

Determinants of Regional Income Disparities in Egypt: An Empirical Evidence

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Abstract

In Egypt, about 70% of population live in regions where per capita Gross Domestic Product is below the national average. Moreover, the growth of per capita GDP shows high level of disparities between regions. Where economic growth in some governorates is around 9%, in other governorates does not exceed 1%. The problem is more evident when we look at the differences between regions using other economic and social indicators. This gives a conclusion that people in Egypt are live under substantial dissimilarity circumstances. This paper attempts to address the regional disparities problem in Egypt and its determinants. The most commonly disparities measures have been used to assess the severity of the problem through 2012-2021 period using per capita GDP of Egypt's 27 governorates. Then, the main determinants of regional income disparities have defined through investigating the factors that affecting regional per capita through a panel data framework using the fixed effect model (FEM). Results show that, government expenditures, public investments, labor productivity, and employment to population rate have significant positive impact on regional per capita GDP, while urbanization and illiteracy rates are insignificant so based on the model used, they are not determinants of regional disparities.

JEL classification: R11, R58, O47

Keywords: regional disparities, disparities measures, regional GDP, panel data, fixed effect model, Egypt.

ملخص:

في مصر، يعيش حوالي ٧٠% من السكان في مناطق يقل فيها نصيب الفرد من الناتج الإقليمي الإجمالي عن المتوسط الوطني. علاوة على ذلك، يُظهر معدل نمو نصيب الفرد من الناتج المحلي الإقليمي فمستويات عالية من الفوارق الإقليمية. ففي حين يصل النمو الاقتصادي في بعض المحافظات إلى حوالي ٩%، لا يتجاوز في بعض المحافظات الأخرى ١%. وتتجلى المشكلة أكثر عندما ننظر إلى الاختلافات الكبيرة بين المناطق باستخدام مؤشرات اقتصادية واجتماعية أخرى. وهذا يعطي نتيجة مفادها أن الناس في مصر يعيشون في ظل ظروف اقتصادية واجتماعية مختلفة إلى حد كبير. تحاول هذه الورقة معالجة مشكلة الفوارق الإقليمية بين محافظات مصر ومحدداتها. حيث تم قياس الفوارق الإقليمية عبر المحافظات باستخدام أكثر المقاييس التفاوتات شيوعاً لتقييم مستوى التفاوتات الإقليمية خلال الفترة ٢٠٢١-٢٠٢٢. ثم تم تحديد المحددات الرئيسية للفوارق من خلال دراسة العوامل المؤثرة على متوسط نصيب الفرد من الناتج المحلي الإجمالي الإقليمي في محافظات مصر باستخدام نموذج التأثير الثابت (FEM). تظهر النتائج أن النفقات الحكومية والاستثمارات العامة وإنتاجية العمالة ومعدل العمالة إلى السكان لها تأثير إيجابي كبير على نصيب الفرد من الناتج المحلي الإجمالي الإقليمي، في حين أن التحضر والأمية غير مهمين، لذا بناءً على النموذج المستخدم فإنهما لا يشكلان محدّدات للفوارق الإقليمية

1. Introduction:

If there are major differences in the quality of life between different people or groups within a single society, one can speak of disparities. Disparities exist everywhere between countries, among regions within a country, between urban and rural areas, between population groups, between people within a group, even among members of a single family (United Nations, 2001). Generally, regional disparities are defined as the differences in economic performance and welfare among countries or regions (Kutscherauer, 2010). Differences in economic performance between regions within countries can be large and sometimes even larger than between countries. Many are concerned that these large and persistent gaps signal that regions and people are being left behind, undermining inclusive growth. Poor regional performance can fuel discontent and erode social trust and cohesion (Bluedorn et al, 2019).

A simple view of the world would predict that regional disparities were transient. Markets would adjust to bring different areas closer to equality. Labor would leave poorer areas for richer areas and capital would move in the opposite direction. However, in regional economics there are contrasting strands of literature that regional inequalities can be persistent and self-sustaining and have economic consequences on individuals across the generations that often exhibit in poorer health, higher mortality rates, lower educational attainment, and greater crime (Frank, et al, 2021).

Levels of economic activity and welfare differ sharply across sub-national regions in both advanced and developing economies. This inequality is evident when looking at output or income. Generally, less developed economies tend to display more unequal distribution of income and wealth compared to developed economies (Carvajal et. Al, 2018). In advanced economies, real Per capita GDP in leading regions is now on average 70 percent higher than in lagging regions. In developing economies, regional disparities are even larger. Such regional disparities are also reflected in labor-market performance and indicators of human development (Floerkemeier, et al, 2021).

During the last six decades, Egypt has experienced visible swings in inequality, but, if we exclude changes in the distribution of land, these swings have been modest for a country that has experienced all kinds of

political and economic changes (Verme, et al, 2014). However, if we look at the income distribution, human development indicators and access to basic services and opportunities, the problem of regional disparities is evident. Some regions grow faster than others due to the concentration of production, wages and income. In other regions incomes are perennially lower and poverty is higher. Moreover, there are still substantial gaps in consumption and opportunities between growth poles and the rest of the country (World Bank, 2012).

Distinction between regional disparities causes and consequences is necessary when addressing the issue. The indicators that reveal inequalities between countries or regions within a country should be considered measures of inequality that help in identifying the magnitude of the problem that faces people living in underdeveloped areas in compared to residents in the rest of their country. On the other hand, exploring determinants of regional inequalities has been an interesting concern to economists who have been curious to know the elements which cause national and sub-national areas to grow.

