FEMISE CONFERENCE PAPER N. 20

MEASURING THREE DECADES OF REGIONAL ECONOMIC INEQUALITY IN EGYPT AND HOW IT WAS AFFECTED BY THE 2016 STRUCTURAL ADJUSTMENT PROGRAM

Hussein Suleiman

FEMISE
ECONOMIC RESEARCH FORUM منتدى البحوث الاقتصادية
IEMed. European Institute of the Mediterranean

FEMISE CONFERENCE **PAPER**

MEASURING THREE DECADES OF REGIONAL ECONOMIC INEQUALITY IN EGYPT AND HOW IT WAS AFFECTED BY THE 2016 STRUCTURAL ADJUSTMENT PROGRAM

Author:
Hussein Suleiman, Al-Ahram Center for Political and Strategic Studies, Cairo, Egypt. Graduate School of International Development, Nagoya University, Japan

Editing: FEMISE
Peer Reviewer: Anonymous
Design Layout: Núria Esparza
Layout: Núria Esparza

September 2025
Published by FEMISE and IEMed

This paper was submitted and accepted for presentation at the FEMISE 2024 Annual Conference, "The Euromed Partnership as a Catalyst for SDGs: Advancing Value Chains, Climate Action, Digital Transformation, and Youth Empowerment," Cairo, Egypt, 10-12 December 2024.

The paper was evaluated and peer reviewed by experts, whose contributions are greatly appreciated. The revised version was accepted for publication under the FEMISE Conference Paper series.

FEMISE, **Forum Euroméditerranéen des Instituts de Sciences Économiques** (the Euro-Mediterranean Forum of Institutes of Economic Sciences), is a Euromed network established in Marseille, France in June 2005 as an NGO (under the French Law of 1901), following 8 years of activities. The network gathers more than 100 members of economic research institutes from the North and South of the Mediterranean, representing the 37 partners of the Barcelona Process and the European Neighbourhood Policy (ENP).

FEMISE is coordinated by the Economic Research Forum (ERF), Egypt.

The **Economic Research Forum** (ERF) is a regional network dedicated to promoting high quality economic research to contribute to sustainable development in the Arab countries, Iran and Turkey. ERF operates from two offices in the region, in Cairo, Egypt and in Dubai, United Arab Emirates. ERF's main office is located in Cairo, Egypt.

Established in 1993, ERF's core objectives are to build strong research capacity in the ERF region; to lead and support the production of independent, high quality economic research; and to disseminate research output to a wide and diverse audience.

The **European Institute of the Mediterranean** (IEMed), founded in 1989, is a think and do tank specialised in Euro-Mediterranean relations. It provides policy-oriented and evidence-based research underpinned by a genuine Euromed multidimensional and inclusive approach.

The IEMed is a consortium comprising the Catalan Government, the Spanish Ministry of Foreign Affairs, European Union and Cooperation, and the Barcelona City Council.

MEASURING THREE DECADES OF REGIONAL ECONOMIC INEQUALITY IN EGYPT AND HOW IT WAS AFFECTED BY THE 2016 STRUCTURAL ADJUSTMENT PROGRAM

CONTENTS

ABSTRACT

Official estimates of income inequality in Egypt, derived from household surveys, are few and dispersed, but report consistently low/falling inequality in recent decades. This contradicts the popular perception of rising inequality that has arguably fuelled the Arab Spring. This discrepancy has been termed the 'Arab inequality puzzle' in recent literature.

This paper revisits the paradox by measuring regional economic inequality across Egyptian provinces from 1992 to 2022, using provincial real output per capita. It shows that regional inequality in Egypt has been high, and has risen since the mid-1990s. The paper provides evidence that a decline that occurred in recent years, was driven by shocks, most notably, the structural adjustment program launched in 2016. This decline has been short-lived and resulted from a short-term fall in output per capita in wealthier provinces, rather than accelerated growth and convergence of poorer ones. Given that poverty and wealth are often spatially concentrated, the study argues that regional economic inequality, while distinct from personal income inequality, can serve as a meaningful proxy for broader inequality dynamics in Egypt.

Keywords: Regional inequality · Structural adjustment · Egypt

JEL Codes: D30, E01, O15, O53, R10

RÉSUMÉ

Les estimations officielles des inégalités de revenu en Égypte, dérivées des enquêtes auprès des ménages, sont rares et dispersées, mais elles indiquent de façon constante un faible niveau d'inégalités ou une tendance à la baisse au cours des dernières décennies. Cela contredit la perception populaire d'une hausse des inégalités, qui a sans doute alimenté le Printemps arabe. Cette contradiction est désignée dans la littérature récente comme le « paradoxe des inégalités arabes ».

Cet article revisite ce paradoxe en mesurant les inégalités économiques régionales entre les provinces égyptiennes de 1992 à 2022, à partir du produit réel par habitant. Il montre que les inégalités régionales en Égypte sont élevées et qu'elles se sont accrues depuis le milieu des années 1990. L'étude fournit des preuves qu'un déclin observé ces dernières années est principalement dû à des chocs, notamment le programme d'ajustement structurel lancé en 2016. Ce déclin a été de courte durée et résulte d'une baisse conjoncturelle du produit par habitant dans les provinces les plus riches, plutôt que d'une accélération de la croissance et d'une convergence des provinces les plus pauvres. Étant donné que la pauvreté et la richesse sont souvent spatialement concentrées, l'étude soutient que les inégalités économiques régionales, bien que distinctes des inégalités de revenu individuel, peuvent servir de proxy pertinent pour appréhender la dynamique générale des inégalités en Égypte.

الملخص

تُعد التقديرات الرسمية لعدم المساواة في الدخل في مصر، المستخلصة من مسوح الأسر، قليلة ومتفرقة، لكنها تُظهر باستمرار انخفاضاً أو مستويات متدنية من عدم المساواة خلال العقود الأخيرة. وهذا يتناقض مع التصور الشعبي بارتفاع عدم المساواة، وهو ما يُقال إنه ساهم في تأجيج أحداث الربيع العربي. وقد أُطلق على هذا التناقض في الأدبيات الحديثة اسم «لغز عدم المساواة العربي».

تعيد هذه الورقة النظر في هذا اللغز من خلال قياس عدم المساواة الاقتصادية الإقليمية بين المحافظات المصرية في الفترة من 1992 إلى 2022، بالاعتماد على الناتج الحقيقي للفرد. وتُظهر النتائج أن عدم المساواة الإقليمية في مصر كان مرتفعاً، وازداد منذ منتصف التسعينيات. كما تقدم الورقة أدلة على أن التراجع الذي شهدته السنوات الأخيرة نتج عن صدمات، أبرزها برنامج الإصلاح الاقتصادي الذي أُطلق في عام 2016. إلا أن هذا التراجع كان قصير الأمد، وجاء نتيجة لانخفاض مؤقت في نصيب الفرد من الناتج في المحافظات الأغنى، وليس نتيجة لتسارع النمو وتقارب المحافظات الأفقر. ونظراً إلى أن الفقر والثراء غالباً ما يكونان متركزين جغرافياً، ترى الدراسة أن عدم المساواة الاقتصادية الإقليمية، رغم تميّزه عن عدم المساواة في الدخل الفردي، يمكن أن يشكل مؤشراً بديلاً مهماً لفهم ديناميات عدم المساواة في مصر.

INTRODUCTION AND LITERATURE REVIEW

Territorial inequality is a major issue in Egypt. Disparities in development are stark between provinces and regions in the country. The per capita output in the richest province in Egypt, by the Red Sea coast, was 26 times that in the poorest province, in the southern region, in 2020/2021, according to official data from the Central Agency for Public Mobilization and Statistics (CAPMAS). Poverty data highlights this issue as well; 42.8% of the rural population, and 12% of the urban population in Upper Egypt (southern) provinces were poor, compared to 23.1% of the rural population, and 4.4% of the urban population in Lower Egypt (northern) provinces in 2019/2020.

Economic inequality in Egypt and the Arab region has received significant attention since the Arab Spring in 2011. The protests were arguably motivated by a popular perception of rising inequality in the leading years, despite official data implying remarkably low inequality measures, whether in Egypt or the region, which is why this phenomenon has been dubbed the 'Arab inequality puzzle' (World Bank, 2015; Hlasny and Verme, 2018).

