Macau's sustainability and diversification

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Abstract
We analyze the socio-economic development of Macau after the return to Chinese sovereignty from the three dimensions of sustainability (economy, society, and environment). Macau's economy has both high growth and high volatility, mainly due to its unbalanced industrial structure and vulnerability to external shocks. During the COVID-19 pandemic, consumer confidence declined, due to the rising and high unemployment rate, while the environment has been relatively good since air quality became better. The overall assessment of sustainable city competitiveness of Macau has slipped gradually. This suggests that Macau's factor endowment structure has reached its upper limit and needs to be changed through internal industrial pluralism and external regional deepening (e.g., Guangdong-Macau In-Depth Cooperation Zone in Hengqin) to promote the moderately diversified and sustainable development of the economy.

Keywords Sustainability · Diversification · Macau

1 Introduction
Since Macau's return to Chinese sovereignty in 1999, its economy has developed by leaps and bounds and achieved significant social and people's livelihood improvements, driven by the tourism and leisure industry. By 2019, gross gambling revenue (GGR), Macau's pillar industry, totaled US $36.5 billion, which is about 5.5 times that of the Las Vegas market in the USA, and gaming tax revenue accounted for about 78% of local revenue. However, although the Macau SAR government and society have made various explorations and efforts over the years, Macau's economy remains little diversified. The gaming industry has been hit hard by the COVID-19 pandemic, the GGR in 2020 was Macau Pataca (MOP) 60.4 billion, down 79% from 2019. GGR in 2021 rose 44 percent to MOP 86.9 billion, but only returning to the 30% level of 2019, which highlights the importance and urgency of moderately diversified economic development to promote steady and sustainable development of Macau.

How Macau should optimize its industrial structure, adjust its industrial layout, and cooperate with the implementation of policies to promote moderate diversification of its economy and achieve long-term and sustainable development will be discussed.

2 Analytical framework
2.1 Examining Macau from the three dimensions of sustainability
Under the 17 goals set out in the 2030 Agenda for Sustainable Development adopted by all United Nations Member States in 2015, the whole world is called on to take joint action to eradicate poverty, protect the planet, and improve the lives and future of all. Sustainable development includes three dimensions: economy, society, and environment, and sustainability is the overlap of the three.

First of all, from the economic perspective, Macau's real GDP fell 2.4% in 1999, when Macau's sovereignty reverted to China, but growth soon turned positive, peaking at 26.6% in 2004. During the Global Financial Crisis growth was a mere 0.2% in 2009. Growth rebounded to 25.1% in 2010, but then fell continuously again to -21.5% in 2015. The
outbreak of COVID-19 led to a remarkable drop of 54.0% in Macau’s real GDP in 2020, followed by an 18% rebound in 2021 (Fig. 1). Among the 11 cities in the Guangdong-Hong Kong-Macau Greater Bay Area (GBA), only Hong Kong and Macau showed negative GDP growth under the pandemic’s impact, with Macau experiencing the largest decline.

Figure 1 shows that Macau’s economy is substantially more volatile than others. This may well be because Macau is essentially a micro-economy with limited resources (World Finance 2020) and an unbalanced industrial structure, dominated by the gaming industry (Fig. 2). Before the pandemic, the entropy index of Macau (Fig. 3), calculated according to the industrial structure, continued to decline, which indicates that the degree of industrial concentration was still rising. After the pandemic outbreak, Macau’s industrial concentration dropped sharply, and the entropy index rose from 1.82 to 2.24. Combined with Figs. 1 and 3, we find a positive correlation between economic growth and industrial concentration in Macau. This is because the gaming industry is the pillar industry of Macau. Essentially, cycles in the gaming industry drive both the overall economy and the degree of industrial concentration.

Even though Macau’s industry structure is not diverse enough, on the bright side, the gaming industry has entered a turning point from monopoly to competition, which is a form of market diversity. As shown in Fig. 4, since 2004, Macau’s gambling industry is no longer only controlled by SJM Holdings Limited. Over the past 19 years, SJM’s market share has gradually declined and finally stabilized at 15% or so. The Sands, Galaxy, and Wynn market shares are growing, all 20% or so in 2020. Nonetheless, due to Macau’s unbalanced industrial structure (Liu et al. 2021),

Fig. 1 Comparison of GDP growth between Macau and Other Countries and Regions. Source: The World Bank and National and Regional Statistics Bureau

Fig. 2 Industrial Structure of Macau from 2017 to 2020. Source: Macau Statistics and Census Service (DSEC)
Macau's economy lacks resilience (low ability to resist risks), which equates to unsustainable economic growth. Therefore, an effort to achieve moderate industrial diversification through promoting non-gambling industries and industrial diversification has been written in the strategic 2020 vision of Macau proposed by the government.

Social and people's livelihood is the second dimension of sustainable development. Since the outbreak of the COVID-19 pandemic, Macau’s unemployment rate has continued to rise while house prices remain high. According to the quarterly consumer confidence survey conducted by The Institute for Sustainable Development (TISD) of the Macau University of Science and Technology (MUST), citizens' confidence fluctuates greatly in the local economy, and the employment rate, market prices, investment income, and sustainable consumption has been greatly affected.

Comparatively speaking, the third dimension of sustainability in Macau—the relevant indicators of the environment—show relatively good performance. The level of air quality in Macau has always been excellent. PM2.5 concentration, for example, has continued to decline in recent years, from 29.08 μg/m³ in 2015 to 16.95 μg/m³ in 2020.

