Analysis of the Impact of Education Level on Regional GDP

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Abstract. Through theoretical model analysis and linear regression analysis of Macao, this paper studies the influence of education level on regional GDP. It is found that education level has a significant positive impact on regional GDP. As an important part of human capital, education can improve labor productivity and innovation ability by improving people's knowledge level and skills, thus promoting regional economic growth. The analysis of the theoretical model reveals the multiple channels and mechanisms of education to economic growth, including technological progress, industrial structure upgrading, and job opportunity upgrading. As a special region, the linear regression analysis results show that there is a significant positive relationship between the education level and the GDP of Macao, which further validates the importance of education to economic development. To sum up, the results of this study emphasize the importance of education, and the government and society should increase the investment in education and improve the level of education to promote regional economic growth and social progress.

Keywords: Regional GDP, Multiple Linear Regression Analysis, OLS Regression, Macao, R.

1. Introduction

There is a lot of research being done on how educational attainment affects regional GDP. Education is seen as a crucial component of human capital, which is crucial to the advancement of society and the economy. Over the past few decades, several studies have found a high correlation between educational attainment and local economic development. This study uses theoretical model analysis and linear regression analysis to investigate the mechanism and magnitude of the effect of education level on regional GDP.

This study will take into account a variety of channels and processes for how education affects economic growth in the theoretical model study. First, the improvement of education level can improve the quality and quantity of human capital, thereby increasing labor productivity and innovation ability. Second, education can promote technological progress and innovation, and promote the upgrading and transformation of industrial structure. In addition, education can provide better employment opportunities and income levels, thereby stimulating growth in consumption and investment. By building relevant theoretical models, this study will explore how these mechanisms interact and the extent to which they affect regional GDP [1].

In linear regression analysis, this study use real data to test the assumptions and predictions of a theoretical model. This study will collect data related to educational attainment and Macao's GDP and conduct statistical analysis. By building a linear regression model, this study will explore the relationship between educational attainment and Macao's GDP and quantify the extent of its impact. At the same time, this study will also consider other possible influencing factors, such as labor market conditions, industrial structure, and institutional environment, to control their impact on the results. Through this analysis, this study will draw empirical conclusions about the impact of education level on Macao's GDP and put forward corresponding policy recommendations.

2. Theoretical Analysis

2.1. Human capital accumulation

The accumulation of human capital, or a rise in the workforce's skill set and knowledge base, can be facilitated by raising the degree of education. It can promote creativity, technical development, and greater productivity, which will fuel regional economic growth [2].

2.1.1 Skill enhancement

People who have completed more education are likely to have greater knowledge and skills, which will increase their productivity and efficiency at work. Higher educated individuals typically possess greater professional knowledge and technical proficiency as well as a better capacity for adaptation and reaction to shifting economic conditions. The workforce's quality and productivity are increased because of this upgrading, which promotes regional economic growth.

2.1.2 Adaptability

People tend to be more adaptive and teachable. They possess the capacity to continually learn and refresh their expertise, and they can adjust to new work requirements and technological advances more quickly. The region's economic resilience and competitiveness are increased as a result of its ability to respond more effectively to changes in market demand and economic structure [3].

2.1.3 System Construction

The growth of social structures and the level of education are also closely associated. Higher-educated individuals are more likely to engage in social activities, democratic procedures, and social collaboration, which support social development and stability. The improvement of the efficient use of human capital is facilitated by a favorable institutional framework and the buildup of social capital, which supports regional economic growth.

2.2. Employment and income

Increased educational attainment is generally associated with better job opportunities and higher income levels. People with higher levels of education are more likely to obtain high-paying jobs, thereby increasing their spending power and wealth accumulation, further driving economic growth in the region.

2.2.1 Rate of employment

A higher employment rate is typically linked to better educational attainment. Higher education improves career prospects and job stability by increasing the likelihood that a person will have a high-paying position. High employment rates contribute to higher labor force participation and productivity, which boost the local economy [4].

2.2.2 Productivity Improvement

Increased educational attainment increases the skill level and knowledge base of the workforce, thereby increasing their productivity at work. People with higher levels of education usually have more professional knowledge and technical skills and can complete work tasks more efficiently. This rise in productivity aids in enhancing the effectiveness of firms and industries, which in turn stimulates regional economic growth.