Various arguments have been provided in recent literature to explain the Arab inequality puzzle. These include that it was not rising inequality, but a broken social contract that motivated the protests (Devarajan and Ianchovichina, 2018). A different argument implies that official measures of inequality, which are based on household surveys, are imprecise and underestimate inequality in Egypt, since they fail to capture top incomes in the country, particularly as the alternative tax records data are unavailable (Achcar, 2020; Abdel Ghafar, 2021). Estimates based on house prices for the year 2009, suggest that the Gini index of household per capita income for Urban Egypt could be as high as 0.52 compared to an official value of 0.39 (Van der Weide et al., 2018); other findings refer to the role of non-wage and informal incomes that could explain the seemingly low official inequality (Krafft and Davis, 2021). More recent findings using household surveys as well argue that inequality within provinces in Egypt has in fact increased on average in the last 15 years, while not challenging the low and stable official national inequality figures, owing to the reliance on the same household survey data (Savoia et al., 2024).

This paper contributes to research on inequality in Egypt by measuring regional (inter-provincial) economic inequality using provincial-level real output per capita data, aligning with a growing body of regional disparities literature (Li and Gibson, 2013; Lessmann and Seidel, 2017; Liu et al., 2024). By building national-level regional inequality indices, both Gini and Theil, on a yearly basis from 1992 onward, the paper addresses two main gaps in the literature; the first is building a yearly long time-series of inequality indices that extend over thirty years, and allow consistent monitoring of patterns of change, in contrast with the few, often dispersed estimates common in the literature. The second contribution is to avoid reliance on the household income survey data, with its limitations as highlighted above, in failing to capture top incomes.

The use of output per capita on the provincial-level means that the paper measures inequality of average living standards between provinces in a given year, which is different from measuring inequality of incomes between individuals using household surveys. However, as poverty and prosperity tend to cluster geographically in regions, as highlighted earlier from official data, regional inequality could still be a useful proxy for individual income inequality in Egypt. This is supported by evidence from the literature, of positive correlation between personal income inequality and regional economic inequality (Amos Jr., 1983). Nonetheless, one limitation of this regional inequality measure is that it does not capture inequality within provinces. Average output per capita in a given province could mask significant levels of inequality in this province, even as wealth and poverty tend to cluster in regions as mentioned. However, measuring within province inequality using the same approach will require data on output per capita at the sub-provincial level, such as neighbourhoods or villages, which is unavailable for Egypt.

Following the first objective, of measuring regional economic inequality, the paper examines whether a recent decline in inequality - measured by the Gini index in particular - in Egypt might have been caused by shock(s), instead of regional convergence. The paper focuses on the effect of the structural adjustment program launched in late 2016. The program represents one of the largest shocks to the Egyptian economy in the last few decades, and marks a significant departure from the social contract established since the 1950s, through a removal of subsidies on most goods and services; cutting public employment; in addition to a sharp devaluation of the national currency. This major shock could have affected inequality in Egypt through several possible channels, yet data limitation has likely restricted research on its impact. The consistent up-to-date yearly time-series of inequality indices, particularly the Gini index, constructed in the first part of this paper, enable measuring the effect of this recent shock on regional inequality in Egypt, which conventional measures would struggle to.

The structure of the rest of the paper is as follows. First, I describe the data used in the analyses; next, I provide the empirical framework and methods of choice for the analyses, measuring regional economic inequality, and examining the effect of the structural adjustment shock on inequality; afterwards, I report the results and discuss them; and finally, I provide the concluding remarks.

DATA

This research relies on a recently-constructed provincial annual output dataset in Egypt, that extends from 1992 to 2012, and augments the official dataset that starts from 2013 onward, for Egypt's 27 provinces. The dataset was constructed using satellite nighttime lights, crop area, and population density datasets, and relied on machine learning algorithms to improve the accuracy of estimation (Suleiman, 2024).

The original constructed dataset reports provincial total output (gross domestic product - GDP) in nominal local currency, the Egyptian Pound (EGP). To leverage it for measuring regional inequality, it is transformed for this research into real output per capita (GDPc), using official provincial population data from CAPMAS, and the national-level GDP deflator from the World Bank's development indicators, with 2022 as the base year, hence building a dataset of provincial annual real GDPc in 2022 Egyptian Pounds (EGP), that extends from 1992 to 2022.

The summary statistics for this provincial GDPc dataset are provided in Table 1 and Figure 2. Additionally, Figure 7 in the Appendix shows the time-series of the provincial real GDPc, in logarithm term for scale comparability, for the 27 provinces between 1992 and 2022. Figure 7 shows that there is consistent growth over time for most provinces. Border provinces on the other hand, particularly Matrouh, Red Sea, and South Sinai, show much larger volatility over time. This could be a result of their reliance on unstable rents from tourism and hydrocarbon extractive industries, alongside with their very small populations. Hence, frequent shocks to these two sectors could lead to such high volatility of GDPc.

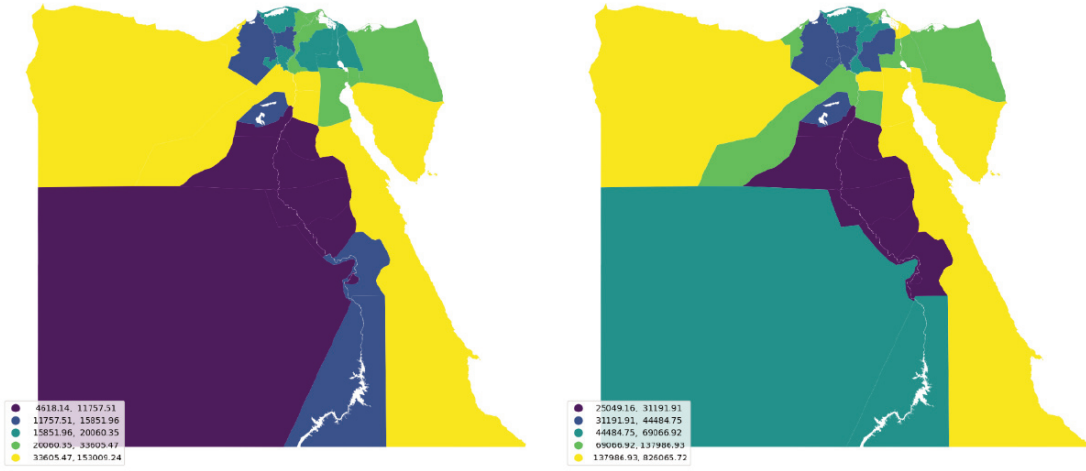
Table 1. Summary statistics of the provincial output per capita (GDPc), in real 2022 Egyptian Pounds, 1992-2022

Variable	Mean	Std. Dev.	Min	Max	Observations
Output per capita overall	72053.46	116403.3	4333.324	894057.5	N= 837
Between		93423.56	14454.86	398587.5	n= 27
Within		71658.75	-191962.2	567523.4	T= 31

Geographic distribution of the provincial real GDPc is illustrated in Figure 1. The figure shows two choropleth maps for the years 1992 and 2022, where brighter colours represent higher real GDPc. As the figure shows, the common provinces with the highest GDPc in both 1992 and 2022 are the capital, Cairo, and three of the border provinces, Matrouh, Red Sea, and South Sinai. Similarly, the common provinces with the lowest GDPc in both years are largely the Upper Egypt provinces, in the southern region of the country, where poverty is concentrated, according to CAPMAS data, as highlighted earlier. The two maps show that while real GDPc increased several folds between 1992 and 2022, including

for the poorest provinces, the geographic distribution of the richest and poorest provinces in Egypt has largely remained the same during the last three decades.

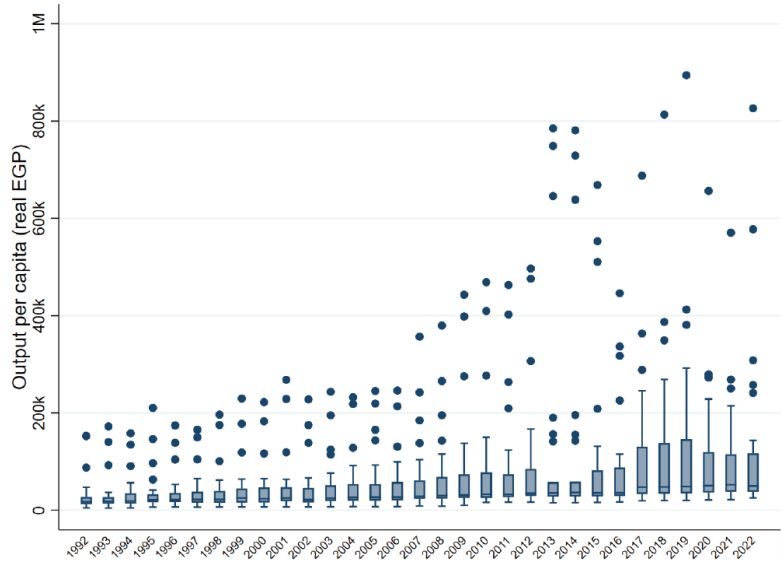
Fig. 1. Distribution of provincial real output per capita in Egypt, in 2022 Egyptian pounds (EGP), 1992 and 2022



(A) 1992 B) 2022

Figure 2, which shows box plots for the distribution of provincial real output per capita, annually from 1992 to 2022, offers preliminary signs of rising regional (inter-provincial) economic inequality in Egypt in the last few decades. The figure shows that the spread of provincial output per capita (GDPc) has increased since the late 1990s, in terms of the interquartile range (IQR) that represents the spread of the middle 50% of the data; the spread of the minimum and maximum values; and the spread of outliers as well.

