Unsustainable Urban Development Based on Temporary Workers: A Study on the Changes of Immigration in Macau between 1992 and 2019

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Abstract: Macau’s urban development model has many unique characteristics, including expansion of the city through sea reclamation, increasing population mainly through immigration, and economic development driven by the gaming industry. Based on data from the Macau Statistics and Census Service, this study uses the Error Correction representation of the Autoregressive Distributed Lag model (ARDL-ECM) to analyze the impact of urban development on the trends of immigration and labor migration in Macau between 1992 and 2019. Results show that both land area and wage level have positive effects on the number of migrant workers and negative effects on the number of immigrants, indicating that Macau is over-dependent on short-term migrant workers. Macau’s land and human resources are tilted towards the gaming industry, resulting in a decreasing living environment and resident carrying capacity as the city develops. Therefore, this paper suggests that Macau should reduce the cost of city expansion and improve economic diversity through strengthening cooperation with neighboring mainland cities, hence sparing resources to absorb non-local talent and ensuring sustainable urban development.

Keywords: migrant workers; immigrants; land shortage; labor shortage

1. Introduction

The measurement of city development is multidimensional, and area, population and economic volume are often regarded as its most important indicators. Macau has shown its uniqueness in all these aspects. Around two-thirds of Macau’s land was reclaimed from the sea and over half of its current population consists of immigrants or migrant workers [1]. Although its immigration policies have been gradually tightened in the recent decades, Macau’s population density still fluctuates up to around 20,000 people per square kilometer, making it one of the most crowded regions in the world. On its 32.9 km² land, Macau has created an economic miracle and established the “Las Vegas of Asia”, with its gross gaming revenue surpassing Las Vegas in 2006 and per capita GDP reaching the second place in the world in 2019 [2,3].

Due to the extreme scarcity of land and the decline of traditional competitive industries, Macau has chosen to focus on developing its gaming–tourism industry in recent decades [4]. The Macau government auctions off six gaming business licenses to large companies, developing a gaming–tourism industry in which over half of the employees are non-local workers and consumers are tourists. Such an economic model shares similarities with convention and exhibition economy: low cost, high flexibility and high output multipliers [5]. However, Macau’s booming gaming industry has significantly more negative social outcomes and has suppressed the development of other industries [4,6]. With gaming–tourism industry as its only pillar, Macau’s economy became strongly dependent on the external environment and lacks economic resilience [7]. The grand casino hotels...
Occupying a huge area have also suppressed housing construction in Macau [8], which makes it difficult for Macau to accommodate new immigrants.

Despite the great contribution of migrant workers to Macau’s urban development, Macau’s migration policies have been rather controversial in view of its dependence on temporary workers and strict regulation on status changing from non-immigrant to immigrant. Since the enforcement of Law 3/2005 and adjustment on temporary residence system for investors, administrators and technicians, Macau has only approved 2084 applications for residence of qualified technicians [9]. Therefore, the chance for 0.2 million migrant workers in Macau to become settlers through talent programs is extremely trivial. Studies find that Macau’s policies on recruitment of non-local talent have no details and their implementation lacks transparency [10,11]. Moreover, the development of the gaming–tourism industry relies heavily on migrant workers with low salary and low social security. Consequently, Macau’s dependence on the gaming industry makes it difficult to change current migration policies and hence reverse the problem of talent shortage [12].

Based on the statistical yearbook and census reports from the Macau Statistics and Census Service, this paper examines the influential factors of two types of migration in Macau and discusses how Macau’s current policies on migrant workers and immigrants might hinder its sustainable development. The current study not only helps understand Macau’s immigration-driven urban development process, but also provides reference for future studies on the development trend of other cities. Immigration-driven population growth is becoming more and more common around the world. For instance, the population growth of San Francisco, New York, and Tokyo bay areas in the last decade has mainly depended on immigration [13]. Macau has historically been built up and developed by immigrants [14], hence findings on Macau’s trend of immigration and its consequences can be applicable to many other research sites as well.

In the following section, this paper reviews the relationship between immigration and the population, land and economic development process of Macau. Then we explain how the Error Correction Model (ECM) is applied to analyze the main influential factors on Macau’s number of immigrants and migrant workers between 1992 and 2019. A section on the findings from data analyses follows. Finally, we discuss and conclude how the case of Macau can deepen our understanding of immigration-driven urban development, the impact of immigration on small economies, and the man–land relationship in land-scarce cities.

2. Background

2.1. Immigrants and Migrant Workers

Migration is one of the most fundamental sources of demographic change. In the 19th century, Ravenstein already proposed some general laws on population migration [15]. As the scale, frequency and distance of migration continue to rise, the theoretical explanations for the occurrence of migration also continue to evolve. Push–pull theory points out that there are all sorts of positive and negative factors (related to the economy, environment, population structure, etc.) in the sending and receiving regions which influence the migration decision of potential migrants, but potential migrants also need to overcome the obstacle factors in-between [16]. Neo-classical migration theory uses economic equilibrium to explain population mobility [17,18]. It suggests that on the one hand, the relative labor shortage among regions is the main driving force of migration, while on the other hand, migration will lead to more balanced labor demand between the sending and receiving regions. According to new economics of labor migration, migrations in developing countries need to be understood from the perspective of families rather than individuals, and that individual migration is more often a way to minimize family risk than to maximize personal benefits [19,20]. An aspiration–(cap)ability framework encourages researchers to pay attention to both individual’s willingness and capability to migrate, and suggests that migration actually occurs when these two aspects match with each other [21–23]. The combination of this framework on micro level migration on the one hand, and regional development
at the macro level on the other, can further form an interaction theory of migration and development that helps explain the scale of regional immigration and emigration [24].

Transnational migrant workers, whose settlement opportunities are severely restricted, have proliferated in recent decades as national controls have tightened. After World War II, due to the lack of labor, many Western European countries adopted the Guest Worker system to import laborers in batches from other countries through national agreements, resulting in matching problems and immigration problems [25]. In modern times, especially in the industrializing countries, the import mode of foreign low-skilled labor has been changed to the short-term contract labor system, which is characterized by the regulation of import methods by the state and the importing of foreign workers organized by enterprises [26]. This kind of cross-country labor migration with a clear path is often called the “point-to-point” globalization in immigration research. Studies on transnational corporations in Africa point out that “point-to-point” globalization allows companies to establish relatively independent production departments away from local societies, thus maintaining “social thinness” and smoothness of transnational capital [27]. Many East Asian countries are important exporters of migrant workers. For instance, Indonesia exported 700,000 regulated workers in 2007 [28], China sent overseas a total of 800,000 contract workers in 2011 [29], and the cross-border workers from Vietnam to China alone exceeded 200,000 in 2018 [30]. Research based on migrant workers in East Asia shows that with the stricter supervision of the state and the embedding of labor intermediary services between the sending and receiving countries, conditions of individualized labor transplanting has been clearly improved [29,31].