2.2.3 High-wage employment and spending power

Higher education typically translates into higher pay. They can spend more money and buy more goods and services thanks to high-wage employment, which increases market demand and economic activity. The region's economy will grow as a result of this increase in power [5].

2.3. Entrepreneurship and Innovation

Individuals are more likely to be innovators and entrepreneurs who can create new goods, services, and business models that stimulate economic innovation and diversity.

2.3.1 Entrepreneurial activities

People are typically more likely to be business owners. They use the knowledge and skills they acquire to launch new projects or launch their enterprises. Entrepreneurship can lead to new employment openings, new value creation, and economic growth. Entrepreneurs typically have greater commercial and professional expertise, and they are better able to adapt to market difficulties and requirements for innovation.

2.3.2 Innovation ability

People with higher education usually have more innovation ability and creative thinking. They can use their newly gained knowledge and abilities to come up with fresh concepts, find solutions to issues, and promote innovation and technical advancement. Innovation activities are essential for encouraging industry upgradation and transformation while bringing new goods, services, and business models to market. Higher educated individuals are more likely to contribute significantly to innovation and the area economic growth [6].

2.3.3 Entrepreneurial Ecosystem

The improvement of education level helps to establish a good entrepreneurial ecosystem. The entrepreneurial ecosystem includes entrepreneurial support institutions, entrepreneurial culture, venture capital, and innovation networks, etc. People with higher education levels are more likely to participate in the construction and operation of the entrepreneurial ecosystem, promote entrepreneurial activities and innovation cooperation, and thus promote the economic development of the region [7].

2.4. Social capital and social development

The advancement of education can support social growth and the building of social capital. Higher education increases one's likelihood of engaging in democratic procedures, social collaboration, and other activities that support societal stability and growth.

2.4.1 Social stability and capacity for governance

The promotion of social stability and the enhancement of governance capacity can result from improvement. People are more likely to engage in social activities, democratic procedures, and social collaboration, which support social development and stability. Good administration, a stable social environment, and increased economic activity all contribute to a region's competitiveness.

2.4.2 Accumulation of social capital

The development of social capital is facilitated by higher educational attainment. Trust, cooperation, social networks, and social norms are all examples of social capital. Individuals are more likely to participate in social networks and cooperative activities, fostering strong bonds and a foundation of trust. This building up of social capital aids in enhancing the efficacy and efficiency of economic activities as well as fostering regional economic development [8].

2.4.3 Social equity and equal opportunity

Raising educational standards can support social justice and equitable opportunity. Equal opportunity is a key component of education. People can overcome poverty and social inequality and realize the growth of their potential by receiving a high-quality education. Equal chances and a just social environment can encourage people to be creative and innovative, which will help the local economy grow.

2.4.4 Demographic Dividend and Human Resource Advantage

The advancement of education will foster the advantage of human resources. People are more inventive, flexible, and creative, and they may provide more human resources to the area. This advantage in human resources can encourage investment, and industrial upgrading, and serve as a major support for local economic growth [9].

3. Multiple Linear Regression Analysis of the Influence of Education Level on GDP in Macao

3.1. Selection of model variables and samples

To assess the educational advancement of the Macao Special Administrative Region, this article uses the education level of the local population in Macao, China. The level of Macao's economic and social development is measured using the GDP of the Macao Special Administrative Region of China as an indicator. A sample of the statistical data from 2002 to 2022 is chosen for research, and the sample data is normally distributed. In terms of variable relationship, the degree of education is taken as the independent variable, and the degree of education is divided into four variables: primary school, general secondary education, technical secondary education, and higher education. A multiple linear regression model is established with GDP as the dependent variable to determine the quantitative relationship between the education development level of the Macao SAR and the economic and social development level of the Macao SAR.

3.2. The quantitative analysis of the data process

3.2.1 Create a model of multiple linear regression

Education level and GDP data follow the multiple linear regression model's underlying tenets of normal distribution.