Addressing regional disparities problem is a pressing need specially in countries suffering from inequality at both economic and social aspects. Such studies would help in formulating policies that help lagging provinces to catch up with the more developed regions. The main goal of this study is to address the regional disparities problem across Egypt's governorates and its determinants. A panel data set of Egypt's 27 governorates through 2012-2021 have been used to assess the regional disparities level and then used to determine the main factors that affecting regional disparities. Section 2 addressing the problem of regional disparities in Egypt using some economic and social indicators. Section 3 introduces the measurement of regional disparities across Egypt's governorates. Section 4 discusses the main factors that affecting regional disparities through literature reviews. Section 5 investigates the determinants of regional per capita GDP in Egypt's governorates through a panel data framework and discusses the estimation results. Finally, summary and conclusion follow.

2. Regional Disparities Indicators in Egypt

Shifting from GDP to well-being indicators that focus on people's outcomes makes the issue of regional disparities within countries broader for policy makers. The concentration of production in space can be beneficial for

overall economic growth due to agglomeration economies. However, the spread of benefits across all regions is an important objective for policy makers who want to ensure equal opportunities in education, access to jobs and health across regions (OECD, 2016).

In this section, we overview the indicators of regional disparities in Egypt, through analysing some economic and social variables across the country's 27 governorates. We focus on the regional gross domestic product GDP, poverty rate, unemployment rate and illiteracy rate (10 years and more). Based on the recent data set from the Ministry of Development and planning and the Central Agency of Mobilization and Statistics (CAPMAS).

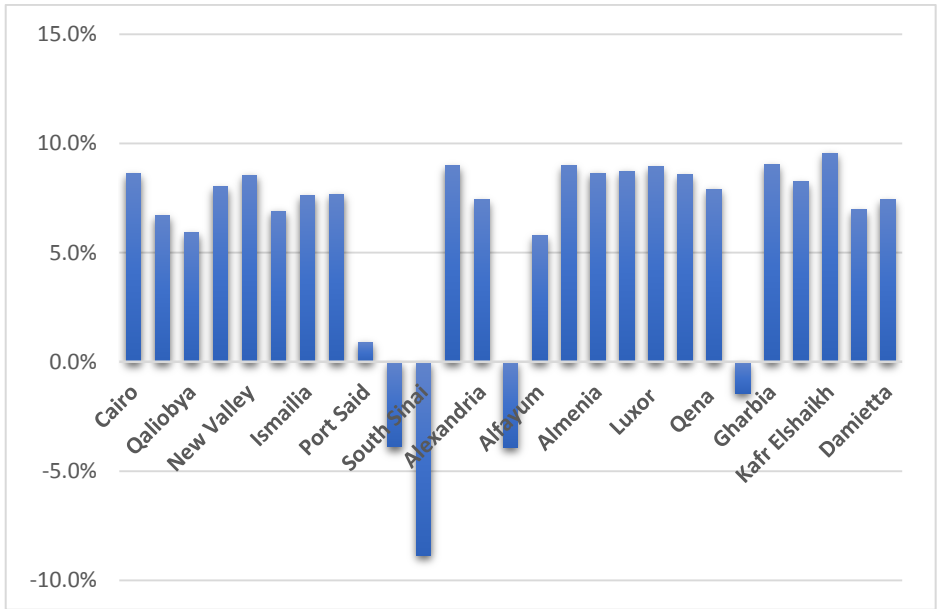
2.1 Regional Gross Domestic Product.

Gross Domestic Product (GDP) is one of the determinants of country's economic growth. it measures the national income and output for a given country's economy. The definition of GDP is based on the total market value of all final goods and services produced within the country in a given time period (normally one year) (Kira, 2013).

Regional Gross Domestic Product (GDP) per capita is one of the ways to measure the level of welfare of the population in a province. The greater per capita GDP of a province indicated the better level of people welfare. Likewise, if the GDP is smaller than the other cities, it shows the low level of people welfare. However, urban regions with higher economic growth will face a growing burden due to the migration of the residents from the lower-level region of economic growth. This condition occurs because of the attractiveness of more employment opportunities in the urban regions. (Purba et al, 2018).

Gross domestic product for Egypt's governorates shows a huge difference between governorates in compared to the national average GDP. Regional Per capita GDP is ranged from 31% to 800% to the national average (Fig.2). About 70% of population live in regions where GRP per capita is below the national average. Also, the economic growth of GRP per capita shows high level of disparities, where economic growth in some governorates is around 9% (Cairo, beheira and Gharbia), in other governorates it does not exceed 1% (Port Said) or even negative growth (North Sinai, South Sinia, Red Sea and Matrouh) (fig.1).

