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The Development of Modern Financial Services in Macao

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Overview of the report

This report is the output of a project under the IEEM Academic Research Grant 2022-2023. The topic of this project is "The Development of Modern Financial Services in Macao", with Prof. Henry Chun Kwok LEI (associate professor, Faculty of Business Administration, University of Macau -- UM) and Prof. Xinhua GU (professor emeritus of UM) acting as two principal investigators. The report contains three chapters: Chapter one discusses the financial development of Macao, Chapter two examines bank efficiency in Macao (via a two-stage DEA model and regression analysis), and Chapter three calls for establishing a neutral and independent financial telecommunications system in Macao as a substitute for the SWIFT in Brussels.

Chapter one introduces various definitions of financial development and its measurement methods, discusses the extent of financial development in Macao measured by the financial development index of the International Monetary Fund (IMF). It analyzes the nexus between financial development and economic growth in Macao, and then performs econometric estimation to detect potential determinants of its financial development. Evidence we find suggests that per capita income, the preceding development level, and the size of financial sector in Macao are significant contributors to its level of financial development. The policy implication is that the Macao SAR government needs to play a proactive role to construct a modern financial ecosystem to accelerate the city's financial development.

Chapter two empirically assesses variations in Macao's bank efficiency and investigates their underlying determinants. It is observed that Macao's bank efficiency reached a very high level in the recent period prior to the Covid19, and still maintained a moderately high level even during the pandemic. Macao's banks exhibited their extraordinary resilience as opposed to its casino tourism that plummeted like a freefall during the pandemic. Evidence also shows that Macao's banking efficiency is positively related to local economic growth, foreign direct investment, financial sector expansion, loanable fund utilization, bank income diversification, interest rate differences, and immigrating financial professionals, but negatively to casino gaming tourism, banking industry concentration, bank reserve holdings, and non-performing loan losses. Useful implications can be derived from these findings for policy makers to improve financial environment and for bank managers to enhance operational performance.

Chapter three discusses various risks behind the adoption of SWIFT that is dominated by the U.S. and the West and has increasingly become a political tool used to impose economic sanctions against other countries. The importance for Asia to set up its own society /system for

cross-border interbank financial telecommunications (SCBIFT) as a substitute for the SWIFT is explained in great detail in this report. It provides a preliminary yet comprehensive analysis for the necessity and feasibility of founding the SCBIFT in Macao SAR, and explores what early actions should be taken to establish this system.

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Chapter 1: The financial development of Macao

ABSTRACT
The financial industry is recognized as an importance sector to output growth and economic development. This sector is also regarded as a key to Macao's adequate diversification and sustainable development. Our research introduces various definitions of financial development and its measurement methods, and reviews its importance and contribution to growth and development as identified in the literature. Based on the suitable measures of financial capacity, depth and efficiency and the IMF's financial (development, institution, market) indexes, we first examine the level of Macao's financial development in comparison with that of Inland China and Hong Kong. Next, we analyze the nexus between financial development and economic growth in Macao. Then, we investigate whether there is bi-directional causality between economic capacity and financial development, but find only one-way causality running from output growth to financial development. Finally, we employ formal econometric estimation to explore potential determinants of financial development in Macao. Our ordinary least squares and dynamic estimation results indicate that the preceding development level, per capita income, and the size of financial industry are significant contributors to Macao's financial development. These findings imply that the Macao government needs to invest in infrastructure and ecosystem essential to financial development, to offer policy initiatives to attract more foreign direct investment, and to encourage the introduction of new products, services, and transactions to speed up financial development.

Keywords: Financial development, Adequate economic diversification, Governance indicators, Determinants of financial development, Macao

1.1 Introduction

The financial sector is one of the most important sectors in a modern economy, channeling capital inputs to various entities and providing returns for investors. Financial activities also involve managing transaction costs and achieving risk reduction. The level of financial development is regarded as an important indicator to the extent of economic advancement, with a strong bearing on the potential of development and the well-being of society.

According to the World Bank (WB), "the financial sector is the set of institutions, instruments, markets, as well as the legal and regulatory framework that permit transactions to be made by extending credit" [1]. The development of financial services contributes to cost reduction in conducting financial transactions, including information gathering, contract formation and enforcement, and intermediary fees. In an IMF report, Asmundson (2011) recognizes financial service as "the process of acquiring the financial good, which involves the transactions required to obtain the financial good." [2] He further specifies the transactions incurred in the financial sector as activities of real estate, consumer finance, banking, insurance and investment funding. In a more recent article, Cote (2022) defines the financial services industry as an entity that "encompasses all roles that deal with managing and exchanging money," [3] which includes the segments of banking, investing, insurance, and financial analysis; all this is named the financial (services) sector as a whole. In terms of the local definition, the Monetary Authority of Macao (AMCM) refers to financial institutions as banks, insurance companies, finance companies, financial leasing companies, exchange shops, lucky gaming licensees engaging in exchange business in casinos, cash courier companies, other credit institutions, financial intermediary companies, payment service providers, other financial institutions, representative offices, etc. [4]

In an Asian Development Bank (ADB) working paper, Estrada, Park, and Ramayandi (2015) attempt to distinguish meanings of financial development between developed and developing economies. For the former countries, such development refers to mortgage-backed securities, structured investment vehicles and/or collateralized assets. In contrast, for developing economies,

[1] The World Bank website: https://www.worldbank.org/en/publication/gfdr/gfdr-2016/background/financial-development
[2] Asmundson, I., 2011. What are financial services? Finance & Development, March 2011, https://www.imf.org/external/pubs/ft/fandd/2011/03/pdf/basics.pdf
[3] Cote (2022), 4 Key roles in financial services industry, April 2022, https://online.hbs.edu/blog/post/financial-services-industry
[4] The Monetary Authority of Macao (AMCM) website: https://www.amcm.gov.mo/zh-hant/other-institution/other-institution-introduction/other-institution-introduction-children

financial development is understood as sound and efficient financial systems for capital allocation and for its productive usage, which tends to bring about diversified impacts on economic growth.

As for the role of financial systems, the WB has identified five key functions, such as 1) producing *ex-ante* information about possible investments and capital allocation, 2) monitoring investments and exerting corporate governance after providing finance, 3) facilitating the trading, diversification, and management of risk, 4) mobilizing and pooling savings, and 5) easing the exchange of goods and services [5] (that is the most important function).

1.2 Measurements of financial development

A series of indicators have been employed by both academics and the regional or international organizations to measure the level of development of the financial sector for various economies. Amongst, the share of the value added of the banking or financial industries to GDP is a direct indicator to measure the size, importance as well as development level of the financial sector. Apart from it, the existing literature has utilized the ratio of current liabilities of banks or banks and financial institutions to GDP (Levine, 1997; Huang, 2010 ; Adusei, 2013; Guru and Yadav, 2019), the ratio of local private credit to GDP (Huang, 2010; Durusu-Ciftci, Ispir and Yetkiner, 2017; Puatwoe and Piabuo, 2017; Guru and Yadav, 2019; Nguyen, 2022), the ratio of commercial bank assets to total banking and central bank assets (Levine, 1997; Guru and Yadav, 2019), the ratio of bank current expenditure to total assets and interest margin (Huang, 2010; Guru and Yadav, 2019; Nguyen, 2022), the loan-to-deposit ratio of banks (Guru and Yadav, 2019), the ratio of money supply M2 to GDP (Puatwoe and Piabuo, 2017), etc., to reflect the size and development level, the depth of the development, as well as the efficiency level of banks and financial institutions. As the financial sector covers banks, financial institutions and financial markets, to assess the development level of the financial markets, existing literatures make use of the ratio of stock market capitalization to GDP, stock market turnover to GDP, and stock market turnover to stock market capitalization (Levine and Zervos, 1998; Huang, 2010; Durusu-Ciftci, Ispir and Yetkiner, 2017; Guru and Yadav, 2019) as indicators to reflect the extent of development and significance level of the financial market.

In practice, regional and international financial organizations, such as the ADB and IMF, have employed the above mentioned banking and equity market indicators, such as the ratio of

[5] The World Bank website: https://www.worldbank.org/en/publication/gfdr/gfdr-2016/background/financial-development

local private credit to GDP, the ratio of money supply M2 to GDP, the ratio of stock market capitalization to GDP, stock market turnover to GDP, etc., to reflect the development depth of the financial institutions and financial markets. The ratio of bank current expenditure to total assets, interest spread, loan-to-deposit ratio, stock market turnover to the market capitalization of stock market, etc., meanwhile, have been adopted to reflect the efficiency level of financial institutions and financial markets. Simultaneously, the number of bank branches and ATMs per 100,000 population and the market capitalization ratio of listed companies outside the top 10 have been used as indicators to show the access to financial services, or they are called the financial market channels or financial institution accession index (Dekle and Pundit, 2015; Svirydzenka, 2016; Nguyen, 2022). Given an increase in the value of these indicators, it infers an improvement in the depth, efficiency and accession of financial institutions and financial markets, revealing the achievement of a higher extent of financial development.

1.3 The importance of the financial industry

1.3.1 The contributions of financial development: International experience

According to the WB, financial development refers to the development of financial institutions, markets, instruments and related laws and regulations that will help to reduce the "cost" of providing financial products and services. Financial development involves the establishment and expansion of institutions for investment in the financial sector and for providing supports to the development of financial instruments and markets. Financial development can help to promote economic growth and reduce poverty. The available literature presents abundant evidences that the development of the financial sector plays a significant role in the process of economic development. Furthermore, it contributes to encourage savings to increase the savings rates, provide investment information, facilitate and encourage foreign capital inflows, and optimize capital allocation, which can ultimately promote economic growth through capital accumulation and technological progress. According to the WB, the financial system tends to grow faster in developed countries. It provides the poor and vulnerable with access to credit, enables them to manage risks and invest to improve productivity to raise returns or incomes, ultimately helping to reduce poverty and inequality. In addition, financial development provides Small and Medium Sized Enterprises (SMEs) with access to financial services and capital, contributing to their growth.

Despite the expected contributions of financial development to growth, in Demetriades and Hussein (1996), the causality between financial development and real GDP is examined for 16 less developed countries. The findings show little support for the hypothesis that financial factors play a leading role in the process of economic development. There is more evidences for the reverse correlation, for example, the growth led financial development and the bidirectional causality. Another important finding is that causality patterns vary across countries, and bi-directional causality is found for Korea and Thailand which are countries with successful financial reforms. Applying the panel techniques to a sample of four Latin American and South East Asian countries over the period 1965-1985, Benhabib and Spiegel (2000) reports that specific financial development variables are associated with specific components of growth (i.e. capital accumulation and productivity growth). This result, however, is sensitive to the inclusion of country fixed effects which is interpreted as an indication that financial factors may proxy for broader country characteristics. Deidda and Fattouh (2002) states that the positive association between financial depth and economic growth is observed only in the high income sub-sample. Their interpretation is that in developing countries, the fixed resource cost associated with the provision of financial services inhibits economic growth. Then non-linearity between finance development and economic growth is proved.

Durusu-Ciftci, Ispir and Yetkiner (2017) synthesizes the contribution of financial development to economic growth in five main areas: 1.) Financial development can optimize the allocation of resources in the economic system; 2.) The presence of financial markets makes portfolios more diversified, helping to increase liquidity and reduce risk, thereby stimulating growth. 3.) Financial development provides an exit mechanism for intermediaries and improves the efficiency of financial intermediation. 4.) Financial markets further professionalize firms and promote the use of new technologies, and 5.) Financial development changes the dynamics of economic growth by providing incentives to alter corporate regulation. There are empirical evidences to prove that with developed financial markets, the efficiency of resource allocation can be optimized through the above channels to achieve long-term economic growth.

In Naceur, Blotevogel, Fischer and Shi (2017), the influences of financial development on major sources of growth components, namely productivity and investment are investigated with a sample of 145 countries for the period of 1960 to 2011. It concludes that financial development cannot guarantee economic growth. Different dimensions of financial development, including the access, efficiency, stability, and openness vary across income levels and regions with no consistent evolutions. In Guru and Yadav (2018), the generalized method of moment system

(SYS-GMM) is employed to estimate the relationship between financial development and growth of the BRICS countries of Brazil, Russia, India, China and South Africa for the period of 1993 to 2014. A series of banking sector and stock market development indicators are adopted in the regressions. It is found that development indicators such as size of financial intermediaries, credit to deposit ratio and domestic credit to private sector are positive and significant determinants to economic growth. There are also evidences to indicate that banking sector development and stock market development indicators are complementary to each other in stimulating economic growth.

So far the existing literatures have employed various econometric techniques to estimate the relationship between financial development and growth across different groups of countries around the world. As a common finding, economic growth is observed to be the outcome of financial development. However, there are also studies which reveal the reverse correlation of economic growth led financial development, or the bi-directional causality between growth and financial development. In general, there exists mixed linkages between financial development and economic growth.

1.3.2 The contributions of financial development: China's experience

In view of the influences of financial development on China, Liang (2005) attempts to address the correlation between finance development and the growth of China on the provincial level for the period of 1990 to 2001. Employing the Generalized Method of Moments (GMM) technique, the empirical estimations suggest that financial development and deregulation in the financial sector can promote economic growth. Ma and Shi (2012) estimates the Chinese data for the period of 1978-2010 to analyze the impacts of financial development on economy in three dimensions, namely the mode, process and result of economic growth. It is found that there exists no long-term relationship between financial development, the stability of the growth mode and process of China's economic growth. Financial development reduces the sustainability of economic growth, but helps to enhance the efficiency of economic growth. As for the relationship between financial development and sectoral output performance, Wang, Li, Abdou and Ntim (2015) examines the relationship between financial development and the sectoral economic growth of China for the period of 1978 to 2013. After controlling for labor force, capital growth, inflation rate and export growth, there are evidences to show that financial development has a negative effect on the growth of the tertiary sector, with insignificant impacts on the primary and secondary sectors.

In Andersson, Burzynska and Opper (2016), the China's banking data for the period of 1997-2008 is estimated. Granger causality tests are organized to examine the links between financial development measured by the efficiency and profitability level achieved by the policy banks, state-owned commercial banks, joint stock commercial banks and rural credit cooperatives of China and the economic growth. The empirical examinations show diversified results with no bi-directional causalities. Meanwhile, policy banks and joint stock commercial banks are found to Granger cause economic growth. Furthermore, by analyzing the provincial data of China from 1996 to 2015, Liu (2017) proposes that financial development and environmental quality has a significant inverted U-shaped relationship with economic growth. In the initial stage of the development, in line with the increase in total deposits, loans outstanding of the financial institutions and industrial exhaust emissions, the economy also grows. However, when the threshold is reached, the sustainable development of finance and the continuous deterioration of environmental quality tend to hinder the pace of economic growth. The study also reveals that there is significant differences in the contribution of financial development to different regions of the country, with the strongest impact on the eastern region. Lin (2020) points out that China's financial development has a significant direct impact on the development level of the tertiary sector. The four dimensions of financial development, namely financial scale, financial structure, financial depth and financial environment affect the development of tertiary sector in different directions and intensities. As a whole, financial development has a strong indirect impact on China's economic development.

As for the role of financial development in the Greater Bay Area, Gao (2020) indicates that promoting financial development is important which can contribute to enhance the economic development of the Greater Bay Area as well as the country. The Granger causality test suggests that the financial innovation of China affects the level of financial development, the extent of financial deepening, the financial structure and the state of economic growth. Therefore, financial innovation can be employed as the mean to promote the level of financial development, to enhance the degree of financial depth, which can in turn strengthen the financial structure to bring about positive effects to economic growth.

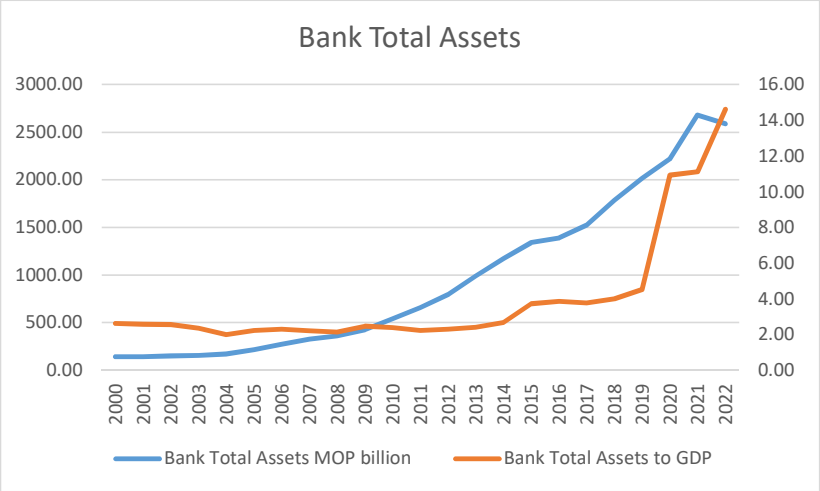
As a whole, studies on the correlation between financial development and growth of China reveal the presence of a direct linkage, which is also conditional to a series of growth related factors and policies. On the disaggregate level, financial development poses diversified impacts on different sectors and regions, bringing about asymmetric influences to the growth process of the country.

1.4 The development of the financial service sector in Macao

1.4.1 An overview

According to the AMCM, by the end of 2022, the total number of banks registered in Macao was 33, of which 12 were local banks, with a total of 263 main and branch offices which was 50% more than the record of 22 registered banks and almost 100% more than the record of 135 main and branches offices in 2000. In the meantime, there were 26 insurance companies which was higher than the record of 24 in 2000, of which 11 were locally registered insurance companies. As for other financial institutions, there were 30 in total, including 16 money changers.

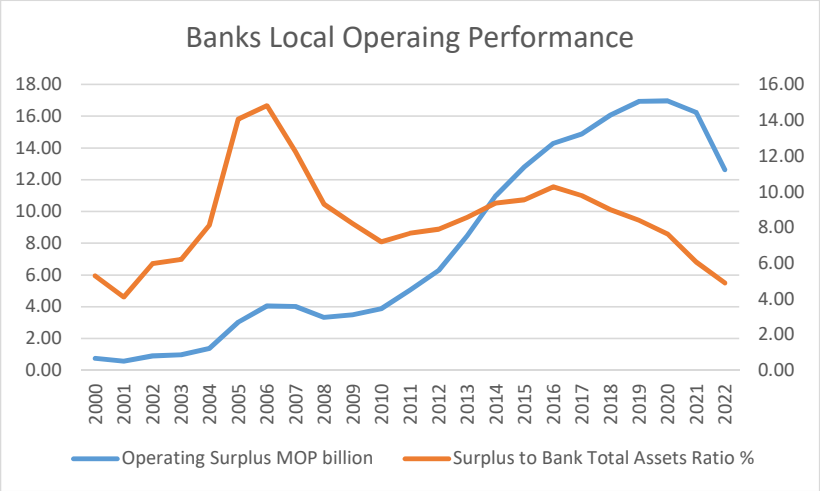
In terms of total bank assets, by the end of 2022, it was MOP2,588.64 billion, or 18 times that of year 2000's which was MOP142.75 billion. As shown in Figure 1.1, bank total assets has been growing continuously since 2000, with the exception of the pandemic period (2020-2022) with an annual average growth rate of 13.91%. As a relative measurement, the bank total asset to GDP ratio is composed in which an increasing trend is observed from 2004, expanding from the value of 2.0 to 2.68 in 2014. Given the massive adjustment experienced by the gaming sector of Macao and the economic recession caused, the ratio was able to expand rapidly to 3.73 in 2015. Then the policy lean in favor of the development of modern financial services has allowed the banking sector to accelerate its expansion, with the bank total asset to GDP ratio increased to 4.52 in 2019. Afterwards, the pandemic has posed an adverse shock to the territory, leading to a deep recession. With its relatively stable operating performance and asset size, the bank total asset to GDP ratio was biased upward to a double digit level in the pandemic period at 10.92%, 11.11% and 14.60% in 2020, 2021 and 2022 respectively, which was significantly higher than the single digit level in the pre-pandemic period.



Source: DSEC's Time Series Database

Figure 1. 1: Macao banks' total assets

As for the local operating result of commercial banks, a surplus of MOP12.64 billion was recorded in 2022, which was almost 17 times of MOP0.75 billion in 2000. Similar to the bank total assets, the operating surplus has been increasing since 2000 and as shown in Figure 1.2, its value has exceeded MOP3 billion level since 2005. In spite of the negative impacts attributed to the Global Financial Crisis in the period of 2008 to 2010, the operating surplus resumed its momentum from 2011 onward and has exceeded MOP11 billion since 2014. Then sluggish performance and contraction was observed in recent years due to the pandemic and the surplus value has dropped from over MOP16 billion in 2018 to MOP12.64 billion in 2022. In terms of banks' revenue streams, net interest margin remains to be the main source of incomes, which was MOP215.36 million by the end of 2022, or 8.87 times the surplus of MOP24.27 billion in 2000. It accounted for 72.65% of the total bank revenue in 2022, which was higher than 68.47% share in 2000. Simultaneously, other banking income was MOP81.09 billion in 2022 which was 7.25 times the income of MOP11.18 billion in 2000. It reflects the dominant role of traditional businesses in the banking sector of Macao, and the relatively slow progress on the development pace of other banking services, leading to an increase in the magnitude of interest income to total banks' revenues.



Source: DSEC's Time Series Database

Figure 1. 2: Macao banks' local operating performance

1.5 The financial development of Macao

With reference to the quantitative measurements on the extent of financial development employed in the existing literatures and adopted by the regional and international financial organizations, taking into account the availability of the relevant statistics, this research selects the ratio of banking value added to GDP, ratio of local private credit to GDP and money supply M2 to GDP, loan to deposit ratio, and interest gap in percentage as the indicators to illustrate the development level of Macao's banking industry in terms of capacity, depth and efficiency.

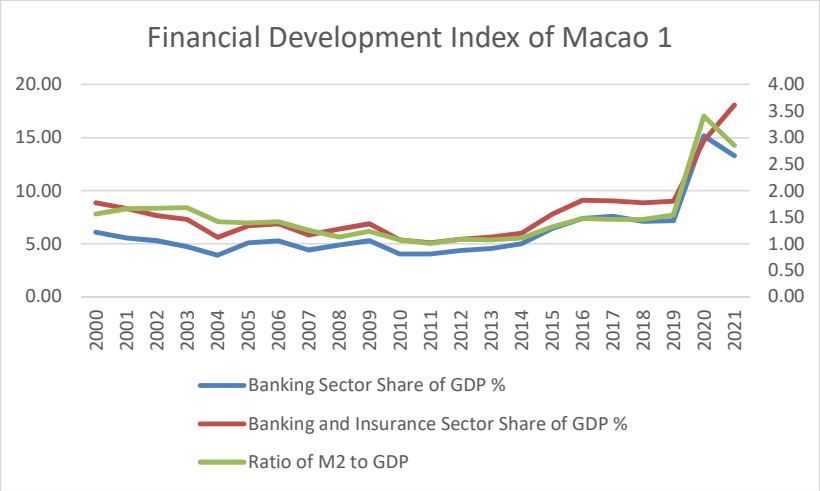
1.5.1 The financial capacity of Macao

The capacity indices of Macao's financial service sector, measured as banking sector and banking and insurance sectors' value added to GDP ratio and the M2 to GDP ratio are exhibited in Figure 1Figure 2.3. The banking sector value added to GDP ratio was 6.1% in 2000 and has been falling to 4.03% in 2011 which was rather low. It was attributed to the rapid increase in GDP driven by the gaming and tourism industries, the banking sector meanwhile could only achieve a moderate growth pace. It was until 2014 that banking sector's value added to GDP ratio could exceed the 5.0% level. Since that, as the Macao Special Administrative Region (Macao SAR) Government accelerated the implementation of the economic diversification policies, with "Modern Financial Services" as one of the core sectors, the growth of the banking sector could start to speed up. By 2019, the value added to GDP ratio of the banking sector was 7.18%. Then

the pandemic has seriously distorted the operation of the gaming and tourism industries, leading to a deep recession with a massive shrink in GDP. In contrast, the negative impacts to the banking sector was limited and consequently a much higher banking sector value added to GDP ratio which was 15.17% in 2020 and 13.28% in 2021 were recorded. When the insurance sector is considered at the same time, the share of aggregate value added was 8.87% in 2000, which has once declined to 5.09% in 2011. Then it was able to improve continuously afterwards. By 2022, the banking and insurance sector value added to GDP ratio was 18.08%.