Fig. 2. Box plot of the distribution of provincial real output per capita in Egypt, in 2022 Egyptian pounds (EGP), 1992-2022



EMPIRICAL FRAMEWORK

MEASURING REGIONAL INEQUALITY

Measuring regional inequality could be more challenging than measuring personal income inequality due to the heterogeneity of regions. The number of regions and their sizes differ significantly from one country to another, and hence if the regional inequality measure does not account for such heterogeneity, cross-country comparisons would be misleading (Lessmann and Seidel, 2017). Even though the focus of this research is on inequality changes within Egypt over time, to address the heterogeneity issue and produce comparable results, the paper calculates the population-weighted Gini (GINIW) and Theil (THEILW) indices as measures of regional inequality.

The population-weighted inequality indices account for the different sizes of regions and satisfy the relative income principle (mean independence), the population principle, and the Pigou-Dalton (transfer) principle. The inequality measures are population-weighted to give smaller (larger) regions a smaller (larger) weight in the overall inequality measure. Thus, highly unequal population distribution within countries is taken into account. One difference between non-weighted and weighted inequality measures is that non-weighted measures capture inequalities between spatial units, whereas the weighted measures could be interpreted as measures of intergroup inequality in a country, where groups of people are formed by their place of residence. The population-weighted Gini index (GINIW) for a given year is calculated from Equation 1 (Lessmann and Seidel, 2017).

$$GINIW_j = \frac{1}{2\overline{GDPpc_j}} \sum_i^{n_j} \sum_l^{n_j} \frac{p_i}{P_j} \frac{p_l}{P_j} |GDPpc_i - GDPpc_l| \qquad (1)$$

Likewise, the population-weighted Theil index (THEILW), which is a general entropy measure that is sensitive to differences at the top of the distribution, is calculated using Equation 2 below (Li and Gibson, 2013; Lessmann and Seidel, 2017).

$$THEILW_j = \sum_{i=1}^{n} \left(\frac{p_i}{P_j}\right) \left(\frac{GDPpc_i}{GDPpc_j}\right) ln \left(\frac{GDPpc_i}{GDPpc_j}\right) \qquad (2)$$

In Equations 1 and 2, j denotes the national level while *i* and *l* denote provinces. , while and are the $\overline{GDPpc_j} = \sum_i^{n_j} \frac{p_i}{P_j} GDPpc_i$, while $\frac{p_i}{P_j}$ and $\frac{p_l}{P_j}$ population weights in provinces *i* and *l*.

Measuring the Effect of Structural Adjustment

To test the effect of a perceived shock from the structural adjustment program, launched in late 2016, on regional inequality in Egypt, focusing on the GINIW, I employ the interrupted time-series analysis

(ITSA). In an interrupted time-series analysis, an outcome variable is observed over multiple, equally spaced time periods before and after the introduction of an intervention/treatment that is expected to interrupt its level or trend (Linden, 2015).

A main advantage of ITSA is that it can be applied for a single treated group, without a control one, in case the latter is unavailable. This is relevant for the data utilized in this research, where there is no control group (countries), since there is a lack of similar regional inequality data for the same period, for countries in the comparable Middle East and North Africa (MENA) region, in particular.

Using a single treated group, ITSA projects the pre-intervention trend into the treatment period, to serve as the counterfactual. This assumes that any unmeasured time-varying confounders are relatively slowly changing, and hence can be distinguishable from a sharp change in the outcome variable post-treatment. Causal inference using ITSA with a single group requires that no other potential interventions take place around the same period, otherwise, their effects will not be distinguishable, and a control group will be required to infer causality. Furthermore, the necessary assumptions for causal inference using single-group ITSA are less plausible if the trend already exits prior to the intervention; however, if a pre-intervention trend is followed by significant change, immediately after the intervention, then causality is more plausible. Furthermore, for a single-group ITSA, the pre-intervention trend should be consistent without major spikes or dips (Linden, 2015; Baicker and Svoronos, 2019; McDowall et al., 2019; Zhang and Rottman, 2023).

To estimate the single group ITSA model, I employ its regression equation as below.

$$Y_t = \alpha + \beta_1 T_t + \beta_2 X_t + \beta_3 X_t T_t + \varepsilon_t \qquad (3)$$

In Equation 3 above, Y is the outcome variable, that is GINIW in this research, and t denotes years. T is the time variable for the entire period, is a dummy variable representing the intervention, coded 0 pre-intervention, and 1 otherwise, and is an interaction term. in the equation is the intercept, is the slope of the outcome variable pre-intervention, captures the change in the outcome in the first period immediately after the intervention, compared to the counterfactual, and is the effect of the intervention over time, which is the difference between the pre- and post-intervention slopes. This model is estimated relying on ordinary least squares (OLS), rather on regression methods based on autoregressive integrated moving-average models (Linden, 2015; Zhang and Rottman, 2023).

RESULTS AND DISCUSSION

One issue when using provincial-level data for Egypt is the low consistency, and high variability of official data for the border provinces, which usually show extreme values that represent outliers. This could be related to challenges of data collection, and/or real economic structures in these regions which are vast, remote, very scarcely populated, while relying on rent-dependent volatile sectors such as tourism and extractive industries, as previous literature has pointed (Suleiman, 2024).

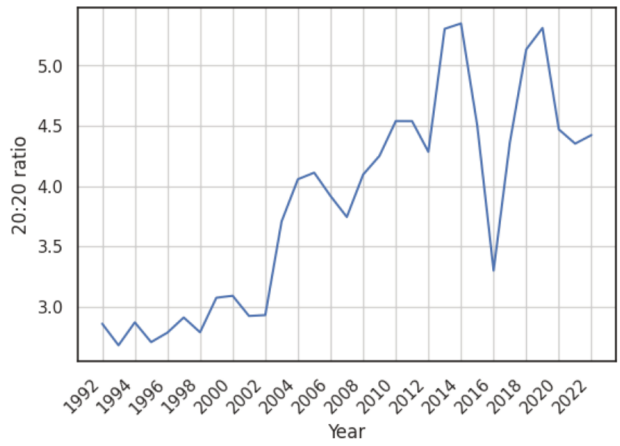
There is relatively scarce empirical literature that uses subnational data from Egypt, but the recent research that does tends to either add these border provinces in Egypt into one subnational unit (Smits and Permanyer, 2019; Crombach and Smits, 2024), or to exclude them from the analysis altogether (Elayouty and Abou-Ali, 2024). This serves to minimize their disproportionate effect on the statistical results as extreme outliers, since they (5) represent 18.5% of all provinces (27), while being home to only 1.2% - 1.8% of the population during the last three decades, according to CAPMAS data.

Nevertheless, for this research, extreme values of output per capita are of interest since they could reflect top distributions of income, which household surveys fail to capture, according to the criticisms in the literature highlighted earlier. Hence, excluding the border provinces or adding them together might distort the results and imply lower inequality, since they consistently host the highest output per capita, as shown in Figure 1, and also since the research already uses population-weighted measures that account for these provinces' tiny populations. The challenge in this context is whether these extreme values are a result of low-quality data collection in the border provinces, or real economic outcomes. Since it is difficult to disentangle these two possibilities, this research provides its results with the border provinces, and reports the results without the border provinces as well, in the Appendix, for robustness.