In this analysis, X_{1i} is set to represent the number of Macao residents with primary education levels in year i. X_{2i} represents the number of Macao residents with general secondary education in year i. X_{3i} represents the number of Macao residents with a technical secondary school degree in year i. X_{4i} represents the number of Macao residents with higher education in year i. ε is the error term. yi represents the gross national product of Macao in the year i, and assuming that a regression model can be established, the initially established model is:

$$y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \varepsilon \quad (1)$$

3.2.2 solve the OLS Regression

Predictor variables among them include (constant), VAR1, VAR2, VAR3, VAR4, and variable, VAR5. Through RStudio, statistical data can be used for various analyses, including regression statistics, variance analysis, parameter estimates, multicollinearity tests, and more. Identify an important linear relationship between GDP and educational achievement. The equation for multiple linear regression is:

$$y = -0.000461X_1 - 0.00017X_2 - 0.00213X_3 + 0.00157X_4 + 49.34985 \quad (2)$$

The gross national product of the region is somewhat influenced by the degree of education of the population of Macao. A low negative link exists between GDP and primary schools from 2002 to 2012 and a low positive link exists from 2013 to 2022, a low negative correlation exists between GDP and general secondary schools, a negative correlation exists between GDP and secondary technical schools, and a moderate positive correlation exists between GDP and higher education [10].

3.3. Comparison and analysis of line chart

3.3.1 Gross domestic product of Macao

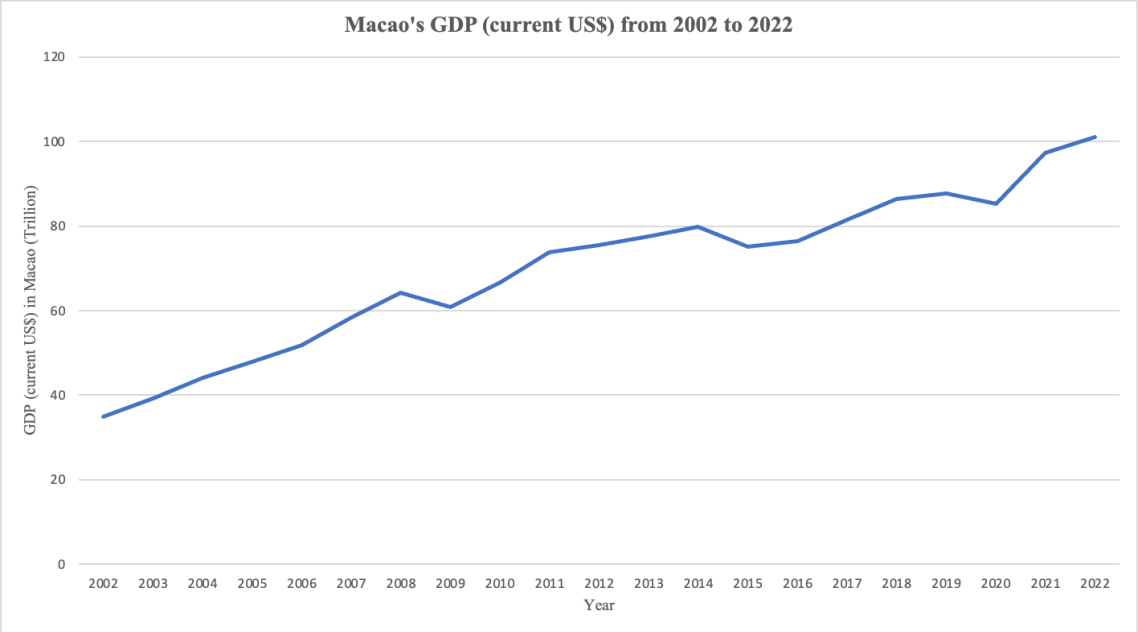

Fig 1. Macao's GDP (current US$) from 2002 to 2022

Figure 1 shows that from 2002 to 2022, Macao's GDP grew steadily.