As for the ratio of M2 to GDP, it was 1.56 in 2000 and has been declining to 1.01 in 2011, attributed to the rapid increase in GDP during the period. Then the ratio has resumed its momentum to reach the value of 1.54 in 2019. Once again, the pandemic led recession has brought about serious drawbacks in GDP, leading to an increase in the M2 to GDP ratio which was 2.85 in 2021.

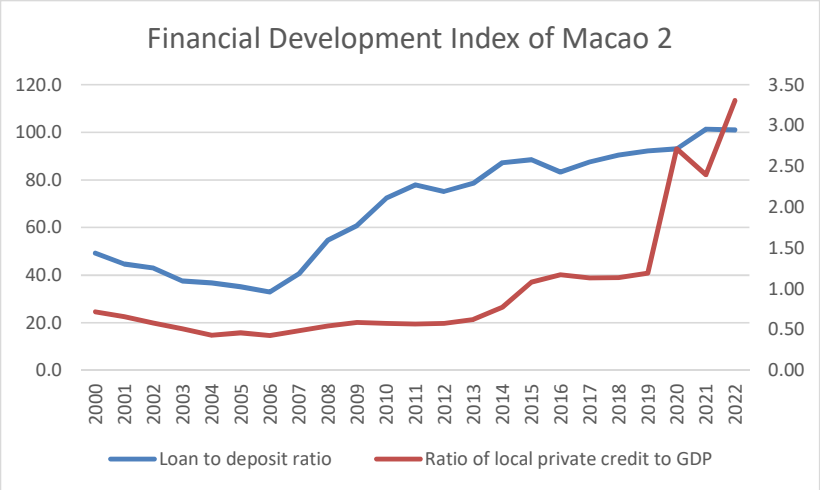
As a whole, the increasing trend on the indices, namely the banking sector value added to GDP ratio, banking and insurance sectors' value added to GDP ratio, and the M2 to GDP ratio suggest an improvement on the capacity of the financial service sector in Macao, especially after 2011 when the Macao SAR Government has attempted to promote the economic diversification development strategy. With the financial service sector as one of the key sectors, the pace of growth of the financial sector was faster than before, coupled with the contraction in GDP caused by the pandemic, these ratios were able to expand rapidly in the recent years.



Source: AMCM's Baking Statistics and DSEC's Time Series Database

Figure 1. 3: The financial development indices of Macao 1

As an alternative financial capacity index, the ratio of local private credit to GDP is shown in Figure 1.4. The local private credit to GDP ratio was 0.72 (or the value of local private credit was 72% of GDP) in 2000. Similar to the other capacity indices, it has been shrinking since then and has once reduced to 0.43 in 2006. Then it was able to resume its momentum afterwards to recover to 0.77 in 2014. In line with the contraction in GDP caused by the gaming industry's major adjustments, the ratio was able to experience a great leap forward to reach 1.08 in 2015. By 2019, it was 1.19 and the pandemic has brought about deep recession and a decline in GDP to the Macao economy, leading to an extensive growth for the ratio, which has exceeded 2.0 since 2020 and was recorded at 3.31 in 2022.



Source: AMCM's Banking Statistics and DSEC's Time Series Database

Figure 1. 4: The financial development indices of Macao 2

1.5.2 The financial depth of Macao

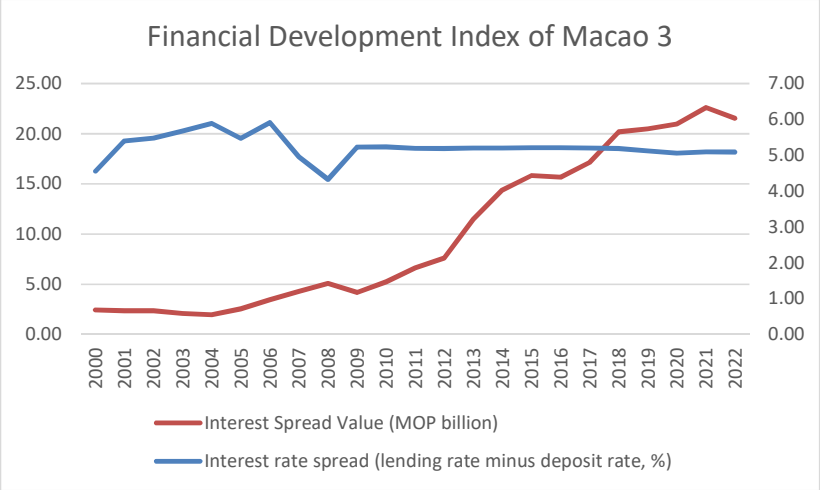
In light of the financial depth index, it is reflected by the loan to deposit ratio in percentage which is shown in Figure 1.4. The loan to deposit ratio is a common measurement composed to assess bank's liquidity by comparing a bank's total loans raised to the total deposits received. The ratio was 49.3% in 2000 and has reduced to 33% in 2006 which was low, reflecting the slow growth in the loan outstanding. From 2007 onward, the ratio has started to increase steadily which has exceeded 80% (87.2%) in 2014. By 2019, it has reached 92.2% which was relatively high since 80-90% is regarded as ideal[6]. It has increased further to 101% in 2022, which does not only indicate an overall improvement in the level of financial depth, but also reflects a more speedy growth of loans than deposits.

1.5.3 The financial efficiency of Macao

Figure 1.5 exhibits the financial efficient indices measured as interest rate spread in percentage and in value. They are composed as the lending interest rate minus the deposit interest rate in terms of percentage and value. As shown, the former carries a stable value since 2009 in

[6] Investopedia: https://www.investopedia.com/terms/l/loan-to-deposit-ratio.asp

the aftermath of the Global Financial Crisis until 2022, staying at around 5%. As for the value, it has been increasing from MOP2.43 billion in 2000 to MOP20.47 billion in 2019 in line with the continuous expansion of the banks' loans and deposits outstanding. Despite the outbreak, the value of interest spread was able to extend its growth path until 2022 when moderate reduction was recorded and the value was MOP21.54 billion. As a whole, the growth in the value of interest spread is caused by the increase in banks' total assets. Meanwhile, the stable interest spread in percentage reflects the inabilities of banks in enlarging the interest incomes or lowering the interest expenses under the current macroeconomic, operational and interest environment of Macao, indicating no significant improvement in efficiency since 2009.



Source: AMCM's Banking Statistics and World Bank's World Development Indicator

Figure 1. 5: The financial development Indices of Macao 3

1.5.4 The IMF's Financial Development Index of Macao

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Financial Development Index	0.33	0.33	0.34	0.33	0.31	0.30	0.32	0.34	0.36	0.36	0.38
Financial Institutions Access Index	0.66	0.68	0.70	0.68	0.63	0.63	0.69	0.79	0.91	0.91	0.91
Financial Institutions Depth Index	0.23	0.22	0.20	0.19	0.17	0.17	0.16	0.17	0.18	0.19	0.18
Financial Institutions Efficiency Index	0.70	0.69	0.71	0.71	0.70	0.75	0.77	0.75	0.71	0.70	0.71
Financial Institutions Index	0.56	0.57	0.57	0.56	0.52	0.54	0.56	0.61	0.65	0.65	0.65
Financial Markets Access Index	0.27	0.27	0.27	0.27	0.27	0.19	0.19	0.19	0.19	0.19	0.32
Financial Markets Depth Index	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Financial Markets Efficiency Index	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Financial Markets Index	0.09	0.09	0.09	0.09	0.09	0.06	0.06	0.06	0.06	0.06	0.10

Table 1.1 a: IMF's Financial Development Index of Macao

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Financial Development Index	0.35	0.36	0.39	0.40	0.43	0.45	0.45	0.44	0.46	0.48
Financial Institutions Access Index	0.91	0.91	0.91	0.92	0.93	0.92	0.94	0.94	0.95	0.95
Financial Institutions Depth Index	0.17	0.18	0.19	0.23	0.37	0.46	0.44	0.42	0.51	0.59
Financial Institutions Efficiency Index	0.70	0.72	0.74	0.74	0.74	0.74	0.73	0.72	0.72	0.72
Financial Institutions Index	0.65	0.65	0.67	0.69	0.75	0.79	0.78	0.78	0.82	0.85
Financial Markets Access Index	0.16	0.15	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Financial Markets Depth Index	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Financial Markets Efficiency Index	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Financial Markets Index	0.05	0.05	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10

Source: IMF Financial Development Index Database https://data.imf.org/?sk=f8032e80-b36c-43b1-ac26-493c5b1cd33b

Table 1.1 b: IMF's Financial Development Index of Macao

Table 1.1a &1.1b show the Financial Development Index of Macao measured by the IMF for the period 2000 to 2020. The index consists of the overall Financial Development Index and the sub-groups of Financial Institutions and Financial Markets with their own indices. Each sub-group is composed of Depth, Assess and Efficiency with their corresponding indices. Taking the Financial Institutions Indicators as the example, for the Depth index, it contains the sub-indicators of private-sector credit to GDP, pension fund assets to GDP, mutual fund assets to GDP, life and non-life Insurance premiums to GDP. For the Access index, it covers bank branches per 100,000 adults and ATMs per 100,000 adults. For the Efficiency index, it includes the net interest margin, lending-deposits spread, non-interest income to total income, overhead costs to total assets, return on assets and return on equity.[7]

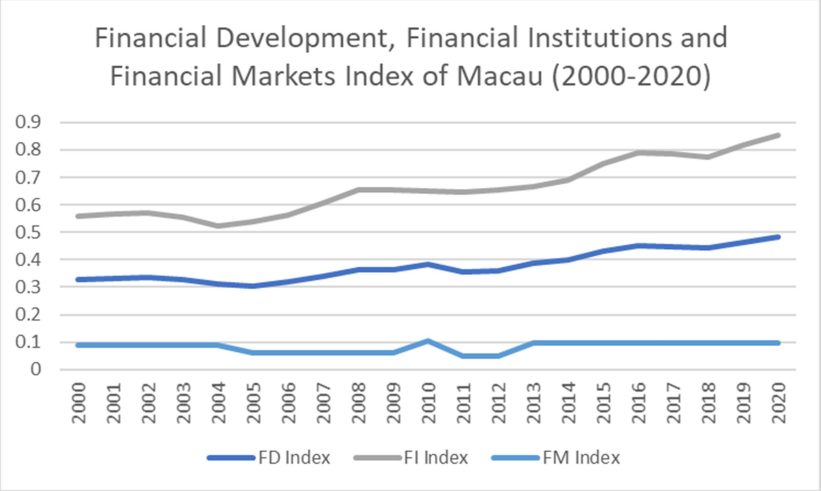
As for the Financial Market Indicators, the Depth index covers the stock market capitalization to GDP, stocks traded to GDP, international debt securities of government to GDP, total debt securities of financial corporations to GDP, total debt securities of nonfinancial corporations to GDP. The Access index includes the percent of market capitalization outside of top 10 largest companies and the total number of issuers of debt (domestic and external, nonfinancial and financial corporations). The Efficiency index takes into account the stock market turnover ratio (stocks traded to capitalization).[8]

In general, the Financial Development Index of Macao rose steadily from 0.33 in 2000 to 0.48 in 2020. The index stagnated in the period of 2000 to 2007 with its value ranging from 0.30 to 0.34. It was able to steadily improve afterwards to reach 0.40 in 2014, then increasing at a faster pace to reach 0.48 in 2020. It reflects the progress of the territory's economic diversification development strategy and the enhanced scale of the financial sector. Among the sub-groups, the Financial Institutions Index rose from 0.56 in 2000 to 0.85 in 2022, representing a significant increase which was mainly driven by the improvement in the Depth Index, increased by 2.57 times from 0.23 to 0.59 attributed to the continuous increase in the ratio of private sector credit to GDP and the growth in insurance premiums. The Access Index, meanwhile, grew from 0.66 to 0.95 by 1.44 times, reflecting a significant increase in the number of bank branches and ATM machines over the years. At the same time, the Assess index is the category with the highest value which is also the most stable one, with the value of over 0.90 since 2008 and has reached 0.95 in 2020. For the Efficiency Index, it performed well and remained stable, carrying

[7] Svirydzenka (2016), p.8.
[8] Svirydzenka (2016), p.8.

the value of over 0.70 since 2000, which can be explained by the stable interest spread maintained by the commercial banks in Macao.

Comparing with the Financial Institutions Index, the Financial Market Index of Macao is very low as the territory has no stock market while the bonds and other financial markets are still in their infancy. It is then impossible to measure both the Depth and Efficiency Indices of the financial market of which the sub-indices were 0. The Assess Index, meanwhile, ranging from 0.15 to 0.32 in the discussion period and has been staying at 0.30 since 2013. All in all, the Financial Market Index of Macao performs poorly, with no significant improvement and has been stagnating at around 0.10 in the period of 2013 to 2020.

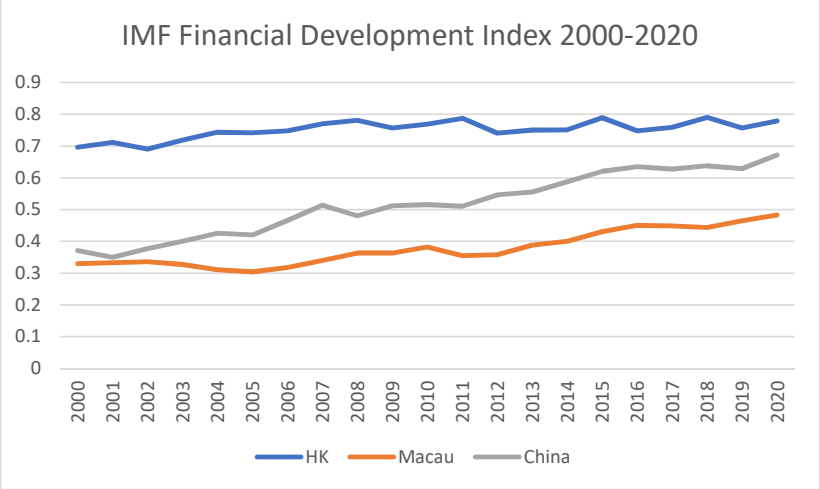


Source: IMF Financial Development Index Database https://data.imf.org/?sk=f8032e80-b36c-43b1-ac26-493c5b1cd33b

Figure 1. 6: IMF's Financial Development Index of Macao

The evolutions of the Financial Development Index, Financial Institutions Index and Financial Markets Index of Macao are exhibited in Figure 1.6 in which an upward trend is exhibited for the Financial Institutions Index (FI Index), contributing to the growth of the Financial Development Index (FD Index). In the meantime, given the sluggish development of the Financial Market Index (FM Index), its gap with the FI Index is significant and enlarging, reflecting the dominant role of the traditional banking and insurance businesses in the financial or better said banking industry, with the financial markets staying at an underdeveloped state.

To show the relative position of Macao in terms of financial development, the Financial Development Indices of China and Hong Kong are shown in Figure 1.7 together with that of Macao for comparison purpose. As indicated, Hong Kong has the score of over 0.7 which is also the highest, with a relatively stable performance throughout the discussion period. In contrast, China started with a low score of 0.37 in 2000 with a relatively large gap with Hong Kong. Then it has experienced rapid and steady financial development in line with the country's continuous growth and reforms, which has contributed to narrow the development gap with Hong Kong. By 2020, it has received the score of 0.67 which was just 0.1 point lower than that of Hong Kong. As for Macao, it has the lowest level of financial development and the score was 0.33 in 2000, with a gap of 0.37 and 0.04 with Hong Kong and China respectively. The accelerated development of Macao's financial institutions has turned out reducing slightly its gap with Hong Kong which was recorded at 0.30 in 2020. Whereas given the rapid financial development of China which is the fastest, its gap with Macao has been enlarging further to 0.13 in 2010 and 0.19 in 2020. As a whole, there still exists a huge gap on the level of financial development between China, Hong Kong and Macao, especially for the financial markets development. It is therefore necessary to introduce policy leans to support the establishment and operation of financial markets and institutions in Macao. Otherwise, it is hard for Macao to rely solely on the market mechanisms to construct its own financial infrastructure and markets, especially under the competitions from China and Hong Kong.



Source: IMF Financial Development Index Database https://data.imf.org/?sk=f8032e80-b36c-43b1-ac26-493c5b1cd33b

Figure 1. 7: IMF Financial Development Index of China, Hong Kong and Macao

1.6 The development of modern financial services in Macao

The financial industry of Macao which was made up of banking and insurance sectors was once one of the four pillars in the economy in the 80s and 90s. Its importance, however, was overwhelmed by the rapidly expanding gaming and tourism industries, with its share of GDP (banking and insurance) declined to less than 4% for the period of 2010-2014. The situation has started to alter when the Macao SAR Government has decided to speed up the process of economic restructuring to achieve moderate diversification. In the Policy Address for the financial year 2016, the Macao SAR Government proposed explicitly for the first time the objective of "studying the feasibility of developing financial services with special features to incorporate Macao's comparative advantages" in order to fully utilize the financial industry in the process of economy diversification. Meanwhile, developing "financial services with special features" is regarded as an important measure to promote the moderate diversification of the Macao economy. The objective is to accelerate and extend the development of the financial industry to solidify the role of Macao as the service platform between China and Portuguese-speaking Countries, and confront to the implementation of the "One Belt, One Road" strategy, so as to allow the financial industry to become an important pillar in the economy to contribute to the economic diversification of the territory. (Liu et.al., 2017).

Besides, in the First Five-Year Development Plan of the Macao SAR (2016-2020), it is mentioned that "the Macao SAR Government will make full use of the financial services function of Macao's role in facilitating commercial and trade co-operation between China and Portuguese-speaking Countries, nurturing a financial industry with Macao characteristics, developing financial leasing and asset management businesses. The government will also make full use of the Renminbi (RMB) clearing function of Macao's role in facilitating commercial and trade co-operation between China and Portuguese-speaking Countries, so actively contributing to the internationalization of the RMB."[9]

In the 2020 Policy Address of the Macao SAR Government, "developing a modern financial services industry and establish Macao as a financial services platform between China and Portuguese-speaking Countries"[10] is specified as the policy goal, while "modern financial services" is mentioned for the first time, which can be understood as a refinement based on the

[9] Macao Trade and Investment Promotion Institute (IPIM): https://www.ipim.gov.mo/en/publication/focus/five-year-plan-to-integrate-development-of-macao/
[10] The Government of the Macao Special Administrative Region Policy Address for the Fiscal Year 2020

previously proposed “financial services with special features” or “specialized financial services”. To facilitate the development, the Macao SAR Government is going to “strengthen the financial infrastructure, improve the legal system governing financial services, and strive to lower the entry thresholds for financial institutions such as banks and insurance companies in Macao, to realize free flow of capital between Hengqin and Macao; and set up a cross-border RMB clearing center and explore ways to establish a stock market using RMB for settlement.”[11]

In the Second Five-Year Plan for Economic and Social Development of the Macao Special Administrative Region (2021-2025) released in 2021, modern financial services industry is regarded as one of the major industries that the government intends to foster, to contribute to the process of rationalizing the industrial structure for adequate economic diversification. Perfect laws and regulations governing the financial services industry; strengthen financial services market infrastructure; accelerate and fostering the development of bonds market, foster diversified development of new financial business structure, including the development of wealth management and financial leasing businesses, as well as exploring the possibility of establishing a RMB denominated stock market are the major tasks stated in the chapter of accelerating the development of modern financial services.

On 4 August 2023, the Macao SAR Government holds a 30-days public consultation on the “Development Plan for Appropriate Economic Diversification of the Macao Special Administrative Region (2024-2028)”. The plan describes comprehensively the steps for the industrial development of Macao, with the major tasks and key objectives stated for the period of 2024 to 2028.[12] It outlines a detailed development blueprint for the most important industries of Macao, namely tourism and integrated leisure business; traditional Chinese medicine and the “Big Health” industry; modern financial services; high and new technology, the conversion and enhancement of traditional industries; and the convention and exhibition, sports, commercial and trade industries which are also called “1 (the tourism and integration leisure business which is also the core industry in Macao in revenues’ raising and employment opportunities’ creation) + 4 (the four other industries mentioned above) industries”. For the development direction of the modern financial services industry as a whole, the target is to maintain its GDP share to 10% or above, with increasing number of financial products and services and an expanded employment share.

[11] The Government of the Macao Special Administrative Region Policy Address for the Fiscal Year 2020
[12] Government Portal of Macao Special Administrative Region of the People’s Republic of China, https://www.gov.mo/en/news/310941/

Service/Year	2019	2020	2021	2020 vs. 2021 Change, %
Locally issued bonds (number)	17	39	97	+148.7
Locally issued listed bonds (MOP billion)	5.86	6.51	25.18	+287
Locally and non-locally issued listed bonds (MOP billion)	40.25	115.67	268.89	+132.5
Market value of wealth management portfolio (MOP billion)	243.62	219.16	225.09	+2.7
Financial leasing related loans and rent outstanding (MOP billion)	22.92	30.56	35.52	+16.2
RMB clearing volume (RMB billion)	750.82	3,035.30	4,747.30	+56.4
Green loans balance (MOP billion)		10.00	11.80	+18
Total bank assets (MOP billion)	2,220.7	2,679.65	2,588.64	-3.5

Source: AMCM's Statistical Report on Modern Financial Services, 2019, 2020 & 2021.

