering, terrorist financing and the proliferation of financing. Macau now ranks amongst the higher tier of APG members.

From an academic perspective, this study fills a gap in the extant literature by proving that technology may significantly assist in enhancing the efficient detection of STRs in a gaming tourism industry. Close coordination between industry players and various AML agencies has also had a positive impact on STR detection. From a practical perspective, this study will be of benefit to gaming tourism destination, showing that casinos can cooperate openly with financial institutions and government bodies to fight money laundering, which will help to ensure that the gaming tourism destination maintains a positive image sustainably. In addition, the study contributes valuable findings for the financial industry, revealing that if unscrupulous patrons or tourists are aware that Macau's financial authorities do not tolerate money-laundering activities, they will shy away from the city and no longer conduct illegal activities there. Moreover, this study will teach younger generations how financial institutions, gaming tourism players and government authorities are fighting money laundering, and will showcase the efforts being made to eradicate money laundering in Macau. Last but not the least, this study has further extended the application of RDT to the AML of gaming tourism industry. The RDT

contributes to explain organizational behavior of gaming tourism industry. In the future, it may foster to extend a new area of study like emotional intelligence and organizational behavior of the gambling industry; employees' ethical behavior and organization justice in the gambling industry, to name but a few. The associated academia and international regulatory organizations may need to pay high attention to a typical controversial sector.

Cross-country studies might be conducted in future to capture longer observation periods and provide comparative data, and more control variables might also be incorporated. Qualitative research with related stakeholders is also necessary to investigate their perceptions and motivations in order to generalize the results of this study.

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