REGIONAL INEQUALITY

Figure 3, shows the simple and commonly used measure of economic inequality, that is the 20:20 ratio, which is the ratio of incomes at the 80th percentile to that at the 20th percentile. The figure, which uses all provinces, shows a trend of rising economic inequality up to the mid-2010s, followed by a decline, then an increase, and a decline again in recent years. Figure 9 in the Appendix shows a similar trend, when the border provinces are excluded. The main difference between the two is the level of inequality; when the – wealthier – border provinces are included, regional inequality is much higher, as the 20:20 ratio peaks at more than 5, while it peaks at around 3 when the border provinces are excluded. In addition, the decline in inequality around the mid-2010s is much steeper when the border provinces are included, which implies that such decline might have been more driven by output changes in these provinces, in particular.

Fig. 3. The ratio of provincial output per capita at the 80th percentile over that at the 20th percentile, all provinces included, 1992-2022



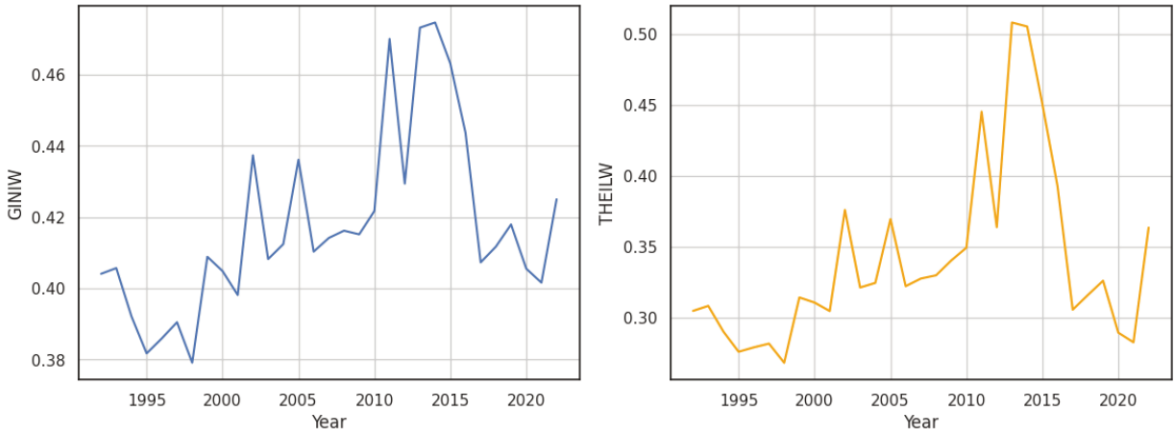
To measure regional inequality more accurately, relying on the population-weighted measures, the next step is to calculate the GINIW and THEILW, as elaborated in section 3.1. The results of the population-weighted Gini and Theil indices for regional inequality, are shown in panels (A) and (B), respectively, of Figure 4. The indices values for all years are provided in Table 3 in the Appendix, with and without the border provinces.

The Gini and Theil indices in Figure 4 exhibit almost identical patterns. They show that regional economic inequality in Egypt declined in the early 1990s up to the mid-1990s when it started to rise for almost two decades. Regional inequality subsequently declined, since the mid-2010s.

The Gini index captures overall inequality and is less sensitive to extreme values. The Theil index on the other hand is more sensitive to large disparities at the top end of the income (output per capita) distribution. Figure 4 and Table 3 show that the Theil index was lower than the Gini index up to the early-2010s, which indicates that the growing regional inequality in that period was more driven by growing disparities between the medium- and low- output per capita provinces. The Theil index surged sharply in the early-2010s, to higher levels than the Gini index, and dropped sharply as well in the mid-2010s, to lower levels than the Gini index. This indicates that the rise and subsequent decline were both driven by changes in output per capita in the wealthiest provinces in particular, i.e. a surge in this group's output per capita in the early-2010s, followed by a sharp decline in the mid-2010s.

Decomposing the population-weighted Theil index, into within-year and between-year inequality, results into values of 0.35 and 0.04, respectively. This implies that there is significant disparity in output per capita in a given year, across provinces, while there is relatively little inequality driven by changes in the national average output per capita over time.

Fig. 4: Population-weighted Gini and Theil indices for regional inequality in Egypt, all provinces included, 1992-2022

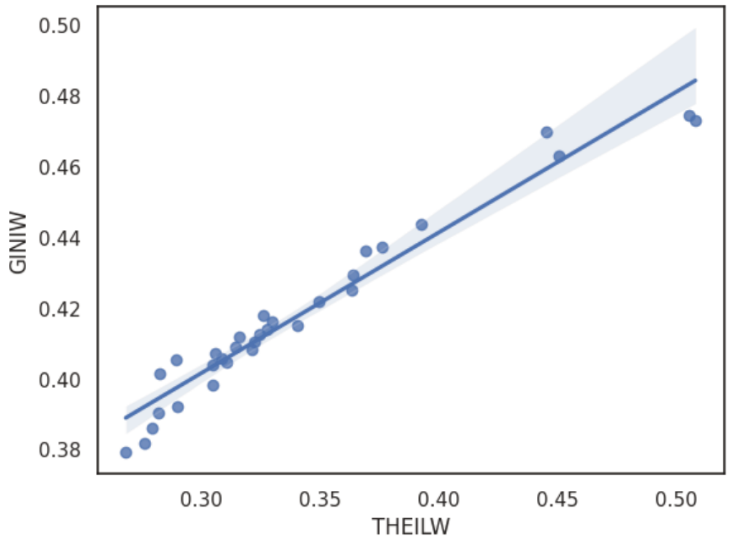


(A) Gini index

(B) Theil index

Even though the population-weighted Gini and Theil indices look almost identical in their trend, as Figure 4 shows, there are in fact differences. Figure 5 shows the correlation between the two measures of inequality, which is not perfect, as the scatterplot in the figure depicts, which highlights the differences in trends of the two measures, mentioned above.

Fig. 5. Correlation of population-weighted Gini and Theil indices for regional inequality in Egypt, all provinces included, 1992-2022



The results of the regional economic inequality measures from 1992 to 2022, using population-weighted Gini and Theil indices, tell a different story of economic inequality in Egypt, both for its level and trend, compared to the official personal income inequality estimates from household surveys. While the highest Gini index in Egypt from official estimates since 1990 was 0.32, the regional Gini index was significantly higher according to the results presented above, and peaked at around 0.47; in fact, the lowest regional Gini in the last three decades was 0.38. Furthermore, while the official personal income Gini estimates show that inequality was at its highest in 1990 and has largely declined since then, with some volatility over time, the regional inequality findings point to a persistent rise between the mid-1990s and the mid-2010s.

Personal income inequality and regional economic inequality are understandably two different measures, as highlighted earlier. Nevertheless, the regional inequality results are interestingly largely similar to personal income inequality estimates in recent literature, in terms of the overall trend. A time-series of personal income Gini index was recently constructed by the World Inequality Database (WID), by correcting survey tabulations provided by the World Bank to account for conceptual discrepancies and the under-representation of top incomes. For Egypt, surveys are available only for the years 1990, 1995, 1999, 2004, 2008, 2010, 2012, 2015, and 2017. Income shares were interpolated linearly when surveys are available at the beginning and the end of a given period. Inequality series were extrapolated

backwards to 1990 and forwards by keeping income shares constant when no data is available for these years (Chancel et al., 2019).

The resulting Gini index time-series is shown in Figure 8 in the Appendix, which is understandably showing smooth trends due to the interpolation and extrapolation techniques mentioned above. The WID Gini index shows much higher inequality compared to the official estimates, with a peak around 0.6. Furthermore, as Figure 8 shows, the WID Gini index highlights declining inequality in the early 1990s, followed by a surge in the mid-1990s, and a later decline in the mid-2010s, reflecting a more similar general trend to the regional Gini index findings shown earlier, with some differences, taking in consideration the artificially-smooth trend of the WID Gini.

THE EFFECT OF STRUCTURAL ADJUSTMENT

The decline in regional economic inequality in Egypt in the mid-2010s is evident in the different indices constructed in the previous section. It is also evident in the personal income inequality estimates from the WID, as highlighted earlier.

A possible explanation for the decline in regional economic inequality is the convergence of poor provinces with wealthier ones, driven by faster per capita growth in the former group, consistent with the Williamson-Kuznets hypothesis (Willamson, 1965; Liu et al., 2024). As highlighted earlier, the Theil index shows that the decline was likely more driven by the wealthier provinces instead. In this section, I provide evidence that the decline in regional inequality in Egypt was shock driven, particularly by the structural adjustment program, that was launched in Egypt in late 2016. The program has been one of the largest shocks to the Egyptian economy in recent decades. Its measures included cutting subsidies on most goods and services, cutting public employment, in addition to the sharp devaluation of the national currency, among other measures. Such measures resulted in a steep surge in inflation and the hiking of interest rates to contain it. The different measures of the program and their direct consequences could affect regional economic inequality through various channels that could be challenging to test directly. Such channels could include for example the unequal effect of higher interest rates on investments and output growth across sectors, and hence across regions/provinces.