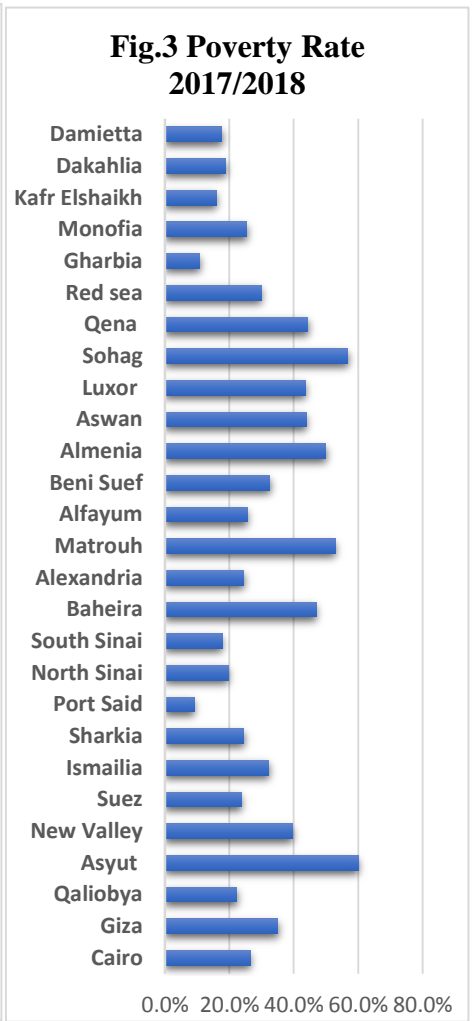
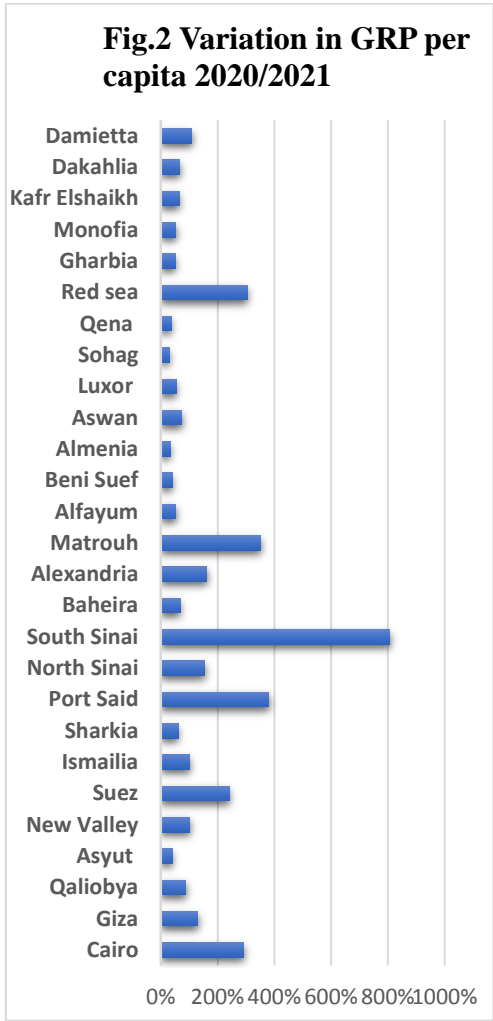
Fig.1 Regional Per capita GDP Growth Rate 2020-2021.



Source: Based on GDP by Governorates, The Ministry of Planning and Development Data, 2024.

2.2 Regional Poverty

Poverty rates is an important measure to reveal the regional disparities across governorates. According to the Household Income, Expenditure and Consumption Survey HIECS 2017/2018, the percentage of Egyptians living below the poverty line increased during 2017/2018 to 32.5%, compared to 27.8% in 2015. The problem is more evident at the regional level, where poverty does not exceed 10% in some governorates like port said (9.1%), more that 50% of residents in other governorates suffer from high poverty rates especially in Upper Egypt. For example, poverty rate in Asyut reaches 60% (Fig.3).



Source: Based on GDP by Governorates, The Ministry of Planning and Development Data,

Source: Based on 2017/2018 HIECS, survey, CAPMAS, 2019.

2.3 Regional Unemployment

The unemployment rate reflects the ability of the economy to provide job opportunities. According to the Central Agency of Mobilization and Statistics (CAPMAS), The unemployment rate of Egypt's governorates in 2021/2021, ranged from 1.6% in Qena to 33% in south Sinai (fig. 4). Increasing the unemployment rate causes many problems such as decreasing regular income purchasing power which making it difficult for individuals to meet their basic needs and sustain a decent standard of living. Moreover, it increases the burden on urban regions with higher economic growth due to the migration of the residents from the lower-level region of economic growth.

2.4 Regional Illiteracy

Literacy rate is an outcome indicator to evaluate educational attainment. It can be used as a proxy instrument to see the effectiveness of education system. Illiteracy rate suggests the capacity of an education system to provide population with opportunities to acquire literacy skills (World Bank, 2024). Illiteracy is one of the most serious problems that countries of the world suffer from especially developing countries due to its negative effects on the social, economic, political, and environmental levels. In Egypt illiteracy is ranged from 5.8% in Red sea to 33% in Matrouh reflects a large inequalities across governorates that affects people's opportunities and welfare.

Based on the previous discussion, the regional disparities in Egypt is an evident problem at both economic and social aspects. Moreover, most governorates that suffer from low per capita GDP, also suffers from high poverty rates and high illiteracy rates (See fig 2, 3 and 5). Per capita GDP is the most frequently used index in measuring regional disparities as it reflects region's production capacity, income, and economic development level. In the next section, the regional disparity in Egypt is measured using some indices that commonly used in the literature.