In recent decades, as the attention of migration scholars has been dispersed by the diversity of population migration, studies are shifting from inducing big-picture migration theory to conceptualizing the lives, identities and experiences of migrants from an insider’s perspective [32]. This change of focus caused by the complexity of research objects has hindered the progress of migration-related theory development [33]. We believe that Macau’s large population of immigrants and migrant workers makes it a strong candidate site to encourage and promote the development of migration theory. Macau used to absorb a large number of immigrants and multi-ethnic immigrants who integrated well into its diversified business-port culture [34]. However, as we will introduce in the following two sections, Macau has now become increasingly dependent on migrant workers due to the limitation of land and its economic development strategy, which in turn leads to a reduced immigration quota and a lower chance for non-local talents to settle.

2.2. Immigrant-Driven Population Growth

Historically speaking, Macau is a city built and fueled up by immigrants. The population record of the Ming Dynasty shows that there were only 400 residents in Macau in the year 1555 [14]. In 1563, Macau’s population grew to over 5000, among which there were 900 Portuguese merchants. By the end of the Ming Dynasty, Macau had become a center harbor in east Asia, with mature trade routes starting from there to Japan, Mexico and Portugal. In 1640, the population of Macau reached a peak of 40,000, but than merchants left due to the sea ban in the early and mid-Qing Dynasty, and Macau’s population shrank sharply to under 4000. In the late Qing Dynasty, China’s foreign trade resumed and Macau became one of the starting points of the Chinese coolie trade. In addition, the Portuguese government occupied the Chinese territory of Macau, and brought the original residents under its jurisdiction. Under its comprehensive influence, the total population of Macau reached 75,000 in 1910. In the 1940s, Macau, being a relatively safe place, had attracted a large number of refugees from Chinese mainland, and its population temporarily surged to 0.25 million, but most refugees moved back to their hometown after the Second Sino-Japanese War. Due to China’s Reform and Opening-up policy, the number of immigrants from the mainland to Macau has increased rapidly since the 1980s, boosting Macau’s total population to 0.68 million within four decades [1].
In the 1970s, the garment export industry became the pillar industry of Macau [35,36]. Local laborers only met 50 to 70 percent of export orders, so factories in Macau hired large numbers of skilled textile workers from the adjacent Pearl River Delta region. During that period, the Macau government had no legislative regulations on labor migration. Through the two greatest amnesties in 1982 and 1990, around 60 thousand undocumented immigrants became local residents of Macau [37]. Research shows that these relatively young immigrants from the mainland alleviated Macau’s low fertility problems to some extent, and postponed aging problems [38,39].

In 1988, Dispatch 12/GM/88 permitted Macau’s enterprises to hire unskilled migrant workers legally, but for these temporary workers, the chance of becoming local residents was insignificant. Through enforcement of Order 2/90/M, Order 55/95/M, Law 4/2003 and Law 16/2021, the Macau government gradually distinguished between different purposes of entry and tightened up the granting of the right of abode [40]. In Macau’s current official documents, migrant workers are recorded as non-resident workers, while immigrants are recorded as new arrivals from mainland China with a one-way permit (i.e., immigrants through the family reunion program) or individuals granted the right of abode (i.e., immigrants through other programs). Both types of immigrants are granted permanent residency after residing in Macau for over seven years, while non-resident workers do not have such rights. Highly skilled migrant workers can apply for immigration through the employer sponsored category, yet this quota is extremely limited in Macau [9]. At the end of 2019, migrant workers and immigrants who had arrived after the mid-1980s accounted for 26% and 27% of the Macau population, respectively; thus, around half of the city’s population consists of recent arrivals [1].

2.3. Booming Gaming Industry and Shortage of Land and Labor

Macau used to have a much higher degree of economic diversification in the 1970s than it does today [15]. During its golden age, the gross product value of Macau’s export processing industries increased by over 20% per year, and the most successful industries included textiles, clothing and toy manufacturing. However, neighboring regions with abundant human resources, such as Guangdong province and Southeast Asian countries, joined the competition of processing trade in the 1980s, forcing Macau to shift its development focus from manufacturing to infrastructure construction [37]. Driven by a large influx of investment and speculators, the land and housing prices in Macau skyrocketed in the early-1990s and the construction industry was extremely prosperous [41]. However, since the number of newly-constructed properties far exceeded the actual market demand, the housing prices dropped sharply from the second half of 1993. Although Macau’s Order 14/95/M boosted the construction industry a little through attracting investment immigrants, this industry was later struck by the 1997 Asian Financial Crisis and 2008 Global Financial Crisis and has continued to shrink ever since [42]. With neighboring countries and regions banning gambling, its legal gambling service has become a unique advantage for Macau. The gross product value of the gambling–tourism industry has surpassed the export processing industry and become the largest industry in Macau since the 1980s, reaching 70 percent of the total GDP in the 2010s [4]. The gaming–tourism industry is relatively insensitive to the global economic environment, such that its gross product value increased by 9.6% during the 2008 Global Financial Crisis [22]. However, this industry is highly dependent on the flow of gamblers, and after the Chinese mainland carried out an anti-corruption campaign and tightened the issue of transit visas to Macau, Macau’s gross gaming revenue dropped by one third in 2015 [2,4].

Studies in the UK note that demands for migrant workers often rise because of certain types of domestic labor shortage caused by welfare policies and other system effects [43]. Similarly, system effects including high welfare for local workers and unbalanced industry development have resulted in the long lasting labor shortage in Macau [35]. During one decade of rapid development, the employment population of the gaming industry increased from 22,900 in 2004 to 83,300 in 2013 [44]. While some high payment and low skill
requirement positions directly involved in gambling (such as the casino dealers) are preserved for local residents, tens of thousands of migrant workers are hired as administrative or service staff in the grand casino hotels [45].