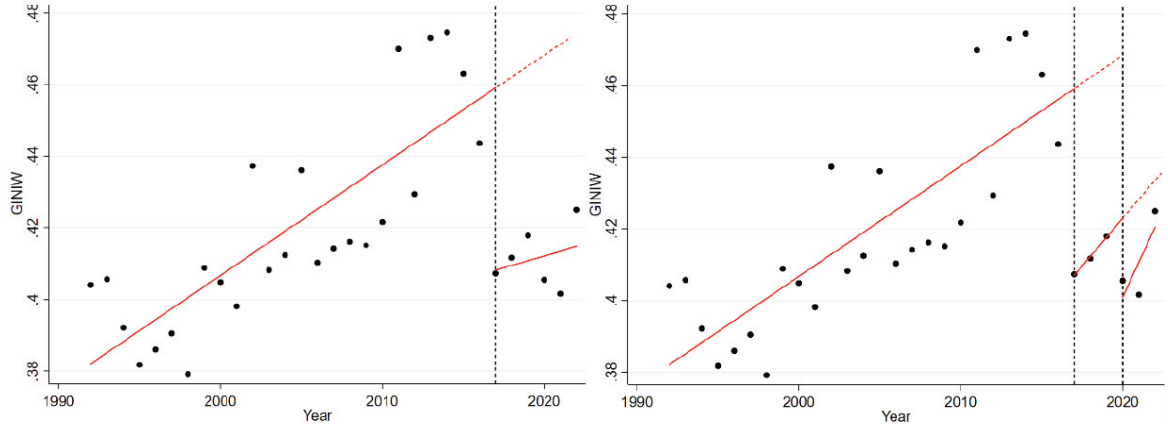
In this section, the focus is on testing whether the structural adjustment program as a package of measures has caused a significant decline in regional inequality in Egypt, rather than on how it might have caused it. To achieve this, I use the regional Gini index calculated from the previous section, and employ the interrupted time-series analysis (ITSA), with the treatment/shock in 2017, since the program was launched in November 2016, hence its effect, if any, would be evident starting from 2017, not 2016. Furthermore, I also include a shock in 2020, to account for a potential effect of the Covid-19 pandemic as a robustness check. This is to avoid confounding effects of different shocks, which might weaken causal inference using ITSA, as discussed in section 3.2.

Figure 6 shows the effect of the structural adjustment program on the population-weighted Gini index in Egypt in panel (A), and the effects of both the program and Covid-19 in panel (B). The trend of

regional inequality before and after the shock(s) is shown in the red solid lines. The counterfactual, that is the projected regional inequality trend if the shock(s) did not occur, is shown in the red dashed lines. The figure shows in panel (A) that the level of the Gini index has dropped since 2017, but the rising trend seemingly persisted, however at a flatter slope. When the Covid-19 shock is accounted for as well in 2020, as panel (B) shows, regional inequality levels immediately drop after both shocks as well, but the rising trend is resumed from the lower levels, indicating that there has not been a reversal of the rising trend after the shock(s), but only a temporary decline in the level of inequality.

Table 2 provides the results of the interrupted time-series analysis, when only the program's shock is introduced in 2017, in model (1) of the table, and when both the program and the Covid-19 shocks are accounted for in 2017 and 2020, in model (2).

Fig. 6. Effect of the structural adjustment program (2017) only, and with and the Covid-19 (2020) on the population-weighted Gini index in Egypt, 1992-2022. All provinces included



(A) Shock in 2017 (B) Shocks in 2017 and 2020

The results in the table confirm the visual observations from Figure 6. In both models the slope of the regional Gini index (GINIW) is positive and statistically significant prior to 2017, confirming the rising trend of regional inequality in Egypt before the structural adjustment program. In model (1), with only the effect of the program, there is statistically significant evidence of a negative *immediate* effect of the program on regional inequality in Egypt. The program caused a *decline* of 0.051 in the GINIW in the first year, but had no statistically significant annual effect afterwards, compared to the counterfactual. These results imply that the program has caused an immediate drop in the level of regional inequality, but did not affect its *trend* in Egypt. When the Covid-19 shock is accounted for in model (2) of the table, the results show that the program caused a decline of 0.052 in GINIW in the first year, followed by a statistically significant annual *increase* of 0.002 in GINIW, compared to the counterfactual. Afterwards, the Covid-19 shock caused another decline of 0.022 in its first year, followed by a statistically significant annual increase of 0.044 in GINIW, compared to the counterfactual, that is based on the slope after the first shock, not the pre-shock slope. These results imply that both the structural adjustment program and

Covid-19 shocks caused immediate temporary drops in regional economic inequality in Egypt, followed by a resumed increasing trend from lower levels, with an even steeper slope after each shock.

According to the results in model (2) in particular, there is no evidence of a declining trend of regional economic inequality in Egypt after the 2016 structural adjustment program. This implies that there is no pattern of convergence of the poor provinces with the wealthier ones after the program – or the Covid-19 shock. The more plausible explanation, which is supported by the larger volatility in the Theil index, is that the program might have had a larger negative immediate effect on the output per capita of the wealthiest provinces, resulting in a temporary drop in inequality, after which the disparity in growth between the wealthy and poor provinces resumed its growing trend, with an even faster pace.

Table 2. Interrupted time-series results with treatments in 2017 only, and in 2017 and 2020. All provinces included

Dependent Variable: GINIW	**(1)** **Shock in 2017**	**(2)** **Shocks in 2017 and 2020**
Slope pre-2017	0.003***	0.003***
	(0.001)	(0.000)
Slope post-2017	0.001	0.005***
	(0.400)	(0.000)
Effect in the first year (2017)	-0.051***	-0.052***
	(0.009)	(0.007)
Effect post-treatment (2017)	-0.002	0.002***
	(0.002)	(0.000)
Slope post-2020		0.010***
		(0.002)
Effect in the first year (2020)		-0.022***
		(0.002)
Effect post-treatment (2020)		0.004**
		(0.002)
Constant	0.382***	0.382***
	(0.007)	(0.006)
Observations	31	31
Number of provinces	27	27
Lags	1	9

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

CONCLUSION AND POLICY RECOMMENDATIONS

This research measured regional inequality in Egypt from 1992 to 2022. It provided evidence that regional inequality has been significantly high and has risen in Egypt for almost two decades from the mid-1990s up to the mid-2010s. Even though regional inequality is different from personal income inequality, it captures inequality in average living standards between provinces' inhabitants, and remains a useful proxy for economic inequality in Egypt, given the geographic clustering of prosperity and poverty in the country, and the evidence from previous literature that the two measures are correlated. Furthermore, the trend of regional inequality measured in this paper, exhibits largely similar patterns to recent estimates of personal income inequality in Egypt, which sought to correct the official bias with its under-representation of top incomes.

Hence, relying on the regional inequality estimates, with their high and rising trend since the mid-1990s, renders the Arab inequality puzzle less puzzling in Egypt. The popular perception of high/rising inequality in Egypt, which could have fuelled the popular uprising in 2011, might indeed reflect a reality which the official estimates failed to capture.

Furthermore, the paper also provided evidence that a seeming reversal of the trend of regional inequality in Egypt into a declining one, following the 2016 structural adjustment program, is in fact a temporary drop, followed by a resumed increase in inequality, with an even faster pace, particularly when the Covid-19 shock is accounted for. The temporary drop in inequality following the program's adoption, and the Covid-19 shock, does not reflect convergence of poor provinces with wealthier ones on the back of accelerated per capita growth. It more likely stems from a larger decline in the real output per capita of the wealthier provinces, after the shock(s), followed by resumed growth of the regional economic disparities.

To tackle regional economic inequality in Egypt, a policy toolkit should be adopted, different to that targeting income inequality among individuals. The latter usually focuses on redistributing income or wealth from higher-income/wealth individuals to lower-income/wealth individuals through interventions that include progressive taxation, social safety nets such as cash transfers and targeted subsidies, or land reforms for example. Mitigating regional economic inequality on the other hand would require different policies to support regional convergence, by fostering faster economic growth in the poorer regions, compared to the wealthier ones.