Fig. 4 Unemployment Rate 2020/2021

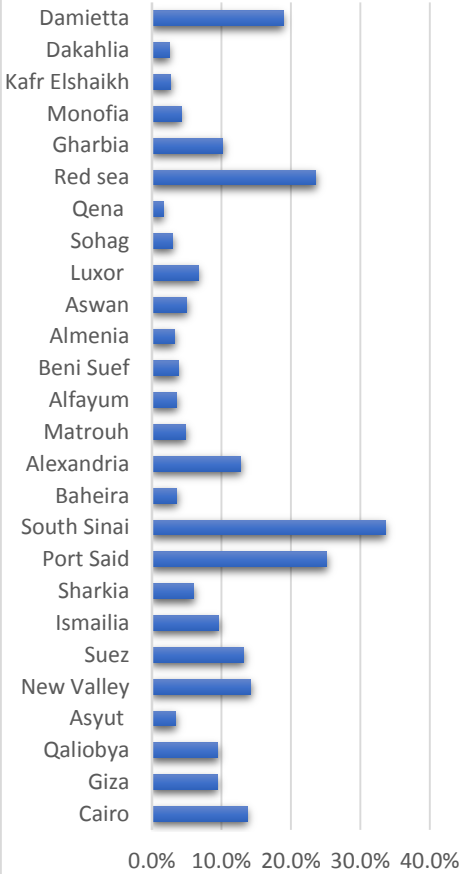
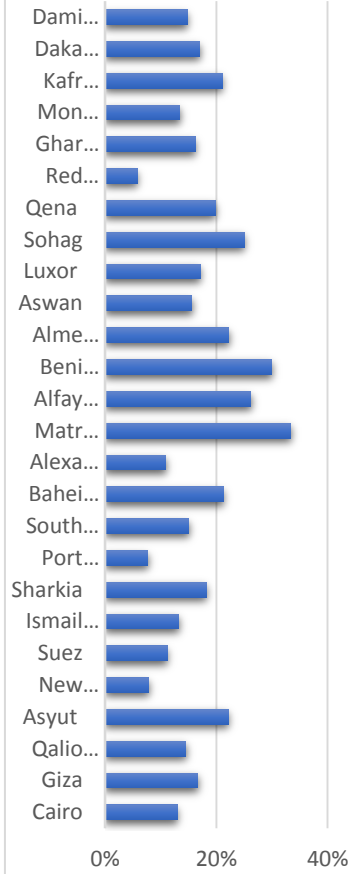


Fig. 5 Illiteracy Rate 2020/2021



Source: Based on Bulletin of Aggregated Labor Force Survey, CAPMAS, 2021.

3. Measuring regional disparities in Egypt:

The concept of disparity (disparity, inequality, imbalance, etc.) is used both by analysts, academics to express differences identified using appropriate mathematical techniques, using specific indicators or indices (Antonescu, 2012). Although it is difficult to measure the regional disparities that reflects different socioeconomic variables, most inequality indexes and polarization measures in the literature based on regional per capita income to measure the regional inequality (Ozrurk, 2012).

The distribution of income could be measured through per capita GDP, household income, and per capita consumption to reflect regional income level and household welfare level in different ways. However, due to limitations in the data availability, the per capita GDP is used to reflect regional disparities. Per capita GDP is the most commonly used indicator that provides initial information about the regional performance (Tvrdoň and Skokan 2011). It is often used for interregional comparison as in compared to other indexes, as its statistics are relatively complete and perfect.

Regional disparities can be measured using the following measures:

3.1 Ratio of maximum to minimum values

To conduct a simple analysis of regional disparities, the ratio of maximum to minimum values of income (Max/Min, or MMR) can be calculated based on regional per capita GDP (Li and Xu, 2008).

$$\text{Maximum to minimum ratio} = \frac{y_{Max}}{y_{Min}}$$

Where y_{Max} is maximum regional per capita GDP and y_{Min} is the minimum regional per capita GDP.

3.2 Coefficient of Variation (CV)

The coefficient of variation is one of the most widely used measures of regional inequality in the literature. The CV is a measure of dispersion around the mean. It represents the ratio between the standard deviation of regional Per capita GDP and national Per capita GDP (Ozturk, 2012).

$$CV_u = \frac{\sqrt{\frac{\sum_i^n (y_i - \bar{y})^2}{N}}}{\bar{y}}$$

Where, CVU is unweighted coefficient of variation, y_i is the income per capita of region i , N is the number of regions and \bar{y} is the of national per capita income.

3.3 The weighted Coefficient of Variation (Williamson index)

The second measure is the weighted coefficient of variation where each regional deviation is weighted by its share in the national population. It also called the Williamson index that introduced by Jeffrey G Williamson in 1965 study to measure income disparity (Anggara, 2018; Hasyim, 2018; Harmadi, 2020; Purba, 2018; Sari, 2018; Fransiska & Setiawan, 2022). The index is based on the estimated value of the regional per capita GDP and the population of the area analysed.

$$CV_w = \frac{\sqrt{\sum_i^n (y_i - \bar{y})^2 \frac{p_i}{p}}}{\bar{y}}$$

Where, CVW is weighted coefficient of variation, y_i is per capita GDP in region i , and \bar{y} is per capita GDP at national level. p is the total population of country, and p_i is the population of region i . The smaller the index or the closer to 0, the smaller the level of regional inequality as long as the coefficient goes up, the size of geographical disparities increases (Maden et al, 2018; Elpisah et al, 2021).

