Regional income inequality in Egypt: evolution and implications for Sustainable Development Goal 10

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Abstract
Research on income inequality in developing economies has scarcely looked at the regional dimension. This is important, as progress in reducing income inequality at national level can only be partially successful if in a country very unequal regions coexist alongside relatively equal ones. This paper contributes to filling this gap. Using newly assembled Luxemburg Income Study data, we investigate the evolution of income inequality within Egyptian regions during 1999–2015. The analysis offers three findings. First, income inequality has generally increased. Second, regional differences in income inequality have tended to reduce, but less unequal regions are converging to similar levels of inequality to those in more unequal regions. Third, there has been a decrease in the income share of the bottom 40% and an increase in the proportion of people living below 50% of median income. Hence, geographically diffused progress on the first two targets of SDG 10 depends on reversing these trends.

Keywords
Income distribution, convergence, regional disparities, SDG 10, Sustainable Development Goals, inequality, decomposition

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1. Introduction

Income distribution is seen as instrumental to human development and to a number of development outcomes through a variety of channels. Its inclusion in the UN Sustainable Development Goals (SDGs) under Goal 10 testifies that there is also an increasing realisation that income distribution is important in itself. [1] Yet the debate on the evolution of income inequality and the consequences of unequal distribution of income in developing economies has scarcely looked at the regional dimension. There are at least two reasons why studying income inequality at the regional level is important. First, we focus on income distribution *within* regions because it allows one to see if progress on the first two targets of SDG 10, on reducing inequalities, translates into progress at both national and regional levels. This has implications for how we measure and monitor SDG 10, as progress in reducing inequality within countries can only be partially successful if a country presents large regional variations, with very unequal regions coexisting alongside relatively more equal ones. Second, apart from its policy relevance, how income is distributed at regional level is important because a significant part of individuals' experiences of economic inequality happens at the local level. This affects political and social attitudes and behaviour and, in turn, wellbeing.[2]

This study offers a systematic empirical assessment of the extent and evolution of income distribution within Egyptian regions, providing evidence on whether differences in income concentration within regions have tended to reduce. This serves a dual goal. First, we contribute to the broader debate on the convergence in living standards across countries or regions: its existence, nature and speed. This is an understudied area, where empirical research is in need of more stylised facts on whether disparities across countries or regions tend to fall over time with regard to many important development goals. Research on convergence in living standards has not delved deeply into disparities in the level of income inequality. Traditionally, empirical work on convergence has been concerned with national income levels (see, for example, Johnson & Papageorgiou, 2020; Sala-i-Martin, 1996). Recent analysis of convergence has also focused on the evolution of other important development outcomes across countries and it is becoming an independent area of research.[3] It has included work on income inequality. Bénabou (1996) and Ravallion (2003) are seminal studies providing initial evidence of (slow) inequality convergence at a cross-country level. Alvaredo and Gasparini (2015) and Chambers and Dhongde (2016a, 2016b) suggest that countries are becoming 'equally unequal', that is, at the same time as the distribution of income becomes increasingly unequal within countries, across countries there is convergence to the same income distribution. Regardless of the inequality measure and the methodology used, the cross-country evidence univocally finds evidence of convergence. However, the

[1] On the social consequences of income inequality, see Klasen (2008), Wilkinson and Pickett (2009), Dabla-Norris et al (2015), Easterbrook (2021) and Hirschman (1973). On its relation to human development, see Stewart (2019) and UNDP (2019, especially chapter 2). On its economic effects, see Ostry et al (2014), Easterly (2007), and Thorbecke and Charumilind (2002). This literature has raised the question of whether equity and efficiency are independent objectives, or whether there could be an efficiency gain from greater equality (see, for example, Klasen, 2008). An implication of this body of research is that there may an optimal level of income inequality, beyond which we see a threat to existing socioeconomic achievements. However, the question of what such an optimal level might be is an open one.

[2] See Peters and Ketten (2023) for a survey. Easterbrook (2021) assesses how individuals' experience of inequality may affect their wellbeing with reference to developing country contexts.

[3] For example, Deaton (2004) and Canning (2012) examined the evolution of health, showing convergence in life expectancy across countries. Prados de la Escosura (2015) looked at convergence in human development in the long run, showing that there has been an overall widening of the human development gap since 1870, and partial convergence among OECD countries and the rest over the period 1913–70. See Asadullah and Savoia (2018) for a brief survey.

estimated speed of convergence seems to be sensitive to the dataset chosen (Lustig & Teles, 2016) and so still open to further empirical scrutiny. Coming closer to the focus of the present paper, a neglected aspect in this rather scant literature concerns the regional dimension of income inequality convergence.[4] Panizza (2001) and Lin and Huang (2011) find convergence between US states. However, Ho (2015) casts doubt on earlier findings when the long-run evidence is re-examined. Focusing on the European Union, Savoia (2019) shows that there has been convergence towards higher levels of income inequality across EU regions since the 1990s. Regional evidence on income inequality convergence remains fairly thin and has not produced much analysis of less developed economies yet.

Second, with this paper we hope to enrich the literature on the state of income inequality in the Arab world. This area, also as a result of the socio-political turbulence of the Arab Spring, has seen a revival of interest in inequality (see Klasen, 2018). Nonetheless, it is still in need of further empirical investigation on income disparities (Hassine, 2015; Alvaredo & Piketty, 2014). And the Arab Spring has inspired new assessments of the 'Arab inequality puzzle' (see Klasen, 2018). A recent report by the UN Economic and Social Commission for Western Asia (ESCWA) explored inequalities in health, education and by gender in Arab countries, and relegated their main drivers to the existing fragile governance structures, the "rentier nature" prevalent in these countries, along with the status of the leading economic sectors which tend to be "unproductive" (UN ESCWA & ERF, 2019). This may have contributed to the onset of the Arab Spring. Indeed, after being hailed as one of the most equal in terms of income distribution thanks to its state-led and socialist heritage, the region, in some new accounts, is estimated as having the highest level of income inequality worldwide. For example, by comparing income inequality levels in the Middle East to Western Europe, the US and Brazil by means of estimating the top decile's share of income, Piketty et al (2019) concluded that the Middle East was the most unequal region – with the top 10% estimated to receive 64% of all income in 2016, compared to 55% in Brazil, 47% in the US and 37% in Europe. Moreover, the estimates presented in the *World Inequality Report*, which included figures for 2021, again attributed to the Middle East and North Africa (MENA) region the highest decile income share (Chancel et al, 2022).

This paper is the first systematic attempt to study the evolution of income inequality within geographical entities in Egypt, the largest country in the MENA.[5] Moreover, looking at the regional variation of income within the MENA context may also shed light on the commonly held view that socioeconomic disparities were one of the main drivers that led to the Arab Spring in 2011. The Egyptian case seems to be a paradox, since the national inequality level has been found to be relatively low and stable in existing studies (Verme et al, 2014).[6] Yet patterns of national income inequality might be providing

[4] Regional studies typically look at inequality *between* regions: territorial differences in average income levels across regions. This study instead looks at inequality *within* regions (how income is distributed in a given region). The former is important to achieving territorially widespread improvements in living standards across the nation, as the empirical consensus is that higher growth often benefits all parts of the distribution, including the bottom (Dollar et al, 2016). However, it is also by studying how income is distributed within such territories that we can understand whether the gains from economic growth are widely shared.

[5] The evolution of wage inequality across sectors and demographic groups in individual MENA countries like Egypt has been thoroughly documented and analysed (see, for example, Said, 2015; Said et al, 2019).