Table 1. 2: The development of modern financial services in Macao

In light of the current development of the modern financial services industry, Table 1.2 summaries the performance indicators for the period of 2019-2021. Among the five major areas of modern financial services, namely bond market, wealth management, financial leasing, RMB clearing and green loans, the bonds market has experienced more speedy development. As an example, Chongwa (Macao) Financial Assets Exchange (MOX) established in Macao in 2018, providing bond issuance, listing, registration, custody, trading and settlement services in the territory[13]. Since then and with the supports from the central government, the Ministry of Finance of the People's Republic of China has started to issue treasury bonds in Macao since 2019. Provincial governments, such as the Guangdong province has also started to issue bonds in Macao, and the amount of corporate bonds issued has been increasing steadily. According to Table 1.2, the number of locally issued bonds has increased from 17 in 2019 to 97 in 2021. Its market value, meanwhile, has increased from MOP 5.86 billion to MOP25.18 billion. Simultaneously, the total market value of bonds listed in Macao has increased from MOP40.25 billion to MOP268.89 billion. Despite its rapid expansion, the scale of Macao's bonds market is still small, especially for the locally issued listed bonds which shared only 1% of the total bank assets of Macao in 2021, indicating its infant stage of development. To compare, Hong Kong issued US$401.6 billion of new bonds in 2021, accounting for 13.05% of the total bank assets of HK$24 trillion. The huge differences in terms of the scale of the bonds market between Hong Kong and Macao does not only reflect the gap in financial market development, but also reveals

[13] MCEX website: https://mcex.mo/

the potential for the development of Macao's bond market. In a recent news report[14], MOX reveals that bond issuances in the first half of 2023 have already surpassed 50% of the previous year's total. It also unveils that the market value of Macao's bond market has surged to a substantial amount of MOP502 billion, with around 32% of bonds denominated in RMB. In 2021, international bonds accounted for only 5% of the total and it has expanded to 13% in 2022. Such achievement has propelled Macao to become the third largest listing venue for Asian issuers, after Hong Kong and Luxembourg.

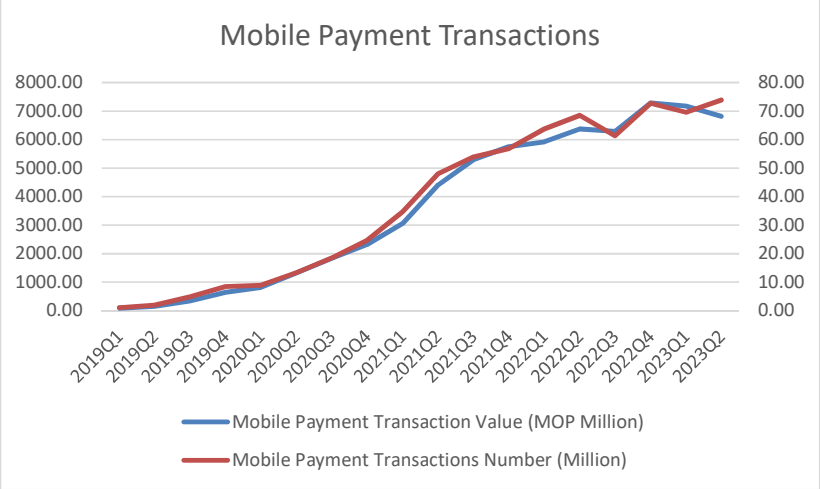
As for the other businesses under modern financial services, RMB clearing transactions is the one which has experienced the most rapid pace of expansion in terms of clearing volume, with the value increasing from RMB750.82 billion in 2019 to RMB4,747.30 billion in 2021, benefited from the continuous growth of China's international trade and the increased popularity of RMB as the settlement currency. For wealth management, the market value of portfolio was MOP225.09 billion in 2021, equivalent to 8.7% of the total banks' assets. The pandemic led market fluctuations has generated certain negative impacts to the investment returns, but recovery and continuous development is expected since wealth management is the type of financial service with increasing market demand. In light of financial-leasing and green loans, despite their limited scale, these two categories have been developing in an orderly manner, growing steadily in the past few years with rather promising prospects given the policy lean offered by the Macao SAR Government.

Another worth mentioning development in modern financial services, in the aspect of provision of innovative financial products and services, is the establishment of Micro Connect Macao Financial Asset Exchange (MCEX) in 2023. MCEX is the first licensed global exchange for Daily Revenue Obligations (DROs) which is the right to share daily operating incomes. MCEX employs a financial technology backed e-payment system for monitoring and providing risk-sharing financing supports to micro and small enterprises. It offers cross-border access to daily revenue shares from quality micro and small businesses. It provides diversified and granular exposure to a broad spectrum of quality stores in China's consumer economy. Investors can enjoy the flexibilities in constructing and trading their portfolios.

Apart from the 5 categories of modern financial services as exhibited in Table 1.2 and the MCEX, mobile payment is another branch of modern financial services related transactions to be worth mentioning. As shown in Figure 1.8, mobile payment has been developing rapidly in recent

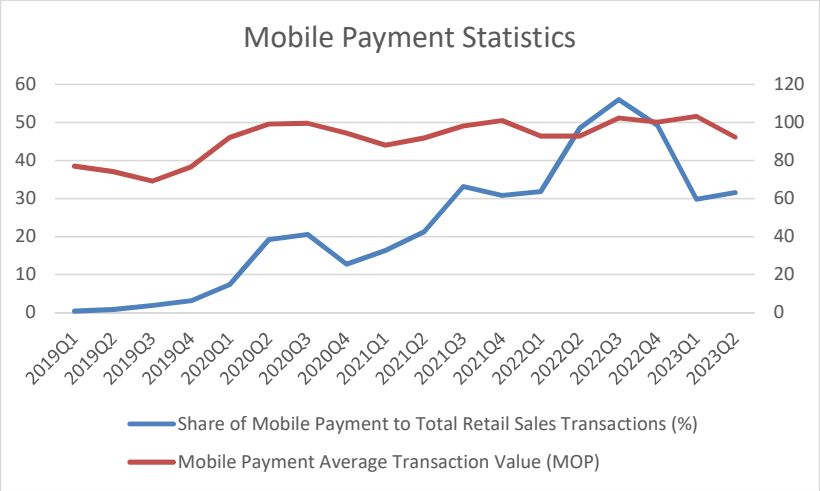
[14] "Macao's bond market surpasses Singapore in international issuances – Operator", Macao Business, 7 September 2023.

years, especially in the pandemic period during which social distancing was preferred. Then e-commerce with mobile payment has substituted for face-to-face cash transactions with increasing popularity. Its development is catalyzed by the anti-pandemic subsidies in the form of e-consumption vouchers distributed by the SAR government since 2020. As shown, before the pandemic and the distribution of e-vouchers, the mobile payment volume was just MOP648.57 million with 8.46 million transactions in Q4 of 2019. It has increased by 3.59 times to MOP2,327.86 million with 24.64 million transactions in Q4 of 2020. From 2020 to 2021, the payment volume has expanded for another 2.47 times to MOP5,747.66 million with 56.86 million transactions in Q4 of 2021. Then it has researched its peak of MOP7,283.36 million with 72.71 million transactions in Q4 of 2022. When the society has returned to normal since the beginning of 2023, together with the completion of the anti-pandemic subsidies programme, both the transaction volume and number has begun to fall, which was recorded at MOP6813.67 million with 73.88 million transactions in Q2 of 2023. In spite of the decline, the payment volume and transaction number represented 76.58 times and 64 times that of Q1 of 2019.



Source: AMCM Statistics

Figure 1. 8: Mobile payment transaction volume and number in Macao



Source: Statistics from AMCM and DSEC

Figure 1. 9: Mobile payment share of retails sales transactions and average transaction value

In Figure 1.9, it shows that the share of mobile payment to total retail sales transactions in terms of value has experienced a remarkable growth, increasing from less than 0.5% in Q1 of 2019 to its peak of 56.06% in Q3 of 2022. It shows that mobile payment has once represented more than half of the retail sales value. Such changes in payment pattern can be explained by various reasons, with the development of information technology, the distribution of e-consumption vouchers by the Macao SAR Government, the promotional campaigns and benefits offered by the payment platforms, the needs for social distancing in the pandemic period, as well as the total retail sales transactions made in the economy as some of the most influential determinants. From Q4 of 2022 onward, in line with the increase in total retail sales values, the share of mobile payment has started to decline and has been staying at around 30% in 2023. When the public resumes their normal economic and social activities, they tend to use other payment methods, such as cash or credit card instead of mobile payment. The average transaction value of mobile payment, meanwhile, is relatively small and stable, fluctuating within the range of MOP70-103 per transaction. It indicates that the majority of the users utilize mobile payment to settle their small bills of daily necessities.

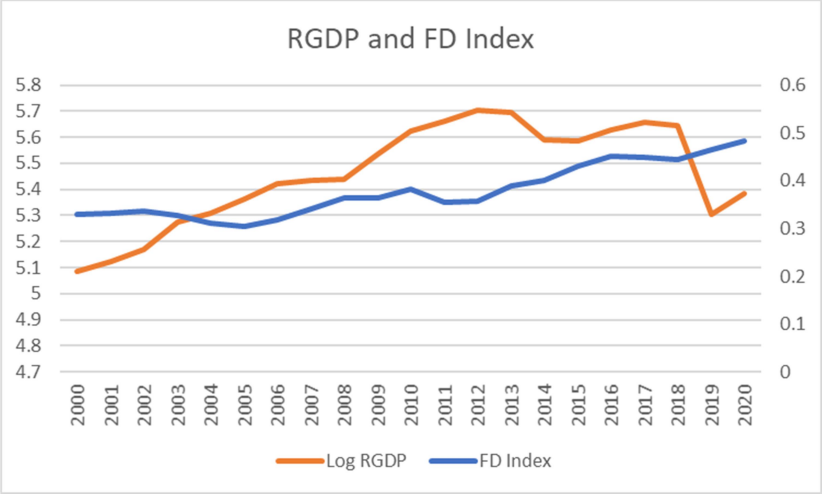
As a whole, despite these achievements, the modern financial services industry of Macao is still in its infancy. There still exists a large gap in terms of scale comparing with the traditional

banking services. Meanwhile, its development gap with the modern financial services industry in the neighborhood, for example, that of Hong Kong, Shenzhen and Guangzhou, is also huge.

1.7 Financial development and economic performance of Macao

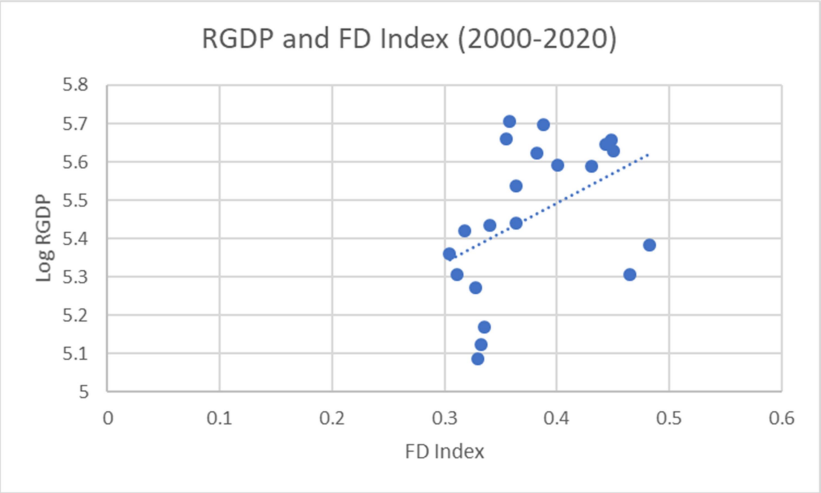
1.7.1 An overview

To investigate the correlation between financial development and economic performance of Macao, to assess the underlining relation between financial development and RGDP, diagrams are plotted to visualize the linkage between the IMF's Financial Development Index (FD Index) and the RGDP and its growth rate. Firstly, RGDP in logarithm and FD Index are plotted and shown in Figure 1.10. In general, these two variables are moving together at the same direction until 2018. Since 2019, the RGDP of Macao has started to drop while the level of financial development can still maintain its momentum, leading to diversified development. As for the correlation between RGDP and financial development, as shown in the scatter diagram in Figure 1.11, a direct linkage can be observed under which the level of financial development is able to advance in line with an increase in the scale of the Macao economy (value of RGDP) for most of the years in the sampling period.



Source: IMF Financial Development Index Database, DSEC RGDP Statistics

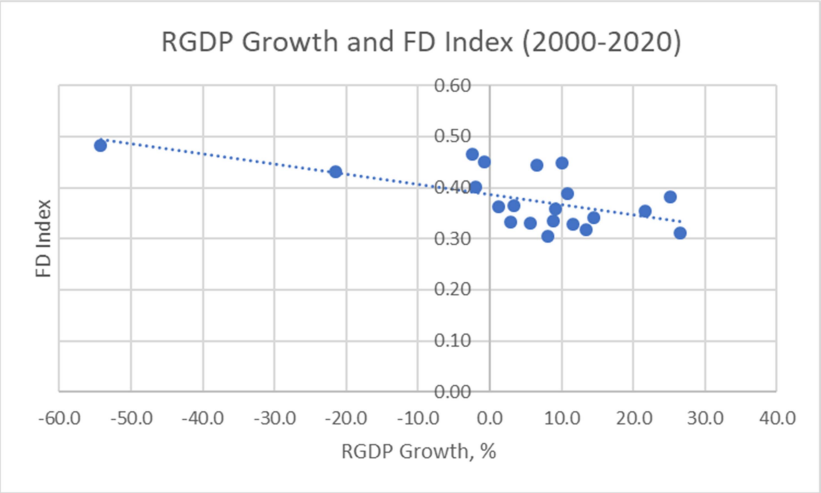
Figure 1. 10: RGDP and Financial Development Index



Source: IMF Financial Development Index, DSEC GDP Statistics and Author's Computation.

Figure 1. 11: The linkage of RGDP and Financial Development Index

As for the correlation between financial development and RGDP growth, Figure 1.12 reveals a negative link, indicating a low or even negative RGDP growth rate is associated with a high FD Index. To explain, in the pandemic year of 2020, the RGDP of Macao was suffered from major contraction. The banking and insurance industry of Macao, meanwhile, was able to sustain its relatively stable performance, with improved level of development and a higher FD Index relative to the previous years. It has brought about a negatively correlation in Figure 1.12. In fact, the RGDP growth of Macao has been fluctuating rigorously, especially in the periods of gaming industry major adjustments (2014-2016) and pandemic (2020-2022), during which double digit negative growth rates were recorded, followed by a strong and double digit rebound in the years that follows. Consequently, the value of RGDP and the growth of RGDP have diversified correlation with the FD Index and more sophisticated estimations are required to examine their relationship.



Source: IMF Financial Development Index Database, DSEC GDP Statistics and Author's Computation.

Figure 1. 12: RGDP growth and Financial Development Index

To further investigate the linkage between financial development, the value RGDP and the growth of RGDP, the Granger Causality tests are conducted to examine for the financial development-growth nexus for the period of 2000-2020. Prior to the Granger Causality test, the Augmented Dicky Fuller (ADF) test for stationarity is done and both the FD Index, value of RGDP and its growth are non-stationary and have converted to stationarity after taking the first difference. Then the Granger Causality tests are performed with the results exhibited in Table 1.3. As shown, bi-directional and positive causality is observed between FD Index and RGDP, suggesting an interdependent relationship. It implies that higher extent of financial development leads to higher RGDP, which in turn, reinforces financial development as the feedback effect. As for FD Index and RGDP growth, a one way RGDP growth-led financial development causality is found, indicating that it is RGDP growth to bring about improved extent of financial development. This one way growth-led financial development is consistent with the reverse causality as described in Demetriades and Hussein (1996).

Variables	Chi Square statistics	Probabilities
FD → RGDP	18.93	0.001***
RGDP → FD	42.90	0.000***
FD → RGDP Growth	7.57	0.109
RGDP Growth → FD	22.83	0.000***

Source: Author's calculation based on IMF and DSEC statistics. ***: Significant at 1%

Table 1. 3: Granger Causality Test Results

These results, in fact, can fit into the empirical situation of Macao in which the gaming and tourism industry is the major economic driving force, to generate a series of business activities and revenues (the gross gaming revenue and tourist expenditures) to boost the external demand and economic growth of Macao. Then the income effect brings about increased demand for financial services, such as increases in private credits, insurance premiums, loan to deposit ratio and bank branches, etc., leading to improvement in the extent of financial development in the processing of economic growth. Then a one-way causality of growth to financial development is resulted. In contrast, the bi-directional causality between FD Index and the value of RGDP reflects the increasing trend of these two variables in most of the years in the sampling period, which is exhibited in Figure 1.9 in which FD Index and RGDP contribute to explain each other with an interdependent and mutually enhancing relationship.

1.7.2 Literatures on the determinants of financial and bonds market development

In Huang (2010), the determinants of financial development are reviewed for a group of 107 developing and transition countries for the period of 1990-2004. It points out that legal systems, economic policies and geographical location play a significant role in the process of financial development. The origin of the legal system has a significant impact on the treatment of creditors and shareholders, as well as the efficiency level of contract enforcement. In addition, initial income level and population size are also important factors. This research indicates the need for improvement in the quality of governance, the implementation of more open and sound trade and macroeconomic policies, and improvement in infrastructure, which can help to accelerate the development of local financial sector. Bhattacharyay (2011) studies the main determinants of bond market development in 10 Asian economies for the period of 1998-2008. It reveals that the size of the economy, the stage of economic development, the degree of economic openness, the size of the banking sector and the interest rate differential are the factors that determine the degree of development of the bond market. The study suggests that international or regional financial organizations, such as the ADB, must take the lead in strengthening financial

cooperation among countries to promote the development of regional bond markets. In addition, measures to promote the development of a liquid corporate bond market and broaden the issuer base have positive impacts on the bond market. The study also suggests that Asian economies need to harmonize and strengthen financial regulations, while developing innovative financial instruments to better attract regional and international investors.

In Bae (2012), it examines the determinants of development in government, financial, and corporate bonds markets dominated in local currency for 43 countries for the period 1990–2009. It indicates that the most important determinant is GDP per capita. Besides, fiscal balance, interest rate, domestic credit outstanding are also important factors. In contrast, institutions' quality of a country is not significant in explaining the development of domestic bond markets, but as a determinant of foreign holdings of domestic bonds. To accelerate the development of China's bond market, this research suggests to firstly promote the development of government bonds market. In addition, it is necessary to build up an active and liquid secondary market which is also the most important and difficult step. This research also suggests to deepen the liberalization of domestic banking sector so as to accelerate the development of China's bonds market. It further proposes to 1.) Coordinate the development of interbank markets and exchanges; 2.) Coordinate and improve the regulatory/regulatory framework, and 3.) Diversify the investor base, in order to accelerate the development of the bond market.

Khalfaoui (2015) is an empirical study examining the determinants of financial development for 15 developed and 23 developing countries for the period of 1997-2013. It shows that the financial development index represented by the ratio of private loans to GDP depends on a series of factors, including the ratio of non-performing loans, stock market capitalization to GDP, money supply M2 to GDP, investment to GDP, trade openness, human resources, etc. Simultaneously, macroeconomic stability and legal and institutional frameworks are also important determinants for developed countries. To conclude, the research indicates the presence of the agglomeration effect, of which economies with a larger banking industry and stock market are also those with higher extent of financial development.

As institutional factors are significant to financial development, Le, Kim and Lee (2016) incorporates governance and institutional quality in examining the determinants of financial sector development in 26 Asia and the Pacific economies for the period of 1995 to 2011. The governance and institutional quality indicators employed in this study are the average of the six dimensions measured in the WB's Worldwide Governance Indicators, namely voice and accountability, political stability and absence of violence, government effectiveness, regulatory

quality, rule of law, and control of corruption. In the GMM estimations, it is found that better governance and institutional quality can foster financial sector development in developing economies, while economic growth and trade openness are key determinants of the financial depth in developed economies.

Smaoui, Grandes and Akindele (2017) studies the determinants of bonds market for 22 emerging and developing countries for the period 1990–2013. It shows that economic size, trade openness, investment status, per capita GDP, bureaucracy, and the size and concentration of the banking system are positively correlated with bond market development. Interest rate fluctuations and local fiscal conditions are negatively correlated with bond market developments. In terms of policy recommendations, it proposes to introduce stable macroeconomic policies to reduce interest rate and exchange rate fluctuations in order to attract investors to hold bonds. Other recommendations include reducing investment risk, improving the quality of governance and bureaucracy, as well as developing the banking system.

The influences of institutional factors is further explored in Sayılır, Doğan and Soud (2018) which is a cross-sectional study to focus on 62 financial markets as listed in the World Economic Forum Financial Development Report 2012. It employs the financial development indicators composed by the World Economic Forum Financial Development Report and the governance indicators extracted from the WB's Worldwide Governance Indicators to address the relationship between financial development and governance. Employing the Structural Equation Model (SEM), the governance indicators in all the six dimensions are observed to be significant, contributing to the process of financial development. Similar assessment is made in Ellahi, Kiani, Malik, Raza and Gul (2019) for the impacts of governance to the development of the financial sector for Bangladesh, India, Pakistan and Sri Lanka for the period 1996 to 2018. The roles of trade openness, output, economic freedom and inflation rate and output growth are assessed simultaneously. The indicator of financial sector development is composed by the Principal Component Analysis (PCA) based on a number of commonly used banking and stock market development indicators, such as the market capitalization to GDP ratio, liquid liabilities, domestic credit to private sector and broad money of M2 to GDP ratio. The governance indicator is the simple average of the six dimensions in the Worldwide Governance Indicators of the World Bank. The GMM estimations show that trade openness and real output moderate the financial development through their positive interactions with institutional governance, indicating the importance of governance in the financial development of the four Asian Economies.

To sum up, the current literature observes a series of factors which have certain impacts on the level of financial development. These factors can be synthesized into four broad categories, including 1.) Legal and regulatory systems: including legal and regulatory systems, bureaucratic or governance; 2.) Basic factors and factors of production: including economic and population size, income level, trade openness, macroeconomic policies, and human resources; 3.) Market factors: including the current development of the banking and financial industry, the degree of development of the government bond market; 4.) Government support measures: including policies to encourage foreign investment, policies to promote regional cooperation, and policies to stimulate market activity, etc.. As for policy recommendations, the existing literatures propose to improve the quality of government governance, perfect the legal and regulatory framework of the financial market, adopt more open and prudent economic and trade policies, strengthen regional financial cooperation, and even accelerate the development of the financial and bond market through the construction of the government bond market as strategies, to fasten and deepen the extent of financial development.