3.4 Theil Index (T)

The final measure of disparities used in this paper is the Theil entropy index. Following Theil (1967), it is computed as follows:

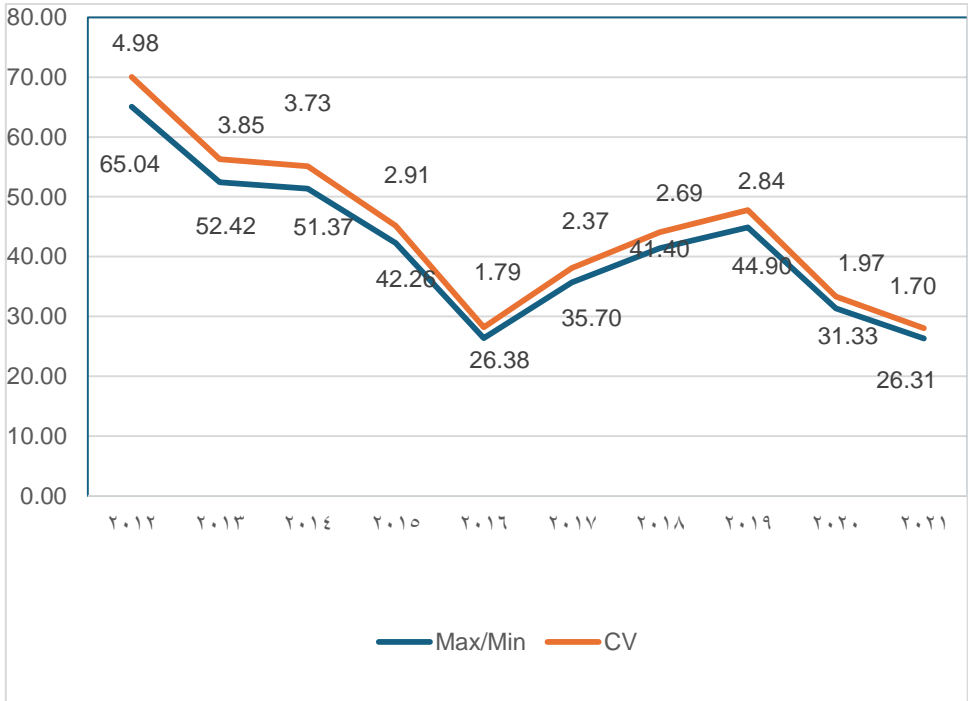
$$T = \sum_{i=1}^n x_i \log\left(\frac{x_i}{p_i}\right)$$

Where n is the number of regions, x_i is the income share of region i and p_i is the population share of region i .

The Theil index follows a descriptive approach to inequality which does not involve welfare judgements. It is based on the concept of entropy, which refers to deviations from perfect equality (Villaverde and Maza, 2009). The index measures an entropic "distance" the population is away from the "ideal" egalitarian state of everyone having the same income (United States Census Bureau, 2024). It takes values from 0 to $\log N$, whichever is the higher value being achieved, the more the uneven distribution of income.

The changes in the disparities between Egypt's governorates is calculated using the four previously discussed measures based on regional gross domestic product (Per capita GDP) over the period 2012-2021. The data set were collected from the database of the Ministry of Planning and Economic Development and the Central Agency of Mobilization and Statistics (CAPMAS) for Egypt's 27 governorates.

Fig.6 Regional Disparities in Governorates based on Max/Min ratio and Coefficient of Variation (CV)

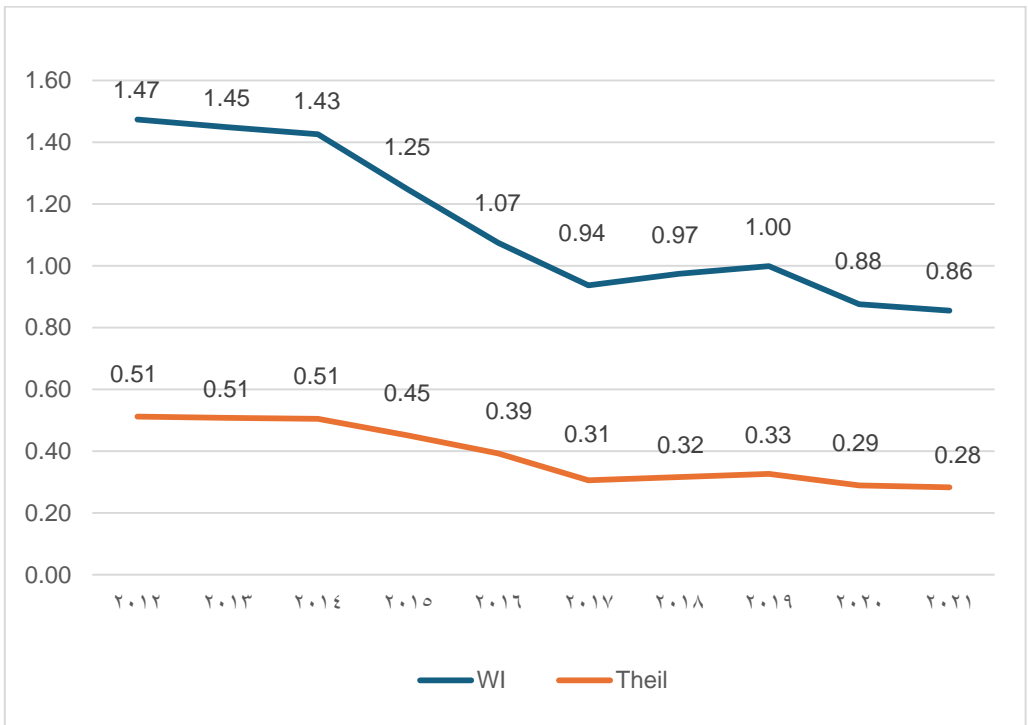


Source: - GDP by Governorates, The Ministry of Planning and Development Data, 2024
 - Statistical Yearbook, Population, CAPMAS, different years.