[6] One way to reconcile this apparent paradox is on technical grounds. There may be substantial discrepancies between the way income inequality is measured and its true extent, because existing inequality statistics underestimate it. One argument is that income inequality estimates are drawn from household surveys fraught with various limitations, especially with respect to the 'true income' of top income earners (Achcar, 2020). Hlasny and Verme (2018) addressed this issue. After correcting for problems such as the number of non-respondents in household surveys, the estimated inequality was found to be higher by a minimum of 1.1 to a maximum of 4.1 percentage points. Similarly, Van der Weide et al (2018) argued that top income shares

partial information about the full extent of the evolution of inequality in the country. For instance, one should systematically examine whether average national inequality masks large inequalities that exist at the regional level. While the growth rate of per capita income in Egypt has been significant during the past 20 years, close to 2.5% (World Bank, 2019), we still know relatively little about the distributive pattern of these growth gains across geographical areas. Such regional analysis also has policy relevance, as Egypt was one of the leading countries in terms of working on the localisation of SDGs at the governorate level (UNFPA, 2020). Such localisation efforts are demonstrated in developing governorate-level reports to attract foreign direct investment at the local level (see Hanafy, 2015) and to track the progress in achieving the SDGs. This entailed creating governorate-level competitiveness indices, in addition to launching the 'Decent Life' initiative with the objective of improving and upgrading different social and economic aspects in the most disadvantaged villages (Ministry of Planning, 2021).[7]

Using newly assembled data from the Luxemburg Income Study (LIS) and the Economic Research Forum (ERF), which provide a rich geographical disaggregation, we constructed comparable regional inequality measures and provided evidence on the extent and evolution of income inequality across Egyptian governorates during the period 1999–2015. We first show that within-region inequality explains most of the overall income inequality and that there is significant variation in how income is distributed within regions. Then we looked at whether differences in inequality levels among regions are narrowing and singled out the most affected segments of the income distribution. The empirical analysis shows that there has generally been an increase in income inequality from 1999 to 2015. Also, it finds statistically significant evidence of unconditional convergence in income distribution across Egyptian governorates, implying that disparities in income inequality within regions tend to reduce regardless of regional characteristics. The pace of convergence has not been uniform; it is sustained for most regions, but significantly slower or even lacking in others. Finally, convergence across regions has also been significant for the bottom 40% and for the proportion of people living below 50% of the median income. Maintaining this convergence process may be an important policy avenue to support geographically diffused progress on SDG 10. However, this will not guarantee shared prosperity without a reversal of the unfavourable trends in both the income share of the bottom 40% and the

in Egypt are greatly underestimated. Using house prices to re-estimate the top tail of the income distribution, the revised Gini index was found to be 25% higher than the value reported in the World Bank's statistics.

[7] The limited existing literature on regional inequality in Egypt has focused mostly on consumption, cost of living and wage disparities. The earliest is a paper by Wahba (1996), examining the disparities in earnings in the different regions with respect to Cairo, and based on data from the Labour Force Sample Survey of 1988. The results pointed to the existence of significant regional discrepancies in returns to education, which constituted a key driver of wage inequality in the country. Studies following the onset of the Arab Spring included one by the World Bank (2012), which examined pre-existing differentials in consumption between the regional blocs, in comparison to Cairo, over the 2000–09 period, and another by Hanafy (2015) focused on regional disparities in the flows of foreign direct investment to the different governorates in Egypt during 1972–2009. Unsurprisingly, the findings of these studies consistently indicate that rural upper Egypt (the poorer south of the country) recorded the highest disparity in all measured outcomes relative to Cairo. Another wave of studies, which followed Wahba's earlier research (1996), exploiting more recent labour panel survey data (1998–2018), focused on: estimating the Mincerian wage equation for each region in Egypt and comparing it to disparities in the funds allocated for education by the government (Nassar & Biltagy, 2016); regional inequality in the cost of living and inflation dynamics by means of constructing the True Cost of Living Index (Alazzawi, 2020); the relationship between the macroeconomic fundamentals in the different regions and real hourly wages (Mostafa, 2021); and the evolution of the gender and sectoral distribution of real wages and regional differences in the percentage of people falling below the 'low earnings line' (Said et al, 2019). The studies highlighted a worsening in the inferior position of rural upper Egypt governorates, whereby almost 70% of the residents in these areas were found to be below this line in 2018, compared with 62% in 2012; there was also an exacerbation of gender wage inequality in the private sector in all regions (Said et al, 2019; Mostafa, 2021).

proportion of people living below 50% of the median income during the pre-SDGs period. The paper proceeds as follows. Section 2 presents the data and provides evidence on the evolution of regional income inequality in Egypt. Section 3 presents the evidence on regional inequality convergence and section 4 discusses the results. Section 5 concludes.

2 Income distribution within Egyptian regions

This section describes the dataset and variables used in this study, and provides descriptive evidence on the evolution of income distribution in Egypt at regional level.

2.1 Income distribution measures and data

We focused on a set of core income inequality measures, chosen following two criteria: (1) their relevance to the debate on the effects of inequality on development outcomes (Easterly, 2007); and (2) the policy relevance of the inequality measure, ie whether they are relevant to one or more SDG 10 targets. For a sample of 27 Egyptian regions during 1999–2015, we computed the Gini index and quintile income shares. The income share of the bottom 40% is of particular interest, as it is central in measuring progress for Target 10.1 of SDG 10. For the same reason, we also computed the proportion of people living below 50% of median income. This captures relative poverty and income inequality, adopted as an official indicator for Target 10.2.[8]

We used the ERF-LIS database which, by harmonising income data for MENA economies, presents two crucial advantages. First, it provides income data from a rich geographical classification, which allows us to draw evidence on how income distribution varies within and across different geographical regions within a country. Second, it ensures clear comparability of inequality statistics over time.[9] In particular, we constructed regional measures of inequality based on disposable household income. This is a harmonised variable including total monetary and non-monetary current income for a given household, net of income taxes and social security contributions. In order to create a fully comparable income variable across regions, we first applied a common top–bottom procedure to delete extreme values in incomes.[10] Then we equivalised the variable using the LIS equivalence scale (ie the square root of the number of household members).[11] Note that data are representative of the population even when disaggregated at the regional level (ie at governorate level), as LIS has retained in the datasets the same weights provided by the Egyptian national statistical office, the Central Agency for Public Mobilisation and Statistics. Therefore, the sample has been proportionally distributed at the governorate level between urban and rural areas, to ensure that even small governorates are equally represented in

[8] SDG Goal 10 aims to “reduce inequality within and among countries”. The first two targets are clearly related to aspects of income inequality. In particular, Target 1.1 aims to “progressively achieve and sustain income growth of the bottom 40 per cent of the population at a rate higher than the national average”. The idea is to achieve “shared prosperity”, ie a form of growth with equity, where progress is measured by how gains from economic growth are shared with the poorest members of society over time. Target 1.2 aims to “empower and promote the social, economic and political inclusion of all, irrespective of age, sex, disability, race, ethnicity, origin, religion or economic or other status”. The idea here is to address social inclusion, relative poverty and inequality (https://sustainabledevelopment.un.org/sdg10). See Lang and Lingnau (2015) for a discussion of inequality in the SDGs and an assessment of its measurement.

[9] See LIS (2019). On the ERF-LIS dataset, see https://www.lisdatacenter.org/our-data/erf-lis-database/.

[10] We bottom-code by setting all values less than zero to zero, and top-code by setting all values greater than ten times the median value to ten times the median value. In Egyptian data, however, using top and bottom coding procedures makes little difference. No significant change occurs when replicating the results after removing top–bottom procedures on income data. The results, not reported here, are available on request.

[11] As we are using an equivalised income variable, we apply the household weight multiplied by the number of household members, to weight by person (*hpopwgt*nhhmem*).

the sample. Table A1, in the Appendix, provides further details of the sample composition at regional level.

2.2 Trends in income distribution within Egyptian regions during 1999–2015

Table 1 offers summary statistics of our set of inequality measures at the regional level for each available wave in the ERF-LIS database.[12] Three facts are worth noting from this table. First, the average regional Gini index has seen an increase over the period in question. This trend is mainly attributed to an average regional increase in the top quintile and a slight decline in the share of the bottom 40%, since no other sizeable variation occurred in the rest of the distribution, on average. Second, the poverty rate, capturing the proportion of the population living below 50% of the median income has also increased. Third, looking at the cross-sectional dispersion as expressed by the coefficient of variation, one can see a general decrease over time (except for the middle quintile). This is indicative of a reduction in regional differences in income inequality, which occurred from 1999 to 2015. However, average values may still hide considerable regional variation (as differences between minimum and maximum levels suggest), which we will explore next.