The mass labor migration in Macau has not been without controversy. Studies show that the wage below market rate in Macau and the insufficient cultivation of local labor potential have led to structural labor insufficiency [11,46]. Approval of the entry of migrant workers met the demands and interests of employers, but suppressed the wage level of local employees. Some studies further claim that using labor migration as the solution to short-term labor shortage has aggravated Macau’s long-term problems including slow industrial restructuring, lagging technological upgrading and disconnection between local talent training and economic demand [11]. Therefore, local scholars have accused the Macau government of adopting a “nonintervention” attitude towards migrant workers, sacrificing the rights and interests of both local and immigrant labor for the benefit of its short-term economic interests [47].

Macau’s gaming industry also has enormous demands on land and has been a strong driver of sea reclamation [37]. Macau is a city built on small islands located at the mouth of the Pearl River [4]. With numerous coastal shores, the water depth around the port is only one to three meters, so the cost of sea reclamation is relatively low [48]. Still, the cost of land expansion for Macau is much higher than expansion costs for non-island cities. Through sea reclamation projects between 1863 and 2020, the land area of Macau grew from 10.37 to 32.9 km\(^2\). In the last two decades, Macau began to acquire land from neighboring mainland cities through cooperative development, such as the cross-border industrial zone established in Gongbei, Zhuhai, and the new University of Macau campus established in Hengqin, Zhuhai [49]. While cross-border cooperation is gradually becoming an important way for Macau to expand and develop, the gaming industry is still constrained within Macau SAR due to legal restrictions.

Through examining the influence of booming sectors in small economies (i.e., the Dutch disease), scholars have concluded that a booming sector would make other sectors uncompetitive and unsustainable through increasing the price of non-tradable goods [50]. Such a finding is also applicable to Mediterranean and Atlanta islands, in that the dominance of tourism on these islands have made these economies excessively dependent on foreign countries and lose the motivation to improve education levels, innovation and technology [51]. Consistent with these prior studies, studies on Macau show that the gaming industry absorbs the scarce land and human resources, promoting deindustrialization through increasing the prices of various resources and increasing the city’s dependency on tourists [4]. Because of its economic pillar role in Macau, the gaming industry takes priority over other industries in the allocation of land resources [44]. Even residents’ demands on housing and living environment have been suppressed to make way for expansion of the gaming industry. Following the current development trend, the gaming–tourism industry will continuously drain Macau’s newly increased land and labor resources, making it difficult for Macau to achieve economic transformation and sustainable development or to attract non-local elites.

2.4. Research Hypotheses

The sea reclamation projects call for a large number of construction workers. With the casino hotels and souvenir shops being built on the new land, Macau’s demand for other types of laborers also keeps increasing [44]. Meanwhile, the abundance of low-wage migrant workers with no social security obligations has kept Macau from training local man power to keep up with economic development [45]. Hence, this study hypothesizes that in the long run, Macau’s dependence on migrant workers would increase along with the expansion of Macau’s urban scale:

**Hypothesis 1.** The number of migrant workers increases if the land area of Macau increases.
The sea reclamation projects have been fueled by the gaming–tourism industry’s hunger for land. However, sea reclamation results in destruction of the landscape and affects the region’s degree of habitability. In addition, with a disproportion of Macau’s new land area occupied by casino hotels, the growth of housing and amenities failed to keep pace with the city’s economic development. Accordingly, this study assumes that when the land scale of Macau expands, the city becomes less attractive to potential immigrants:

**Hypothesis 2.** The number of immigrants decreases if the land area of Macau increases.

Macau has long provided higher wages than surrounding regions, which is a key pull factor for migrant workers. The rise in wage level in the past decade has largely resulted from development of the gaming industry, which has a great demand for manpower [4]. Since the wage level in general reflects the demand for labor, this study puts forward the following research hypothesis:

**Hypothesis 3.** The number of migrant workers increases if the median wage in Macau increases.

Different from migrant workers who pursue higher income, the driving forces of immigrants’ arrival in Macau are more diverse. For instance, before the 2005 revision of policies on investment immigration, a large proportion of immigrants were investors being bullish on Macau’s real estate development. After 2005, the majority of new immigrants are holders of one-way permits for the purpose of family reunion. Since migrant workers and immigrants are in fact competing for quotas in Macau due to its limited natural and social resources, the rising demand of the city for labor usually results in restrictions on immigrants. Therefore, this study hypothesizes that as an indicator of labor demand, wage level would have a negative effect on the number of immigrants:

**Hypothesis 4.** The number of immigrants decreases if the median earning of Macau increases.

As is shown in Figure 1, we hypothesize that along with the urban development of Macau, which is featured by increasing land through sea reclamation and rising wage level, the number of migrant workers would keep increasing, while the number of immigrants would keep decreasing. While we do not directly examine the relationship between the numbers of migrant workers and immigrants, we would assume that Macau’s reliance on migrant workers is a main driving force of reducing quotas for immigrants. Employers in Macau can now avoid high employee welfare for locals and immigrants and fulfill their demand for laborer through hiring more obedient migrant workers [11]. However, as we will discuss more specifically in later sections, this strategy is not a solution to Macau’s problem of insufficient manpower, but only postpones while deteriorating its consequences.

**Figure 1.** Analytical Framework of Migration in Macau.
3. Data and Methodology

3.1. Data

This study examines the trends of immigration in Macau based on data from the Statistical Yearbook compiled by the Macau Statistics and Census Service [1]. In addition, this study compares population structure and educational attainment between Macau’s local residents (accounting for 83.4% of the total population) and non-local residents (including migrant workers who account for 13.9% of the population and non-local students accounting for 2.8% of the population) based on Macau census report data.

Due to the lack of statistical data on Macau before the 1990s and the dramatic change in 2020 caused by Covid-19, this paper analyzes the impact of city development on the number of migrant workers and immigrants between 1992 and 2019. There are two dependent variables in this paper (Table 1). The first dependent variable is the number of migrant workers, i.e., the number of non-resident workers at the end of each statistical year in Macau. The second variable is the number of immigrants, i.e., the cumulative number of individuals granted the right of abode either through family reunion, investment or employer sponsored programs since 1984 (There are no official records on numbers of foreign residents and new immigrants from Chinese mainland before 1984 nor any official statistics on year-end numbers of new immigrants; we therefore constructed a variable to measure the accumulated number of new immigrants in Macau since 1984. In fact, Macau’s population consists basically of immigrants, so this dependent variable only measures the cumulative number of new immigrants after Macau established formal immigration policies. The other independent variable, i.e. year-end number of migrant workers, is also to some extent accumulative, in that it measures the number of migrant workers who arrived in the recent years and stayed until the end of a certain year). Independent variables include the total urban land area of Macau (unit: km$^2$) and the median annual wage (unit: 1000 MOP or Macau Pataca). Because there are a total of 28 analysis time points in the autoregression models, the number of independent variables that can be included is rather limited (In an ARDL model, the number of variables plus their lag terms should not exceed half of the degrees of freedom, so only 1 to 3 independent variables can be included in our regression model. Moreover, statistics on unit housing price, wage of migrant workers, etc., are only available since the 2000s, so inclusion of related variables would further reduce time points in regression analysis. Therefore, even though we examined potential indicators such as housing price, housing space, population density and wage gap, we finally chose land area and wage level as best reflecting Macau’s urban development and yielding a higher $R^2$. We do, however, plan to examine further indicators in future studies after collecting individual data).