Figure 6 depicts changes in both the ratio of maximum to minimum and the Coefficient of Variation (CV) across the 27 governorates. In 2012, the ratio of maximum to minimum value of per capita GDP was 65.04. It then started to decrease until 2016 reaches 26.4. The ratio increases from 2017 to 2019 then started to decrease again until it reaches the lowest rate in 2021 as it recorded 26.3 which means that the maximum per capita GDP equal 26.3 the minimum one. Results of Coefficient of Variation (CV) show similar trends. It also decreases along the period from 4.9 in 2012 to 1.7 in 2021 except for 2017-2019 years.

According to Williamson Index and Theil Index, regional disparities decrease along the research period except for 2017 and 2018. The two measures reach their lowest values in 2021 by recording 0.86 and 0.28 for Williamson index and Theil index respectively as it shown in figure.7.

Fig.7 Regional Disparities in Governorates based on Williamson Index and Theil Index



Source: GDP by Governorates, The Ministry of Planning and Development Data, 2024

Statistical Yearbook, Population, CAPMAS, different years.

According to the measurement results, regional disparities in Egypt decreased overtime. However, it still too large based on the indices values. If we exclude the five border governorates which are: Red Sea, The New Valley, Matrouh, North Sinai, and South Sinai that may affect the results due to the large per capita GDP as these regions accounts for only 1.7% of total population, the indices values will decrease but still reflects high

regional disparities. For example, in 2021, The maximum to minimum ration will decrease from 26.3 to 12.4, the Coefficient of Variation (CV) will decrease from 1.7 to 0.8, the Williamson Index will decrease from 0.86 to 0.79 and the Theil index decreases from 0.28 to 0.22 (see table.1)

Table.1 Regional Disparities in Egypt 2012-2021 (Based on regions' per capita GDP)

	With border governorates				Without border governorates			
	Max/Min	CV	WI	Theil	Max/Min	CV	WI	Theil
2012	65.04	4.98	1.47	0.51	12.4	0.69	0.88	0.1
2013	52.42	3.85	1.45	0.51	12.6	0.65	0.85	0.073
2014	51.37	3.73	1.43	0.51	12.8	0.66	0.87	0.077
2015	42.26	2.91	1.25	0.45	13.1	0.66	0.90	0.095
2016	26.38	1.79	1.07	0.39	13.3	0.67	0.95	0.123
2017	35.70	2.37	0.94	0.31	14.9	0.88	0.79	0.088
2018	41.40	2.69	0.97	0.32	17.7	1	0.80	0.086
2019	44.90	2.84	1.00	0.33	19.1	1.04	0.80	0.086
2020	31.33	1.97	0.88	0.29	13.3	0.83	0.79	0.22
2021	26.31	1.70	0.86	0.28	12.4	0.80	0.79	0.22

Source: Based on the researchers' calculations.

Based on the previous discussion. The regional disparities problem in Egypt is evident. The regional disparities reveal large differences in per capita GDP across Egypt's governorates. Addressing the main causes regional disparities is critical and may help policy makers to adapt polices to narrow the economic gaps between Egypt regions. The main determinants of regional disparities could be addressed through investigating the main factors that affecting the regional per capita GDP is the main variables used in calculating the disparities indices.

4. Literature Review

It is generally accepted, that economic growth exists when there is positive change in the Gross Domestic Product (GDP) supported by an increase of per capita GDP (Pires Manso et al, 2015). The rise in per capita GDP could enhance regional growth and help regions to cope with their challenges such as unemployment, poverty, and other socioeconomic problems. Distributions of average income (in the form of Per capita GDP) are used by EU authorities to evaluate the development level of each region and to determine the funding of each region through national and European policies

(Goletsis and Chletsos, 2011). On the other hands, changes in regional income disparity can be caused by differences in regional economic growth rates. If high-income provinces grow faster than the national average, the interregional income disparity can expand; if low-income provinces grow faster, the inter-regional income disparity will narrow (Li and Xu, 2008). Based on that addressing the main factors that affects the regional per capita GDP will help in identifying the main factors that could enhance regional growth and narrow regional disparities.

Previous studies that addressed the factors that affects the regional economic performance have relied on different theoretical approaches and have demonstrated shown mixed results. In order to formulate a model that can define the causes of changes in regional per capita GDP, we explored a number of studies that addressed the determinants of regional performance in the form of per capita GDP, regional growth and income inequality.

(Juliannisa and Artino, 2022) relied on Solow and Swan's Theory to address the factors that affects regional per capita GDP using data of 7 Asian countries by applying multiple linear regression. The theory suggested that economic growth is affected by the growth of production factors such as population, labor, capital accumulation and level of technological progress. Results show that labor does not have a significant impact on per capita GDP, while the entrepreneurship and technology variables have a positive and significant impact on per capita GDP.

(Mose, 2021) has also adopted the Solow and Swan theoretical framework using a Cobb Douglas production equation to estimate the long-run and short-run effects of regional economic growth determinants in Kenya. Results show that public investment, government consumption, quality of governance and institutions, electricity infrastructure and human capital stock as the main determinants of economic progression in the Kenya counties.

Moreover, (Zheng et al, 2021) investigate the changes in regional disparities based on the endogenous growth model's approach which emphasise the role of research and development (R&D), human capital accumulation and externalities in the growth process. The study examines the effects of investment rate, education level, infrastructure, marketization degree, urbanization rate, regional government expenditure on economic growth. Results show that domestic capital investment and inward FDI have positive

significant impact while labor productivity and human capital variables are insignificant.