1.7.3 The determinants of financial development in Macao

- *Ordinary Least Square (OLS) estimations*

To unveil the role of various economic, institutional, market and government supports factors to the development process of the financial industry of Macao, regression analyses are formulated to estimate empirically the extent of financial development, represented by the IMF Financial Development Index (FD), against a number of independent variables, which include 1.) the economic factors of RGDP per capita (Ycap) and trade openness as the sum of exports and imports to GDP (Open); 2.) the legal and regulatory factors composing of the governance efficiency indicators of Government Effectiveness (GE), Regulatory Quality (RQ), and the average of the six dimensions of government performance scores (AVG), namely Control of Corruption, Government Effectiveness, Political Stability and Absence of Violence/Terrorism, Regulatory Quality, Rule of Law and Voice and Accountability, extracted from the WB's Worldwide Governance Indicators (WGI); 3.) the market factor which is the scale of the financial industry composed as the sum of value added of the banking, insurance and other financial services industries to GDP ratio (Fin_sh) and lastly 4.) the government supports factors which include the size of the government measured as the government expenditure to GDP ratio (G_sh) and the accumulated inward foreign direct investment in banking, insurance and other financial sectors to GDP ratio (IFDI_sh). These independent variables have also been employed in Huang (2010), Voghouei, Azali, and Jamali (2011), Le, Kim and Lee (2016), Zainudin and Nordin

(2017), Sayılır, Doğan and Soud (2018), Ellahi, Kiani, Malik, Raza and Gul (2019), Ellahi, Kiani, Awais, Affandi, Saghir and Qaim (2021). Subject to the data availability constraint, the sampling period is restricted to 2000-2020 to assess the determinants of financial development since the handover until the beginning of the pandemic. In the empirical analyses, the following specification is adopted:

$$FD_t = \beta_0 + \sum_{n=1}^{N} \beta_n X_{nt} + \varepsilon_t \quad (1)$$

where FD_t is the Financial Development Index of Macao measured by the IMF at time t, X_{nt} are the economic, institutional, market and government supports factors described above which tend to affect the level of financial development of Macao, ε_t is the error term and the β_s are the constant and coefficients to be estimated. All the dependent and independent variables are in their logarithm before performing the regression analysis. Table 1.4 exhibits the summary statistics of all the variables together with their sources.

Variables	Description	Source	Mean	SD	Min	Max
FD	Financial Development Index	IMF	-0.427	0.062	-0.517	-0.316
Ycap	RGDP per capita	DSEC	5.707	0.160	5.439	5.931
Fin_sh	Sum of value added of the banking, insurance and other financial sector industries to GDP	DSEC	0.858	0.111	0.706	1.167
G_sh	Government expenditure to GDP ratio	DSEC	0.989	0.127	0.813	1.411
Open	Sum of exports and imports to GDP ratio	DSEC	2.105	0.046	2.050	2.183
IFDI_sh	Accumulated Inward foreign direct investment in banking, insurance and other financial sectors to GDP	DSEC	1.069	0.180	0.917	1.631
GE	Government Efficiency	WGI of WB	1.924	0.026	1.852	1.954
RQ	Regulatory Quality	WGI of WB	1.933	0.049	1.825	1.983
AVG	Average score of the six dimensions of government performance	WGI of WB	1.869	0.035	1.810	1.930

Sources: IMF: International Monetary Fund; DSEC: The Statistics and Census Service of Macao SAR Government; WGI of WB: World Governance Indicator of the World Bank.

Table 1. 4: Summary statistics of the dependent and independent variables

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Ycap	0.450*** (0.052)	0.436*** (0.102)	0.475*** (0.109)	0.510*** (0.152)	0.477*** (0.114)	-0.010 (0.091)
Fin_sh	0.319*** (0.093)	0.314*** (0.101)	0.269** (0.109)	0.270** (0.113)	0.306*** (0.102)	
G_sh	0.306** (0.112)	0.300** (0.122)	0.364** (0.136)	0.393** (0.164)	0.344** (0.134)	
Open		-0.040 (0.249)	-0.068 (0.250)	-0.040 (0.270)	0.007 (0.258)	
GE			-0.240 (0.229)	-0.159 (0.333)		
RQ				-0.091 (0.266)		0.857* (0.300)
AVG					-0.124 (0.148)	
Constant	-3.572*** (0.341)	-3.398*** (1.143)	-3.126** (1.169)	-3.393** (1.435)	-3.537*** (1.165)	
Adj R-square	0.9071	0.901	0.902	0.896	0.900	0.364
F-statistic	66.106	46.744	37.841	29.699	36.848	6.73
Prob(F-statistic)	0.000	0.000	0.000	0.000	0.000	0.007
Observations	21	21	21	21	21	21

The standard errors are stated in parenthesis. *, **, *** represents significance at 10%, 5% and 1% level.

Table 1. 5: Ordinary Least Square (OLS) estimations on the determinants of financial development

The benchmark OLS estimations on the determinants of financial development of Macao is firstly performed with the results reported in Table 1.5. In general, the economic variables including the RGDP per capita (Ycap), size of the government (G_sh) and the market variables of size of the financial industries (Fin_sh) are significant in explaining the level of financial development that Macao has achieved, with RGDP per capita carrying the strongest magnitude. This result is consistent with the findings in Zainudin and Nordin (2017) and Ellahi, Kiani, Malik, Raza and Gul (2019), but deviated from the insignificant RGDP per capita as observed in Ellahi, Kiani, Awais, Affandi, Saghir and Qaim (2021). The scale of the financial industry is the factor with the second largest estimated coefficient. It is significant and positive, representing that current scale of the banking and finance industry is critical to its future development, which reflects the agglomeration effect as indicated in Bae (2012). The size of the government is another significant determinant as an increase in government spending is constructive to the development of the financial industry. In contrast, the openness ratio and the inward FDI ratio are insignificant, these findings deviate from the results of Le, Kim and Lee (2016), Khalfaoui (2015), Zainudin and Nordin (2017) and Ellahi, Kiani, Malik, Raza and Gul (2019), which can be

attributed to the gaming and tourism driven economic structure of Macao. The rapid development in the gaming industry brings about expansion in gross gaming revenues, leading to a growth in the exports of services and an increase in openness ratio, contributing to a strong RGDP growth. Given the stable development of the financial industry, the rapid increase in RGDP, in turn, may distort the financial development index which is measured as a ratio of GDP, bringing about such insignificance.

When we shed lights on the impacts of the institutional factors, to our surprise, most of them, including the Government Efficiency (GE) and the average score of all the six dimensions of governance indicators measured in the WGI (AVG) are insignificant. In short, the institutional factors fail to explain the extent of financial development of Macao. Regulatory Quality (RQ), meanwhile, is significant only in Model 6 with low explanatory power. It becomes statistically insignificant in Model 4 when additional economic, market and government supports factors are incorporated in the estimation. It reveals that the quality of the overall governance of Macao is good, with GE, RQ and AVG at the rank of 85.10, 96.15 and 77.46 out of 100 in 2020. These indicators are also stable over the sampling period, with standard deviation of 6.79, 9.77 and 6.43 respectively which are less than or close to 10% of the indicator. Given such solid institutional background with relatively small room for further improvement, the economic, market and government supports factors have become the main driving forces to the development of the financial industry of Macao.

- *Dynamic Estimations of Financial Development*

As indicated in Takyi and Obeng (2013), Le, Kim and Lee (2016), Ellahi et al. (2019), Asratie (2021), Ellahi, et al. (2021), Raifu, Okunoye, and Aminu (2023), financial development is a dynamic process in which current development depends on its past performance and empirically, it is proven that countries with certain achievements in financial development in the previous period tend to attain higher level of financial development, with the first lag of financial development as a significant explanatory variable. To assess the contribution of the previous achievement on current financial development, it is necessary to employ a dynamic regression model while the Generalized Method of Moment (GMM) and Autoregressive Distributive Lag (ARDL) are two of the popular estimation techniques. The former has been employed in Le, Kim and Lee (2016), Ellahi et al. (2019), Ellahi et al. (2021) and Raifu, Okunoye and Aminua (2023), while the latter was used in Takyi and Obeng (2013) and Asratie (2021). To choose between these two techniques, Shrestha and Bhatta (2018) indicates that the ARDL model is developed based on the OLS model which can be applied to assess the long term relationship between a

series of non-stationary and stationary time series with mixed order of integration. It can overcome the limitation of the Johansen cointegration test which requires non-stationarity and that of the GMM with stationarity as the pre-requisite.

Variables		T-statistics	P-value	Level of Integration
FD	Level	0.333	0.974	
	1st Difference	-3.898	0.010***	I(1)
Ycap	Level	-1.503	0.512	
	1st Difference	1.127	0.996	
	2nd Difference	-2.949	0.063*	I(2)
Fin_sh	Level	-0.210	0.922	
	1st Difference	-2.931	0.060*	I(1)
G_sh	Level	-0.345	0.901	
	1st Difference	-0.844	0.783	
	2nd Difference	-2.434	0.147	I(3)
Open	Level	-1.414	0.555	
	1st Difference	-3.900	0.009***	I(1)
GE	Level	-2.939	0.059*	I(0)
RQ	Level	-0.147	0.928	
	1st Difference	-10.08	0.000***	I(1)
AVG	Level	-4.280	0.004**	I(0)

*, **, *** represents significance at 10%, 5% and 1% level.

Table 1. 6: Augmented-Dicky Fuller (ADF) tests results for the dependent and independent variables

As shown in Table 1.6, the ADF tests reveal mixed order of integration ranging from I(0) to I(3) for the time series of the dependent and independent variables. Furthermore, GMM is designed to estimate panel data with a short time span, such that the number of cross sections is greater than the length of the time series with better precision. Given our time series studies, the ARDL model is employed with the level of financial development in the previous period, namely FD(-1) being inserted into Equation (1) with the renewed specification as shown below:

$$FD_t = \beta_0 + \beta_1 FD_{t-1} \sum_{n=2}^{N} \beta_n X_{nt} + \varepsilon_t \quad (2)$$

Variables	Model 7	Model 8	Model 9	Model 10	Model 11
FD(-1)	0.630** (0.171)	0.514** (0.211)	0.678*** (0.179)	0.678*** (0.191)	0.739*** (0.174)
Ycap	0.142** (0.058)	0.229* (0.108)	0.142** (0.058)	0.142** (0.063)	0.123** (0.056)
Fin_sh	0.228** (0.094)	0.192* (0.101)	0.211** (0.096)	0.211* (0.101)	0.195* (0.091)
G_sh		0.129 (0.135)			
GE			-0.184 (0.195)	-0.183 (0.281)	
RQ				-0.0007 (0.211)	
AVG					-0.214 (0.125)
Constant	-1.158** (0.470)	-1.804** (0.825)	-0.769 (0.628)	-0.769 (0.654)	-0.576 (0.559)
Adj R-square	0.926	0.926	0.926	0.920	0.934
F-statistic	80.377	60.18	60.07	44.85	68.350
Prob(F-statistic)	0.000	0.000	0.000	0.000	0.000
Observations	20	2	21	21	21

The standard errors are stated in parenthesis. *, **, *** represents significance at 10%, 5% and 1% level

Table 1. 7: Autoregressive Distributive Lag (ARDL) estimations on the determinants of financial development

The results of the ARDL estimations are shown in Table 1.7. The significant and robust previous period financial development level FD(-1) does not only confirm the appropriateness for the employment of the ARDL model, but also demonstrates the dynamic nature of the financial development process in which the presence of solid foundation is important to the next stage of development. High extent of financial development in the previous period contributes to enhance the reputation which can help to attract new investments as well as new businesses, enhancing further the future development of the financial industry. This finding is consistent with the results exhibited in the existing literatures. The other findings, for example, the significant and positive RGDP per capita (Ycap) and scale of the financial industries (Fin_sh) are consistent with the results obtained in the OLS estimations. In the meantime, the institutional factors of government efficiency (GE), regulatory quality (RQ), the average score of governance (AVG) and the openness ratio are still insignificant as before. Comparing with the benchmark OLS estimations, the only difference is the size of the government (G_sh) which is no longer significant. It is attributed to the presence of a strongly significant lagged financial development level as well as the short time-series of the estimation.

- *Robustness tests*

To test for the robustness of the estimation results, the dependent variable in both the OLS and ARDL models which is the aggregate level Financial Development Index (FD) from the IMF, is replaced by the disaggregate level Financial Institutions Index (FI) which is an indicator composed by the IMF to measure the level of development of the banking and insurance institutions. Then the OLS and ARDL estimations are performed once again employing the specification as stated in equations (1) & (2). As a whole, the estimation results are similar to the previous findings in which only the economic factors of RGDP per capita, size of the financial industry and size of the government are signification in the OLS. In the ARDL model, the lagged FI index has a robust association with its current value. Governance indicators, meanwhile, are still insignificant. Furthermore, suggested by Le, Kim and Lee (2015), a cross product term is inserted to test if the institutional factors become significant when they exceed the threshold level. Then a cross term of government efficiency and regulatory quality (GERQ) is considered as an extra independent variable but is not able to explain financial development represented by both the Financial Development Index (FD) and Financial Institutions Index (FI). All in all, it can be concluded that the findings obtained in our quantitative analyses are robust.

1.8 Conclusion and policy implications

1.8.1 Conclusion

This chapter begins its discussion by indicating the increasing significance of the financial services. With reference to the descriptions made by the ADB, IMF and WB on the functions, features and importance of financial services and financial markets, we define financial development and discuss the measurement methods by reviewing a series of banking and financial market related indicators employed in the existing literatures. Afterwards, the growth and financial development nexus is focused, and there is a consensus on the direct correlation between financial development and economic growth, given that financial institutions and financial markets contribute to enhance saving, facilitate investment, reduce transaction costs and share risk. Nevertheless, the existing literatures indicate the likeliness on the presence of reverse correlation of growth-led financial development, display the diversified impacts of financial development on different production sectors in the economies.

To assess the level of development of Macao's financial industry, the ratios of banking value added to GDP, local private credit to GDP, money supply M2 to GDP and loan to deposit, as well as the interest gap in percentage are employed which are able to reflect the capacity, depth and efficiency of Macao's banking industry according to the literature. Besides, the Financial Development Index and the sub-groups of Financial Institutions Index and Financial Market Index of Macao, composed by the IMF are also examined. As a whole, the level of financial development in Macao has been steadily improving since 2000, while short term fluctuations is observed which is attributed to the major adjustments in the gaming industry and the pandemic, leading to a disproportionated contraction in GDP and an increase in the relative scale of the financial industry. On the disaggregate level, Macao has obtained a better progress on the development of the financial institutions with under-developed financial markets. Meanwhile, it has a significant financial development gap, especially for the financial market when comparing with China and Hong Kong. Apart from the extent of financial development that Macao has achieved, the development of modern financial services and mobile payment of Macao in recent years are also revealed. Promising progress is recorded given the strategic development plan imposed by the Macao SAR government to promote its advancement.

To shed light on the economic growth and financial development nexus of Macao, the Granger Causality test is performed which reveals a bi-directional causality between RGDP value and financial development, whereas a one-way causality of growth-led financial development is exhibited simultaneously. Such result is consistent with the economic structure of Macao in which economic growth is mainly driven by the revenues generated by the gaming and tourism industries, leading to improved financial development as the consequence. Afterwards, econometric estimations are organized to address the major determinants of financial development across a series of institutional, economic, market and government supports factors. The results suggest that economic, market and government supports factors, including the RGDP per capita, the size of the financial industries measured as the financial industries value added to GDP ratio, the size of the government indicated by the public expenditure to GDP ratio are significant and robust factors associated with financial development, with openness and the institutional factors of government efficiency and regulatory quality, or the average performance of the government as insignificant determinants. Given the endogeneity nature of financial development, the dynamic model of ARDL is then employed to examine the role of previous period financial development, which is observed to be strongly significant in explaining the current development level of the financial industry, with RGDP per capita and the size of the

financial industry as the other two significant determinants. Openness and the institutional factors, meanwhile, remain to be insignificant in explaining the level of financial development in Macao.

1.8.2 Policy implications

The results of econometric estimation reveal that the development of the financial industry is market driven to a large extent, which depends heavily on its past performance as well as the income level of the economy, with supports from the government and good governance playing insignificant role. However, it does not rule out the importance and necessity of public interventions and the potential contributions of policy leans, especially when an agglomerative pattern is found in the development process, with the size and development level in the previous period as strong drivers. Given that, the Macao SAR government should take the lead to promote proactively the development of the financial industry.

When Macao is still in its infant stage in financial market development, subject to the competition from mature financial centers in the region, such as Hong Kong and Shenzhen at the same time. It is hard if not impossible to rely on its own strength and the market forces, to enable Macao's financial markets and its modern financial services to achieve satisfactory scale and performance in the short run. With reference to the existing literatures, it is proposed to have the Macao SAR government to actively engage, to consider to establish a sovereign fund like investment management company to cooperate with the local financial institutions, to issue offshore RMB bonds and other financial products in Macao, with green, blue, anti-inflation or silver bonds as the first mover, providing high-quality investment tools to the market and giving priorities to the local and Greater Bay Area markets. Simultaneously, it is also important and essential to promote the development of the relevant secondary markets to improve the liquidity of the assets. It aims to generate quality financial products and market activities to create the scale/agglomeration effect, contributes to accelerate the development of Macao’s financial markets and transactions.

Besides, it is also important to attract foreign financial institutions with leading positions to establish their operations in Macao. In the process, Macao can make full use of their expertise and experience, as well as their mature and extensive business networks. Simultaneously, it is also important to encourage Macao’s financial institutions to extend their services, particularly in the domain of modern financial services. In combination with the unique institutional advantages and policy leans and incentives offered by Macao and the Hengqin Deep Cooperation Zone in, it is likely to contribute to accelerate the development of the financial industry in Macao.

In addition, it is inevitable for the Macao SAR government to make continuous efforts to perfect the laws and regulations which govern the operations of the financial market and protect the interests of the financial institutions and investors. The government can also contribute to strengthen the supply of financial specialists through the introduction and efficient implementation of well-designed talent recruitment programmes, and the training and vocational training programmes to cultivate local talents. Last but not the least, government supports to promote the adoption and spillover of financial technology is also important in the process of development. As a whole, these are all critical steps for the construction of a modern financial series ecosystem, offering a friendly macro environment and the needed factor inputs for the long term sustainable development of Macao's financial industry.

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Chapter 2: Bank efficiency in Macao: A two-stage DEA model and regression analysis

ABSTRACT

This chapter empirically assesses variations in Macao's bank efficiency and investigates their underlying determinants. We find that local bank efficiency was originally at very low levels before 2004 but has substantially increased ever since. Macao's bank efficiency reached a very high level in the recent period prior to the Covid19, and still maintained a moderately high level even during the pandemic. Macao's banks exhibited their extraordinary resilience as opposed to its casino tourism that plummeted like a freefall during the pandemic. We show that Macao banking efficiency is positively related to local economic growth, foreign direct investment, financial sector expansion, loanable fund utilization, bank income diversification, interest rate differences, and immigrating financial professionals, but negatively to casino gaming tourism, banking industry concentration, bank reserve holdings, and non-performing loan losses. Useful implications can be derived from our findings for policy makers to improve financial environment and for bank managers to enhance operational performance.

Keywords: Data envelopment analysis, bank efficiency, regression analysis, efficiency determinants, Macao.

2.1 Introduction

The three-year Covid19 pandemic had a devastating effect on the tourism-based economy in Macao, yet its financial sector was affected by this pandemic much less badly than gaming tourism. This catastrophic effect makes it absolutely necessary to diversify the Macao economy from casino gaming towards other sectors, that is, non-tourism sectors, especially the financial sector. It is good that modern finance has now been listed as one of four diversifying sectors in the local government policy agenda. As a matter of fact, this sector provides high value added but requires low land use, especially suitable for Macao to develop. Macao has been got used to making quick money and easy profit since casino tourism is a super-profitable business, and modern finance will also provide the city with another highly profitable option.

A typical financial sector includes direct finance (i.e., capital markets) and indirect finance (i.e., banking systems). Macao has a well-developed set of commercial banks, and now is starting to set up its bond market. Macao is lucky to have a promising outlook of modern finance development due to solid economic fundamentals of which it can make good use because it is situated in the Hengqin Deep Cooperation Zone and the South China Greater Bay Area, which are the best-developed regions in the country with a high rate of saving and a strong demand for financing. However, there is no serious research for the current situation of Macao's financial sector. This chapter coming from the IEEM AR Grant supported project is to assess the intertemporal evolution and real determinants of Macao's bank efficiency. The results from this study will make it clear at what point Macao will start its modern finance development. And this point will give some helpful hints on what measures the city should take to speed up financial development. That is, such results can be further utilized in future research to derive policy implications for practical use by the local government and financial sector in Macao.

As a tourism-based economy, Macao relies mainly on casino tourism for economic growth, yet it has also experienced rapid growth in its banking sector over the last two decades. In 2015, for example, its banks saw a year-on-year rise in deposits by 15%, loans by 22%, and profits by 15% (MBD, 2016). The size of Macao's banking sector is small compared with that of Hong Kong, but its supervision, regulation and capitalization are consistent with international norms. It is to be expected that Macao's banking sector could have great potential for further growth as it taps into huge opportunities from Mainland China's market. Macao's banking development is deeply rooted in its own economic growth. This city is very small in territorial size, yet its US$45.2 billion casino revenue in 2013 was seven times as high as that of Las Vegas ten years after its 2003 opening of casino gaming to Mainland Chinese visitors (Schwartz, 2015). Macao

used to be much less developed than nearby Hong Kong for more than 150 years up to 2006, but Macao's real GDP per capita was more than twice as high as Hong Kong's in 2013 due to its fast growth in casino tourism at 28.2% per year in 2002-2013 (Gu et al., 2017). Macao has become the world's largest casino resort in revenue terms since 2006, with its economy growing 13.4% a year in this period and its real GDP per capita rising to the world's top-three level in 2014 (World Bank, 2015). There seems no doubt that Macao's banking expansion will continue with its economic growth, and so it is interesting to study its bank performance. Yet, no one has used the data envelopment analysis (DEA) or stochastic frontier analysis (SFA) to exclusively examine Macao's banking performance and its driving forces. As an effort to fill the research gap, our work presents a special study of bank efficiency for Macao by employing a two-stage DEA model.

Our adoption of this methodology is due to three considerations specific to Macao's banking issues. First, bank efficiency scores are obtained in the first-stage DEA non-parametric estimation, and driving forces behind efficiency changes are then identified in the second-stage parametric regression. Second, the set of inputs and outputs for efficiency estimation is selected on the basis of usual practices in the literature and real situations in Macao. The determinants of bank efficiency to be detected in regression include resource, institutional, and other environmental factors that affect banking operation. Third, an un-oriented, non-radial DEA model is used, along with Tone's (2001) slack-based measure (SBM) of technical efficiencies, to estimate their levels more flexibly than do the traditional DEA approaches.

This chapter is to employ the two-stage model framework to address some important questions about Macao's banking sector. The questions to be addressed are: Has bank efficiency increased, decreased, or stayed stable during the sample period? At what pace has the efficiency evolved over time? What are the main sources of (in)efficiency in a particular sub-period? Do banks that diversify business activities perform differently and at what significance level? What are policy implications from efficiency estimation and determinant regression? Some of these questions may be different than those addressed in the existing literature since we utilize different methodologies while including special covariates (e.g., the ratio of bank loans to deposits, the unpopular yet key ratio of bank reserves, and the interest rate spread between Macao SAR and Inland China[15]) not attempted by any other studies. Our answers to those questions can create some new insights into Macao banking issues, which should be useful to both bank managers and policy makers.

[15] Variations in this spread have certain implications directly for exchange rate swings and capital flow intensities / directions, and hence indirectly for banking business and performance.

The rest of the chapter proceeds as follows. Section 2 provides a brief review of the banking literature on efficiency measurement in different regions. Section 3 discusses theoretical and empirical methodologies related to our study. Section 4 contains a concise description for both variables included in our models and sources of data sampled for empirical use. Section 5 estimates various efficiency scores for Macao banking. Section 6 explores the potential driving forces that affect Macao bank efficiencies. Section 7 concludes the chapter.