Table 1. Descriptive Statistics ($n = 28$).

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Mean</th>
<th>S.D.</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent Variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Migrant Workers</td>
<td>79,812</td>
<td>62,354</td>
<td>21,088</td>
<td>196,538</td>
</tr>
<tr>
<td>Number of Immigrants</td>
<td>94,516</td>
<td>51,603</td>
<td>24,974</td>
<td>179,055</td>
</tr>
<tr>
<td><strong>Independent Variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land Area (Unit: km$^2$)</td>
<td>26.92</td>
<td>4.24</td>
<td>18.70</td>
<td>32.90</td>
</tr>
<tr>
<td>Median Annual Wage (Unit: 1000 MOP)</td>
<td>99.32</td>
<td>51.66</td>
<td>41.998</td>
<td>204.00</td>
</tr>
</tbody>
</table>

The number of migrant workers in Macau at the end of each year has increased from 21,088 in 1990 to 196,538 in 2019 (Figure 2). The number of migrant workers is strongly influenced by the local economic environment. After the collapse of Macau’s real estate industry in 1993, Macau’s demand for construction workers remained extremely low for nearly a decade, resulting in a smaller flow of labor migration. The 2008 Global Financial Crisis also led to a clear decline in labor migration to Macau. Before the COVID-19 outbreak, Macau had witnessed a decade of prosperity fueled by the gaming industry, while about half of its labor force were migrant workers. Among non-local employees, 60% were from
the mainland, 10% from the Philippines, 10% from Vietnam, 5% from Hong Kong and 5% from Indonesia.

![Figure 2.](image2.png)

**Figure 2.** The Number of Non-Immigrant Workers and immigrants in Macau, 1992–2019.

Between 1992 and 2019, the number of immigrants in Macau increased quite steadily from around 24,974 to 179,055 (Figure 2). The only sharp change is related to the enforcement of Law 3/2005, which significantly raised the threshold for investment immigration. Since then, the number of new foreign residents granted right of abode by the Macau government each year dropped from several thousand to around one thousand [52]. Immigration from the mainland to Macau with the purpose of family reunification is under the strict regulation of the mainland government, and the cumulative number of immigrants with a one-way permit has increased by an average of 3500 per year.

The median annual wage in Macau increased from MOP 42,000 to MOP 204,000 between 1992 and 2019, with an annual growth rate of 5.8% (Figure 3). The salary in Macau fell sharply after the Asian Financial Crisis, and the absolute value of median wage did not recover to the 1997 level until 2004. Wages have since risen rapidly as the gaming industry was trying to recover from the economic shock caused by the mainland’s anti-corruption campaign [3]. Meanwhile, Macau’s land area grew relatively steadily from 18.7 km² in 1992 to 32.9 km² in 2019 through sea reclamation, with an average annual growth rate of 2 percent.

![Figure 3.](image3.png)

**Figure 3.** The Median of Annual Wage and Land Area in Macau, 1992–2019.
3.2. Analytical Methods

This paper uses the Error Correction representation of the Autoregressive Distributed Lag model (ARDL-ECM) to analyze the impact of Macau’s land area and wage level on the number of migrant workers and immigrants. The EC model is a special application of the ARDL model that separates the long-term and short-term impacts through the inclusion of an error correction term [53]. The reason for using an autoregressive model is that the number of migrants of either type in Macau is not only affected by the current effect of land area and wage level, but is also affected by the number of migrants in the previous years and the lagged effect of land area and wage level.

ECM suffers from several limitations. Specifically, the biggest one is that it requires the variables to be cointegrated. Otherwise, the disequilibrium error term will not be a stationary variable, because the errors in the long-run relationship become larger and larger. Moreover, in terms of model specifications, ECM can be explained as a reparameterization of the general ARDL or dynamic linear regression (DLR) models because it focuses on the importance of general to specific modeling [54]. Although the ARDL-ECM imposes no restrictions on the DLR, there are no statistical criteria to distinguish between the two model specifications because they are observationally equivalent. Hence for these coefficients, the interpretation of the ECM is heavily dependent on explicit theory [55].

On the other hand, ECM has much more advantages than limitations in empirical studies. The biggest one is that it does not suffer from the problem of serial autocorrelation since it was formulated in terms of first differences, which eliminates trends from the variables. In this sense, it can overcome the problem of spurious regressions. In addition, the estimated coefficients have explicit interpretation [56]. Specifically, for our study it is able to analyze the short-term and long-term dynamics of wage and urban area changes on migrants, producing better forecasts for migration policy analysis. Hence, since it can measure the correction from disequilibrium of the previous period with an explicit implication, it is a well-recognized convenient model in many applications. To conclude, the advantages of the ECM outweigh the disadvantages, making it a suitable model for our study.