Table 1: Income inequality within Egyptian regions: summary statistics

		1999 (Obs 27)	2004 (Obs 27)	2008 (Obs 27)	2010 (Obs 27)	2012 (Obs 27)	2015 (Obs 27)
Gini index							
	mean	0.25	0.26	0.27	0.26	0.25	0.27
	cv	0.18	0.15	0.15	0.16	0.16	0.14
	sd	0.04	0.04	0.04	0.04	0.04	0.04
	max	0.37	0.35	0.36	0.38	0.31	0.40
	min	0.16	0.20	0.19	0.20	0.12	0.19
Quintile 1							
	mean	10.85	10.20	10.25	10.94	11.42	10.23
	cv	0.12	0.11	0.10	0.16	0.24	0.10
	sd	1.31	1.13	0.99	1.76	2.73	1.02
	max	13.52	11.83	12.18	16.17	23.35	12.50
	min	7.71	7.99	8.35	8.08	8.96	7.14
Quintile 2							
	mean	14.31	14.03	13.77	14.17	14.14	13.87
	cv	0.08	0.07	0.08	0.09	0.07	0.07
	sd	1.11	0.98	1.12	1.34	0.98	0.96
	max	16.36	15.70	15.80	17.51	17.42	15.58
	min	11.21	11.69	11.11	11.02	12.70	10.44
Quintile 3							
	mean	17.43	17.49	17.29	17.86	18.09	17.13
	cv	0.06	0.06	0.06	0.10	0.21	0.07
	sd	1.03	1.10	0.98	1.71	3.80	1.12
	max	19.00	20.04	19.08	22.01	36.22	19.26
	min	14.49	15.21	15.46	13.07	15.05	14.12
Quintile 4							
	mean	21.89	21.99	21.55	21.23	21.71	21.93
	cv	0.06	0.04	0.05	0.08	0.19	0.05
	sd	1.34	0.94	1.01	1.62	4.13	1.09
	max	26.33	24.21	24.00	23.76	30.27	25.15

[12] Empirically, we show that inequality *within* regions is relevant. Section A4 in the appendix decomposes income inequality by population subgroups based on their geographical location. The results reveal that within-region inequality explains most of the overall income inequality. For example, according to the Theil index decomposition in 2015, the contribution of the *within* component (or intra-regional inequality) amounts to 90.8% of the total, whereas the *between* component (or inter-regional inequality) accounts for the remaining 9.2%. The *within* component in 1999 was lower, but still very high, at 79.3%.

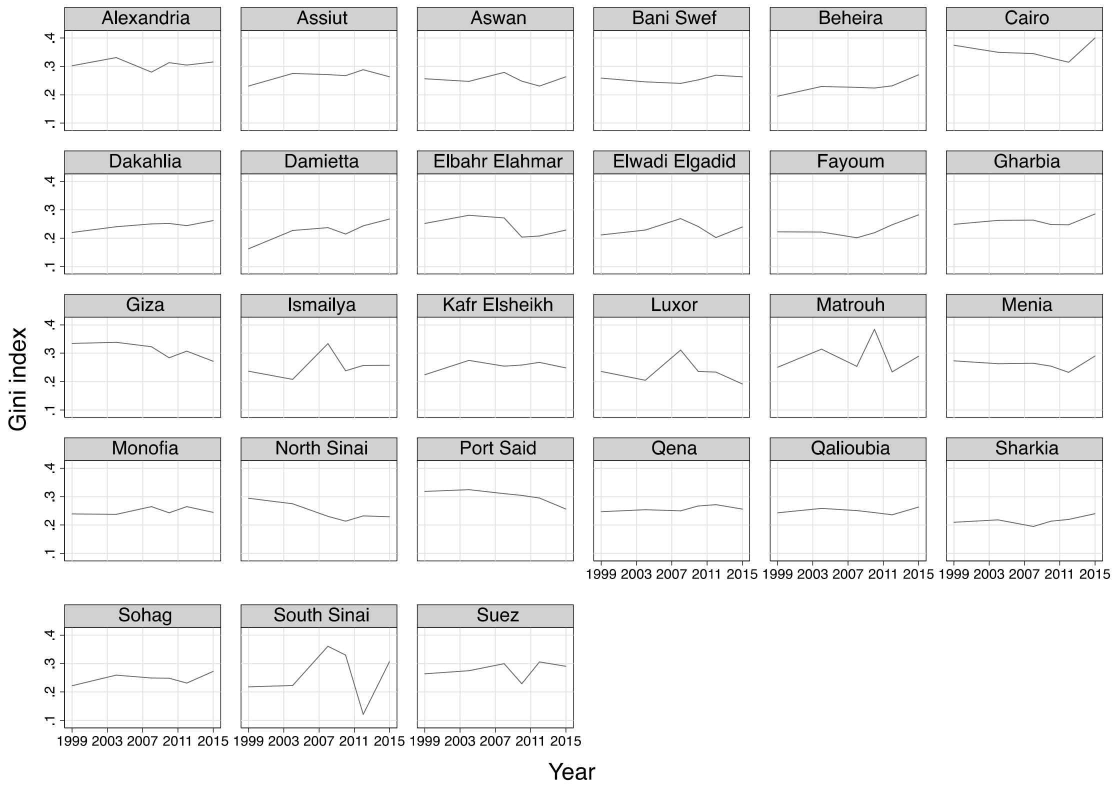
	min	19.74	20.25	19.41	16.78	3.83	20.27
Quintile 5							
	mean	35.52	36.29	37.14	35.80	34.65	36.84
	cv	0.10	0.09	0.09	0.11	0.13	0.09
	sd	3.67	3.41	3.29	3.80	4.50	3.22
	max	46.33	43.79	44.09	48.43	40.98	47.96
	min	29.25	30.99	31.49	29.59	18.53	30.97
Bottom 40%							
	mean	25.15	24.24	24.03	25.11	25.55	24.10
	cv	0.09	0.09	0.08	0.09	0.11	0.08
	sd	2.37	2.06	2.01	2.33	2.85	1.93
	max	29.89	27.23	27.97	30.43	36.29	27.93
	min	18.91	19.78	20.29	19.40	21.88	17.58
Poverty rate: % households below 50% median income							
	mean	4.33	5.52	4.93	4.91	4.51	5.29
	cv	1.22	1.12	1.23	1.27	1.13	1.09
	sd	5.29	6.18	6.06	6.24	5.12	5.78
	max	18.41	26.02	23.46	26.70	18.03	25.15
	min	0.00	0.00	0.00	0.00	0.00	0.00

Notes: Variables are calculated using ERF-LIS data on equivalised disposable household income.

Figure 1, presenting income inequality time trends since 1999 for the 27 Egyptian regions, reveals two regularities. First, there is a significant territorial disparity. The Gini index's pattern shows that most equal and unequal regions have been separated by a gap ranging from 15 to 20 percentage points, with the Cairo region displaying the highest levels of income inequality (about 0.40 in 2015) and the region of Sharkia showing the lowest such levels over time (between 0.21 and 0.24).[13] Second, the evolution of inequality in Egyptian regions showed markedly different patterns during the 1999–2015 period. Some regions saw a break from a fairly stable trend, with upward or downward swings during the Arab Spring years (eg Cairo, Fayoum, South Sinai, Elbahr Elahmar and Damietta). However, regions with low levels of inequality either experienced very minor fluctuations or none at all (eg Sharkia, Elwadi Elgadid, Qena, Qalioubia, Monofia and Bani Swef).

Figure 1: Income inequality within Egyptian regions: Gini index 1999–2015

[13] Compare also regional measures with income inequality measures for Egypt at national level. We report them in the Appendix at Table A8. This highlights that income inequality *within* regions may be very different from national income inequality. The national-level picture suggests that income inequality has been relatively low and stable during 1999–2025, in stark contrast to the large variation in inequality at regional level.