On the other hand, (Kira, 2013) relied on the Keynesian theoretical approach to analyse the factors that affect the GDP in Tanzania. This approach focuses on investment, savings and government expenditure as the major variables affecting the growth rate of GDP. The model has estimated by investigating the impact of government expenditure, household expenditure, investment, and exports on GDP from 1970 to 2009. Results show that Tanzanian GDP is affected only by government expenditure, household expenditure and exports while investment has no significant impact on GDP.

Within a geographic economy framework (Zhang, 2022) assessed the regional inequality of resident income in local China by investigate the factors that affects the per capita disposable household income. The geographic aspect focuses on the effect of spatial heterogeneity on the income level of residents. Results show that the disposable income is determined by commerce prosperity, urban intensity, and technological capacity, while the effect of regional income, household deposits and industrial production were insignificant.

Using the per capita GDP as the dependent variable, (Pires Manso et al, 2015) define the determinants of regional growth in Portugal between 1999 and 2010. A panel data approach using the fixed, random, and pooled effects models for the analysis. The results confirms that employment, sectorial gross value added GVA, electricity consumption, number of museums and landline phone accesses have a positive impact on regional per capita GDP. While, the number of residents, population density, number of medical doctors and technical progress presents a negative correlation instead. Furthermore, (Ilter, 2017) explores too the social and economic factors that affect per capita GDP for a sample of 40 countries. Results showed that population, GDP, transparency score and compulsory education are the factors that affect Per capita GDP the most.

To determine factors that affecting regional economic growth (Li and Xu, 2008) conducted a quantitative analysis using provincial economic growth data in China to investigate the effects of fixed asset investment rate, average education level, development level of infrastructure, regional marketization degree, urbanization rate, and share of regional government

expenditure in GDP on economic growth. Results show that all the suggested factors have significant positively affected regional economic growth. Following the same approach, (Nawatmi et al, 2020) determined the factors that influence regional economic growth using data from 2015 - 2017 of 34 provinces in Indonesia. The study applied the fixed effect model (FEM) and results show that fiscal decentralization, capital, and labor have a significant positive effect on regional economic growth.

To analyse patterns of income inequality and its determinants in the countries of Latin America (Carvajal et. Al, 2018) applied an econometric panel data model is then to study the determinants of inequality. Results show that per capita GDP, per capita health spending, tax pressure, the poverty rate, the literacy rate and years of schooling are statistically significant variables in explaining inequality. Also, (Wilantari et al, 2022) investigated the factors that affecting regional income disparities six provinces of Java Island, Indonesia during the period 2010 -2019 by assessing the impact of physical investment, number of workers, technology, and education on disparities index. Results show that only investment has significance effect on regional income disparities.

Based on the previous discussion, different approaches have applied to address the determinants of regional economic performance. Relying on them and based on the available information at the governorates level in Egypt. We next formulate a framework to investigate the main factors that affect regional per capita GDP in Egypt.

5. Methodology and Results:

To investigate the main factors that influence the regional per capita GDP. A panel data set of Egypt's 27 governorates from 2012 to 2021 will be employed to estimate the impact of government expenditure, public investments, Labor productivity, employment to population rate, urbanization rate and illiteracy rate on regional per capita GDP. The governorates GDP data obtained from the Ministry of Planning and Economic Development. Government expenditures and public investment were sourced from the Ministry of Finance, Where, Employment, total population, urban population, and illiteracy rate, were sourced from the Central Agency of Mobilization and Statistics (CAPMAS).

Dependent Variable

regional per capita GDP has chosen to be the dependent variable in the estimation model. On one hand as it is the most frequently used index to reflect regions income, and economic development level. On the other hand, its statistics are available for the 27 governorates in Egypt along the research period 2012-2021.

Independent Variables

The first independent variable that has been chosen to estimate the determinates of regional income is *public investment* which supported by both theoretical and empirical literature to have a positive impact on regional economic performance by increasing productive capacity, enhance technology and labor productivity. *Government Expenditures* that suggested by the Keynesian model to affect GDP. It could increase regional GDP through its direct effect on education, health, infrastructure, and human development. *Labor productivity* is a crucial factor in determining economic output and the long-run growth trend. *Employment to Population Ratio* is a key factor to affect regional GDP as it indicates how efficiently an economy provides jobs for people who want to work. It also provides a picture of the percentage of the total region population that gain income. *Urbanization rates* reveal the percentage of population that live in urban areas to total region population. Urbanization rates is often associated with increases job opportunities and higher wages. *Illiteracy rate* which considered an outcome indicator to evaluate educational attainment and can serve as a Human Capital Index.

The model that will be estimated can be formalized as:

$$\ln grpc_{it} = \alpha_0 + \beta_1 \ln INV_{it} + \beta_2 \ln GOV_{it} + \beta_3 \ln LP_{it} + \beta_4 Emp + \beta_5 URB_{it} + \beta_7 HK_{it} + \varepsilon_{it}$$

i ($i = 1, 2 \dots 27$) identifies the region; t ($t = 2012 \dots 2021$) identifies the year.

Where

$\ln grpc_{it}$ is regional per capita GDP in region i ,

$\ln INV_{it}$ stands for public investments to region i ,

- $\ln GOV_{it}$ is government expenditures allocated to region i
 $\ln LP_{it}$ stands for labor productivity,
 emp_{it} is the labor force participation rate,
 URB_{it} is the urbanization rate,
 HK_{it} is the illiteracy rate.
 ε_{it} is the error term.