This study applies the ARDL-ECM on the Macau data to specify the long-term influence of land area and wage level on the number of migrant workers and immigrants:

$$Migrant = a_1 \text{Area} + a_2 \text{Wage} + a_0,$$

$$\Delta Migrant_t = \sum_{i=1}^{p-1} \theta_{1,i} \Delta Migrant_{t-i} + \sum_{i=0}^{q-1} \theta_{2,i} \Delta \text{Area}_{t-i} + \sum_{i=0}^{r-1} \theta_{3,i} \Delta \text{Wage}_{t-i} + \delta \ast \text{ecm}_{t-1} + \epsilon_t,$$

$\text{ecm}_{t-1} = Migrant_{t-1} - a_1 \text{Area}_{t-1} - a_2 \text{Wage}_{t-1} - a_0.$

Equation (1) demonstrates the long-run equilibrium relationship between dependent and independent variables, where Area measures Macau’s land area, and Wage measures median annual wage. Migrant in Equation (1) stands for the dependent variable, that is, the number of migrant workers in the first EC model and the number of immigrants in the second EC model. Equation (2) demonstrates the short-run relationship, where each of the symbols with $\Delta$ represents the first difference of the corresponding variable. A symbol with $t_i$ subscript represents the $i$th lag term. The $p$, $q$ and $r$ represent the optimal lag orders of the dependent variable and the two independent variables in each EC model. In Equation (2), each $\theta$ indicates a short-term regression coefficient, $\epsilon_t$ indicates the residual term, and $\delta$ indicates the coefficient of the error correction term “ecm$\ast$1”. Equation (3) shows how the error correction term is calculated. As is shown in Figures 1 and 2, indicators of population, economy and city scale in Macau all share a rising trend during the last few decades. Therefore, this study also includes the variable year in the models as a way to detrend and to avoid spurious regression, forming two EC models with unrestricted trends and unrestricted constants [57].
All variables included in a ARDL-ECM are required to be either I(0) or I(1) variables [53]. A stationary time series, i.e., a time series without trend or seasonality, is said to be integrated of order zero and denoted as I(0). A non-stationary time series with its first difference being stationary is said to be integrated of order one and denoted as I(1). The results of the Augmented Dickey–Fuller Test (ADF) in Table 2 show that the two dependent variables and two independent variables in this study are all I(1) variable (Normally the land area of a city over time would be a stationary series; however, the land area of Macau increased rather fast in the recent decades due to large-scale sea reclamation projects, to such an extent that it does have a trend and is not integrated of order zero). Each group of variables needs to pass a cointegration test to ensure cointegration relationship, i.e., a long-term equilibrium relationship, before being included in an ARDL-EC model [57]. The results of the bounds test for cointegration are also shown in Table 2. The variables in both EC models have F values and t values significant at 0.05, indicating that long-run relationships of both groups of variables have been confirmed. Optimal lag lengths of variables in these two EC models are selected based on the Akaike Information Criterion (AIC).

Table 2. Results of the ADF Test and Bounds Test.

<table>
<thead>
<tr>
<th>ADF Test</th>
<th>Migrant Workers</th>
<th>Immigrants</th>
<th>Land Area</th>
<th>Median Wage</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADF Value</td>
<td>1.125</td>
<td>2.564</td>
<td>0.229</td>
<td>2.183</td>
</tr>
<tr>
<td>ADF Value of First Difference Integration Order</td>
<td><strong>-2.616</strong>*</td>
<td><strong>-4.826</strong>*</td>
<td><strong>-6.181</strong>*</td>
<td>-2.667*</td>
</tr>
<tr>
<td>Bounds Test</td>
<td>ECM for Migrant Workers</td>
<td>ECM for Immigrants</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>12.253***</td>
<td>6.677*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>t</td>
<td>-5.680***</td>
<td>-4.172*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optimal Lag Lengths (AIC)</td>
<td>[3,0,3]</td>
<td>[2,2,2]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Significance: *< 0.05; **< 0.01; ***< 0.001.

4. Findings

4.1. Influential Factors on the Number of Migrant Workers

Table 3 demonstrates the results of regression analysis on the number of migrant workers in Macau using ECM. Results at the Long Run section clearly show that both land area and median wage have long-term positive effects on the number of migrant workers, which are significant at 0.01 and 0.001, respectively. In the long term, increasing 1 km$^2$ of Macau’s land area would lead to an increase in the number of migrant workers by 8050, and each MOP 1000 increase in the median annual wage would result in the number of migrant workers increasing by 1642. These results offer support to our research hypotheses 1 and 3, that the sea reclamation project and the rising wage level are significant driving forces of the growth of labor migration in Macau.

The adjusted $R^2$ is 0.854, indicating that over 80% of the variance of the number of migrant workers in Macau can be explained by this model. Figure 4 shows the model fitting results, where the curve of the annual variation of labor migration fitted by the model (dashed line) is very close to the curve of the actual annual variation (solid line), further indicating that the model fits well.

4.2. Influential Factors on the Number of Immigrants

Table 4 shows the results of regression analysis of the number of immigrants in Macau. Both land area and median wage have long-term negative effects on the number of immigrants, which are significant at 0.001 and 0.01, respectively. In the long run, increasing 1 km$^2$ of Macau’s land area leads to a decrease in immigrants by 11,855, and each MOP
1000 increase in the median annual wage reduces the number of immigrants by 527. These results provide support to the research hypotheses 2 and 4. They also imply that Macau has allocated so much land to the gaming–tourism industry that the growth of its living space failed to keep pace with the city’s development; hence, the expansion of the city leads to a higher dependency on migrant workers with small demand for land resources, and to a reduced number of immigrants for whom long-term occupancy of land and housing is essential.

Table 3. ECM Predicting the Number of Migrant Workers in Macau (n = 25, Adj. R² = 0.854).

<table>
<thead>
<tr>
<th></th>
<th>Coef.</th>
<th>S.E.</th>
<th>t</th>
<th>p &gt; t</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EC Term</strong></td>
<td>−1.400</td>
<td>0.247</td>
<td>−5.68</td>
<td>0</td>
</tr>
<tr>
<td><strong>Long Run</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land Area (km²)</td>
<td>8050</td>
<td>2353</td>
<td>3.42</td>
<td>0.004</td>
</tr>
<tr>
<td>Median Wage (1000 MOP)</td>
<td>1642</td>
<td>122</td>
<td>13.46</td>
<td>0</td>
</tr>
<tr>
<td><strong>Short Run</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Immigrant Worker</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First Lag of First-Difference</td>
<td>0.391</td>
<td>0.183</td>
<td>2.13</td>
<td>0.05</td>
</tr>
<tr>
<td>Second Lag of First-Difference</td>
<td>0.346</td>
<td>0.225</td>
<td>1.54</td>
<td>0.145</td>
</tr>
<tr>
<td>Median Wage (1000 MOP)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First-Difference</td>
<td>−561</td>
<td>348</td>
<td>−1.61</td>
<td>0.128</td>
</tr>
<tr>
<td>First Lag of First-Difference</td>
<td>−742</td>
<td>334</td>
<td>−2.22</td>
<td>0.042</td>
</tr>
<tr>
<td>Second Lag of First-Difference</td>
<td>1160</td>
<td>332</td>
<td>3.49</td>
<td>0.003</td>
</tr>
<tr>
<td>Year</td>
<td>−9466</td>
<td>2928</td>
<td>−3.23</td>
<td>0.006</td>
</tr>
<tr>
<td>Constant</td>
<td>18,600,000</td>
<td>5,751,746</td>
<td>3.23</td>
<td>0.006</td>
</tr>
</tbody>
</table>

Note: Significance: *< 0.05; **< 0.01; ***< 0.001.