Global experiences could provide useful guidelines for policies to address regional economic inequality in Egypt. China and the European Union (EU) offer lessons on the significance of infrastructure investments for fostering regional economic development. Public investment in transportation, energy, and digital infrastructure can help integrate lagging regions into national and global markets, fostering

economic growth. The Chinese government has invested heavily in infrastructure projects, such as highways, railways, and airports, in its less-developed western regions since the late 1990s, in the 'Go West' program. These investments have helped reduce regional disparities by improving connectivity and attracting private investment (Fan et al., 2011). Similarly, the European Union's (EU) Cohesion Policy allocates funds to infrastructure projects in poorer regions, aiming to promote economic convergence among member states (McCann, 2015).

Public infrastructure investment must be complemented by policies to attract private investments and foster job creation and output growth in poor regions, particularly in high productivity sectors. Regionally-targeted industrial policies can play a critical role in fostering economic growth in lagging regions. One example that stands out is South Korea's regional development strategy, which highlighted regional industrial development, with a focus on establishing free economic zones (FEZs) and techno parks in economically weaker areas, incentivizing firms to relocate and invest outside the capital region (OECD, 2012). In addition to traditional industrial policies, promoting regional innovation systems has gained traction. The smart specialization strategy in the EU's Cohesion Policy encourages regions to leverage their unique assets and knowledge bases to foster local innovation-driven growth (Foray et al., 2015).

Place-based policies and infrastructure investments need to be combined with human capital development in the targeted regions, so that high productivity sectors could grow. Investing in education and skills development is key for regional development by improving labour productivity, employability, and entrepreneurial returns in disadvantaged areas. (Gennaioli et al., 2013). China provides a valuable example in this context as well. Since 2005, the government has launched several policies to mitigate education inequalities across regions, particularly between the wealthy east coast and the central and western hinterlands. The policies included increasing public funding for education for the targeted regions, extending exemptions from tuition and miscellaneous fees for basic education, providing additional funding for rural areas and low-performance schools (Xiang et al., 2020).

Strengthening local governance is also key for fostering regional development to mitigate territorial disparities (Li et al., 2025). Channelling large public funds to infrastructure, education, and establishing industrial zones in disadvantaged regions could prove less productive if challenged by underdeveloped governance and administrative capacities in these regions. A closely related factor to local governance is decentralization and whether it might mitigate or exacerbate regional inequalities. Decentralization could lead to more responsive governance and tailored economic strategies that address region-specific challenges; hence it could enhance regional economic development by granting local governments more control over resource allocation and policy decisions. However, there is growing evidence that decentralization might mitigate regional inequalities in richer or more developed countries, while it might oppositely exacerbate disparities in poor or developing ones (Rodriguez-Pose and Ezcurra, 2010; Lessmann, 2012). A possible explanation is that decentralization at early stages of development, both political, fiscal, or else, would leave the disadvantaged regions in a developing or poor country with their own lacking resources for investments in infrastructure or human capital development, and less

administrative capacities for efficient policy-making and planning (Xiang et al., 2020). Consequently, it is necessary for the central government to support local ones in disadvantaged regions with funding, planning, and executing, to foster faster economic growth and mitigate regional disparities. However, this also comes at a risk of misallocation of resources by the central government across the regions, which requires a balance of central government intervention side by side with local governments' involvement.

These policy measures, drawn from global experiences, could provide the bedrock of a national strategy to mitigate the growing regional economic inequality in Egypt, which this research provided evidence of. The findings of this research take a step towards a deeper understanding of regional disparities in Egypt. One limitation, however, relates to the inequality measures used, which might be biased in small samples leading to underestimation (De Nicolò et al., 2024). Hence, the use of subnational data with a small number of units (provinces), could result in a – downward - bias in the *level* of inequality; however, it is expected to have little effect on its *trend.* Additionally, inequality indices have other general limitations, particularly the Gini index. As highlighted earlier, it is more sensitive to inequalities in the middle of the income distribution, which means that the income/output shares of the top or bottom quintiles can change significantly, without much change in the Gini index value (Osberg, 2017). Furthermore, Gini indices values are not unique. Two countries might have the same Gini index value, but with two different Lorenz curves and income distribution patterns (De Maio, 2007). This research tried to mitigate such limitations by measuring the Theil index for comparison, showing differences between the two measures. However, the Theil index has its limitations as well, most notably being less intuitive than the Gini, and highly sensitive to outliers and data quality, particularly in the upper tail of the distribution (Cowell, 2011). Additionally, both indices also share limitations common to all aggregate inequality measures, they compress complex income/output distributions information into single values, potentially obscuring structural patterns and aspects of inequality in a given society (Blesch et al., 2022). As such, while these indices provide useful insights of inequality, they should be interpreted in conjunction with other socioeconomic measures and contextual analysis. Another limitation of this research is the potential for high within-province inequality, which may be masked by the provincial-level output per capita. Measuring within-province inequality would require output and population data at sub-provincial levels, which are currently unavailable in Egypt, but offer a promising area for future research.

REFERENCES

Abdel Ghafar, A. (2021). Causes and consequences of inequality in Egypt. The Muslim World, 111(1):5–26.

Achcar, G. (2020). On the 'Arab inequality puzzle': The case of Egypt. Development and Change, 51(3):746–770.

Amos Jr, O. M. (1983). The relationship between regional income inequality, personal income inequality, and development. Journal of Regional Analysis and Policy, 13(1), 3-14.

Baicker, K. and Svoronos, T. (2019). Testing the validity of the single interrupted time series design. Technical report, National Bureau of Economic Research.

Blesch, K., Hauser, O. P., & Jachimowicz, J. M. (2022). Measuring inequality beyond the Gini coefficient may clarify conflicting findings. *Nature human behaviour,* 6(11), 1525-1536.

Chancel, L., Cogneau, D., Gethin, A., and Myczkowski, A. (2019). How large are African in- equalities? towards distributional national accounts in Africa, 1990-2017. World Inequality Lab – Working paper, 2019/13.

Cowell, F. (2011). *Measuring Inequality.* Oxford University Press.

Crombach, L. and Smits, J. (2024). the subnational corruption database: Grand and petty corruption in 1,473 regions of 178 countries, 1995–2022. Scientific Data, 11(1):686.

De Nicolò, S., Ferrante, M. R., & Pacei, S. (2024). Small-sample bias correction of inequality estimators in complex surveys. *Journal of Official Statistics,* 40(2), 238-261.

De Maio, F. G. (2007). Income inequality measures. *Journal of Epidemiology & Community Health,* 61(10), 849-852.

Devarajan, S. and Ianchovichina, E. (2018). A broken social contract, not high inequality, led to the Arab spring. Review of Income and Wealth, 64:S5–S25.

Elayouty, A. and Abou-Ali, H. (2024). A comprehensive analysis of the dynamic space-time impacts of climate change on poverty in Egypt. Economic Research Forum.

Fan, S., Kanbur, R., & Zhang, X. (2011). China's regional disparities: Experience and policy. *Review of Development Finance,* 1(1), 47-56.

Foray, D., McCann, P., & Ortega-Argilés, R. (2015). Smart specialization and European regional development policy. *Oxford handbook of local competitiveness,* 458-480.

Gennaioli, N., La Porta, R., Lopez-de-Silanes, F., & Shleifer, A. (2013). Human capital and regional development. *The Quarterly journal of economics,* 128(1), 105-164.

Hlasny, V. and Verme, P. (2018). Top incomes and the measurement of inequality in Egypt. The World Bank Economic Review, 32(2):428–455.

Krafft, C. and Davis, E. E. (2021). The Arab inequality puzzle: the role of income sources in Egypt and Tunisia. Middle East Development Journal, 13(1):1–26.

Kuznets, S. (1955). Economic growth and income inequality. The American Economic Review, 45(1):1–28.

Lessmann, C. (2012). Regional inequality and decentralization: an empirical analysis. *Environment and planning a,* 44(6), 1363-1388.

Lessmann, C. and Seidel, A. (2017). Regional inequality, convergence, and its determinants–a view from outer space. European Economic Review, 92:110–132.

Li, C. and Gibson, J. (2013). Rising regional inequality in China: Fact or artifact? *World Development,* 47:16–29.

Li, Y., Wang, Z., Lin, Z., & Gao, Y. (2025). Revisiting regional governance and regional development: Measurements, linkages and coupling effect. *World Development, 1*85, 106816.

Linden, A. (2015). Conducting interrupted time-series analysis for single-and multiple-group comparisons. The Stata Journal, 15(2):480–500.