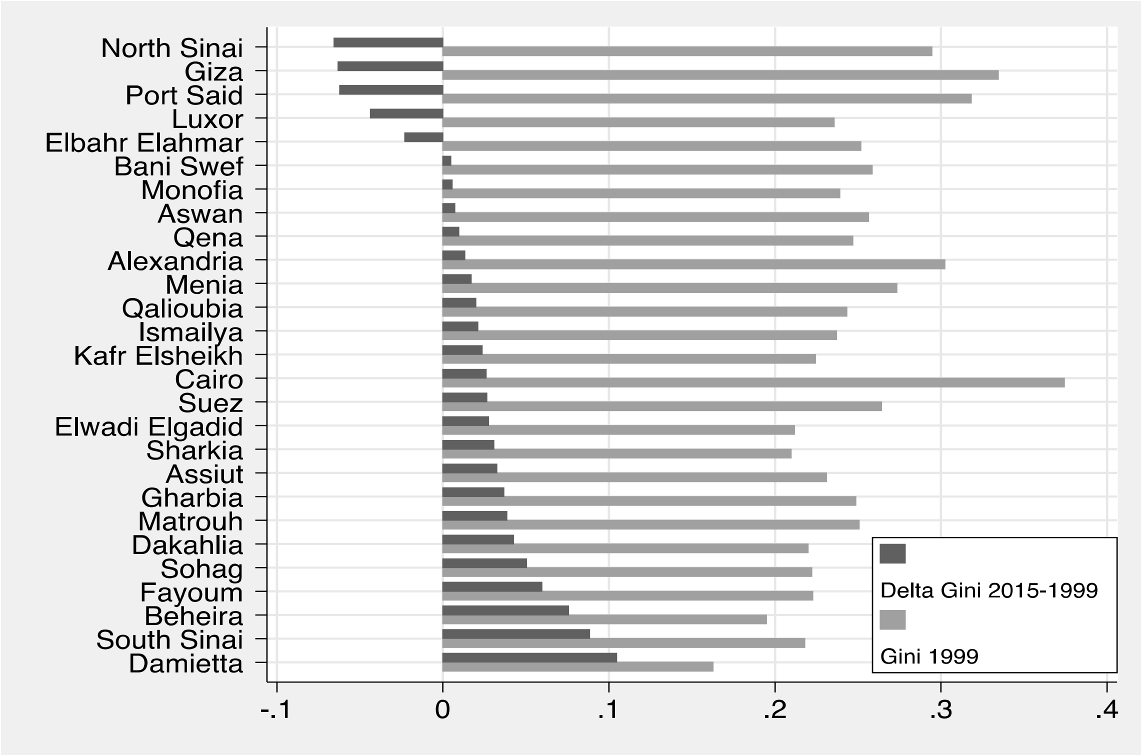
Note: Gini index at regional level calculated using LIS data on equivalised disposable household income.

2.3 Change in regional income inequality during 1999–2015

Figure 2 provides details of the evolution of inequality, plotting for each region the initial value of Gini for 1999 (light grey bars) and the corresponding variation between 1999 and 2015 (dark grey bars). Although there is significant variation in income inequality levels across regions, most have witnessed a significant increase in such levels. This is attributable to a concurrent decrease in the income shares of the first two quintiles and to an increase in the top (fifth) quintile's share in most regions over the 1999–2015 period (see Figures A1 and A2).

Five regions, however, have seen significant reductions. Interestingly, the regions which have seen the highest inequality reduction (about 6.5 percentage points for North Sinai, Giza and Port Said) were among those with the highest initial level of inequality in 1999. Similarly, the regions which experienced an increase in inequality by up to ten percentage points (eg Damietta) were also those with the lowest initial level of inequality in 1999. This indicates that there may have been convergence during this period.

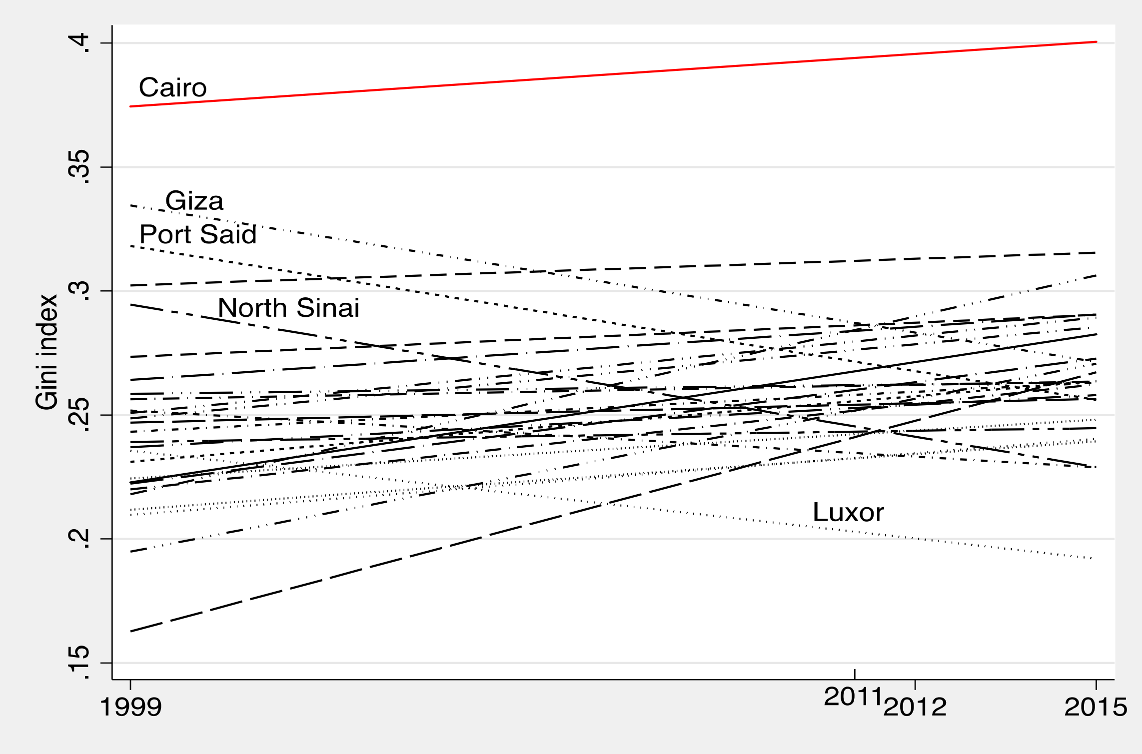
Figure 2: Initial level of inequality and change over time: Gini 1999–2015



Note: Gini index calculated using equivalised disposable household income.

Figure 3 elaborates further on this, by plotting the first (1999) and last (2015) values of the regional Gini index. It is noticeable that most regions tend to converge towards middle levels of inequality, whereas regions witnessing higher levels of inequality in 1999 have subsequently narrowed their gap in income concentration with less unequal regions. Nevertheless, it is also worth noting that Cairo (red line) appears to be a potential outlier, seemingly out of line with the convergence pattern. We investigate this further in the next section.

Figure 3: Evolution of income inequality within Egyptian regions: Gini index (first and last year)



Note: Gini index calculated using equivalised disposable household income.

3 Are differences in income inequality levels among regions narrowing?

In the previous section, stylised facts on the evolution of income inequality suggest that there may have been regional convergence in income inequality. This section introduces a formal econometric test of convergence, with results to follow.