Figure 4. The Fitted Curve of The First-Difference of The Number of Migrant Workers.

The adjusted R² of this model is 0.465, indicating that nearly half of the variation in the number of immigrants in Macau has been explained. As is shown in Figure 5, the annual variation in the model-fitted number of immigrants (dashed line) is relatively closer to the actual annual variation (solid line) after the year 2000. The poor fit before 1999 may be caused by the great changes in the immigration situation of Macau before its return to China.
Table 4. ECM Predicting the Number of Immigrants in Macau \( (n = 25, \text{Adj. } R^2 = 0.465) \).

<table>
<thead>
<tr>
<th>Term</th>
<th>Coef.</th>
<th>S.E.</th>
<th>t</th>
<th>p &gt; t</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EC Term</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long Run</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land Area (km(^2))</td>
<td>−11,855</td>
<td>2578</td>
<td>−4.60</td>
<td>0</td>
</tr>
<tr>
<td>Median Wage (1000 MOP)</td>
<td>−527</td>
<td>169</td>
<td>−3.11</td>
<td>0.001</td>
</tr>
<tr>
<td>Short Run</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Immigrant Worker</td>
<td>0.452</td>
<td>0.246</td>
<td>1.84</td>
<td>0.086</td>
</tr>
<tr>
<td>First Lag of First-Difference Land Area (km(^2))</td>
<td>12,655</td>
<td>4927</td>
<td>2.57</td>
<td>0.021</td>
</tr>
<tr>
<td>Second Lag of First-Difference Median Wage (1000 MOP)</td>
<td>5361</td>
<td>2988</td>
<td>1.76</td>
<td>0.093</td>
</tr>
<tr>
<td>First-Difference Median Wage (1000 MOP)</td>
<td>712</td>
<td>289</td>
<td>2.46</td>
<td>0.026</td>
</tr>
<tr>
<td>First Lag of First-Difference Year</td>
<td>525</td>
<td>245</td>
<td>2.14</td>
<td>0.049</td>
</tr>
<tr>
<td>Constant</td>
<td>−46,400,000</td>
<td>12,600,000</td>
<td>−3.68</td>
<td>0.002</td>
</tr>
</tbody>
</table>

Note: Significance: *< 0.1; *< 0.05; **< 0.01; ***< 0.001.

Figure 5. The Fitted Curve of the First-Difference of the Number of Immigrants.

4.3. Structural Difference between Locals and Non-Locals

In the 2021 Macau census, the non-local population numbers a total of 113,438, and includes 94,637 migrant workers and 18,771 non-local students who face policy restrictions and are not allowed to become permanent residents. Immigrants, on the contrary, are counted as part of the local population in the census. As is shown in Table 5, the labor force population (people aged 15–64) accounted for 99.5% of the non-local population, while it only accounted for 68.1% of the local population.
The proportion of the non-local population in 2021 is extremely large in Macau, equivalent to 24% of the local population. The non-native population had been equivalent to 14% of the local population in the 2011 census. When non-locals are excluded from the statistics, the labor share in Macau falls from 73.3% to 69.1%, and the proportion of the elderly (aged 65 and up) rises from 12.1% to 14.5%. The proportion of women of prime reproductive age (20–34 years old) also falls from 27.7% to 24.4% when non-natives are excluded from the statistics (Figure 6).

Table 5. Age Structure of Local and Non-Local Populations in Macau.

<table>
<thead>
<tr>
<th>AGE GROUP</th>
<th>Local, N</th>
<th>Local, Per.</th>
<th>Non-Local, N</th>
<th>Non-Local, Per.</th>
<th>Total, n</th>
<th>Total, Per.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–14</td>
<td>98,981</td>
<td>17.41%</td>
<td>30</td>
<td>0.03%</td>
<td>99,011</td>
<td>14.52%</td>
</tr>
<tr>
<td>15–19</td>
<td>23,643</td>
<td>4.16%</td>
<td>4532</td>
<td>4.00%</td>
<td>28,175</td>
<td>4.13%</td>
</tr>
<tr>
<td>20–24</td>
<td>27,878</td>
<td>4.90%</td>
<td>13,912</td>
<td>12.26%</td>
<td>41,790</td>
<td>6.13%</td>
</tr>
<tr>
<td>25–29</td>
<td>38,688</td>
<td>6.80%</td>
<td>15,587</td>
<td>13.74%</td>
<td>54,275</td>
<td>7.96%</td>
</tr>
<tr>
<td>30–34</td>
<td>51,094</td>
<td>8.98%</td>
<td>19,791</td>
<td>17.45%</td>
<td>70,885</td>
<td>10.39%</td>
</tr>
<tr>
<td>35–39</td>
<td>46,797</td>
<td>8.23%</td>
<td>17,674</td>
<td>15.58%</td>
<td>64,471</td>
<td>9.45%</td>
</tr>
<tr>
<td>40–44</td>
<td>34,400</td>
<td>6.05%</td>
<td>14,501</td>
<td>12.78%</td>
<td>48,901</td>
<td>7.17%</td>
</tr>
<tr>
<td>45–49</td>
<td>37,278</td>
<td>6.56%</td>
<td>12,010</td>
<td>10.59%</td>
<td>49,288</td>
<td>7.23%</td>
</tr>
<tr>
<td>50–54</td>
<td>37,476</td>
<td>6.59%</td>
<td>8376</td>
<td>7.38%</td>
<td>45,852</td>
<td>6.72%</td>
</tr>
<tr>
<td>55–59</td>
<td>45,309</td>
<td>7.97%</td>
<td>4850</td>
<td>4.28%</td>
<td>50,159</td>
<td>7.35%</td>
</tr>
<tr>
<td>60–64</td>
<td>44,829</td>
<td>7.88%</td>
<td>1652</td>
<td>1.46%</td>
<td>46,481</td>
<td>6.81%</td>
</tr>
<tr>
<td>≥65</td>
<td>82,289</td>
<td>14.47%</td>
<td>523</td>
<td>0.46%</td>
<td>82,812</td>
<td>12.14%</td>
</tr>
<tr>
<td>Total</td>
<td>568,662</td>
<td>100%</td>
<td>113,438</td>
<td>100%</td>
<td>682,100</td>
<td>100%</td>
</tr>
</tbody>
</table>