2.2 Brief literature review

Parametric stochastic frontier analysis (SFA) or nonparametric data envelop analysis (DEA) have been used to estimate bank performance since 1990s because such estimation has useful policy implications for efficiency enhancement. Numerous studies have emerged for banking efficiencies in other world regions than Asia. There are only a handful of comparative studies for Asian banks, with cross-border efficiency differences explained by using DEA or multiple-stage models.

A study is conducted to investigate potential linkages between bank efficiency and risk taking among five countries badly hit by the 1997-98 Asian financial crises (Laeven, 1999; Sufian, 2010). Another study aims to explore the possible implications of differing efficiencies for future competition in banking sectors of other Asian economies less severely affected by the crisis (Lim & Randhawa, 2005).

Studies of cross-border efficiency comparison related to Chinese banking are relatively rare compared to those for other regions. One comparative study of bank efficiency is provided for Hong Kong and Macao (Fu & Vong, 2011). Another study is found to use a three-stage DEA model to compute efficiency differences and compare their environmental determinants for three Chinese-speaking regions: Mainland China, Hong Kong, and Taiwan (Shyu et al., 2015). Yet another comparative study of banking efficiencies is published recently to focus on banking efficiency comparison between Mainland China and its two special administrative regions (i.e., Hong Kong and Macao) (Gu et al., 2022).

There is no study of efficiency measurement exclusively for Macao banks, and this is a research gap that needs to be filled, as done in this chapter. With the most recent data in the updated sample, our DEA study supplies a clear picture for the long-term evolution of Macao's bank efficiency and the strong evidence on its potential determinants.

2.3 Theoretical and empirical methodologies

The evaluation of firm performance is rooted in the theory of production and the concept of distance functions. In our setting, commercial banks are money-making /profit maximizing firms, which seek out maximal outputs given the inputs or minimum inputs given the outputs. This section describes the methodologies suitable to measure bank efficiency in Macao. A slacks-based measure (SBM) for data envelop analysis (DEA) of technical efficiency is incorporated into the framework of meta-frontier and group frontiers that are built on production possibility sets and output distance functions. While the empirical measurement of efficiency is based on these non-parametric methods in the first stage as done in our work, the potential determinants of efficiency can be examined through parameter estimation in the second-stage regression of this work.

DEA is a mathematical programming model designed to measure the relative efficiency of a set of decision-making units (DMUs) such as banking firms, with multiple inputs used to produce output(s) (Charnes et al. or CCR, 1978; Banker et al. or BCC, 1984). Production frontiers are constructed via the envelopment of the DMUs, with the "best practice" DMUs forming the non-parametric frontier. An obvious advantage of DEA over parametric stochastic frontier analysis (SFA) (Ferrier & Lovell, 1990) is that SFA must assume specific functional forms for production and distance but DEA need not do so. The problem with SFA is that it is difficult to find right functions to characterize the true relationships between outputs and inputs/resources. DEA can envelop the input/output data with no need to look for such functions but SFA cannot; as such, the former method is utilized in our work.

DEA makes no assumption about how a DMU produces output(s) from inputs; each DMU is a "black box" in the production process. DEA modeling of technology allows for constant returns to scale (CRS) and variable returns to scale (VRS). DEA models can also be input-oriented, output-oriented, or un-oriented. (i) An input-oriented model identifies the maximum input reduction given the output level for a DMU to become efficient. (ii) An output-oriented model defines the efficiency frontier by holding input levels constant and seeking the maximum output increase. (iii) An un-oriented model requires a combination of both input and output adjustments to achieve efficiency. The first two models offer the same (/differing) technical efficiency scores if the technology exhibits CRS (/VRS) (O'Donnell et al., 2008). The third model is employed in this chapter under the CRS assumption.

Either a radial or a non-radial measure can be used in DEA to evaluate the efficiency of DMUs. (a) Radial models assume proportional changes in inputs or outputs while discarding input/output slacks in efficiency scoring (CCR; BCC). (b) By contrast, non-radial models take into account such slacks while assuming that input/output variations are not necessarily proportional (Fare & Lovell, 1978; Pastor et al., 1999). This research adopts a flexible non-radial DEA model with slack-based measure (SBM) of efficiency by following the recent literature (Tone, 2001). Such an SBM approach works directly with input excess slacks and output shortfall slacks, which are integrated into an efficiency measure for banking production systems.

Suppose each DMU_j ($j = 1, \ldots, n$), i.e., a banking firm, employs inputs $x_{ij} > 0$ ($i = 1, \ldots, m$) to produce outputs $y_{kj} > 0$ ($k = 1, \ldots, s$). As an un-oriented, non-radial model to be used in our study, the SBM setting for DEA of a particular DMU_o (i.e., $j = o$) is specified under VRS as follows:

$$\rho^* = \min \rho = \left(1 - \frac{1}{m}\sum_{i=1}^{m} \frac{s_i^-}{x_{io}}\right)\left(1 + \frac{1}{s}\sum_{k=1}^{s} \frac{s_k^+}{y_{ko}}\right)^{-1}$$

$$\begin{aligned} \text{s. t.} \quad & x_{io} = \textstyle\sum_{j=1}^{n} x_{ij}\lambda_j + s_i^-, \qquad i = 1, \ldots, m; \\ & y_{ko} = \textstyle\sum_{j=1}^{n} y_{kj}\lambda_j - s_k^+, \qquad k = 1, \ldots, s; \\ & \textstyle\sum_{j=1}^{n} \lambda_j = 1; \\ & \lambda_j \geq 0, \quad s_i^- \geq 0, \quad s_k^+ \geq 0; \end{aligned} \tag{1}$$

where λ_j is the intensity factor, s_i^- and s_k^+ are, respectively, the input and output slacks, and $\rho^* \in (0, 1]$ is the SBM efficiency score (Ashrafi et al., 2011). A DMU_o is SBM-efficient iff $\rho^* = 1$ (i.e., its production is fully efficient on the frontier), which is equivalent to $s_i^- = s_k^+ = 0$ (i.e., there are no input excesses or output shortfalls at optimum). For inefficient DMUs, the SBM relative efficiency must be no greater than the BBC scores (Drake et al., 2006). The SBM model will be reduced to CRS if the convexity constraint ($\sum\lambda = 1$) is removed from Eq.(1).

Firms in different groups (e.g., regions or countries) make choices from different sets of feasible input-output combinations. Such technology sets differ in resource endowments, economic infrastructure, (physical, human, and financial) capital stocks, and other environmental factors. As such, there should be separate production frontiers for different groups of firms. While the relative performance of firms within a group can be measured by estimating the group's frontier as a reference set, it is often necessary to compare the performance of firms across groups. This can only be done by estimating a common frontier as the comparison benchmark for different groups. Such a frontier is referred to as the meta-frontier in the literature, which

envelopes the group frontiers. Thus, efficiencies of firms from different groups measured relative to the meta-frontier can be decomposed into two components: one is the within-group efficiency measured as the distance from an input-output point to the group frontier, while the other is the cross-group gap measured as the distance between the meta-frontier and the group frontier. These two types of frontiers can be computed by using either DEA or SFA. Such considerations are omitted in this research because it is not a comparative study and it involves no other regions.

Although the SBM-DEA model explicitly incorporates the information embedded in the slacks, it does not directly deal with environmental factors that affect DMUs' decisions. Since this model provides us with little information on the determinants of bank efficiencies in the first stage non-parametric estimation, it must be complemented by a second-stage parametric analysis for efficiency determinants. In this analysis, we attempt to estimate the direct impacts on bank efficiencies of non-discretionary external factors such as local market, regulatory, and macroeconomic variables. This analysis tests the significance of each of these environmental variables and their joint impact on banking efficiencies (Naceur et al., 2011). All such variables will be explained in details in the next section.

It is worth reiterating the necessity for using the two-stage method to analyze bank efficiency in Macao. Two types of models are used in the literature to detect environmental impacts. One is that environmental variables are incorporated into efficiency estimation in a one-stage model (say, SFA). The other is that, in a two-stage model (say, DEA), efficiency scores from the stage 1 estimation are regressed on environmental variables to obtain the stage 2 results. The former model is preferred if very confident in efficiency assessment about functional forms of input-output relationships in a parametric approach such as SFA; whereas, the latter is a favored model if having to avoid such functions in estimating efficiency via a non-parametric approach such as DEA, with efficiency then regressed on various explanatory variables (Coelli et al., 2005). This research adopts the latter model and identifies efficiency determinants via regression analysis. It is indicated in the literature that such a two-stage treatment performs considerably better than its one-stage counterpart (Banker & Natarajan, 2008).

In our stage-2 analysis, the regression for bank efficiency in Macao is specified as follows:

$$\mathrm{Eff}_{it} = \alpha_o + x_{it}\,\alpha_1' + y_{it}\,\alpha_2' + z_{it}\,\alpha_3' + \varepsilon_{it}, \qquad (2)$$

where i and t are, respectively, the bank and time indexes, the dependent variable Eff is the efficiency score computed from the DEA model, x is a vector of bank-specific characteristics, y is a vector of industry or market-level characteristics, z is a vector of economy-wide or institutional

characteristics, α is a vector of coefficients on these characteristics, and ε is the residual term. Eq.(2) is estimated through different methods (OLS, Tobit) to ensure result robustness.

2.4 Data and variables

Our sample involves Macao's financial and economic data that have arisen shortly after its sovereignty was returned to China in 1999, with a one-year period allowed for transition, so that our sample started from 2000. A quarterly dataset is used in our sample that ended in the fourth quarter of 2022, so that we can make full use of available information in our efficiency estimation and regression analysis. No monthly data are available for all variables or factors so that we have to work with quarterly data. Using the after-1999 data allows us to avoid the distorting impacts of structural shifts on our estimation and regression for bank efficiency.

We collect sample data from several reliable sources, including the AMCM website of Macao Monetary Authority, the DSEC dataset of Macao Statistics and Census Services, the CEIC global database of the Emerging Markets Group Company, the IMF international finance statistics of International Monetary Fund, and the economic resources & data of Federal Reserve Bank of St. Louis (fred.stlouisfed). Macao banks follow the International Accounting Standards, and we are confident about the integrity and reliability of our data with no sampling bias.

Table 2. 1: Operating accounts of Macao banks (Excluding external branches) (2000-2010)

Month/Year	*12/2000*	*12/2001*	*12/2002*	*12/2003*	*12/2004*	*12/2005*	*12/2006*	*12/2007*	*12/2008*	*12/2009*	*12/2010*
Interest margins	2427.44	2357.37	2342.54	2080.22	1948.02	2552.83	3453.85	4295.95	5071.68	4182.24	5240.46
Interest incomes	8355.30	6163.81	4072.33	3329.54	3043.47	5943.01	10976.31	14236.51	13403.99	8257.27	8844.70
Interest costs	5927.87	3806.44	1729.79	1249.33	1095.45	3390.17	7522.47	9940.57	8332.31	4075.03	3604.24
Other types of banking incomes	1117.79	951.01	1104.21	1422.46	1725.55	2995.31	3489.75	3760.13	4954.91	5205.32	3888.15
Incomes from banking services and operations	779.42	677.96	731.13	857.74	1163.86	1228.01	1887.15	2676.37	4024.30	3510.48	3231.51
Incomes from securities investment (bond and equity)	180.92	163.21	262.22	412.60	367.91	1362.59	1390.83	758.79	443.73	406.08	369.25
Others	157.45	109.84	110.87	152.11	193.79	404.71	211.77	324.97	486.89	1288.76	287.39
Operating costs	2790.44	2723.31	2540.19	2536.36	2280.20	2506.16	2895.95	4046.08	6689.53	5880.61	5244.80
Personnel costs	775.49	741.25	802.61	840.94	886.91	954.20	1181.24	1507.68	1685.12	1719.33	1852.79
Supplies and services from third parties	440.06	438.09	418.43	435.36	440.23	488.11	553.72	737.24	806.74	827.23	871.80
Depreciation allowances	225.28	192.25	148.62	149.72	155.98	162.83	187.45	205.78	285.42	309.27	309.51
Provision allowances	1204.12	1189.07	1003.76	894.78	503.48	352.95	234.67	458.01	1244.50	559.65	850.95
Others	145.49	162.65	166.78	215.57	293.60	548.06	738.87	1137.37	2667.75	2465.13	1359.76
Operating results	754.79	585.08	906.56	966.31	1393.37	3041.99	4047.65	4009.99	3337.06	3506.95	3883.81
Cash flows	2184.19	1966.40	2058.93	2010.81	2052.83	3557.77	4469.76	4673.78	4866.99	4375.88	5044.26

Notes: (1) Figures in the table are cumulative numbers for the year, measured in terms of MOP million. MOP is the unit of Macao currency, with MOP8 = US$1.

(2) Operating results = interest margins + other banking incomes - operating costs，where operating costs = personnel costs + supplies and services from third parties + depreciation allowances + provision allowances + others.

(3) Cash flows = operating results + depreciation allowances + provision allowances.

(4) The original statistics include all quarterly data, but this table contains only data of the fourth quarter for each year to conserve space and prevent the table from swelling. For raw data details, go to the website of Macao Monetary authority https://www.amcm.gov.mo/zh-hant/research-statistics/statistics-page/official-statistics-summary-page

Table 2. 2: Operating accounts of Macao banks (Excluding external branches) (2011-2022)

Month/Year	*12/2011*	*12/2012*	*12/2013*	*12/2014*	*12/2015*	*12/2016*	*12/2017*	*12/2018*	*12/2019*	*12/2020*
Interest margins	6623.16	7607.10	11481.59	14395.35	15821.61	15653.05	17123.64	20191.32	20471.06	20968.51
Interest incomes	12767.43	17690.04	22140.85	29933.24	32581.38	30072.33	34465.34	47657.91	58702.66	50800.51
Interest costs	6144.28	10082.94	10659.26	15537.89	16759.77	14419.28	17341.70	27466.59	38231.60	29831.99
Other types of banking incomes	3557.83	4000.65	3829.23	4960.79	6289.94	7210.64	7864.47	6761.12	7534.16	8307.78
Incomes from banking services and operations	2758.23	2910.62	3042.13	3998.74	4234.01	4912.22	5406.67	5641.36	5911.12	6668.17
Incomes from securities investment (bond and equity)	292.41	636.75	430.16	608.32	1243.90	1780.18	1951.06	702.89	1272.37	1348.67
Others	507.19	453.28	356.94	353.73	812.03	518.25	506.74	416.87	350.67	290.95
Operating costs	5128.15	5320.20	6843.12	8352.41	9304.63	8585.13	10091.34	10879.85	11078.53	12309.85
Personnel costs	2108.81	2351.95	2737.51	3425.76	3604.60	3866.43	4151.39	4481.40	4766.18	4939.97
Supplies and services from third parties	967.71	1042.68	1205.35	1371.27	1403.94	1541.10	1629.05	1851.01	2122.04	2217.20
Depreciation allowances	313.40	341.93	386.83	461.71	545.93	577.14	589.81	629.29	695.93	727.62
Provision allowances	1087.57	857.18	1417.87	1724.37	1504.69	812.37	1502.22	1604.94	1075.75	2536.30
Others	650.66	726.47	1095.56	1369.32	2245.48	1788.10	2218.87	2313.22	2418.63	1888.76
Operating results	5052.83	6287.55	8467.70	11003.73	12806.92	14278.56	14896.77	16072.59	16926.69	16966.45
Cash flows	6453.80	7486.66	10272.40	13189.80	14857.54	15668.07	16988.80	18306.81	18698.37	20230.37

Notes: (1) Figures in the table are cumulative numbers for the year, measured in terms of MOP million. MOP is the unit of Macao currency, with MOP8 = US$1.
(2) Operating results = interest margins + other banking incomes - operating costs，where operating costs = personnel costs + supplies and services from third parties + depreciation allowances + provision allowances + others.
(3) Cash flows = operating results + depreciation allowances + provision allowances.
(4) The original statistics include all quarterly data, but this table contains only data of the fourth quarter for each year to conserve space and prevent the table from swelling. For raw data details, go to the website of Macao Monetary authority https://www.amcm.gov.mo/zh-hant/research-statistics/statistics-page/official-statistics-summary-page

Tables 2.1 and 2.2 present a comprehensive operating account of Macao banks (excluding external branches) for the fourth quarter of each year over the sample period (2000-2010, 2011-2022). This account covers all banks in each year that may witness different numbers of banks, so our sample constitutes a good representation of Macao's banking growth. Bank income comes from two sources as usual: Interest margins (i.e., loan interest receipts minus deposit interest expenses), non-interest /other incomes (including revenue from banking services and returns on security investment), and others. Banking operation incurs various costs, such as personnel costs, supplies and services from third parties, depreciation allowances, provision allowances, and others. The so-called "operating results" in the two Tables are actually bank profits /net incomes that are equal to the total income minus the total cost. Our DEA estimation of Macao bank efficiency is based on selected variables of banking inputs and output(s) that will take advantage of information in these Tables.

The input/output variables are used in the stage-1 estimation of bank efficiency, the level of which is affected by other variables that are termed the "environmental" factors and will be identified in the stage-2 regression. Various such efficiency determinants have been examined in the literature, and we need to find out which ones are really most relevant to Macao banking. There are three broad types of underlying determinants for bank efficiency: (i) Macroeconomic & institutional factors; (ii) market /industry-level factors; and (iii) bank-specific factors (not so "environmental" but internal within a bank). Some of these factors are continuous variables while others may be categorical covariates. The variables of potential determinants are listed in Table 2.3 together with detailed information on their definitions and data sources.

The factors of type (i) include: LN (GDP), LN (GDP per capita), LN (GGR) (where GGR means gross gaming revenue), GGR / GDP, gaming value added / GDP, and interest rate differences (determined by central banks such as the People's Bank of China or other monetary arrangements such as currency board systems adopted by Macao). The factors of type (ii) include: Financial development index, Lerner index (measuring monopoly power), banking sector /GDP, and FDI in banking sector. The factors of type (iii) include: LN (Other incomes), LN (Bank professionals. imported workers), loan /deposit ratio, reserves /assets, and nonperforming loan ratios. All these factors will be considered as explanatory variables in the second-stage regression analysis.

Table 2. 3: Variables definition and data source

Variable	Definition	Data source
Interest rate differences	Difference in interbank overnight rates (3-month IBOR) between Macao and Shanghai	CEIC, AMCM
LN (Other incomes)	Ln value of banks' non-interest incomes	AMCM
LN (Bank professional. imported workers)	Ln number of imported employees for Macao banks	DSEC
FDI in banking sector	Share of foreign direct investment (flow, not stock) in Macao's financial sector, %	DSEC
Gaming value added / GDP	Share of gaming tourism's value added in Macao's GDP, %	DSEC
GGR / GDP	Ratio of gross gaming revenue to Macao's GDP	DSEC
LN (GGR)	Ln value of gross gaming revenue	DSEC
Loan /deposit ratio	Ratio of bank loans to deposits for residents and non-residents, %	DSEC
Banking sector /GDP	Share of banks' value added in Macao's GDP，%	DSEC
Financial development index	Indexes calculated by International Monetary Fund	IMF
Non-performing loan ratio	Share of nonperforming loans in total loans，%	DSEC
LN (GDP per capita)	Ln value of GDP per capita in Macao	DSEC
LN (GDP)	Ln value of GDP in Macao	DSEC
Reserves / assets	Ratio of bank reserves to bank assets，%	AMCM
Lerner index	Indexes computed by Federal Reserve Bank of St. Louis	Federal Reserve Bank

2.5 The first-stage estimation of efficiency levels

If appropriate variables are selected along with suitable methodologies, bank efficiency can be expected to be assessed with precision. It is thus important to choose a right set of input and output variables for banking sectors in Macao. Two approaches are widely used in the literature to measure banking services: one is the *production* approach (taking deposits and making loans are viewed as bank services or outputs provided for customers), and the other is the *intermediation* approach (deposits as an input are taken by banks as intermediaries to make loans as outputs besides other earning assets). While there is no controversy over the use of fixed assets and employees as main inputs, both these approaches treat the status of deposits as an input or an output in differing manners. A *third* approach to banking efficiency arises in the recent literature by modeling deposits *D* as an intermediate product in a two-stage DEA or SFA framework, with *D* regarded as the output from stage 1 yet an input to stage 2 (Ashrafi et al., 2011; Holod & Lewis, 2011).

We will not follow any of these approaches, but rather design a new approach to Macao's banking efficiency assessment. We still use fixed assets, personnel costs and deposits as the input variables as widely used in the empirical literature on banking efficiency, but instead utilize Macao's data on the "operating results" as the most informative output variable. Doing so has certain conceptual or sampling advantages and is most suitable for Macao. Summary statistics of our input and output variables are given in Table 2.4 with no further explanation since they are self-evident.

	Variable	Obs.	Mean	Median	St. Dev.	Max	Min
Inputs	Fixed assets	92	5195.47	3284.67	3172.51	10321.32	1930.65
	Personnel costs	92	1551.04	1082.58	1288.51	5283.71	191.26
	Deposits	92	339328.98	269001.47	217800.69	697425.22	79092.18
Outputs	Operating results	92	4821.61	3267.45	4705.35	16966.45	146.61

Notes: Values are measured in million MOP.

Table 2. 4: Summary statistics of input and output variables

Our scores of Macao bank efficiency are obtained from a simplified version of Eq.(1). As done in Naceur et al. (2011) for other economies, these scores are averaged for all banks in each year of the sample period. The evolution of efficiency score over time is depicted in Figure 2.1, whose interpretation is briefly given below.

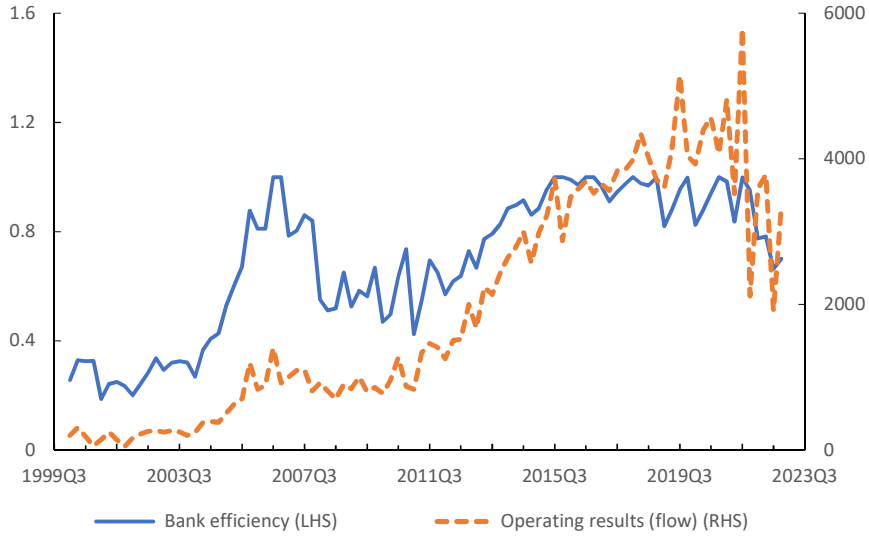

Figure 2. 1: Bank efficiency scores and operating results in Macao

Plotted in Figure 2.1 are the annual average efficiency scores for all sampled banks in Macao along with its banking operating results. Four observations can be made from those scores. First, Macao's bank efficiency scores move closely in line with its bank operating results over time in the long term (that spans 20 years). Such co-movements imply that our scientific assessment of bank performance is consistent with the traditional accounting index (i.e., net income or profit).