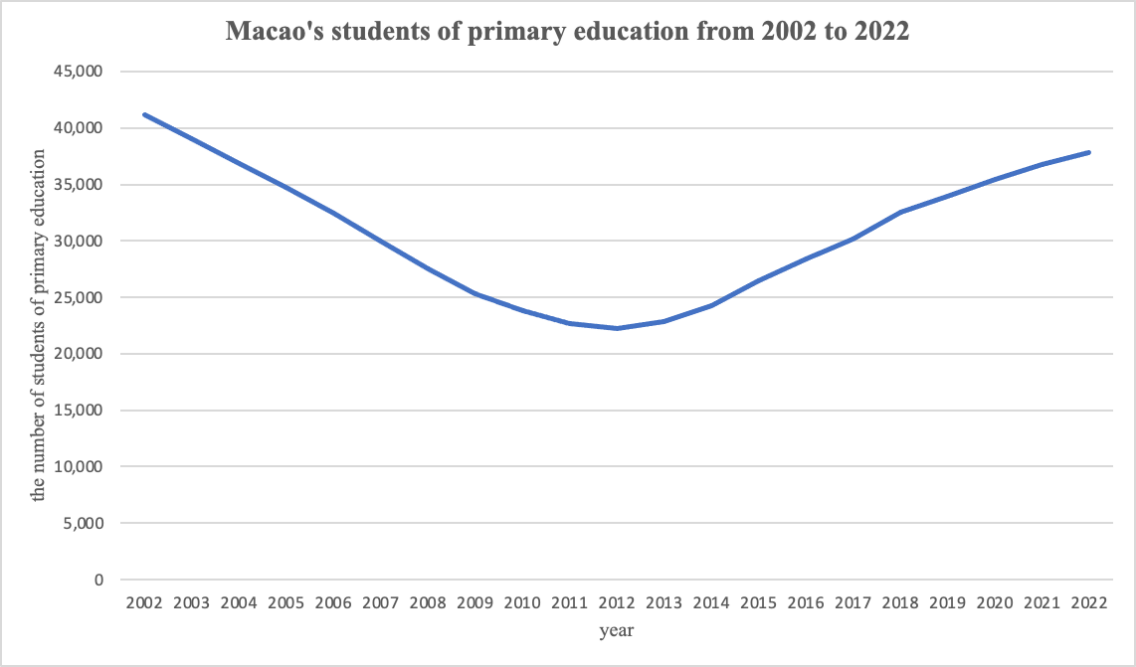

Fig 2. Macao's students of primary education from 2002 to 2022

Figure 2 demonstrates that primary school enrollment in Macao fell between 2002 and 2012 but gradually rose between 2013 and 2022. When compared to Figure 1, it shows that before 2012, the primary school enrollment pattern in Macao was in opposition to the region's GDP, but after 2012, the opposite was true. After 2012, the trend shifted in the opposite direction from that of the region's GDP.

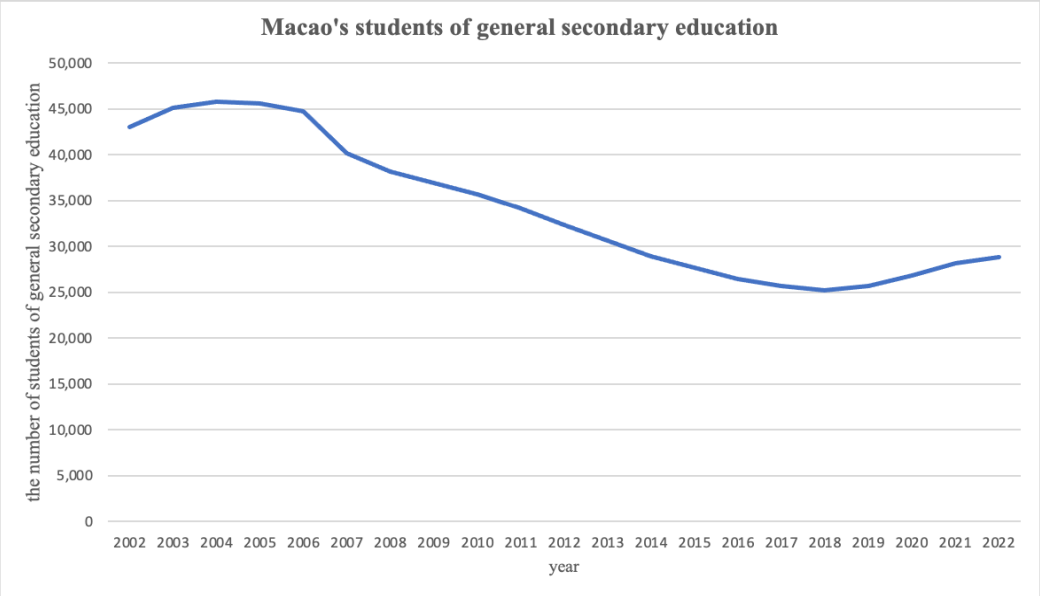

Fig 3. Macao's students of general secondary education

Figure 3 shows that although Macao's students of general secondary education became lower and lower, the GDP of Macao increased steadily. The trend of Macao's students of general secondary education from 2002 to 2022 is the contrary direction of the GDP trend.