3.1 Inequality convergence tests

As we are interested in documenting whether initial income inequality matters for differences in income distribution across regions, we have focused on the notion of beta-convergence.[14] This allows us to obtain evidence on whether regions with lower inequality levels tend to experience larger changes in income inequality and so catch up with regions with higher inequality levels, giving an appreciation of convergence speed and its significance, which are the key empirical aspects of the evolution of the regional disparities we are seeking to document. The corresponding test, following Ravallion (2003), is a regression of the observed absolute changes over time on a given inequality measure on the measure's initial values across regions. Let $I_{i,t}$ denote the observed inequality index in region i, at time $t = 0$ and $t = T$, ie in the first and last year of the period considered, respectively. A test equation for regional convergence is then:

$$I_{iT} - I_{i0} = \alpha + \beta \cdot I_{i0} + \varepsilon_i \;\; (i=1 \ldots 27) \qquad (1)$$

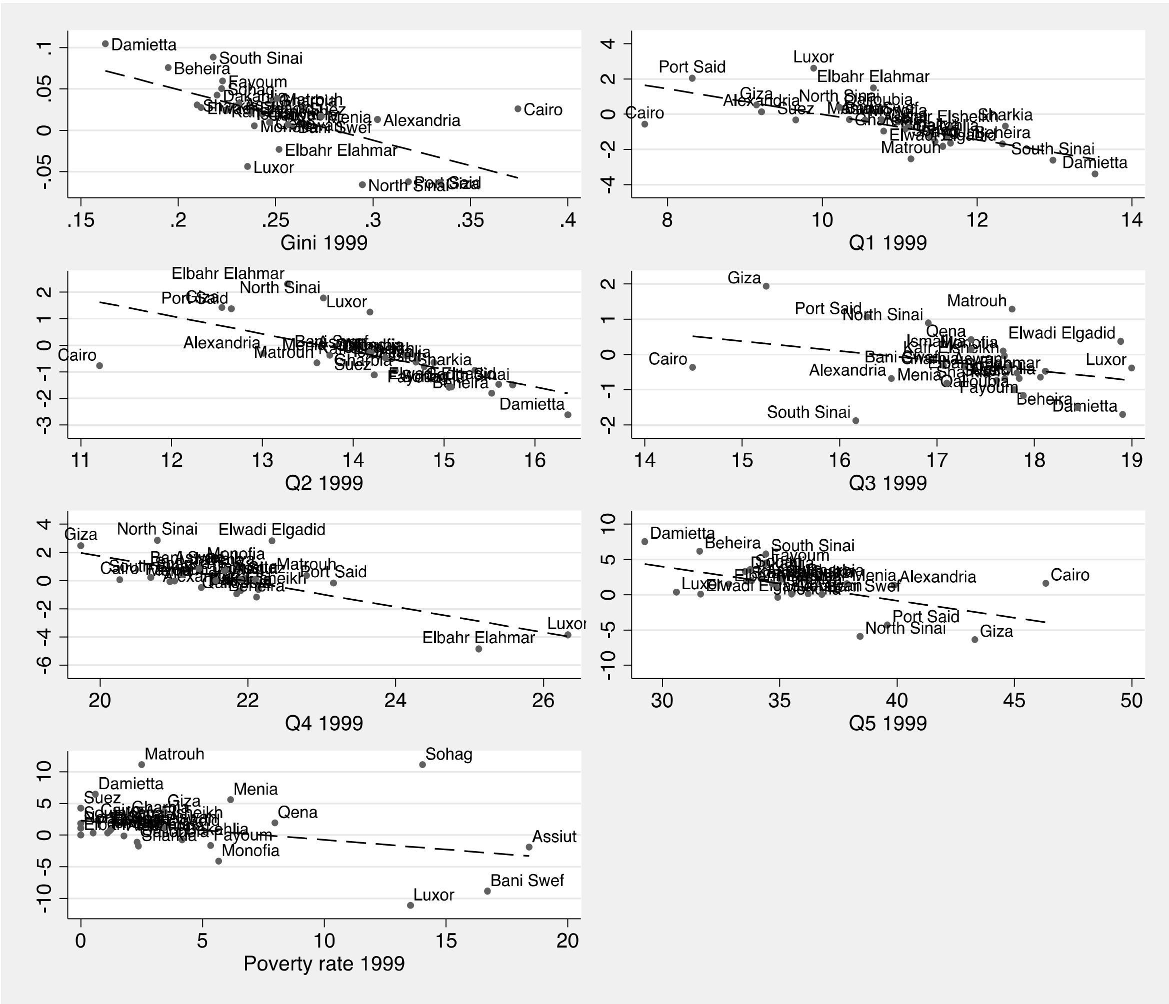
where α and β are parameters to be estimated. A significant negative (positive) estimate of β implies that there is convergence (divergence) and its magnitude expresses the speed of convergence

[14] Others have emphasised a different statistical notion of convergence (see, for example, Quah, 1993): σ-*convergence*, which looks at whether the cross-sectional dispersion across countries is decreasing, and for which β-*convergence* is a necessary, but not sufficient, condition. See Sala-i-Martin (1996) for a comparison of the two notions.

(divergence). Equation (1) captures the hypothesis of unconditional (or absolute) convergence, according to which regions' inequality measures converge with one another in the long run, independently of their initial conditions – that is, differences are transitory.

Figure 4 shows the scatter plots of the initial inequality level against its subsequent change for all our measures. Regions with higher initial levels of income inequality seem to catch up with those having lower initial levels of inequality during 1999–2015, thereby providing suggestive evidence of unconditional convergence. However, this is less evident for the poverty index. The significance and speed of the convergence process can be best assessed when referring to the regression estimates, in the next section.

Figure 4: Income inequality: initial level versus 1999–2015 change



Note: Inequality measures are calculated using LIS data on disposable household income.

3.2 Unconditional convergence in regional inequality

Table 2 reports unconditional convergence estimates from 1999 to 2015. With respect to the Gini index, the results show that differences in within-region income inequality have reduced since 1999, on average. To provide an assessment of the speed of convergence, consider two typical regions: Giza (having an initial Gini of 0.335) and Assiut (with an initial Gini of 0.231). Both are positioned very close to the regression line, but at the opposite extremes. According to Ordinary Least Squares (OLS) estimates (in Panel a, column 1), the expected change in inequality will be 0.171 + (-0.611×0.335) = -0.034, in the former case, and 0.171 + (-0.611×0.231) = 0.030 in the latter. Such trends imply that, after 16 years, the two regions would be predicted to reach a level of inequality of 0.335 + (-0.034) = 0.301 in Giza, and 0.231 + 0.030 = 0.261 in Assiut. This is indicative of a significant process of convergence, taking into account the sluggish nature of income inequality and the length of the period analysed, where income concentration levels across regions are narrowing. Such a trend implies that Egyptian regions are converging to an average Gini index level of |0.171/-0.611|= 0.280. While they are reducing their disparities and hence becoming more similar in terms of income concentration, the regions are converging to a higher level of income inequality.

In Panel b, we present further results exploiting the panel dimension of the regional inequality statistics. This is a useful exercise that supplements the initial set of unconditional convergence regressions, relying on a cross-section of 27 regions. We estimate the panel version of (1):

$$\Delta I_{it} = \alpha + \beta \cdot I_{it0} + \varepsilon_{it} \quad (t=1\ldots5;\ i=1\ldots27) \qquad (2)$$

where the dependent variable ΔI_{it} captures the variation of the inequality measure for each region in each sub-period (and t_0 is the beginning of each episode). Pooled OLS regressions – which do not include any other initial condition among the explanatory variables – express unconditional convergence estimates (and pick the average speed of convergence across the five periods). The corresponding estimates confirm cross-section evidence on unconditional convergence. In addition, the results suggest that the apparent lack of convergence in the third quintile and in the proportion of the population living below 50% of the median income was perhaps simply reflecting low degrees of freedom in cross-section regressions.

Both cross-section and panel estimates indicate that more unequal Egyptian regions seem to be narrowing their gap in income concentration with less unequal regions. But which parts of the income distribution are converging? In further regressions (columns 2–6, in both parts of Table 2), we ‘unpack’ the distribution of income by considering its quintiles. In this case, the coefficients of initial values are negative and statistically significant for all measures. This suggests that it is movements across all parts of the distribution that have driven the process of income inequality convergence during 1999–2015.