2.2 Overall evaluation

TISD and the Urban and Competitiveness Research Center of the Chinese Academy of Social Sciences (CASS) have maintained long-term cooperation in evaluating Macau and GBA cities' sustainable urban competitiveness, and participated in the annual report on the Competitiveness of Chinese Cities. The evaluation of sustainable urban competitiveness is based on the 17 sustainable development goals of the United Nations for the sustainable competitiveness of cities.
The sustainable development of Macau was measured and evaluated from five dimensions: economic vitality, environmental resilience, social inclusiveness, scientific and technological innovation, and global links. The research result is that sustainable urban competitiveness in Macau shows a downward trend. Take the 2021 assessment results as an example, Macau's environmental resilience indicators are very high, while the sustainable development indicators of social, economic, and scientific and technological innovation are on the low side.

### 2.3 Practice of sustainable development in Macau

The Macau SAR government, enterprises, universities, and communities have made various economic, social, and environmental efforts, which have promoted the sustainable development of Macau.

In September 2021, the Master Plan of the Development of Guangdong-Macau In-Depth Cooperation Zone in Hengqin (the Cooperation Zone) was issued. Under the Plan, the development and management of the Cooperation Zone will be jointly led by the Governor of the Guangdong province and the Chief Executive of the Macau SAR. The Cooperation Zone will demonstrate a new integrated high-level opening-up system between Macau and adjacent Hengqin. In December 2021, the Macau SAR government published the city's second Five-Year Plan for Economic and Social Development (2021–2025), setting economic and social development goals for the next stage.

Externally, the Cooperation Zone in Hengqin is a new platform for promoting Macau's adequate economic diversification, which focuses on scientific and technological research and development, high-end manufacturing, traditional Chinese medicine, culture, tourism, exhibition, trade, and modern financial industries, so as to provide supplement and support for Macau's limited development space. Internally, the development goal of the Five-Year Plan is to continuously enhance the driving force, vitality, and competitiveness of Macau's development and build a modern, beautiful, happy, safe, and harmonious Macau, which coincides with this the goal of sustainable development.

In addition to issuing programmatic policy papers, the SAR Government also deepens environmental governance at the corporate level, such as the setup of the "Macau Green Hotel Award" to encourage hotels to reduce kitchen garbage. Award-winning hotels set up their kitchen garbage machines to deal with food waste, and strengthen the recovery and reuse of food waste. Macau's Environmental Protection Bureau makes the soil produced after the disposal of food waste into organic fertilizer for citizens to take for free, which will help citizens realize the concept of sustainable development.

Besides government governance, corporate social responsibility is also an important part of sustainable development. For example, six gaming companies in Macau all issue sustainable development reports or environmental, social, and governance (ESG) reports every year, reflecting corporate social responsibility. China (Macau) Financial Asset Exchange Co., Ltd. (MOX) cooperates with the Macau SAR government to promote and develop various types of green and sustainable financial products in the GBA. MOX also issues bonds supporting long-term project financing as a starting point for green and sustainable financial development to fully play Macau's role as a meeting point in the "dual circulation" development pattern. The Bank of China's Macau Branch issues advanced unsecured green bills denominated in RMB with the theme of biodiversity, and the funds are used to provide financing and refinance for biodiversity-related qualified green projects as defined in the Bank of China Sustainable Development Bond Management statement to raise funds for green financial development in the GBA.

Macau academic circles pay more and more attention to the issue of sustainable development. In 2005, the Macau SAR Government established the Sustainable Development Strategy Research Center, which was merged into the Macau Foundation Research Institute in 2010. Besides, some research institutes and academic organizations, including The United Nations University Institute in Macau, TISD of MUST, and Sustainable Development Association, jointly promote the research and concept popularization of sustainable development in Macau.

### 3 Conclusion and prospect

Macau has high environmental resilience, while the economic volatility caused by an unbalanced industrial structure restricts the diversified development of society. Economic diversification is the only way for Macau to achieve sustainable development. The path to promoting Macau's economy's moderately diversified and sustainable development lies in internal industrial pluralism and external regional deepening.

For internal industrial pluralism, it is necessary to build a diversified industrial structure in Macau in order to enhance the city’s economic resilience, through promoting non-gaming industries such as trade and logistics, finance, cultural and creative industries, and traditional Chinese medicine. For example, to develop the trade and logistics industry, Macau's language and cultural advantages should be used to construct a service platform for business cooperation and promote the sustained and rapid development of trade cooperation between China and Portuguese-speaking countries. This effort has brought a large number of opportunities for
Macau to participate in the construction of "the Belt and Road Initiative." Besides, it also appears essential to take advantage of Macau's trade-free and duty-free port to develop cross-border e-commerce transactions.

For external regional deepening, it is necessary to change the existing factor endowment structure, that is, to expand the development space, which requires Macau to deeply cooperate with neighboring Hengqin to jointly build the Cooperation Zone in Hengqin to promote the flow of resources, and then integrate into the construction of the GBA.

The sustainable urban development of Macau is pluralistic, which requires both coordination of the relationship between economic development and population, resources and environment. It requires changes from paying attention to immediate and local interests to long-term and global interests, just like the definition of "sustainable development" by the United Nations World Commission on Environment and Development: not only does it meets the needs of contemporary people, but it also does not damage the ability of future generations to meet their needs.

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