Liu, H., Wang, L., Wang, J., Ming, H., Wu, X., Xu, G., and Zhang, S. (2024). Multidimensional spatial inequality in china and its relationship with economic growth. Humanities and Social Sciences Communications, 11(1):1–13.

McCann, P. (2015). *The regional and urban policy of the European Union: Cohesion, results-orientation and smart specialisation.* Edward Elgar Publishing.

McDowall, D., McCleary, R., and Bartos, B. J. (2019). Interrupted time series analysis. Oxford University Press.

OECD (2012), Industrial Policy and Territorial Development: Lessons from Korea, Development Centre Studies, OECD Publishing. http://dx.doi.org/10.1787/9789264173897-en

Osberg, L. (2017). On the limitations of some current usages of the Gini Index. *Review of Income and Wealth,* 63(3), 574-584.

Rodríguez-Pose, A., & Ezcurra, R. (2010). Does decentralization matter for regional disparities? A cross-country analysis. *Journal of Economic Geography,* 10(5), 619-644.

Savoia, F., Bournakis, I., Said, M., and Savoia, A. (2024). Regional income inequality in Egypt: Evolution and implications for sustainable development goal 10. Oxford Development Studies, 52(1):17–33.

Smits, J. and Permanyer, I. (2019). The subnational human development database. Scientific data, 6(1):1–15.

Suleiman, H. (2024). Illuminating the Nile: estimating subnational GDP in Egypt using nighttime lights and machine learning. GeoJournal, 89(3):1–19.

Van der Weide, R., Lakner, C., and Ianchovichina, E. (2018). Is inequality underestimated in Egypt? evidence from house prices. Review of Income and Wealth, 64:S55–S79.

Williamson, J. G. (1965). Regional inequality and the process of national development: a description of the patterns. Economic development and cultural change, 13(4, Part 2), 1-84.

World Bank (2015). Inequality, uprisings, and conflict in the Arab world.

Xiang, L., Stillwell, J., Burns, L., & Heppenstall, A. (2020). Measuring and assessing regional education inequalities in China under changing policy regimes. *Applied spatial analysis and policy,* 13(1), 91-112.

Zhang, Y. and Rottman, B. M. (2023). Causal learning with interrupted time series data.

Judgment and Decision Making, 18:e30.

APPENDIX

Fig. 7. Real output per capita (in logarithm term) in Egypt by province, 1992-2022

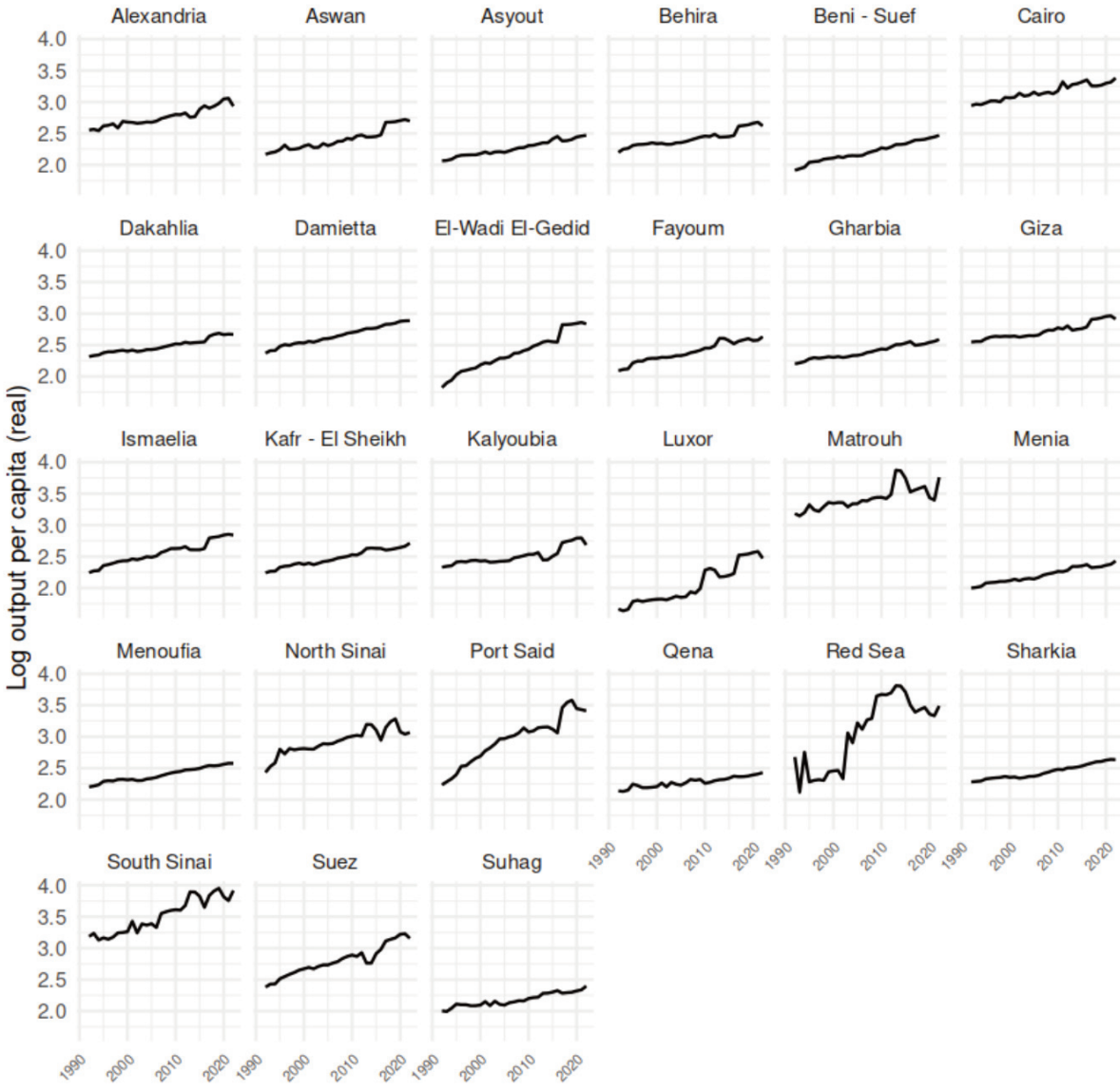
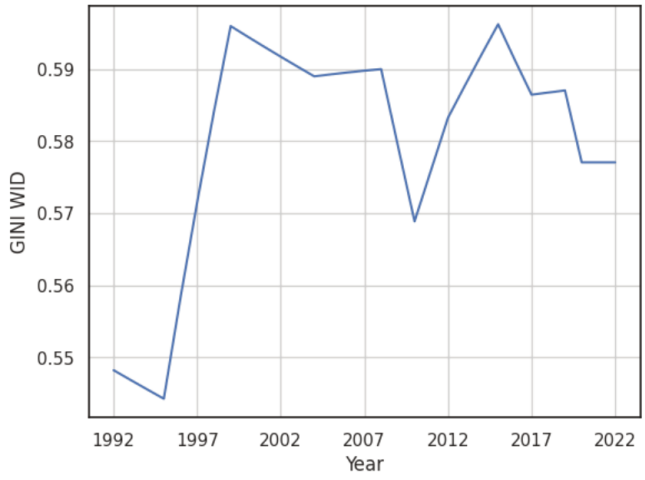


Fig. 8. Gini index based on pre-tax national income in Egypt, 1992-2022. Note: Data from the World Inequality Database (WID). Figures were obtained by correcting survey tabulations provided by the World



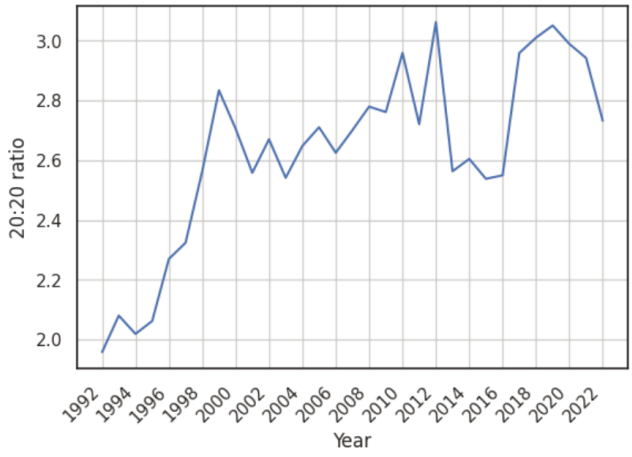
Bank. Only 9 surveys are available; interpolations and extrapolations were used to fill the missing values.