Second, Macao's bank efficiency in early years before 2004 (=0.28) fell behind the lower bound of the developed-economies range of 55-95% (Naceur et al., 2011). This situation has greatly been improved ever since. The average efficiency of Macao banks was 0.78 in 2004-2022 and 0.81 in 2006-2022. This index of banking performance even reached a very high level of 0.94 in 2014-2021 before Macao was badly hit by the complete lockdown during the peak of Covid19 crisis.

Third, there is a clear trending improvement in Macao's bank efficiency during 2000-2021, albeit with some fluctuations. In 2006, Macao banks experienced year-on-year annual growth in assets by 26.5%, in deposits by 24.2%, and in loans by 17.1%, with the capital adequacy ratio rising to 14.7% well above the Basel Accord's requirement. In 2012-2016, Macao bank efficiency

increased sharply due to dramatic capital inflows under political stability in Macao as well as under a currency depreciation and an anticorruption campaign in Inland China.

Fourth, Macao's bank efficiency score, albeit fluctuating and declining in 2020-2022, still reached an average level of 0.86 during this period of the pandemic crisis that had a catastrophic effect on casino tourism. People were not allowed to move in person during the lockdown but money could flow via digital finance. Modern finance is so resilient that it should be fostered and developed in Macao to promote its economic diversification.

2.6 The second-stage regression for efficiency determinants

In this section, Macao's bank efficiency (as depicted in Figure 2.1) is regressed on its potential determinants that include economy-wide, industrial /market-level, and bank-specific factors. Two types of regressions are run on the basis of Eq.(2) via the OLS and Tobit estimators commonly used in the DEA literature. Various model specifications are used to examine the robustness of estimation results. The regressors used to detect the impacts of environmental factors on bank efficiencies are listed in Table 2.5, with a brief interpretation given below.

Variable	Obs.	Mean	Std. dev.	Min	Max
Bank efficiency	92	0.69	0.26	0.19	1.00
M2 / GDP	92	6.35	3.29	3.51	19.40
Banking sector / GDP	92	5.70	3.12	2.92	15.40
Loan /deposit ratio	92	68.15	23.31	33.00	103.70
Financial development	92	0.39	0.06	0.31	0.49
Local private credit / GDP	92	3.88	3.24	1.42	15.20
Interest rate differences	65	-2.25	1.91	-6.10	2.61
LN (Bank professionals. Imported workers)	78	4.76	0.55	3.33	5.80
LN (Other incomes)	91	6.86	0.75	4.76	7.82
LN (GDP per capita)	92	4.43	0.59	3.34	5.26
LN (GDP)	92	10.75	0.73	9.44	11.69
Reserves / assets	92	1.75	0.51	1.22	3.98
Assets / GDP	92	15.68	13.76	7.05	67.58
LN (Assets)	92	13.29	1.02	11.83	14.80
Lerner index	92	0.32	0.05	0.22	0.38
Nonperforming loan ratio	92	4.25	7.65	0.09	24.30
FDI in banking sector	80	0.20	0.20	-0.09	0.97
Gaming value added / GDP	88	0.46	0.11	0.21	0.63
GGR / GDP	80	0.62	0.20	0.09	0.94
LN (GGR)	80	10.37	0.88	8.11	11.54

Table 2. 5: Summary statistics of bank efficiency determinants

Table 2.5 reports descriptive statistics of bank efficiency scores and efficiency determinant variables, with six points of interest worth mentioning and with other points omitted due to space limitation. First, the mean value of Macao's efficiency scores is 0.69 and reaches the middle level of the developed-economies range of bank efficiencies (55-95%). More recent bank performance has become even better, and this provides a solid base for Macao to foster and develop modern finance.

Second, there is much room for Macao to progress along this direction since the mean value of its banking share in GDP is only 5.70%. By contrast, the financial sector remains one of Hong Kong's most important economic pillars, accounting for 21.3% of its GDP in 2021.

Third, the mean value of Macao's loan-to-deposit ratio (LDR) is 68.15%, whereas the ideal LDR is between 80% and 90%. If this ratio is too high, the bank may not have enough liquidity to cover any unforeseen withdrawals. Conversely, if the ratio is too low, the bank may not be earning as much as it could be. Macao's LDR was very low previously but lifted up substantially later on with housing bubbles, and it still remains to be further lifted to a high enough level.

Fourth, Macao is a small SAR in China with only 0.69 million residents, and there is a shortage of banking professionals. The data Min is 3.33, meaning that the number of net migrant financial workers is positive (immigrants >> emigrants).

Fifth, banks make most of their money from taking deposits at lower interest rates and making loans at higher interest rates while treating non-interest income as a strategic activity off their balance sheets. When difficult to profit from the spread of loan and deposit interest rates, banks often rely on non-interest income to maintain their profit margins. The higher is a bank's ability to dial up non-interest income, the better it will be able to weather adverse economic conditions. The value of mean over standard deviation is as high as 9.15 for other incomes, indicating that Macao banks did well in treating this off-balance-sheet activity as a good strategic item in their income statement.

Sixth, the local currency, *pataca* de Macau, is anchored by the Hong Kong dollar that in turn is linked to the US dollar, so interest rates move together in the three regions. However, the interest rates differ between Macao and Shanghai since China maintains an independent monetary system, independent of the U.S. Fed. Such interest rate differences affect both the exchange rate of *pataca* relative to RMB (Inland China's currency) and capital flows across Macao-Zhuhai borders. The mean value of interest rate differences is negative at -2.25 but the data Max is

positive at 2.61, suggesting that relative changes in the interest rate are somewhat volatile. Previously, China adopted high interest rates when the U.S. followed a long-run quantitative-easing (QE) policy; but currently, China has changed to low interest rates while the US is still sticking to its aggressive policy of high interest rates after abandoning its QE. It is inevitable for Macao's banking sector to be affected directly and deeply by different monetary policies of the two economic superpowers via resultant changes in interest rates and in capital in- & out- flows.

Note that some of the regressors listed in Table 2.5, such as M2/GDP, financial development, etc., are not included in any regressions presented below because they are statistically insignificant or even distort estimation results for other regressors. Unfortunately, the regressions are not run for the whole sample period that has 92 observations due to missing data of some variables, inconsistent values of some data, and distorted impacts of the pandemic crisis.

Table 2. 6: OLS estimation results for Macao's bank efficiency in 2000-2020

Variable	Reg1	Reg2	Reg3	Reg4	Reg5	Reg6	Reg7	Reg8	Reg9	Reg10
Interest rate differences	0.024*	0.027**	0.031**		0.023***		0.032***		0.028**	0.039***
	(1.92)	(2.06)	(2.32)		(2.72)		(2.72)		(2.44)	(3.42)
LN (Bank other incomes)		0.080**	0.076**				0.099***		0.102***	0.100***
		(2.24)	(2.19)				(3.36)		(3.19)	(3.32)
LN (Imported bank professionals)	0.143***	0.184***	0.137**							
	(2.95)	(2.87)	(2.23)							
FDI in banking sector	0.143***	0.165***	0.145***	0.163***	0.110***	0.193***	0.154***	0.175***	0.115***	
	(3.49)	(3.66)	(3.22)	(3.98)	(2.69)	(4.52)	(3.46)	(4.49)	(2.71)	
Gaming value added/GDP in Reg (4,5,9) GGR/GDP in Reg8				-0.396***	-1.068***			-0.344***	-0.475***	
				(-2.91)	(-8.40)			(-3.28)	(-2.92)	
Loan /deposit ratio				0.003***		0.002**		0.003***		
				(3.65)		(2.34)		(3.66)		
Banking sector / GDP						0.019***	0.019***			0.016**
						(2.78)	(2.92)			(2.25)
Nonperforming loan ratio				-0.028***		-0.028***	-0.284***	-0.035***	-0.323***	-0.215**
				(-10.27)		(-10.30)	(-3.38)	(-8.68)	(-3.74)	(-2.22)
LN (GDP) in Reg (1,3,5), LN (GDP per capita) in Reg (2,10)	0.239***	0.228***	0.222***		0.383***					0.221***
	(4.51)	(3.77)	(4.26)		(10.35)					(2.75)
Reserves / assets in Reg (1,4,6,8) Lerner index in Reg5	-0.082***			-0.107***	-0.644*	-0.110***		-0.086***		
	(-3.07)			(-3.60)	(-1.69)	(-3.57)		(-2.79)		
Constant	-2.381***	-1.723***	-2.852***	0.942***	-2.701***	0.712***	0.136	0.938***	0.467	-0.882**
	(-3.62)	(-4.72)	(-4.92)	(8.72)	(-6.91)	(7.05)	(0.67)	(9.51)	(1.53)	(-2.20)
No. of observations	61	60	60	80	61	80	60	76	60	64
R-squared	0.586	0.529	0.559	0.723	0.735	0.723	0.506	0.680	0.506	0.526

Notes: Robust *t*-statistics are in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

The OLS regression results for Macao bank efficiency are reported in Table 2.6, with 11 interpretations given below. 1) The differences in interest rates between Macao and Inland China are found to significantly affect Macao's bank efficiency due to resulting capital flows across their borders. This result has not been established before in the banking literature, which overlooks the significant impact on bank efficiency of exchange rates and capital flows under financial integration across economies. 2) GDP and its per capita level are found to contribute greatly to bank efficiency in Macao since estimated coefficients on these covariates are significantly positive with large size. Indeed, healthy economic fundamentals are strong support for local banking efficiencies. 3) The effect of casino tourism on bank performance is surprisingly negative and substantial. This result is surprising to outsiders or non-professionals because they do not know that huge amounts of gambling money in Macao casinos circulate outside the local banking sector. Banking business is not so closely related to gaming operation as many perceive when taking a glance at the Macao economy, and our findings imply that banks and casinos in Macao are not very complementary but rather substitutable somewhat, as also evidenced by the poor performance of casinos during the pandemic and the high efficiency of banks in the meanwhile.

4) Foreign direct investment (FDI) in local banks is found to be significantly conducive to bank efficiency improvement. This result of course accords well with people's perception since the number of banks in Macao has been rising all along since 2000 (that is the starting point of our sample). 5) The more of new banks are opened in Macao, the higher will be its financial efficiency since the share of the banking sector in Macao's GDP is estimated to have a significantly positive sign. This size effect of finance in Macao is consistent with its ongoing effort to develop modern finance for economic diversification. 6) The Lerner impact of industrial concentration is estimated to be negative on bank efficiency at a marginally significant level. This estimated effect is similar to those in existing papers (Chen et al., 2005; Staub et al. 2010; Fu & Vong, 2011) and also with economic theory (showing that market power is bad for efficiency). 7) Our estimate for the coefficient of imported bank workers is statistically significant and positive in reported regressions. This result confirms a general impression that many people have on Macao's banking sector, and makes it clearer that the city needs to import financial professionals by easing its overly strict immigration policy.

8) Banks' non-interest incomes are identified to have significantly good effects on bank efficiency in Macao. Such other income allows banks to shield from the adverse impacts on their profit margins of the low interest spread between loan and deposit rates during bad times. In fact,

income diversification should be a strategic action banks can take in all times. 9) Macao's bank efficiency is found to have a significant bearing on its loan-to-deposit ratio (LDR) as expected. A higher such ratio implies a better utilization of loanable funds for more profits; there is still room for improvement by Macao since its LDR is not high enough. 10) Nonperforming loans are not a serious problem in Macao since local borrowers are really credit trustworthy. Even so, this regressor has a significant and negative effect on bank performance as expected. 11) The ratio of bank reserves to total assets exerts a negative and significant influence on bank efficiency in Macao, implying that holding too large reserves is not good for efficiency. The choice of this ratio is equivalent to making a trade-off between keeping enough liquidity and making high profits. There is no study in the literature to examine the effect of bank reserves as a key indicator of liquidity because many Western economies have abandoned reserve requirements. Yet, such banking regulation is still important in Macao, Inland China, and other parts of Asia.

The Tobit regression results for Macao bank efficiency are presented in Table 2.7, and their interpretations can also be listed at three levels: the macro level, the market level, and the bank level. The estimation results in Table 2.7 are quite similar to those reported in Table 2.6 in terms of sign, size, and significance, except that the Lerner index is omitted from Table 2.7 due to its statistical unimportance. Therefore, there is no need to provide further explanations for the Table 2.7 results. Yet, it is necessary to point out that this new Table can play a good role for robustness check of our results across different estimators and model specifications.

Table 2. 7: Tobit estimation results for Macao's bank efficiency in 2000-2020

Variable	Reg1	Reg2	Reg3	Reg4	Reg5	Reg6	Reg7	Reg8	Reg9	Reg10
Interest rate differences	0.029**	0.025**		0.039***	0.036***	0.033***		0.034**		0.041***
	(2.38)	(2.10)		(3.22)	(2.67)	(2.73)		(2.42)		(3.18)
LN (Bank other incomes)	0.096*			0.113***		0.091*		0.107**		0.113**
	(1.83)			(2.90)		(1.80)		(2.20)		(2.45)
LN (Imported bank professionals)	0.179***	0.146***	0.141***			0.132**				
	(2.95)	(2.96)	(3.08)			(2.22)				
FDI in banking sector	0.213**	0.188**	0.181**		0.169*	0.191**	0.220**	0.222**	0.238***	
	(2.41)	(2.30)	(2.04)		(1.94)	(2.22)	(2.56)	(2.37)	(2.77)	
LN (GGR) in Reg4, Gaming value added/GDP in Reg7, GGR/GDP in Reg9				-0.236***			-0.461**		-0.387***	
				(-3.84)			(-2.51)		(-3.43)	
Loan /deposit ratio					0.004***		0.003***		0.003***	
					(3.31)		(3.76)		(3.76)	
Banking sector / GDP								0.021**		0.016**
								(2.60)		(2.43)
Nonperforming loan ratio			-0.015*	-0.195**			-0.029***	-0.290***	-0.036***	-0.228**
			(-1.68)	(-2.23)			(-8.43)	(-3.22)	(-6.92)	(-2.47)
LN (GDP) in Reg (2,6), LN (GDP per capita) in the other Reg's	0.231***	0.245***	0.135***	0.610***	0.178**	0.227***				0.225***
	(3.75)	(4.86)	(2.68)	(4.40)	(2.63)	(4.32)				(2.90)
Reserves / assets		-0.084**	-0.137***		-0.123***		-0.106***		-0.083**	
		(-2.39)	(-3.88)		(-3.48)		(-2.88)		(-2.28)	
Constant	-1.821***	-2.460***	-0.284	-0.221	-0.061	-2.974***	0.969***	0.073	0.957***	-0.980**
	(-4.76)	(-4.48)	(-0.98)	(-0.47)	(-0.22)	(-5.31)	(9.99)	(0.22)	(11.20)	(-2.13)
No. of observations	60	61	74	64	61	60	80	60	76	64

Notes: *t*-Statistics are in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

2.7 Conclusion

Our work examines Macao's bank performance and its potential determinants over a long period of time (2000-2022). In the first-stage analysis of this work, we resort to the DEA model to assess bank efficiency in Macao with three main observations. First, its bank efficiency had been quite low at 0.28 in early years prior to 2004 but has increased to a high level afterwards at 0.78 on average. This efficiency level (2004-2022) places Macao in a middle position of the developed-economies range of bank efficiencies (55-95%). Second, Macao's bank efficiency experienced a long-term trending rise over the entire sample period (2000-2022) even with certain wild fluctuations. This long period witnesses two episodes of sharp rise in bank performance for some reasons related to external factors from Mainland China: one was in 2004-2006 and the other was in 2012-2015. Additionally, Macao's bank efficiency attained a very high level of 0.94 in the recent period of 2014-2021, and even rose above 0.95 in 21 quarters out of total number 92 (i.e., 23% of the sample period to exceed the highest level of developed economies). Third, Macao banks reached an efficiency level of 0.86 even during the period of pandemic crisis (2020-2022). The commercial banks in Macao have exhibited their extraordinary resilience as opposed to its casino tourism that plummeted like a freefall during the pandemic.

Our second-stage analysis reveals the real determinants of bank efficiencies in Macao. Regressions are run for efficiency scores based on different estimators and on numerous model specifications to check for estimates' robustness. Three levels of covariates are used in regression to detect the driving forces behind bank efficiencies. First, at the macro level, our results show that technical efficiency in Macao's banking sector moves strongly in line with GDP growth, average income, and the interest rate spread whose variation governs the movement of exchange rates and the direction/intensity of capital flows across borders. Surprisingly, Macao casino gaming is found to have no complementary role for bank efficiency due to the fact that huge amounts of gambling money circulate outside its banking sector. Second, at the market level, our results indicate that bank performance in Macao is significantly and positively related to FDI in its financial sector, to the size of this sector relative to the local economy, and to the number of immigrating financial professionals. As anticipated from economic theory, market decentralization is good for banking efficiency. Third, at the bank level, our results suggest that high levels of income diversification (other income) and fund utilization (LDR) contribute to bank efficiency in Macao while bank reserves (for enough liquidity) and nonperforming loans (representing asset losses) can be bad for its financial performance.

Our findings can be utilized to induce changes in production environment and design programs for performance improvement in Macao finance, and this line of thinking may be a good topic in future

research. As a concluding remark in the end, it is worthwhile to point out that the present level of financial efficiency in Macao is sufficiently high that it can confidently develop modern finance, such as security markets and universal banks. We are optimistic about prospects of Macao financial development with a reason beyond its high level of current bank efficiency. The reason is that Macao can now extend its financial business into the Hengqin Deep Cooperation Zone that is in turn connected to the well-developed yet still-growing Greater Bay Area. Furthermore, Macao's development of modern finance has won strong support from the Chinese central government in Beijing. Presumably, a tiny city can do great things. Two decades ago, nobody could imagine that Macao would soon surpass Las Vegas to become the world's largest casino resort in revenue terms; nowadays, not many can believe that Macao will eventually succeed once again to become an influential international finance center even faced with adjacent competition from Hong Kong and Shen Zhen. Then, wait and see!

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Chapter 3: Establishing a neutral and independent system in Macao as a substitute for the SWIFT in Brussels

ABSTRACT

The SWIFT dominated by the U.S. and the West has increasingly become a political tool used to impose economic sanctions against other countries. Such misuse of the SWIFT disrupts normal activities of international trade, investment, and finance among affected countries, with the world economy adversely affected as well. It is therefore essential for Asia to set up a society /system for cross-border interbank financial telecommunications (SCBIFT) as a substitute for the SWIFT. This new system should be politically neutral and operationally independent to ensure financial security and defend economic growth for all participating countries in the region and beyond. This chapter provides a detailed analysis for the necessity and feasibility of founding the SCBIFT in Macao SAR, and explores what early actions should be taken to establish this system. We believe that such establishment in Macao may serve as one of new engines for its economic growth amid its industrial diversification, and can also foster its erection of offshore finance center in the adjacent Hengqin Island. This attempt, if successful, will be helpful for the development of the Guangdong-Hong Kong-Macao Greater Bay Area (GBA) and for the fulfillment of the Belt & Road Initiatives.

Keywords: SWIFT, SCBIFT, substitution, importance, necessity, feasibility, neutrality, independence, modern finance, offshore finance, economic diversification.

3.1 Introduction

Financial security is an important part of economic safety for a country and a fundamental condition for its growth and stability. On February 27, 2022, however, the US, the EU, the UK, Canada, and other Western countries issued a joint statement for the SWIFT to ban against some Russian banks, where the SWIFT refers to the Society for Worldwide Interbank Financial Telecommunications. Those banks are the 10 largest ones in the Russian financial sector, and their assets combined account for 80% of the sector's total assets. Their removal from the SWIFT is equivalent to dropping a "financial nuclear bomb" onto Russia. The West deviates from the neutral status and independent operation that the SWIFT should have maintained. With such political weaponization of the SWIFT used for economic sanctions against other countries, international rules and orders have been violated and disturbed. Faced with this enormous risk, China and Global South countries should take precautionary measures to defend their financial safety and economic stability from severe disruption caused by the misuse of SWIFT.

As a highly open small economy relying heavily on a single sector (i.e., inbound gambling tourism) for economic growth, Macao is vulnerable to external shocks such as macroeconomic policy shifts and sudden event eruptions. In particular, the Covid-19 Pandemic during 2020-2022 exerted a massive bad impact on all aspects of the local economy after tourist arrivals had been substantially reduced. For example, Macao's GDP was lowered by 54.2% in 2020 as compared to its level in 2019. Macao's experiences with the three-year pandemic make clear that it is necessary and urgent to diversify its economy and seek out multiple industries for balanced growth.

Developing a modern finance sector can effectively promote Macao's economic diversity and balanced growth, as believed by many after the many-year discussion. As a matter of fact, its banking performance was least affected during the three-year devastating pandemic. In November 2015, the policy address of Macao SAR government proposed, for the first time, that featured finance (a financial sector with special characteristics) be fostered by making use of the SAR's related advantages, where the SAR refers to special administration region. In February 2019, the Chinese central government in Beijing approved an official document on the guidelines of developing the Guangdong-Hong Kong-Macao Greater Bay Area (GBA), stipulating that Macao should be developed into a global center for leisure tourism, a service platform for commerce and trade among China and Portuguese-speaking countries, and a cooperation base for multicultural exchange among international partners. This document also supported Macao's effort to develop featured finance, especially in lease financing. In September 2021, the central government approved another official document regarding the Guangdong-Macao deep cooperation zone (DCZ) to be built in Hengqin Island adjacent to the SAR, further emphasizing the importance of developing Macao's modern finance sector. This sector was listed as one of the four

development targets in the 2023 policy address of Macao SAR government. The current businesses in this sector include: bond markets, wealth management, finance lease, Renminbi offshore settlements, private equity funds, green finance etc., where the Renminbi (RMB) is also called the Chinese yuan (CNY). We believe that an immune-to-politics substitute for SWIFT set up in Macao and dominated by Asia can bring about a significant breakthrough in developing the SAR's modern finance. Developing such a politically independent and mutually beneficial system /society for cross-border interbank financial telecommunications (SCBIFT) will surely be good for Macao's economic diversification and also conducive to its forming of an offshore finance center that can serve China, Asia, and even the entire world. Our study of this issue will be unfolding below in this chapter.

3.2 The importance of setting up the SCBIFT dominated by Asia

Some people may think it unnecessary to set up an SCBIFT similar to the SWIFT because China has established a Cross-border Interbank Payment System called the CIPS. It is worthwhile to clarify this issue by comparing China's CIPS and America's CHIPS that is a Clearing House Interbank Payment System. The CIPS engages in CNY Renminbi settlements while the CHIPS involves US dollar payments. More importantly, the two systems cannot replace the SWIFT but rather need to use its unique functions to complete international payments or settlements among different banks in different countries. The SWIFT provides the CIPS, the CHIPS, and other countries' similar institutions with a safe channel for financial telecommunications and a convenient platform for digital transmission. A well-functioning SWIFT system along with clearing institutions of all countries rests on (1) its neutrality and independence and on (2) their willingness to join this international system of interbank financial telecommunications.