Table 2: Unconditional convergence, 1999–2015: OLS estimates

	PANEL A: CROSS-SECTION OLS ESTIMATES						
	1	2	3	4	5	6	7
	Dep variable is the 1999–2015 change in:						
	Gini index	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5	Poverty
Gini index, 1999	-0.611**						
	(0.242)						
Quint 1, 1999		-0.722***					
		(0.195)					
Quint 2, 1999			-0.667**				
			(0.267)				
Quint 3, 1999				-0.278			
				(0.220)			
Quint 4, 1999					-0.903***		

					(0.171)		
Quint 5, 1999						-0.484**	
						(0.232)	
Poverty, 1999							-0.304
							(0.250)
Constant	0.171***	7.213***	9.084**	4.540	19.796***	18.512**	2.279***
	(0.058)	(2.207)	(3.945)	(3.908)	(3.713)	(8.050)	(0.816)
F-stat	6.34**	13.74***	6.19**	1.59	27.77***	4.36**	1.48
Adj R-Sq	0.390	0.474	0.386	0.067	0.539	0.292	0.080
Obs	27	27	27	27	27	27	27
RMSE	0.033	0.973	0.908	0.857	1.099	2.650	4.549
Converging to:	0.280***	9.990***	13.619**	16.331	21.922***	38.248**	7.497

PANEL B: POOLED OLS ESTIMATES

	1	2	3	4	5	6	7
	Dep variable is the five-year change in:						
	Gini index	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5	Poverty
Gini, initial val	-0.625***						
	(0.169)						
Quint 1, initial val.		-0.740***					
		(0.117)					
Quint. 2, initial val			-0.642***				
			(0.122)				
Quint 3, initial val				-0.722***			
				(0.059)			
Quint 4, initial val					-0.815***		
					(0.080)		
Quint 5, initial val						-0.744***	
						(0.202)	
Poverty, initial val							-0.175**
							(0.074)
Constant	0.165***	7.822***	8.958***	12.665***	17.679***	26.961***	1.040***
	(0.043)	(1.345)	(1.766)	(1.137)	(1.857)	(7.144)	(0.263)
F-stat	13.66***	39.89***	27.52***	148.77***	104.07***	13.51***	5.57**
Adj R-Sq	0.327	0.374	0.331	0.351	0.410	0.377	0.074
Obs	135	135	135	135	135	135	135
RMSE	0.037	1.656	1.010	1.969	2.089	3.611	3.401
Converging to	0.264***	10.570***	13.953***	17.541***	21.692***	36.238***	5.943**

Notes: Significance levels: 10% (*), 5% (**) and 1% (***). Cross-section estimates report heteroscedasticity-robust standard errors in parentheses. In pooled OLS estimates, standard errors are clustered at region level.

3.3 Has convergence been uniform across regions?

The foregoing illustrations fit the ‘typical’ region, on the regression line or close by. However, while they approximate well the trends of a significant part of our sample, our regressions may not be able to explain why some regions, though showing similar levels of initial inequality, present out-of-line variations in their subsequent inequality change. For example, with the Gini index and most of the quintile convergence regressions, the Cairo region is an outlier. In poverty regressions, consider the regions Luxor and Bani Swef, and compare them to Sohag. The initial level of the proportion of the population living below 50% of the median income was similar in all three. Yet Luxor and Bani Swef have been successful in reducing poverty, while Sohag has not. This suggests that the estimated speed of convergence may reflect the disproportionate influence of specific regions.

To investigate this further, Table 3 tries to detect the effect of influential observations by using Iteratively Reweighted Least Squares (IRLS). Such regressions, which drop potential outliers and down-weight influential observations in the sample, largely confirm previous convergence results from OLS estimates. IRLS results also confirm that the Cairo region is something of a special case. It is identified as a potential outlier and dropped in many regressions (indeed, OLS regressions dropping the Cairo region, shown in Table A2, are remarkably similar to the results in Table 3). Similarly, by downweighting Luxor, Bani Swef and Sohag, the speed of poverty convergence is significantly faster, with the regions converging to a lower level of poverty.

In conclusion, while IRLS results confirm the occurrence of convergence, they also suggest that the speed of convergence has not been uniform: the pace may be sustained for most regions, but is significantly slower or even lacking in others. In the case of Gini and quintile shares, the Cairo region seems to behave differently from the rest. As a large and populous urban area, it plays a significant role in the process of inequality reduction at the national level. In the case of poverty, while most regions converged, a small group did not follow the same pattern (eg Luxor, Bani Swef and Sohag). This indicates that a future avenue in the research and policy agenda on regional income disparities in Egypt would be to look at the specific narratives of these regions and how they are progressing with respect to Target 10.2 during the SDG period.

Table 3: Unconditional convergence, 1999–2015: IRLS estimates

	1	2	3	4	5	6	7
PANEL A: CROSS-SECTION IRLS ESTIMATES							
	Dep variable is the 1999–2015 change in:						
	Gini index	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5	Poverty
Gini index, 1999	-0.934***						
	(0.138)						
Quint 1, 1999		-0.861***					
		(0.110)					
Quint 2, 1999			-0.877***				
			(0.123)				
Quint 3, 1999				-0.279			
				(0.173)			
Quint 4, 1999					-0.890***		
					(0.153)		
Quint 5, 1999						-0.785***	
						(0.159)	
Poverty, 1999							-0.454***
							(0.126)
Constant	0.248***	8.690***	12.070***	4.553	19.465***	28.952***	1.880**
	(0.034)	(1.211)	(1.779)	(3.015)	(3.365)	(5.603)	(0.853)
F-stat	45.82***	61.48***	50.85***	2.62	33.67***	24.37***	12.96***
Adj R-Sq	0.642	0.708	0.665	0.059	0.557	0.483	0.315
Obs	26	26	26	27	27	26	27
RMSE	0.026	0.642	0.580	0.904	1.047	2.409	3.404
Converging to:	0.266***	10.093***	13.763***	16.319	21.871***	36.881***	4.141***
PANEL B: POOLED IRLS ESTIMATES							
	1	2	3	4	5	6	7
	Dep variable is the five-year change in:						
	Gini index	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5	Poverty
Gini, initial val	-0.375***						
	(0.054)						
Quint 1, initial val		-0.563***					
		(0.063)					
Quint 2, initial val			-0.544***				
			(0.060)				
Quin. 3, initial val				-0.519***			
				(0.061)			
Quint 4, initial val					-0.870***		
					(0.038)		
Quint 5, initial val						-0.393***	
						(0.050)	
Poverty, initial val							-0.250***
							(0.038)
Constant	0.098***	5.801***	7.627***	9.035***	18.916***	14.273***	0.962***
	(0.014)	(0.676)	(0.852)	(1.060)	(0.821)	(1.814)	(0.281)
F-stat	48.39***	79.83***	81.36***	73.19***	534.21***	61.05***	44.31***
Adj R-Sq	0.261	0.372	0.375	0.354	0.800	0.309	0.244
Obs.	135	134	135	133	134	135	135
RMSE	0.026	0.986	0.777	0.811	0.925	2.209	2.492
Converging to	0.261***	10.304***	14.020***	17.929***	21.743***	36.318***	3.848***

Notes: Significance levels: 10% (*), 5% (**) and 1% (***).

3.4 Has the speed of convergence accelerated over time?

This section presents further results exploiting the panel dimension of the regional inequality statistics. The regression results in Tables 1 to 3 pick the average speed of convergence across the five periods. We supplemented the initial set of unconditional convergence regressions with further evidence exploring whether (and how) the pace of convergence has changed over time. We estimated the following specification:

$$\Delta I_{it} = \alpha + \lambda_t + \beta_1 \cdot I_{it0} + \Sigma\beta_t \cdot \lambda_t I_{it0} + \varepsilon_{it} \qquad (t=1\ldots5;\ i=1\ldots27) \qquad (3)$$

where the dependent variable ΔI_{it} captures the variation of the inequality measure for each region in each sub-period and $I_{i,t0}$ is the initial value of inequality in each period. The time dummies λ_t capture economy-wide common shocks related to the specific sub-period. According to Equation (3), the sign and magnitude of the speed of convergence may change depending on the historical period. The estimated coefficient of parameter β_1 refers to the initial value of inequality for the first sub-period. Hence, the time-specific speed of convergence for each sub-period $t=2\ldots5$, will be calculated as: $\beta_1 + \beta_t$.