In this type of studies, it is preferable to convert the variables into natural logarithms. except variables that presented negative values or rates, and the trend to minimize the eventual presence of multicollinearity between the explanatory variables reduce the variability of the values (homogenization of variance) (Pires Manso, 2015). We converted the per capita GDP, government expenditures, public investment, and labor productivity into natural logarithms. Other variables have presented as rates.

The data are described in the following table:

Table.2 The Description of The Model Variables

Variable	Description	Expected sign with $\ln grpc_{it}$
$\ln grpc_{it}$	Per capita gross regional product which calculated by dividing governorate's GDP by governorate's population.	NA
$\ln INV_{it}$	Public Investment measured by total public investments allocated to governorate.	+
$\ln GOV_{it}$	government expenditures measured by total government expenditure allocated to governorate.	+
$\ln LP_{it}$	Labor productivity measured by dividing region's GDP by population.	+
emp_{it}	Employment to population rate. Measured by dividing the employment and total population,	+
URB_{it}	Urbanization rate, which is the share of governorate population that live in urban areas to total population.	+
HK_{it}	Illiteracy rate. Which is the share of population that cannot read or write (10 years or more) to total governorate's population.	-

To identify the most appropriate panel model, both a fixed effects and a random effects models will be estimated first. The fixed effects model treats each α_0 as a constant in the regression, while the random effects model treats α_0 as a component of random disturbance. Hausman test (1978) is performed to detect whether the random effects estimator is more suitable than the fixed effects. If the test probability value below the 5%, the best model is the fixed effect, whereas if it is above 5% then the best model is a random effect. The result in Table 3 shows that the probability value of the Chi-square cross-section (0.0025) is smaller than 5%. That is, the best model between the two models is the fixed effect model (FEM).

Table.3 Hausman test

Ho: difference in coefficients not systematic		
Test Summary	<i>Chi-Sq.</i>	<i>Prob</i>
	20.28	0.0025

because $\text{prob} < 0.05$, the selected model is Fixed Effect.

Results of the fixed effect model are presented in table.4. Results show that government spending, investments, labor productivity and employment rate have a significant positive impact on regional per capita GDP. While the illiteracy as an indicator of human capital and urbanization that indicate the share of people live in urban areas are not determinant of regional disparities as the results show that they have insignificant impact on regional per capita GDP. The model explains 97 % of changes in per capita GDP as R^2 coefficient shows.

Table.4 Fixed Effect Model Result

Dependent Value: ln per capita GDP	Number of observations =270
Method: Fixed Effect Model	Number of groups = 27
<i>Ln gov- exp</i>	0.053995***
<i>Ln investment</i>	0.018744*
<i>Ln labor productivity</i>	0.9579545***
<i>employment rate</i>	5.039385***
<i>Urbanization rate</i>	-0.179202
<i>Illiteracy rate</i>	_ 0.4139755
<i>Cons</i>	3.52042***
<i>R²</i>	97.8%
<i>Adjusted R²</i>	97%
<i>Fisher test (f-stat)</i>	(146.34) ***
<i>Note:</i> - ***, **, * indicate significance at 1%, 5% and 10% respectively.	

The government expenditure variable has a coefficient 0.053 and probability shows a value of 0.006 which is smaller than the confidence level $\alpha = 5\%$ so this can prove that government expenditure variable has a positive significant effect on per capita GDP. Investments has a coefficient 0.0187 and probability shows a value of 0.07 which is smaller than the confidence level $\alpha = 10\%$ so this can prove that the investments variable has a positive significant effect on regional disparities. Also, labor productivity has a coefficient 0.957 and probability shows a value of 0.000 which is smaller than the confidence level $\alpha = 1\%$ so this can prove that the variable has a positive significant effect on per capita GDP. Employment to population rate has a coefficient 5.03 and probability shows a value of 0.000 which is smaller than the confidence level $\alpha = 1\%$ so this can prove that the variable has a positive significant effect on per capita GDP. The urbanization rate as well as illiteracy rate show insignificant effects.

6. Summary and Conclusion

A common goal for regional development policy is to reduce regional disparities by boosting performance in the lagging regions. In Egypt, despite rapid progress in welfare indicators in lagging regions, there are still substantial gaps in income and opportunities between growth poles and the rest of the country. In this paper, we addressed the issue of regional disparities in Egypt. We started by shed the light on some indicators that reveals the problem (GRP per capita, poverty, unemployment and illiteracy) which show huge differences between governorates. Then, we tended to measure the regional disparities using some commonly used indices that rely on measuring the variance economic gap between gross regional product and national average and comparing income across regions using the per capita GDP of Egypt's 27 governorates through 2012-2021 period. Regional disparities measures indicate high income inequalities between governorates. Despite the decreasing in the measures values throughout the study period, the economy still suffers from the high income disparities.

Then, we proceed to determine the main factors that affect regional GDP per capita as the main variable that directly affects the regional disparities measures. The study examines the impact of some variables that suggested by both theoretical and empirical literature to have significant impact on regional GDP. Results show that, government expenditures, investments, labor productivity and employment to population rate have significant positive impact on regional per capita GDP, while the impact of both urbanization and illiteracy is insignificant so based on the study empirical model, they are not determinant of regional disparities.

To reduce regional development disparities in Egypt, the formulation of policies that gives more attention to lagged regions would enhance both regional and national economic growth and development. This implies that in order to effectively boost economic growth in Egypt's regions and reduce inequalities, policies and resources should be directed to increase public investment and government expenditures, which allocated to governorates especially the most lagged. More important is to increase productive activities and job opportunities in less developed regions.

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