To see different roles played by the CIPS and the SWIFT and their relationships, let us look at a hypothetical example. Suppose Tom having a RMB account in China's bank A wants to send 100 CNY to Jerry who has a RMB account in America's bank B. Both banks (called the direct participants in the process), though located in different countries, have maintained their respective accounts with the CIPS. Such a cross-border payment needs to be carried out through certain procedures. First, bank A needs to send payment information to the CIPS via the SWIFT system while subtracting 100 CNY from Tom's account. Second, the CIPS uses the SWIFT channel to send the information to bank B while subtracting this amount of money from bank A's account. Third, the CIPS adds 100 CNY to bank B's account while this bank will add the same amount to Jerry's account. All these adjustments (-, -, +, +) to the related accounts are based on the transmission and confirmation of information flows via the SWIFT (as depicted in Figure 3.1).

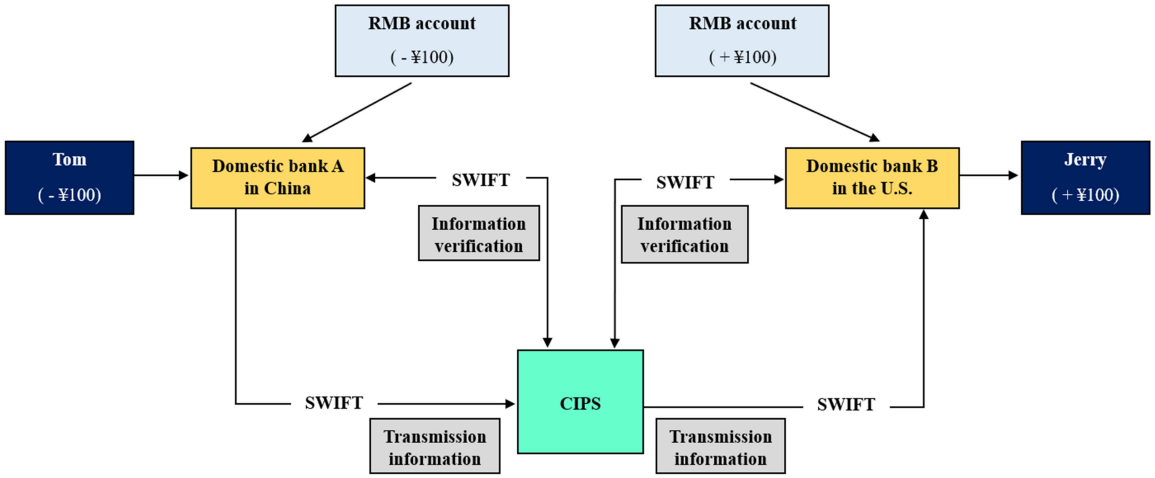


Figure 3. 1: Roles played by the CIPS and the SWIFT

In another example, suppose William has a US dollar account with bank C in China, wanting to send $100 dollars to Joseph who has a US dollar account with bank D in the US. This time, the CIPS has no role to play, but instead must be replaced by the CHIPS. If banks C and D are not connected to the SWIFT but want to complete the money transfer, they will have to act as indirect participants in this system and find some other banks that are (direct) participants in the CHIPS as well as in the SWIFT. In this process, cross-border settlements must go through more procedures, with payments slowed down inevitably. Huge amounts of transactions, payments, and settlements arise from international trade, investment, and financing at any time on every day, thereby making the SWIFT an instantly indispensable system for interbank financial tele-communications among various countries all over the world.

We see from the above examples that the SWIFT and the CIPS play different roles in international transactions, payments, and settlements. The CIPS undertakes the settlements of international transactions while the SWIFT is responsible for financial information transmission required for cross-border payments. Although a module for interbank telecommunications is incidentally installed when erecting the CIPS, this device has not been effectively utilized or further developed. In fact, the CIPS and the SWIFT are parallel and complementary to each other in the course of cross-border RMB settlements. At present, many indirect participants can be connected to the CIPS only via the SWIFT in order to have settlements completed. In the meanwhile, the SWIFT as a telecommunications system can play its role of information network only via various settlement /clearing institutions like the CIPS.

The CIPS is unlikely and unable to replace the SWIFT at the moment because of different functions that they have. What is more, the SWIFT is not substitutable in the short run since it has developed into a global network over the past half century for information exchange among all banking institutions in this world's financial mainstreams. The question then is whether or not this system can be used in a safe and fair manner. The problem is that no one can answer this question given the SWIFT sanctions befalling Iran, Russia, and other countries. We hold that it is not an issue but a must for setting up an Asia-dominated, grand new system of cross-border interbank financial telecommunications. This task is crucially important for China and the rest of Asia to get well prepared for all prospects of international trade and finance, whether they are good or bad. Three points will be made below to show the importance of founding an SCBIFT in Asia.

Firstly, nobody knows how likely the SWIFT is to be used in the future as a "financial nuclear bomb" to attack China, given the fact that the US-Russia relation is getting worse, that the US-China relation has no hope to return to normal, and that the EU-China relation becomes more complicated. The SWIFT once boasted of its political neutrality as a global cooperative for interbank financial telecommunications by saying that it was privately owned by all shareholders. It has 25 shareholders with voting power, but it is actually controlled by the US because it gives 2 shares to the US, 19 shares to NATO members, and 3 shares to Japan, Australia, and Singapore, with only one share allocated to China even if this country is the world's largest trader (both for merchandise exports and imports). The pro-US voting power takes up 19 out of 25 within the SWIFT, with the US acting as the chairman of the board and the EU as a CEO of this institution. Two centers for data processing and information exchange are located in the EU (Amsterdam) and the US (New York). Such institutional arrangements for the SWIFT structure and operation are totally unfair to most of other countries in the world, making it difficult, if not impossible, for the system to keep neutral and independent, but rather render it easy for the West to steal financial & trade secrets and conduct economic sanctions.

As a matter of fact, the US has developed a habit of using economic sanctions against other countries, with the SWIFT becoming one of its sanction tools. A country, if banned from the SWIFT, will be driven away from international finance markets, and faced with various disruptions in foreign trade and investment. In July 2020, the US once considered whether to remove Hong Kong (HK) from the SWIFT and delink the HK dollar from the US dollar. If this had occurred, many Chinese banks in Hong Kong would have been deprived of US dollar transactions and international settlement systems. Trade supply chains and related financing activities would have been affected very badly. Yet this action, if taken, would also have hurt the US itself badly, let alone retaliated by China.

At present, many people are deeply worried about the previous US decoupling from China even though this process has now got a new wording of de-risk. They fear unpredictable /catastrophic consequences if the US bans China from access to the SWIFT as a two-edged sword. The current situation (at the end of March 2023) is that there are 1427 participants in the CIPS for CNY transaction, only 5.54% of which are direct ones (79 banks) and 94.46% of which are indirect ones (1348 banks) that must use the SWIFT to get connected. Some direct participants in the CIPS that are located outside China still use the SWIFT to connect to the CIPS. For dollar transaction, all cross-border activities have to rely on the SWIFT and the CHIPS. As soon as China's access to the SWIFT is restricted, its foreign trade, investment, and financing will be affected immediately and severely.

Secondly, as the second largest economy in the world and the largest exporter in the global supply chain, China has engaged with all countries in trade, investment, and financing activities. As such, China is particularly in need for a safer, nimbler, and more effective system of cross-border interbank financial telecommunications. The SWIFT, albeit boasting of its own safety and reliability, has encountered network intrusions and cyber-attacks since 2015. In January 2015, unknown hackers attacked the South Bank of Ecuador and stole 12 million US dollars via the SWIFT system. At the end of 2015, the Pioneer Commercial Bank of Vietnam was hacked, yet with no harm due to no money transferred from its account. In February 2016, the central bank of Bangladesh lost 81 million US dollars in its SWIFT-related account after being attacked by skillful hackers. These cases get SWIFT security bugs exposed, and many central banks become worried about the safety of their SWIFT connections

Reasonably, China worries most about its financial safety as the world's largest trader and the SWIFT's most-frequent user. More than 500 Chinese firms in the financial and non-financial sectors have become network users of the SWIFT since it was allowed to set up offices in China in 1985. As China is opening more widely to foreign capital and as its digital finance is developing faster, the financial connection between domestic and foreign markets will be getting closer and closer while the risk transmission will be becoming quicker and quicker. Under these circumstances, there will be greater uncertainty about financial safety and trade stability if there is no reliable system for interbank financial telecommunications. Security flaws of the SWIFT can be utilized by hacking criminals, but this problem can be largely avoided if a more advanced SCBIFT is developed in Asia.

Thirdly, as an important participant in new global economic rules and orders, Asia should build its own SCBIFT. Asia should also keep its own dominance over this system for good purposes, such as

providing better public goods /services for the region and beyond, raising the regional voice in global finance, and promoting the international use of the RMB and other Asian currencies. What currencies, what settlement systems, and what kind of financial telecommunications are to be used in trade, investment, and finance? The resolution of these issues is affected by international relations and economic superpowers. Asia should get united to deal with these issues jointly. The strong dollar status is expected to fade quickly, the temporary CNY weakness is believed to vanish soon, and the huge volume of cross-border RMB transactions will continue to increase with enormous and rising trade between China and the rest of the world. The other problems that remain are that the number of direct participants in the CIPS is too small, that the supply of services by the CIPS is too low, and that the CIPS deals only with CYN transaction having no compatibility with other currencies.

If a new SCBIFT is established in Asia with comparative advantages of security, efficiency, and independency, it can possibly become a better option than the SWIFT and it will probably attract more bank customers from outside the region. The SCBIFT should strengthen connectivity partnerships with the Single Euro Payments Area (SEPA), Iran's System for Electronic Payment and Settlement (SEPAM), the China Union Pay Settlement（CUPS), the RMB Cross-border Interbank Payment System (CIPS) etc. Various function modules should be inserted in the SCBIFT to provide developing countries with needed information about financing sources and all world regions with reliable information about Asian financial products and services. It may be a long and difficult task to develop the SCBIFT into a perfect substitute for the SWIFT, yet this new system, once succeeding, will function as a strong representation for Asia on the world arena and as a reliable supporter for Global South by fixing up security defects that now appear in the SWIFT. Scale economies arising from the new system will in turn help the CIPS to bring in more financial customers and increase the usage of RMB in international trade and finance

To sum up, it is strategically important for Asia to set up a new SCBIFT and make this system politically neutral and operationally independent, given the increasingly chaotic international relations. Our proposal for this new system, if realized someday, will surely be very good for sustaining China's growth and quickening Asia's development.

3.3 The necessity for erecting the SCBIFT headquarters in Macao SAR

What is stated above is the importance of the Asia dominated SCBIFT, and what follows is to explore where the headquarters of this system should be located. On the list of location options, if in

China, are Beijing, Shanghai, Guangzhou, Shenzhen, and Hong Kong, which are all strong in finance. While Hong Kong is a well-known international finance center, the other four cities are within-border financial centers (as ranked in the Global Financial Center Index 25, GFCI25). Yet, we believe that Macao SAR is the right choice to found the SCBIFT headquarters. Subsequent discussions are devoted to the necessity for building the headquarters in Macao.

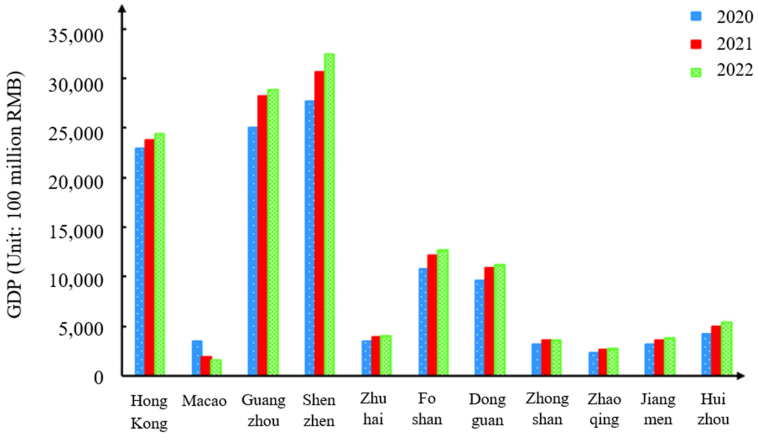
First, setting up the SCBIFT in Macao is a key measure taken to promote the SAR's economic diversification. The devastating effects of the three-year pandemic have completely unmasked its economic vulnerability of industrial structure singulation, also pushing the SAR government to choose modern finance as one of the four diversifying sectors. Currently, bond markets are selected as a starting point to develop modern finance. In August 2018, Macao began to construct a bond market platform by establishing a security trading company called the MOX and by publishing a series of rules and guidelines for financial asset trading. In 2020, Macao hired an international consulting firm to explore how to expand financial trading, and got the result that bond markets should be developed first in association with RMB offshore finance. The volume of corporate and treasury bonds issued in Macao reached MOP 409.1 billion (Macao dollar), and the Macao-Luxembourg jointly issued bond amounted to MOP 17.2 billion. The situation of bond markets is far from perfect in Macao, and its initial development relied mainly on government support from within (SAR) and outside (up-country). This arises because of imperfect market mechanisms and incomplete financial infrastructures. There is a long way to go before assets become highly liquid and their markets are widely acceptable.

> Although several infrastructures were built for operation (an instant system for payment and settlement, an electronic system for bill clearing, and a central securities depository and clearing limited company), other important facilities such as the instant system for US dollar–Macao pataca settlement have not been well established. The size of bond issuance in the Macao market is quite limited, and this market is still not very attractive to investment institutions. However, if the SCBIFT is erected in Macao, this financial infrastructure will effectively bring in many institutions for investing, financing, intermediating (by brokers /dealers), and trading. Such attractiveness can hopefully spread to inland China, Portuguese-speaking countries, and other countries along the Belt & Road. These developments will powerfully increase the depth and width of Macao's bond market, and also serve as a new engine for its economic growth and as a fresh impetus for its industrial diversification.

Second, establishing the SCBIFT in Macao is an effective breach of difficulties in prompting the development of the Guangdong-Hong Kong-Macao Greater Bay Area (GBA). This development is an

important step for China to deepen reform and widen opening, and the GBA has already become one of major engines for economic growth of China and the entire world. Yet, there are two problems with GBA development. One is that development used to be and now still is unbalanced in the sense that the economy is strong on the eastern side of the Pearl River Delta but weak on its western side. The other problem is that the distribution of industries is homogeneous across different cities in this Delta, forming an adverse situation of vicious competition.

Guangzhou is a large city with strong manufacturing and exportation trade, but many smaller cities in the surrounding area have similar economic structures. Hong Kong is good at trade, logistics, financial and productive services. Shenzhen, albeit stronger in high-tech innovations, is also good at similar businesses. For example, financial value added in Shenzhen rose at an annual rate of 11.7% in the past ten years. Macao is unique in economic growth, with its GDP per capita ranked the highest in Asia in 2014 and the second highest now (as plotted in Figure 3.2). Yet, Macao's over-reliance on casino gambling for growth is not sustainable but controversial due to its high social costs. There will be no much room for further growth in this economic sector. Nevertheless, Macao's economy can be substantially revived if the SCBIFT is built in the territory. This system will allow Macao to make better use of its freeport advantage in helping Guangzhou and its surrounding cities, especially those located on the western bank of the Pearl River, further develop export-oriented manufacturing. Such arrangements for the staggered allocation of economic sectors are expected to promote collaborative and sustainable development at high levels in the whole GBA.



Data sources: https://research.hktdc.com/tc/article/MzYzMDE5NzQ5

Figure 3. 2: GDP and GDP per capita in cities of the GBA

Third, erecting the SCBIFT headquarters in Macao is an impelling force to strengthen its role as a financial service provider for Portuguese-speaking countries and others along the Belt and Road. In February 2019, the guidelines for GBA development issued by the central government made it clear to develop Macao into an economic entity with three characteristics: a global center for leisure tourism, a service platform for commerce /trade cooperation between China and Portuguese-speaking countries, and an international base for multi-cultural exchange and assimilation. In particular, such official guidelines stipulate that actions should be taken to support Macao as a key provider of financial services for Portuguese-speaking countries, as a settlement center for RMB transactions with these countries, and as a major mediator for financial cooperation between China and these countries. However, no great progress has been made so far, for not many successful projects in this aspect were facilitated via Macao in the past few years. The territory has yet to fulfill its missions by importing professional talents, strengthening information exchange, and improving financial infrastructures.

If the SCBIFT is founded in Macao, it can really play its role of a service platform for Portuguese-speaking countries. Interbank financial telecommunications will offer a new direction for promising business with these countries. Recently, the Macao Monetary Authority has contacted its counterparties of Portugal, Mozambique, East Timor, Sao Tome and Principe, Cabo Verde, and Western African countries to sign a memorandum of cooperation and to widen channels for cooperation with them. The SCBIFT, if settling down in Macao, will become a new handle of which it can take advantage to provide various countries with more opportunities for economic cooperation with China. Furthermore, the push for the Belt & Road Initiatives will be generating the rising demand for and supply of trade transactions and financial settlements. Cross-border interbank financial communications will become increasingly important for all participating economies. Macao can make full use of the SCBIFT as a good substitute for the SWIFT and get Portuguese-speaking countries involved more deeply in the Initiatives-induced opportunities for economic growth.

3.4 The feasibility of setting up a substitute system for the SWIFT

Having the SCBIFT founded in Macao is helpful for promoting its economic growth, the GBA development, and the Belt & Road construction, as discussed above. On the other hand, we will show that Macao has various advantages over many other alternatives to erect the headquarters of this system. Five points are made below for the feasibility of building the system in Macao.

First, Macao possesses the ideal condition of political neutrality for setting up an independent SCBIFT. Recall that the SWIFT originated from the fear about the monopolistic use of cross-border interbank telecommunications, with neutrality formerly embodied in its gene. Telex networks had been

used for tele-communications between banks across borders before the SWIFT came into being. Such networks could not satisfy a rapidly rising demand for financial information business, so the First National Bank of America in New York proposed a new system called the MRTI (Machine Readable Telegraphic Input, done later by Citibank). However, this financial IT innovation aroused competitors' worry about a likely monopoly by the MRTI and a possible manipulation by the government. As such, some European banks collaborated with their American counterparties to avoid this situation by establishing the SWIFT in 1973. To ensure neutrality, the headquarters of this society were erected in a small European country called Belgium, far away from New York and London. To keep its management independent, the institutional arrangement for the SWIFT was designed to steer clear of potential control by a single group or government, with its data centers located in several de-centered places in Europe and the US.

Unfortunately, the initial tradition of the SWIFT was broken under the 911-terrism attack in 2001; from then on, the entire world has witnessed the reluctant cooperation of the SWIFT with the US government. Gene mutations of the SWIFT over the recent two decades have been alternations in its use not for financial but for geo-political purposes by the US and the West against other nations. In 2012, the US Senate further enacted a law to formally weaponize the SWIFT that has been no longer neutral or independent ever since and will never be so forever. The main purpose of setting up a new SCBIFT is to counter the SWIFT's operational monopoly and political manipulation and to restore /revitalize the neutrality and independency of worldwide financial information networks.

Four inland Chinese cities BSGS (i.e., Beijing, Shanghai, Guangzhou, Shenzhen) are more mature than Macao in financial sectors, capital markets, and IT technologies. However, they are perceived as being unable to house a neutral or independent SCBIFT because of the widespread prejudice that their market economies are subject to government interventions.[16] Hong Kong is a well-known freeport with a well-developed financial system, yet violent political movements took place many times in this city in the past years, with such "color revolution" supported and manipulated by some anti-China clout from the US. Hong Kong has thus become a hotbed of geo-political trouble. If a SCBIFT were located in Hong Kong, it would be susceptible to political interventions from the UK and the US. Fortunately, Macao is under no such pressure even though it is an SAR of China as well.

[16] As a matter of fact, the US and other Western countries have interfered more with market behavior and economic activity than does China, especially in trade and investment across borders. On the one hand, they abuse the concept of national security and make it suffused with all economic relations with China. On the other hand, their fake news (joked frequently by former US President Donald Trump) has persistently boasted of their economies as free markets while their propaganda has long demonized China in a systematic way. In fact, the US government is the greatest propaganda of disinformation in the history of the world, as mentioned by US Senator Rand Paul in May, 2022. Contrary to their demonization, ironically, China is too open to foreigners under too liberal policy, as believed by many observers. For example, no other countries than China would allow foreign casinos to take up more than half of the market share of gambling business that is highly profitable yet with high social costs.

Macao's advantages of political neutrality are three-fold. The first advantage is that Macao is also a freeport, with its markets as free as Hong Kong's. Macao is a separate customs territory with very low tax rates, allowing free entry and free exit for commodities, funds, and people. The second advantage is that Macao was treated as a neutral zone during World War II under Portuguese colony. Macao was thus a safe haven for capital, property, and staff in that period. After its sovereignty returned to China, Macao still enjoys high independency and autonomy in politics, legislation, currency (anchored to HK$ and US$), etc., even though it is now integrated economically with inland China. The third advantage is related to the fact that two and half of Macao's six gaming licenses are granted to US casino firms that have invested a lot in the territory. The US firms have taken up more than half of the Chinese gambling market via Macao, and the US market share within China is expected to rise to 2/3 soon. The US firms have reaped such huge amounts of casino profits that the US government is not supposed to impose any severe sanctions against Macao when the territory engages in the SCBIFT business. Any trouble made by the US is likely to trouble itself in Macao；this territory has become a gaming place that is too connected to fail for the US firms.

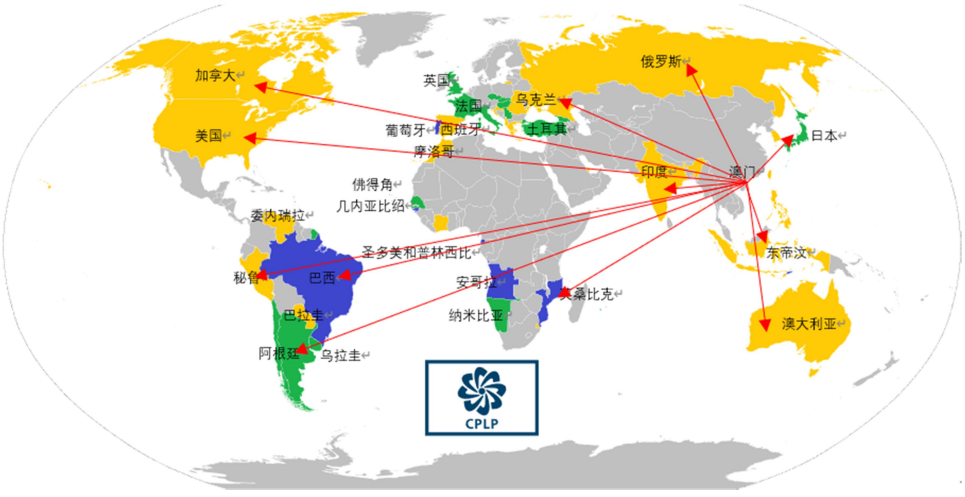
Second， Macao has great potential to attract various banks and financial institutions as its telecommunications customers. There is no technological problem for Macao to develop a substitutable system for the SWIFT since IT technologies are as well-developed in China as in the West (actually, better-developed in China than in other world regions). The only difficult point is how to quickly bring in sufficient customers from around the world. Admittedly, it is not easy to acquire a large enough customer base overnight, yet we are optimistic about the market prospect of financial information networking for Macao based on three points.