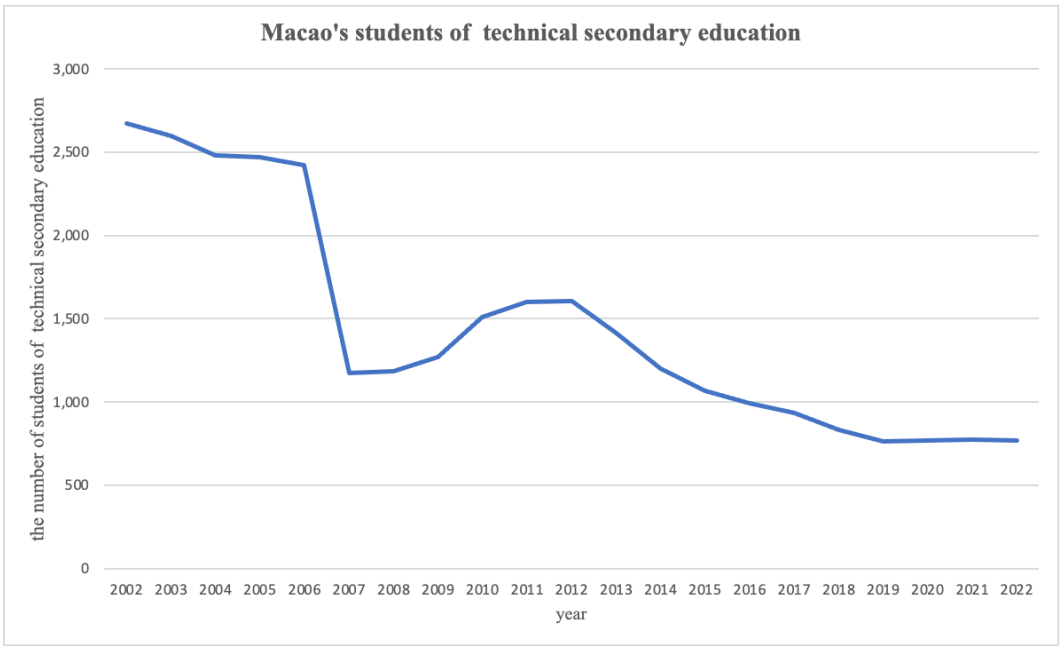

Fig 4. Macao's students of technical secondary education

Despite a little uptick from 2007 to 2012, the overall trend for technical secondary education students in Macao is down. With a few small exceptions, its trend is roughly in line with GDP growth. (Figure 4)