Since those people belonging to the non-local population are not allowed to settle down, they only work or study for a few years and are unlikely to reproduce in Macau, and statistics excluding the non-local population can reflect the actual population situation. The proportion of the non-local population in 2021 is extremely large in Macau, equivalent to 24% of the local population. The non-native population had been equivalent to 14% of the local population in the 2011 census. When non-locals are excluded from the statistics, the labor share in Macau falls from 73.3% to 69.1%, and the proportion of the elderly (aged 65 and up) rises from 12.1% to 14.5%. The proportion of women of prime reproductive age in Macau (20–34 years old) also falls from 27.7% to 24.4% when non-natives are excluded from the statistics (Figure 6).

Table 6 demonstrates the educational attainment of Macau’s local and non-local populations aged 25 and above. The proportion of people with higher education in the local population is 31.9%, a bit higher than that for the non-local population (27.7%). Benefiting from funding from the rich government and local universities hiring large numbers of non-local professors, the higher education coverage rate among local residents has more than doubled in Macau since 1999 [6]. However, 64.4% of the non-local population has a high school education or above, which is 8.3 percent points higher than high school coverage rate of the local population. Given the intensifying competition for talent in the Pearl River Delta [58], and the impact of post-pandemic deglobalization [59,60], it remains to be seen whether Macau will be able to attract another wave of migrant workers with similar educational attainment as a succession of the current wave. Assuming that Macau fails in the competition for non-local laborers, it might gradually lose 16.5% of its workforce.

Figure 6. Age Structure of the 20–64 Year-Old Local and Non-Local Populations in Macau.
with higher education and 25.6% of its workforce with high school diplomas, resulting in an enormous number of job vacancies that will not be able to be filled with the local workforce.

Table 6. Education Attainment of 25+ Local and Non-Local Populations in Macau.

<table>
<thead>
<tr>
<th>Education</th>
<th>Local, N</th>
<th>Local, %</th>
<th>Non-Local, N</th>
<th>Non-Local, %</th>
<th>Total, N</th>
<th>Total, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower than Elementary</td>
<td>38,815</td>
<td>9.28%</td>
<td>2997</td>
<td>3.16%</td>
<td>41,812</td>
<td>8.15%</td>
</tr>
<tr>
<td>School</td>
<td>73,246</td>
<td>17.52%</td>
<td>10,030</td>
<td>10.56%</td>
<td>83,276</td>
<td>16.23%</td>
</tr>
<tr>
<td>Elementary School</td>
<td>71,364</td>
<td>17.07%</td>
<td>20,736</td>
<td>21.84%</td>
<td>92,100</td>
<td>17.95%</td>
</tr>
<tr>
<td>Middle School</td>
<td>101,236</td>
<td>24.21%</td>
<td>34,902</td>
<td>36.75%</td>
<td>136,138</td>
<td>26.53%</td>
</tr>
<tr>
<td>High School</td>
<td>133,499</td>
<td>31.93%</td>
<td>26,299</td>
<td>27.69%</td>
<td>159,798</td>
<td>31.14%</td>
</tr>
<tr>
<td>Higher Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>418,160</td>
<td>100%</td>
<td>94,964</td>
<td>100%</td>
<td>513,124</td>
<td>100%</td>
</tr>
</tbody>
</table>

Prior studies show that localization of labor migration used to be an important approach for Macau to improve its population structure [37–39]. Results of regression analysis and comparison of non-local to local populations in this study also imply that converting a larger proportion of migrant workers to immigrants would still be a potential way for Macau to ensure sustainable population and manpower development.

Our four research hypotheses are supported by results of regression analysis, which implies that the current development strategies of Macau would only lead to higher dependency on migrant workers and a smaller quota for new immigrants. A vicious circle might lie within Macau’s current urban development process: (A) due to rapid economic development and insufficient local labor accumulation, Macau must import some non-local manpower; (B) since the economic and social cost of hiring migrant workers is much lower than hiring immigrants, the government and employers are more in favor of non-resident migrant workers; (C) relying on migrant workers suppresses Macau’s accumulation of local human resources, resulting in more serious shortages of local laborers in the future; (D) Macau has to import more non-local employers in the next round, because of the increasing vacancies in labor market due to economic growth and aging local population. Furthermore, once migrant labor supply declines, Macau’s economic development would be interrupted and its population problems would deteriorate.

5. Discussion

Through applying the ARDL-ECM on population studies, this paper presents a more accurate long-term relationship between Macau’s immigration, land and economy. Our study shows that the number of migrant workers increases as the land area and median wage increase. This is not a surprise, since Macau has long regarded temporary migrant workers as an important solution to its scarcity of land and social resources. Migrant workers are only allowed to work in Macau for a few years, so they can flexibly fill vacancies in the labor market without causing long-term pressure on the city’s welfare and social resources [38]. Moreover, a large number of migrant workers from the Chinese mainland have become cross-border commuters, who work in Macau but reside in neighboring cities such as Zhuhai or Zhongshan, sparing the scarce housing resources for residents in Macau [61].

Our study also shows that land area and wage level are negatively correlated with the number of immigrants in Macau. This finding implies that Macau has been suppressing the chance for migrant workers to become residents during its urban development process. Although a large proportion of migrant workers are young and highly educated, they are not able to settle in Macau due to the restrictions of the immigration policy [10]. Unlike earlier immigrants who improved the population structure of Macau and alleviated aging, low fertility and other demographic problems [11], migrant workers’ contributions to
Macau are relatively short-term. In fact, the findings of this study imply that under Macau’s current migration policy, an increase in the number of migrant workers would result in a negative impact on sustainable population development.