Point one is that Macao is backed up by the Guangdong-Hong Kong-Macao GBA, with the geographical advantage of access to Southeastern Asia and with traditional connections to Portuguese-speaking countries (PSCs) for more than 400 years. Specifically, within the GBA are Guangzhou that owns various manufacturing sectors and complete supply chains, Shenzhen that engages in advanced industries and technological innovations, and Hong Kong that houses headquarters of many large international banks and financial institutions. Steady trade growth led by Guangzhou with the rest of the world entails secured financial tele-communications between banks across borders. Domestic and foreign banks in Shenzhen and Hong Kong can be connected directly to China's CIPS and also treated as direct participants in Macao's SCBIFT. Additionally, Macao may proceed with the usual strategy of doing easier things earlier before moving onto harder tasks. Macao can first take advantage of its traditional connection with PSCs (as shown in Figure 3.3),

contacting Brazil, Angola, Cape Verde, Guinea-Bissau, Mozambique, Sao Tome, Principe, East Timor via the existing platform for trade & commerce cooperation between China & PSCs and inviting their banks to participate in the new system as a substitute for the SWIFT. In April 2023, Brazilian President Luiz Inacio Lula da Silva visited the headquarters of New Development Bank recently founded in Shanghai by the five BRICS countries (Brazil, Russia, India, China, South Africa), making an important appeal for the use of BRICS's currencies in cross-border payments and for the removal of US dollar hegemony from international settlements. It is really the right time for Macao to take this opportunity of de-dollarization to set up a new SCBIFT and solicit financial customers.

Point two is that Macao can take advantage of its traditional connection with Latin countries to invite Southern European countries to participate in the new system of interbank telecommunications. Historically, Macao was somewhat related to Latin nations in the aspects of language, culture, education, religion, and law; France, Italy, and Portuguese used to be Macao's major trade partners. More than half of foreign nationals living in Macao are from Latin countries. Macao branches of foreign banks are operated mostly by those who belong to the Romance language family. Macao is so unique in wide international connections that it can become a good platform to do financial information networking business with those related countries.

Point three is that with those countries as a good gangplank, Macao will be able to get access to broader markets in the entire Europe, the whole Africa, and all Latin countries. In this way, Macao's SCBIFT will grow up into an important substitute for the SWIFT, attracting more and more customers around the globe.



Data sources: https://investhere.ipim.gov.mo/zh-hans/port/?print=print

Figure 3. 3: Economic connections between Macao and Portuguese-speaking countries

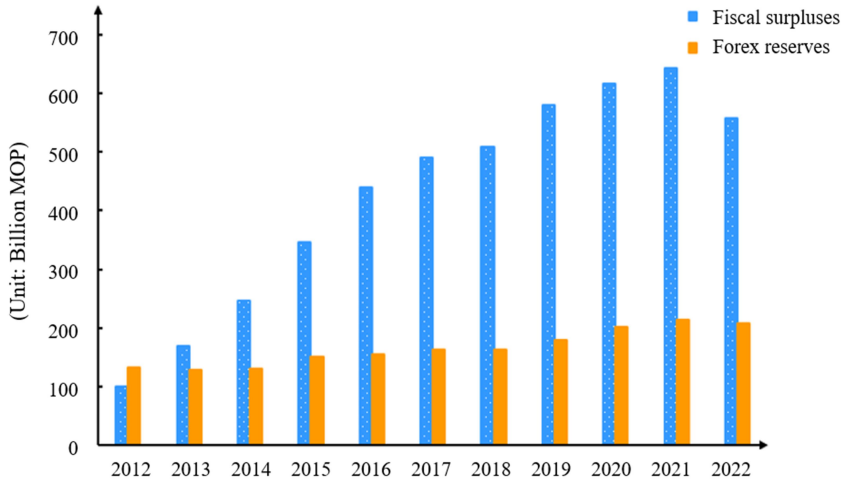
Third, Macao's development into an influential offshore finance center is presumably helpful for setting up a new framework of cross-border financial telecommunications. This framework as a substitute for the SWIFT is in essence a financial infrastructure, functioning as a nervous system for financial transactions, payments, and settlements. Yet, even a perfect infrastructure cannot play a role without participation of various banks and other financial institutions. More participations will enter the system if it is erected in a better-developed finance center. Macao, albeit small in its population (only 0.69 million) and territory (only 33 square kilometer), has great potential to grow up into a large offshore finance center for three reasons.

One reason is that Macao is a truly free economy with no capital controls. It houses 29 independent banks whose out-of-area assets and liabilities account for 62% and 46% of their respective totals at the end of 2022, according to the Macao Monetary Authority. There are no such advantages in the four inland Chinese cities BSGS. As a matter of fact, as early as in 2000, Macao was defined as one of offshore finance centers in the world by the International Monetary Fund (IMF), having as equal status as Luxembourg, Monaco, Cayman, and Hong Kong.

Another reason is that there is a large demand for financial services of which Macao can make good use to develop its offshore finance. Massive tourism inflows attracted by Macao casino gambling are accompanied by enormous money in- & out- flows. Macao's gross gaming revenue was US$ 45.2 billion in 2014 (more than 7 times as high as Las Vegas's) and US$ 36.6 billion in 2019. Although its fiscal reserves made a large loss by US$ 2.6 billion in 2022 due to the pandemic crisis and the geo-political tensions, Macao still holds ample public savings now (as the past accumulation of fiscal surpluses) amounting to US$ 69.8 billion. In addition, Macao is connected to inland China as a super vast market and to the Portuguese-speaking countries with their GDP totaling at US$ 2.4 trillion. Such economic fundamentals imply a huge demand for financing services across borders.

Yet another reason is that Macao is lucky enough to gain full support for its offshore finance development from inland Chinese governments at various levels. In its 2019 guidelines for developing the Guangdong-Hong Kong-Macao GBA, the Chinese central government made clear its support for Macao's development of the so-called featured finance. In February 2023, the Chinese central bank, Guangdong provincial government, and other inland Chinese authorities jointly issued an official document on supporting Macao's development of offshore finance in Hengqin's Macao-

Guangdong Deep Cooperation Zone. This document called for further financial interconnections of markets and infrastructures between Macao and Guangdong.



Data sources: https://www.amcm.gov.mo/zh-hant/; https://www.io.gov.mo/

Figure 3. 4: Fiscal surpluses and forex reserves in Macao

Fourth, the cost of trial and error in the course of technological innovation is lower in Macao than in other Chinese cities such as BSGS and Hong Kong. Setting up a SWIFT substitute system in Macao is of course an unprecedented project of innovation. This project may be affected by many factors some of which go beyond local control, and its success can be attained only after many-year's hard-working; even so, its potential gains to Macao presumably overwhelm its possible losses. Over the past three decades, China has transformed from a trade-oriented economy to a capital-rich country. Trade expansion prompts economic growth and capital accumulation; as a result, China has built up a huge stock of forex reserves and becomes a net credit country, now needing to invest abroad to obtain high returns. Hong Kong has benefited a lot from fast growth in the inland economy by engaging in entrepot trade and other related sectors. The resulting economic outcome for Hong Kong is the upgrading of its sectoral structure, with service sectors accounting for most of its GDP and financial services playing a major role in its service economy. As a tiny city, Macao has relied heavily on casino tourism in getting rich quick, and this

favorable situation results mainly from the policy support of inland China (whose outbound tourists take up the majority of Macao visitors who are willing to spend a lot).

> Nowadays, Hong Kong's financial service sector is faced with competitive challenges from inland cities, and Macao's polarized economic growth seems unsustainable due to high social costs associated with casino gambling. These situations require the two SARs to find new growth engines and foster new production sectors amid the economic transition and capita outflows of inland China. Modern finance features the highest value added in all economic activities and a high output-input ratio in the industry chain, and should be developed into one of core industries or one of economic pillars. We believe that setting up a SWIFT substitute system in Macao is vitally important for its development of modern finance because the cost of trial and error for this new system is low for Macao. This claim is supported by three points made below.
>
> The first point is that the population of Macao is only 1/10 of Hong Kong's and the economy of Macao is just 1/7 of Hong Kong's, so the risk and impact of Macao's financial innovations are maneuverable and controllable. The innovative activities include the fostering of security markets, offshore RMB transactions, and interbank telecommunications. The second point is that the high openness of markets and the high handiness of regulations equip Macao with a good environment for such innovations. Even though some activity does fail, the incurred cost and resultant loss are likely to be bearable to Macao. The third point is that compared with Hong Kong, Macao enjoys higher social stability and closer connections with inland Chinese society. So, any unbearable cost of innovation projects to the local authorities can easily be absorbed by supportive measures to be taken by inland governments.

Fifth, Macao has success experiences to imitate and failure lessons to learn. It sounds fanciful to do a big thing in a small town, i.e., to establish a new system in Macao similar to the 50-years-long SWIFT in Brussels. Yet, who could believe /imagine, 20 years ago, i.e., in 2003, that Macao would surpass Las Vegas to become the world's largest casino resort in terms of gaming revenue? Another example is Iceland that was once regarded as an economic miracle. This tiny country used to be the poorest one in Europe, previously making a living from marine fisheries. Later on, the country became a small financial empire and the top 5 richest /happiest nation in the world. Its economy, albeit hit badly by the 2008-09 global financial crisis, recovered quickly from the Great Recession. Macao is somewhat similar to Iceland in three aspects.

> Similarity one is that both these economies are very small, with the population being only 0.36 million in Iceland and 0.69 million in Macao. The two places are also short of natural resources, for

Iceland is covered by volcanics and Macao's land territory is only 33 sq km. Similarity two is that the local economy relied /rests only on a single sector: ocean fisheries in Iceland and casino gaming in Macao. Both were /are confronted with a quite difficult task: economic diversification. Similarity three is that the financial sector initially was very weak. There was no capital market in this sector, and there were some commercial banks and insurance companies with only small scales. Iceland's transition to finance-led economic growth was quite remarkable, enjoying a resounding success initially for more than ten years.

Later, the financial crash in Island was due to mainly its excessive purchase of toxic US subprime mortgage securities, its overreaching itself into European capital markets, and its officials' & civilians' overspending sprees. Macao differs significantly from Iceland in four socio-economic and connectivity aspects.

The first difference is that the Macao SAR government maintains no budget deficits but rather has affluent fiscal surpluses. The second difference is that Macao has accumulated a large enough stock of forex reserves that it can deal easily with external shocks with no risk of being caught in a financial crisis. The third difference is that Macao is well endowed with massive inbound gambling visitors to its casinos and advanced manufacturing exportation from the GBA to the rest of the world, so that there will be no risk of over-financialization facing Macao. The fourth difference is that Macao is an SAR backed up by the Chinese central government and supported by the inland Chinese society. All these differences also represent Iceland's defects, not just Macao's advantages. Even Iceland can achieve a big success in financial development, let alone Macao. We believe that so long as regulation and supervision are appropriate while government support is strong, Macao's SWIFT substitute system along with its offshore finance center will become a new success story and a new business card.

3.5 Three early measures taken to build a substitute for the SWIFT

To build a substitute system for the SWIFT and an offshore finance center in Macao, certain measures should be taken at the early stages to make up for the territory's short-board weaknesses while bringing into play its comparative advantages. These measures are proposed below to enhance Macao's competitiveness in financial markets and to expand its influences on the world arena.

First, Macao needs to seek out domestic and foreign support from all possible sources in its attempt to foster the offshore finance center and to found the Asia-dominated SCBIFT. Setting up a new system as a competitive substitute for the SWIFT cannot be done without support from the government of a large

country with economic superpower (whose credibility is a necessary endorsement and a strong backup for international affairs).

The Macao SAR government may as well contact the central government in Beijing directly and send out a formal SCBIFT proposal to all its relevant ministries /departments. The proposal should be amended after receiving responses from these ministries, and also sent to the Beijing top authorities for official approval. Then, Macao may consider inviting Asian Infrastructure Investment Bank (led by China), China National Development Bank (a state-owned firm), and New Development Bank (owned by the BRICS countries) to join the process of setting up the SCBIFT. Next, Macao can use part of its ample public savings and establish a large sovereign wealth fund in charge of all affairs related to founding the SCBIFT. Macao need to promote this matter by contacting foreign invested banks and Chinese owned banks in Macao and the GBA, and financial institutions in Portuguese-speaking countries and other nations along the Belt & Road.

Macao must make the SWIFT substitute system more advanced with broader coverage of services provided for international customers. This system should be made more open, more convenient, and even safer by connecting to various financial infrastructures at home and abroad. Additionally, Macao's collaboration with Guangdong in the Hengqin deep cooperation zone can make good use of Guangdong's innovation capabilities and Macao's freeport advantages. The establishment of SCBIFT will enhance, and can even amplify, these advantageous conditions in the development of The Macao offshore finance center. Macao's currency, *pataca*, is now linked directly to the Hong Kong *dollar* and indirectly to the US *dollar*. Macao may consider undertaking some necessary financial reforms, such as changing its monetary anchor to the European Union's currency, *euro*, to facilitate its founding of the SCBIFT and to Mainland China's currency, *CNY*, in the future. Given its low costs of trial and error, Macao should have the courage to dock with the national development strategies via the SWIFT substitute system, which may allow Macao to obtain new advantages and can let this system play a new role in China's further development.

Second, since the development of modern finance and the SWIFT substitute system is inseparable from devoted efforts by high-level professionals specialized in finance and IT, there is an urgent need for Macao SAR government to make perfect its plan for introducing talents from outside and training the local elite via higher education. The financial customer base of Macao involves inland China, Portuguese-speaking countries, and many other countries along the Belt & Road. Macao personnel have to be familiar with politics, law, economy, finance, IT, markets in the targeted countries.

However, there is a shortage of such personnel in terms of their quantity and quality in Macao. According to "the 2020-2022 Research Report on the Macao Demand for Financial Professionals" by the Macao Committee for Talents Introduction, the size of Macao financial personnel is too small since the share of those people in total employment is only 3%, Macao lacks skilled finance professionals and high-level management talents since most of its finance personnel are those who can only sell financial products and services, and the training and education levels of those personnel are not high enough since only 49.7% of them have received university/college education and few of them were educated at an academic level above the undergraduate /bachelor degree.

On May 18, 2023, the Macao SAR government enacted a new law for "the Introduction of Talents", stipulating that for promoting the economic diversity, it is essential to introduce high-end human resources into key industries, and it is also important to preserve various talents required for sustainable socio-economic development. Modern finance has been included in the set of key industries, but concrete procedures and guidelines remain to be worked out. While importing high-level professionals, Macao need to strengthen its training of local personnel in finance and IT and its support for higher education in these two fields. Enough human resources with high talents should be preserved for the long-term development of modern finance and the SWIFT substitute system.

Third, Macao need to do more in the aspects of law and orders, regulation and rules, surveillance and supervisions, and other (software and hardware) infrastructures as supporting facilities for modern finance and the SWIFT substitute system. Much of the current Macao legislative practice comes from the continental /civil law system adopted also by Portugal, German, Austria, Japan etc. By contrast, the Anglo-Saxon /common law system prevails in the UK, the US, and Australia. Market-dominated financial systems merge under the common law system, with New York and London growing into global finance centers; whereas, bank-based financial systems arise under the continental law system, with Paris, Frankfurt, Tokyo functioning as regional finance centers. Clearly, the existing legal system in Macao has certain limitations to the development of asset exchanges, capital markets, offshore finance, and the SCBIFT. In particular, the operation of an infrastructure system similar to the SWIFT requires a special legal framework and regulatory mechanism to ensure its security, compliance, and transparency.

Nowadays international relations between large countries have become more complicated and unpredictable, with the SWIFT frequently used as a geo-political weapon. Macao need to pay attention to various risks associated with such international environment when conducting financial innovation and regulation in the development of the SWIFT substitute system. When making perfect its regulation and supervision, Macao should keep in touch with the Hong Kong Monetary Authority

and the central banks of mainland China and Portuguese-speaking countries. These regional /international coordination and cooperation must be helpful for enriching the means of financial supervision in Macao and for prompting the steady growth of its modern finance.

3.6 Concluding remarks

A system for cross-border interbank financial telecommunications (SCBIFT) plays a crucially important role in foreign trade and modern finance. A well-developed such system can achieve rapid, safe, and convenient telecommunications between banks with foreign businesses, and also deliver other helpful services in financial information and professional analysis. This article analyzes the importance, necessity, and feasibility of setting up a new SCBIFT in Macao as a good substitute for the problematic SWIFT. We show that establishing this new system can become a powerful engine for Macao's economic growth and an effective impetus for its industrial diversification. This new system, if succeeding in facilitating interbank communications across borders, can also stimulate the development of Macao's offshore financial business in the Hengqin Deep Cooperation Zone, push for staggered development strategies among cities in the GBA, and get Portuguese-speaking and other countries more deeply involved in the Belt & Road Initiatives to share growth opportunities more easily. Our article, casting a brick to attract jade, is a preliminary study of the Asian substitute for the SWIFT in the hope of arousing attention from academic scholars, policy analysts, and government officials in Macao, inland China, and beyond.

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註解 [A1]: Hi Professor, there is one link expired so I look for the official information for that.

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Concluding remarks and future lines of work

Research findings

In this research, we define financial development, reviews the extent of financial development that Macao has achieved, and explores the major determinants to the financial development of Macao. Besides, we conduct an empirical analysis to firstly estimate the efficiency level of the banking sector in Macao, then investigates the determinants behind. Furthermore, when the existing Society for Worldwide Interbank Financial Telecommunications (SWIFT) system is dominated by the United States and has been increasingly used as a political tool to impose economic sanctions against other countries, we study the feasibility, importance, macro environment and policies needed to develop a Renminbi based system in Macao as a substitute for the SWIFT.

As a whole, the level of financial development in Macao has been steadily improving since 2000 with fluctuations. On the disaggregate level, Macao has obtained a better progress on the development of the financial institutions with under-developed financial markets. Meanwhile, it has a significant financial development gap, especially for the financial market when comparing with China and Hong Kong. It is found that economic, market and government supports factors, including the RGDP per capita, the size of the financial industries measured as the financial industries value added to GDP ratio, government supports indicated by the public expenditure to GDP ratio are significant and robust factors associated with financial development of Macao.

In the bank sector efficiency analyses, three main observations are obtained. First, the efficiency level of Macao had been quite low at 0.28 in early years prior to 2004 but has increased to a high level afterwards at 0.78 on average. Second, Macao's bank efficiency experienced a long-term trending rise over the entire sample period (2000-2022) even with certain wild fluctuations. It attained a very high level of 0.94 in the recent period of 2014-2021. Third, Macao banks reached an efficiency level of 0.86 even during the period of pandemic crisis (2020-2022). The commercial banks in Macao have exhibited their extraordinary resilience as opposed to its casino tourism that plummeted like a freefall during the pandemic. For the major driving forces, the regression analyses show efficiency moves in line with GDP growth, average income, and the interest rate spread. Meanwhile, Macao casino gaming is found to have no complementary role for bank efficiency. At the market level, it is significantly and positively related to FDI in financial sector, to the size of the banking sector relative to the local economy, and to the number

of imported financial professionals. At the bank level, bank efficiency is positively linked with income diversification (from non-interest income) and fund utilization. Simultaneously, bank reserves and nonperforming loans can be bad for its efficiency.

Last but not the least, we illustrate the importance of a cross-border interbank financial telecommunications system, particularly in foreign trade and modern finance. The presence of a well-developed system of such can achieve rapid, safe, and convenient telecommunications between banks with foreign businesses, and also deliver other helpful services in financial information and professional analysis. This new communication system, if successfully stablished in Macao, can also stimulate the development of the territory's offshore financial business in the Hengqin Deep Cooperation Zone, push for staggered development strategies among cities in the Greater Bay Area, and get Portuguese-speaking and other countries more deeply involved in the Belt & Road Initiatives to share growth opportunities more easily.

Policy suggestions

1. It is believed that with the strong supports from the Central Government, the Macao SAR government can do more, particularly in the aspects of laws and regulations, supply of financial professionals, attracting foreign financial institutions and investment, as well as the creation of financial products and markets to accelerate the development of modern financial services in Macao.
2. The existing legal system in Macao which comes from the continental law system has certain limitations to the development of asset exchanges, capital markets, offshore finance, and cross-border interbank financial telecommunication system. Therefore, the SAR government needs to do more in the aspects of law and orders, regulation and rules, surveillance and supervisions, and other financial infrastructures to facilitate the territory's financial development.
3. Macao needs to seek out domestic and foreign supports, particularly from the Central Government, to nurse and foster the offshore finance center and to found a cross-border interbank financial telecommunication system. Financial development in a market with very limited capacity, like Macao, cannot be done without support from the government of a large country with economic superpower, such as China.
4. The development of modern financial services is inseparable from devoted efforts by high-level professionals specialized in finance and IT. There is an urgent need for Macao SAR government to make perfect its plan for introducing talents from outside and training the local elite via higher education.

5. It is important to attract foreign financial institutions with leading positions to establish their operations in Macao. Simultaneously, it is also critical to encourage Macao's financial institutions to extend their services, particularly in the domain of modern financial services.
6. We propose to have the Macao SAR government to actively engage, to consider to establish a sovereign fund like investment management company to cooperate with financial institutions, to issue offshore Reminbi bonds and other financial products in Macao, providing high-quality investment tools to the market and giving priorities to the local and Greater Bay Area markets. Simultaneously, it is also important and essential to promote the development of the relevant secondary markets to improve the liquidity of the assets.

Future lines of work

1. When the financial markets in Macao are still underdeveloped, with a huge development gap comparing with Hong Kong and China, further studies are needed to formulate a strategic plan so as to speed up the development progress of financial markets.
2. The present level of financial efficiency in Macao is sufficiently high that it can confidently develop modern finance. A good topic in future research is to study the necessary changes in production environment and design programs for performance improvement in Macao finance.
3. We show that establishing a new cross-border interbank financial telecommunication system can become a powerful engine for Macao's economic growth and an effective impetus for its industrial diversification. Further investigate is still necessary so as to work out a more detailed blueprint for the introduction of such system.

End Notes

The research team confirms the completion of the current lines of work under IEEM's AR Grant 2022-2023 with all the research objectives fully achieved. We would like to take the chance to express our sincere gratitude to IEEM for its kind supports. We look forward to working with IEEM continuously to initiate our next lines of work to conduct a more in-depth study on the strategic planning of Macao's financial development which helps to facilitate the adequate economic diversification of the Macao economy.