Table A3 presents results from Pooled OLS regressions. As they do not include any other initial conditions among the explanatory variables, such regressions still express unconditional convergence estimates. The results suggest that unconditional convergence in income inequality has occurred throughout the whole period (see column 1, especially point estimates of the speed). When looking at the profile of the distribution, point estimates of the speed of convergence over time suggest that convergence has occurred with greater constancy for the bottom 40% and for the top quintile. In contrast, the speed of convergence has changed over time for the third and fourth quintiles, the upper echelon of the middle-income bracket, concentrating more in initial and final periods. Finally, convergence seems to have intensified in the last two periods (from 2010 onwards).

4 Discussion

From the foregoing analysis, it is apparent that there has generally been an increase in regional income inequality during the 1999–2015 period in Egypt. This is reflected in the evidence shown in the paper from unconditional convergence regressions in income distribution across Egyptian governorates. In particular, it is important to note here that convergence towards higher levels of inequality across Egyptian regions is consistent with the notion that the political upheaval leading to the Arab Spring of 2011 was rooted, among other things, in increasing income inequality. Despite aggregate data showing a relatively low and stable level of income inequality in Egypt at national level, the disaggregate picture told us a rather different story. Increasing income concentration, which occurred in both relatively equal and unequal regions, may have contributed to creating resentment across the population, perhaps causing a feeling of social injustice to pervade the public domain.[15] We do not investigate the mechanisms explaining regional differences in economic inequality (or its changes during this period), leaving this as a task for future research. Nonetheless, it is worth noting here that long-run structural factors, such as the institutions and policies associated with cotton and land relations, are likely to play a significant role.[16] The cultivation of cotton, which acquired importance in the 1860s and has been a prominent commodity export in Egypt until the 1970s, was associated with the rise of agricultural slavery, providing a workforce in cotton farming in the Nile Delta (Saleh, 2017). Land may have significantly contributed to the emergence and persistence of inequality through tax policy and property rights. The contribution of agricultural land taxes to the national budget in 1917–18 was such that the tax burden was falling disproportionately on small landholders (see Berque, 1972). An important characteristic of rural Egypt was that land ownership was limited to a modest number of owners, to the

[15] Shenker (2016) provides an account of how the Arab Spring in Egypt arose also as a reaction to the iniquities of neoliberal policies, and how this was misread abroad by some as a cry for more of them.

[16] Inequality regressions using fixed effects suggest that time-invariant regional characteristics, such as historical economic structure, may explain the persistence of and change in inequality. We have produced preliminary evidence, based on conditional convergence estimates, showing this in the Appendix. Further systematic econometric analysis is needed to shed light on which region-specific characteristics matter (see Durlauf et al, 2009, on the methodological challenges).

extent that 6% of the total number of landowners had acquired 66% of the total landholding in 1947 (see Abd al-Khāliq et al, 1982). Nasser's leadership and the emergence of Nasserism may have significantly contributed to mitigating economic inequalities (O'Brien, 1982), but their resurgence appears evident during the Mubarak era (Shenker, 2016).

What does this suggest in terms of progress on reducing inequality, as in SDG 10? The analysis presented here does not cover the actual SDG period (for which an assessment is not possible for the time being). Nevertheless, it is insightful to the extent that it tells us how Egypt has performed during the period leading to the adoption of the SDGs; hence it provides us with an understanding of where its starting line on SDG 10 should be drawn. Egypt does not start from an advantageous position with respect to Target 10.1 of SDG 10, but convergence in the first and second quintiles may bear good news in the future. Although specific analysis of Target 10.1 will require additional new data, convergence results suggests that the increase in the income share of the bottom 40% has been greater in the regions where the first two quintiles had smaller shares and, as a result, it tends to converge to a higher level than in the past. If this trend is maintained during the SDG period, income growth among the bottom 40% of the population at a rate higher than the national average will translate into future progress on this target at both national and regional levels. But for such progress to materialise, the unfavourable trend in the income shares of the bottom 40% seen during 1999–2015 will need to be reversed.

Similarly, convergence in the proportion of the population living below 50% of the median income suggests that its evolution is such that Target 10.2 of SDG 10 has tended to become geographically more even during 1999–2015. But such a reduction in regional disparities will support progress in Target 10.2 if Egypt can reverse a trend that has seen an increase in the proportion of people living below 50% of median income during 1999–2015. We recommend close monitoring and investigation of this trend during the SDG period. Since Target 10.2 is based on a poverty rate, it will also be necessary to see how the process of economic growth has affected the poor in the Egyptian regions, by combining information on inequality *between* regions (differences in average income levels across regions) with inequality *within* regions. Following Bourguignon (2012), the evolution of the proportion of people living below 50% of the median income can be assessed by decomposing the net effect of growth on poverty in its two components: the pure growth effect and the effect coming from changes in the pattern of income inequality.

5 Conclusions

Income distribution is an important dimension of living standards and it is part of SDG 10 on the "reduction of inequality within and among countries". Nevertheless, empirical research on income inequality has neither extensively analysed the Arab world nor provided much analysis on disparities in income inequality across countries or regions. In this paper, we have focused on the regional dimension in the largest country of the Arab world, Egypt. Using a newly assembled LIS dataset and a range of inequality measures, the results have shown that there has generally been an increase in income inequality from 1999 to 2015. Although regional disparities remain significant, we have also found statistically significant evidence of unconditional convergence across Egyptian governorates. This means that disparities in income inequality between equal and unequal regions are tending to reduce, regardless of regional characteristics. However, since Egyptian governorates have also seen a concurrent increase in income inequality within regions during 1999–2015, less unequal regions are converging to similar levels of inequality with more unequal regions (as expressed by the Gini index). This does not mean that Egyptian governorates will continue to grow unequally. We will not know whether the increase in inequality and the convergence that happened during 1999–2015 will continue until we know what caused it. Nonetheless, it is an empirical fact laying the foundations for progress on SDG 10 in the country.

The increase in regional inequality is also attributable to a decrease in the income share of the bottom 40% and an increase in the proportion of people living below 50% of median income. Hence, with reference to Targets 10.1 and 10.2 of SDG 10, Egypt is starting from a disadvantageous position. The reduction in regional disparities experienced during the 1999–2015 period has also meant that the income of the bottom 40% and the proportion of people living below 50% of the median income have tended to become geographically more even. However, even if this convergence process is maintained during the SDG period, progress on the parts of the distribution that are core objectives of SDG 10's first two targets will translate into progress on these targets at both national and regional levels if the unfavourable trend of rising income inequality during the period leading up to the SDGs can be reversed.

We hope our paper will be part of a growing research agenda shedding light on regional disparities and convergence in living standards. In particular, future research should explore further what links regional disparities and progress on the SDG 10 targets. It should systematically investigate the factors that drive fluctuations in income inequality at regional level, including the role of regional structural characteristics, such as the quality of local institutions (political and economic), economic integration, historical development and natural resources. This would help us advance our understanding of why some regions are more unequal than others and of how regional characteristics may affect progress with reference to important targets of SDG 10, such as the implementation of progressive fiscal policies. Similarly, future research should explore how relevant and widespread are the obstacles to equality of opportunity across regions, as well as addressing the role of social and political inclusion, which are also key elements of SDG 10 in tackling inequalities.