Consistent with prior studies [6], this study reveals a critical problem of Macau’s current development strategy, in that after allocating most of the new land reclaimed from the sea to the gaming–tourism industry, the city fails to reserve sufficient land resources for increased economic diversification or improvement in the living environment. The booming gaming–tourism industry not only affects Macau’s attractiveness to non-local talent, but its high-salary and low-skill-requirement positions reserved for local residents also drives local students to concentrate on majors related to gambling, resulting in extremely high homogeneity of local manpower [45]. Macau’s GDP plunged by more than half and gross income of the gaming industry dropped by 79.2% in 2020 due to the Covid-19 pandemic, clearly showing the vulnerability of an economic system solely based on gaming–tourism [62]. Meanwhile, the neighboring mainland cities in the Pearl River Delta have significantly increased the welfare for the non-local high-skilled population in recent years in order to compete for human resources [55,63]. Macau has become relatively less attractive to the non-local manpower that it relies on, and its strategy of rotating high-end workers has become harder to sustain. Therefore, Macau urgently needs to improve its immigration policies and increase opportunities for skilled migrant workers to gain residency, so as to attract non-local talent essential for its economy.

These findings not only help deepen the understanding of the driving factors within Macau immigration, but also allow for theoretical extension in the following aspects. First, Macau has long been depending on a migrant population, making it a suitable site for analyzing the long-term impact of migration on urban development. There is a rather consistent correlation between the decline in fertility and economic growth. At present, the total fertility rates (TFR) of most developed countries have dropped to below the replacement level (i.e., 2.1 children per woman) [64]. Cross-country comparisons of fertility policies show that policies supporting gender equality in the workforce are more effective than traditional family supports for stay-at-home mothers [65,66]. The low fertility issue in Confucian countries is even more severe, such that China’s TFR was only 1.4 in the early-2000s, Korea’s TFR in 2005 was 1.08, Japan’s TFR in 2013 was 1.43, and Singapore’s TFR in 2010 was 1.15 [63]. Fertility support programs in these countries have only slowed down the decline of TFR. In fact, except for a few Northern European countries that have achieved fertility growth through ultra-high social welfare [67], countries with low fertility level often reverse the declining TFR through influx of immigrants with higher fertility [68]. The TFR of Macau dropped to below 2.1 in 1970 and decreased by 22% in the following two decades [38]. This relatively slow decline was mainly due to the absorption of immigrants. In 1991 the fertility rate of mainland immigrants in Macau was twice that of locals. However, with the implementation of Dispatch 12/GM/88 and Order 2/90/M, Macau imposed restrictions on settlement of migrant workers, leading to an increase in the average age of new immigrants and a decrease in their fertility rate. From 1991 to 1996, Macau’s TFR plummeted by 22% [38]. Macau can be regarded as a preview of future cities, where, in common with Macau, immigration is the main driving force of population growth [69], and offers important insights into the long-term demographic consequences of certain migrant policies.

Second, prior studies on tourism economies primarily focus on places that developed on the basis of comparative advantages in natural resources [51]. Macau, by contrast, makes more use of man-made landscapes, offering tourism, entertainment and consumption activities inside grand casino hotels. Among them, the Venetian Resort Hotel is the largest, occupying an area of 0.975 km², that is, 3% of Macau’s total land area [44]. The advantage of Macau’s economic model lies in its relatively low dependence on natural landscape, while its disadvantage is the very neglect of the natural environment. Macau’s land reclamation has aggravated multiple environmental problems, such as inland sea pollution, coastal ecosystem degradation, flood resistance degradation, soil salinity increase, natural
landscape destruction, and heat island effect [8]. Therefore, in addition to the unsustainable population growth and the unstable economic development [70,71], Macau’s economic pattern is also environmentally unfriendly and thus conflicts with many United Nations Sustainable Development Goals. This study presents more facets of the development problems of tourism economies and urges the Macau government to restore the balance between short- and long-term development.

Third, the extremely high population density of Macau makes it a good research site to rethink the man–land relationship. Previous studies have shown that institutional resistance to migration mainly comes from local people’s rejection of outsiders [72]. For example, after Chinese food buffets challenged the local restaurant industry in Germany, the German government judged that Chinese food buffets did not belong to the ethnic restaurant category and turned down work visa applications of all their employees [73]. While the local residents’ view on immigrants also has a policy impact in Macau [11], due to the extreme shortage of land resources, economic development and improvement of housing conditions to some extent become mutually exclusive options, which in turn leads to competition between migrant workers and immigrants in the resource allocation process. The relationship between migration and land is highlighted under such conditions of tension.

6. Conclusions

Based on the annual data from the Macau Statistics and Census Service, this study analyzes the influencing factors in immigration trends in Macau between 1992 and 2019. Through analysis using ARDL-ECM, our study shows that two important indicators of Macau’s urban development, its land area and wage level, have both positive long-term influence on the number of migrant workers, and negative long-term impact on the number of immigrants.

Our study suggests that one possible way out of Macau’s current dilemma is to reduce the cost of urban expansion and improve economic diversity through cross-border cooperation with mainland cities. Macau has mainly expanded its city scale through sea reclamation, the high cost of reclamation programs driving it to become more dependent on the tax revenue from the gaming–tourism industry and hence to allocate yet more land and manpower to this pillar industry. Consequently, Macau cannot fundamentally solve its land shortage through sea reclamation, which only postpones the problem by relying on migrant workers who make low demands on land and social resources. Facing increasing short-term pressures, Macau is unable to address its long-term problems through recruiting skilled immigrants or nurturing local talent. Through transferring a larger proportion of its non-gaming sectors to cooperation zones, Macau might be able to spare land and other resources to absorb a larger amount of non-local talent as well, which would in turn increase the sustainability of its urban development.

Our study is not without limitations. Although Covid-19 and subsequent sudden changes have had a significant impact on the long-term patterns of immigration in Macau, it is not possible for us to include the pandemic period into the analysis of this paper due to data constraints. Both the Statistical Yearbook data and Census data provided by the Macau Statistics and Census Service have rather long intervals between survey time points, which put a limit on their ability to capture sudden changes. Thus, further study of the influential factors on Macau’s immigration trends during and after the pandemic is essential. Moreover, censuses often sacrifice survey comprehensiveness for their coverage. Surveys and interviews on immigrants and migrant workers in Macau in the future should allow for deepened exploration of the changing mechanism. We also notice that regional factors have yet to be taken into account in the causal analysis of migration flows in Macau. In the future, we expect there to be studies combining data from Macau, Hong Kong and mainland cities in the Pearl River Delta which will present a more comprehensive picture of migration in this bay area.
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**Data Availability Statement:** The data analyzed in this study are publicly available at the website of the Macau Statistics and Census Service: https://www.dsec.gov.mo/en-US/ (accessed on 5 November 2022).

**Conflicts of Interest:** The authors declare no conflict of interest.

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