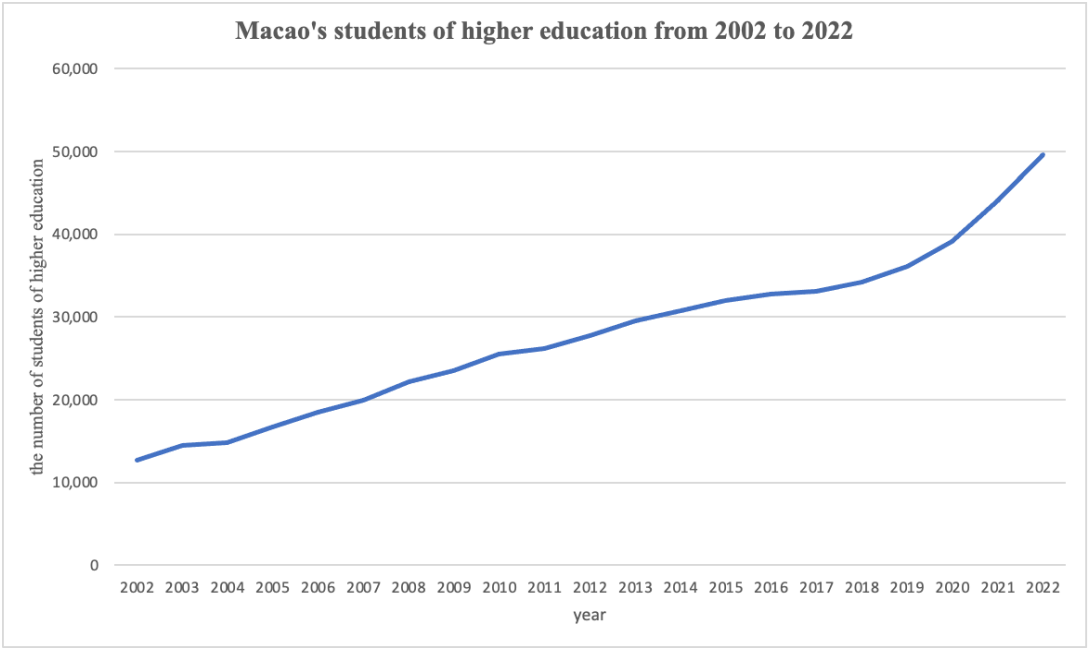

Fig 5. Macao's students of higher education from 2002 to 2022

According to Figure 5, the trend of Macao's students of higher education from 2002 to 2022 also rose steadily. And this trend is similar to Macao's GDP (current US$) from 2002 to 2022.

3.4. Analysis of Factors Affecting Conclusions

The following conclusions can be drawn from this equation:

The education level of Macao residents has a certain impact on the gross national product of the local area. Each level of education has a certain correlation with regional GDP, and the higher the level of education, the greater the role in promoting the economy.

From the above analysis, this study can see that there is a linear relationship between education level and regional GDP. Therefore, vigorously developing education in Macao is of great significance to improving the economy of the Macao Special Economic Zone.

4. Conclusion

Educational level has a significant positive impact on regional GDP. Education has been proven to be an important component of human capital. By improving people's knowledge and skills, it can increase labor productivity and innovation, thereby promoting economic growth in a region.

There are various mechanisms for the impact of education on economic growth. The improvement of education level can promote technological progress and technological innovation, and promote the upgrading and transformation of industrial structure. In addition, education can provide better employment opportunities and income levels, stimulating growth in consumption and investment [11].

As a special region in Macao, the impact of education level on its GDP has also been verified. Through the linear regression analysis of Macao, this study found that there is a significant positive relationship between the level of education and the GDP of Macao. This shows that in this particular region of Macao, education has played an important role in promoting economic development.

To sum up, the level of education has a positive impact on regional GDP. This conclusion has been verified in the theoretical model analysis and the empirical analysis of Macao. Therefore, the government and society should pay attention to the development of education and improve the level of education to promote economic growth and social progress in the region.

References

[1] Gilsdorf, R. A. Dance K-12 in the Vancouver Schools: Innovating, Advocating, Educating. Journal of Dance Education, 2004, 4(4): 111–114.

[2] OECD. Productivity, human capital, and educational policies -OECD. 2022.

[3] Freeman, W., Burns, W., Leonard, M., Fletcher, J., Frederick, M., & Hartman, E. Developing an Adaptability Training Strategy and Policy for the Department of Defense (DOD). 2010.

[4] Bonnie, R. J., Stroud, C., Breiner, H., Committee on Improving the Health, Safety, and Well-Being of Young Adults, Board on Children, Youth, and Families, Institute of Medicine, & National Research Council. Education and Employment. Nih.gov; National Academies Press (US). 2015.

[5] Symthe, A. U.S. labor markets require a new approach to higher education. Equitable Growth. 2021.

[6] Grant, C. The contribution of education to economic growth. 2017.

[7] Malecki, E. J... Entrepreneurship and entrepreneurial ecosystems. Geography Compass, 2018, 12(3): e12359.

[8] Adler, P. S., & Kwon, S. Social Capital: Prospects for a New Concept. The Academy of Management Review, 2002, 27(1), 17–40.

[9] Nations, U. REIMAGINING OUR FUTURES TOGETHER: a new social contract for education. United Nations Educationa. 2022.

[10] Palmisano, F., Biagi, F., & Peragine, V. Inequality of Opportunity in Tertiary Education: Evidence from Europe. Research in Higher Education, 2021, 63(3).

[11] ELAC. Digital technologies for a new future. 2022.