Table 3. Population-weighted Gini and Theil indices for regional inequality in Egypt, 1992-2022

Year	All provinces		Excluding border provinces	
	Gini	Theil	Gini	Theil
1992	0.404094	0.304839	0.396693	0.292982
1993	0.405695	0.308352	0.399641	0.298795
1994	0.392159	0.290218	0.384592	0.279082
1995	0.381782	0.276052	0.369917	0.255919
1996	0.385986	0.279154	0.378243	0.267665
1997	0.390521	0.281784	0.382839	0.27093
1998	0.379162	0.268302	0.368326	0.250732
1999	0.408863	0.314312	0.398702	0.296826
2000	0.404861	0.310701	0.394556	0.293371
2001	0.398133	0.304712	0.386381	0.283961
2002	0.437327	0.375934	0.428927	0.362343
2003	0.408215	0.321313	0.397327	0.30574
2004	0.41241	0.324554	0.401814	0.308965
2005	0.43609	0.369435	0.424728	0.352676
2006	0.410312	0.322242	0.39742	0.301845
2007	0.414145	0.327613	0.392766	0.290518
2008	0.416185	0.329885	0.393806	0.290145
2009	0.415144	0.340312	0.378256	0.26288

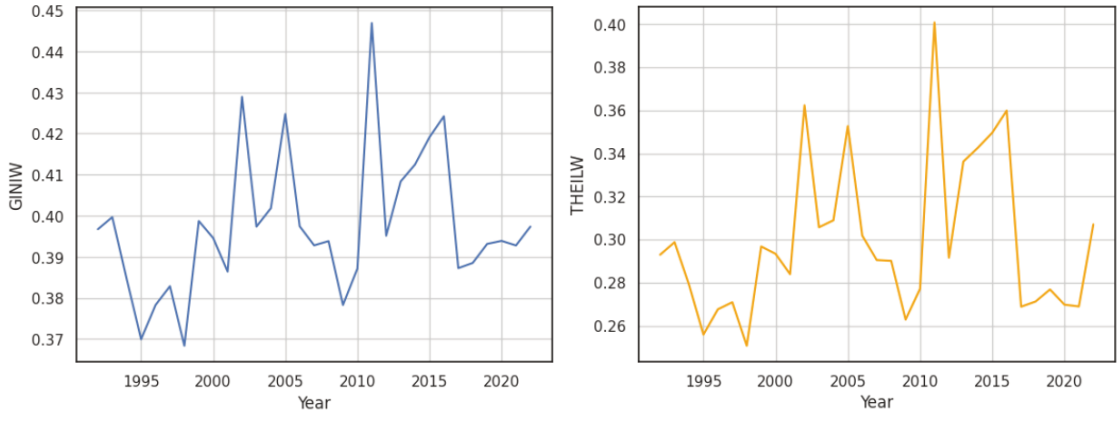
2010	0.421712	0.349354	0.387115	0.277162
2011	0.469953	0.445091	0.446878	0.40080
2012	0.429373	0.363786	0.395127	0.291629
2013	0.473096	0.507917	0.408306	0.336227
2014	0.474552	0.505069	0.412458	0.342614
2015	0.463041	0.450614	0.419094	0.349614
2016	0.443637	0.392628	0.424191	0.359893
2017	0.407293	0.305678	0.387226	0.268872
2018	0.411698	0.316032	0.388491	0.271261
2019	0.417926	0.326079	0.393119	0.276868
2020	0.405542	0.289515	0.393867	0.269808
2021	0.401611	0.282716	0.392744	0.268987
2022	0.424999	0.363465	0.397345	0.307057

Fig. 9. The ratio of provincial output per capita at the 80th percentile over that at the 20th percentile,



excluding border provinces, 1992-2022

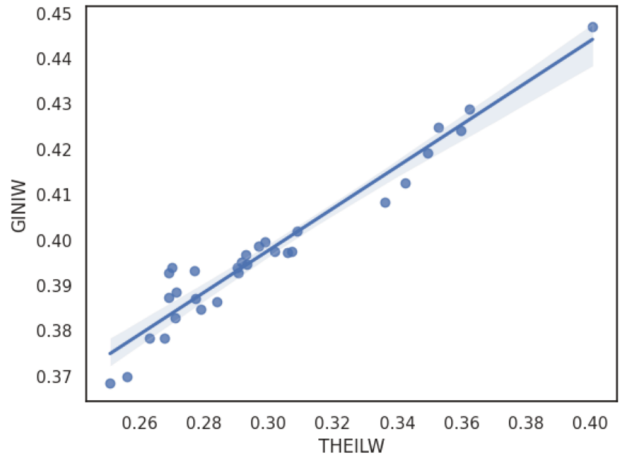
Fig. 10. Population-weighted Gini and Theil indices for regional inequality in Egypt, excluding border



provinces, 1992-2022

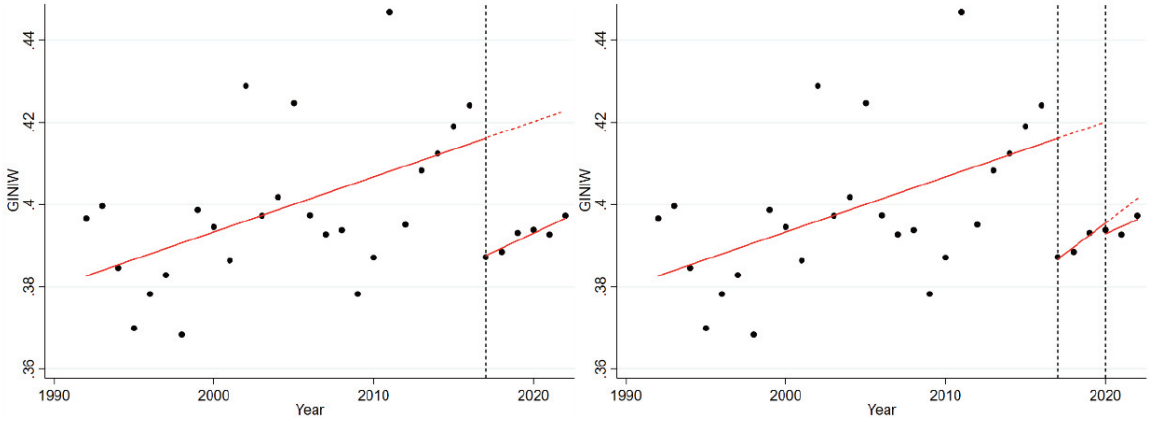
(A) Gini index (B) Theil index

Fig. 11. Correlation of population-weighted Gini and Theil indices for regional inequality in Egypt,



excluding border provinces, 1992-2022

Fig. 12. Effect of the structural adjustment program (2017) only, and with and the Covid-19 (2020) on



the population-weighted Gini index in Egypt, excluding border provinces, 1992-2022

(A) Shock in 2017 (B) Shocks in 2017 and 2020

Table 4. Interrupted time-series results with treatments in 2017 only, and in 2017 and 2020. Excluding border provinces.

Dependent Variable: GINIW	**(1)** **Shock in 2017**	**(2)** **Shocks in 2017 and 2020**
Slope pre-2017	0.001***	0.001***

	(0.000)	(0.000)
Slope post-2017	0.002***	0.003***
	(0.000)	(0.000)
Effect in the first year (2017)	-0.029***	-0.029***
	(0.006)	(0.004)
Effect post treatment (2017)	0.0005	0.002***
	(0.000)	(0.000)
Slope post-2020		0.002***
		(0.000)
Effect in the first year (2020)		-0.003***
		(0.001)
Effect post treatment (2020)		-0.001***
		(0.000)
Constant	0.382***	0.383***
	(0.006)	(0.004)
Observations	31	31
Number of provinces	22	22
Lags	1	12

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

FEMISE

CMCI · 2 rue Henri Barbusse · F-13 241 Marseille cedex 01 · France
+ 33 (0) 4 91 31 51 95 · www.femise.org

ECONOMIC RESEARCH FORUM
منتدى البحوث الاقتصادية

21 Al-Sad Al-Aaly Street, Dokki, Giza, Egypt · PO Box: 12311
+202 333 18 600 · https://erf.org.eg/

IEMed.
European Institute of the Mediterranean

Carrer Girona, 20 · 08010 Barcelona · Spain
+34 93 244 98 50 · https://www.iemed.org/

With the financial support of

MINISTERIO DE ASUNTOS EXTERIORES, UNIÓN EUROPEA Y COOPERACIÓN · aecid · Cooperación Española