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Appendix 1

Table A1: Sample size by region, across LIS waves (number of households)

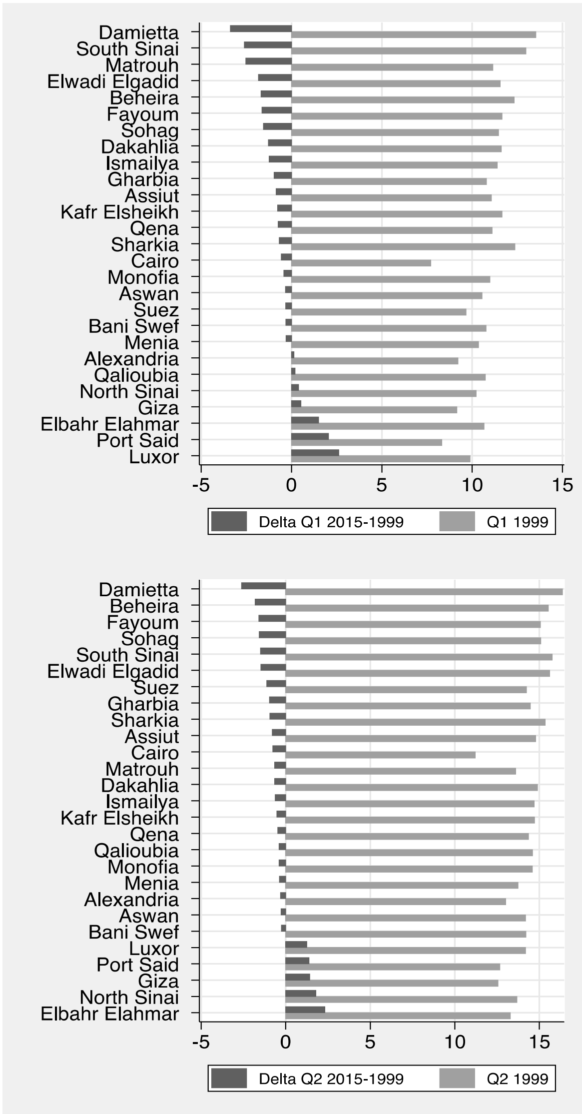
	1999			2004			2008			2010			2012			2015		
	Non-rural	Rural	Total	Non-rural	Rural	Total	Non-rural	Rural	Total	Non-rural	Rural	Total	Non-rural	Rural	Total	Non-rural	Rural	Total
Cairo	4,230	0	4,230	5,898	0	5,898	2,597	0	2,597	821	0	821	820	0	820	748	0	748
Alexandria	2,155	0	2,155	2,908	0	2,908	1,401	0	1,401	519	0	519	431	0	431	492	0	492
Port Said	320	0	320	439	0	439	460	0	460	67	0	67	66	0	66	495	0	495
Suez	319	0	319	348	0	348	477	0	477	60	0	60	52	0	52	476	0	476
Damietta	200	200	400	234	552	786	181	299	480	46	76	122	47	77	124	188	291	479
Dakahlia	518	960	1,478	1,016	2,438	3,454	460	1,184	1,644	159	403	562	171	398	569	146	478	624
Sharkia	600	1,000	1,600	811	2,553	3,364	380	1,250	1,630	127	419	546	132	435	567	122	488	610
Qalioubia	480	520	1,000	1,102	1,532	2,634	512	823	1,335	211	252	463	235	226	461	154	347	501
Kafr Elsheikh	320	440	760	433	1,196	1,629	177	596	773	68	206	274	61	207	268	110	366	476
Gharbia	560	679	1,239	910	1,740	2,650	397	894	1,291	137	300	437	123	303	426	114	372	486
Monofia	279	600	879	412	1,661	2,073	206	786	992	69	266	335	59	273	332	107	395	502
Beheira	480	880	1,360	792	2,035	2,827	288	1,145	1,433	100	382	482	101	394	495	87	448	535
Ismailya	200	120	320	317	278	595	234	251	485	44	54	98	46	56	102	208	275	483
Giza	1,399	640	2,039	2,475	1,538	4,013	1,189	779	1,968	365	0	365	406	242	648	363	324	687
Bani Swef	240	440	680	355	1,035	1,390	161	487	648	52	160	212	54	166	220	118	377	495
Fayoum	200	400	600	355	1,147	1,502	178	554	732	60	192	252	60	200	260	119	378	497
Menia	320	720	1,040	549	2,103	2,652	232	954	1,186	84	322	406	84	331	415	77	418	495
Assiut	399	520	919	619	1,467	2,086	255	680	935	91	237	328	88	240	328	132	355	487
Sohag	319	600	919	551	1,866	2,417	233	840	1,073	78	284	362	77	291	368	105	384	489
Qena	280	359	639	390	1,380	1,770	178	636	814	60	213	273	45	188	233	106	385	491
Aswan	240	200	440	315	398	713	207	283	490	54	68	122	55	71	126	184	290	474
Luxor	120	120	240	159	160	319	64	66	130	23	24	47	38	55	93	240	260	500
Elbahr Elahmar	40	39	79	79	38	117	101	20	121	18	0	18	21	0	21	103	0	103
Elwadi Elgadid	40	40	80	40	40	80	36	38	74	8	8	16	8	12	20	40	40	80
Matrouh	40	40	80	77	80	157	74	31	105	22	8	30	22	8	30	71	37	108
North Sinai	40	40	80	120	80	200	66	53	119	24	14	38	25	16	41	96	39	135
South Sinai	40	40	80	39	35	74	27	8	35	8	8	16	8	4	12	20	20	40
Helwan										131	46	177						
6th of October										81	190	271						
Total	14,378	9,597	23,975	21,743	25,352	47,095	10,771	12,657	23,428	3,587	4,132	7,719	3,335	4,193	7,528	5,221	6,767	11,988

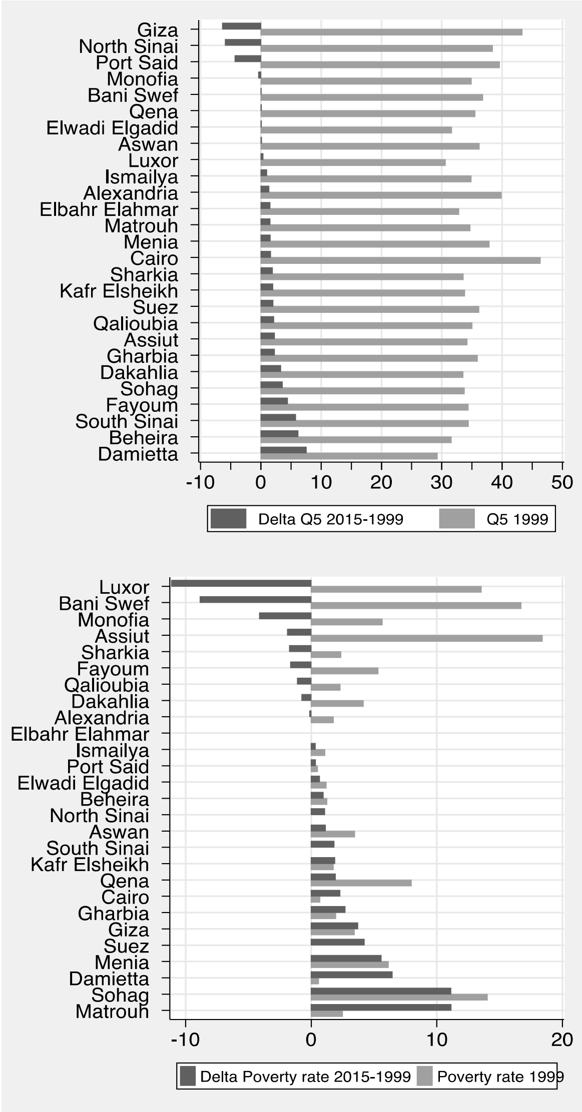
Notes: Figures refer to the number of households surveyed by the national statistical office (CAPMAS). In 2008 an administrative reform created two new governorates, Helwan and 6th of October, changing regional boundaries for Cairo and Giza governorates. In April 2011, however, the Helwan and 6th of October governorates were again incorporated into the Cairo and Giza governorates, respectively.

Appendix 2

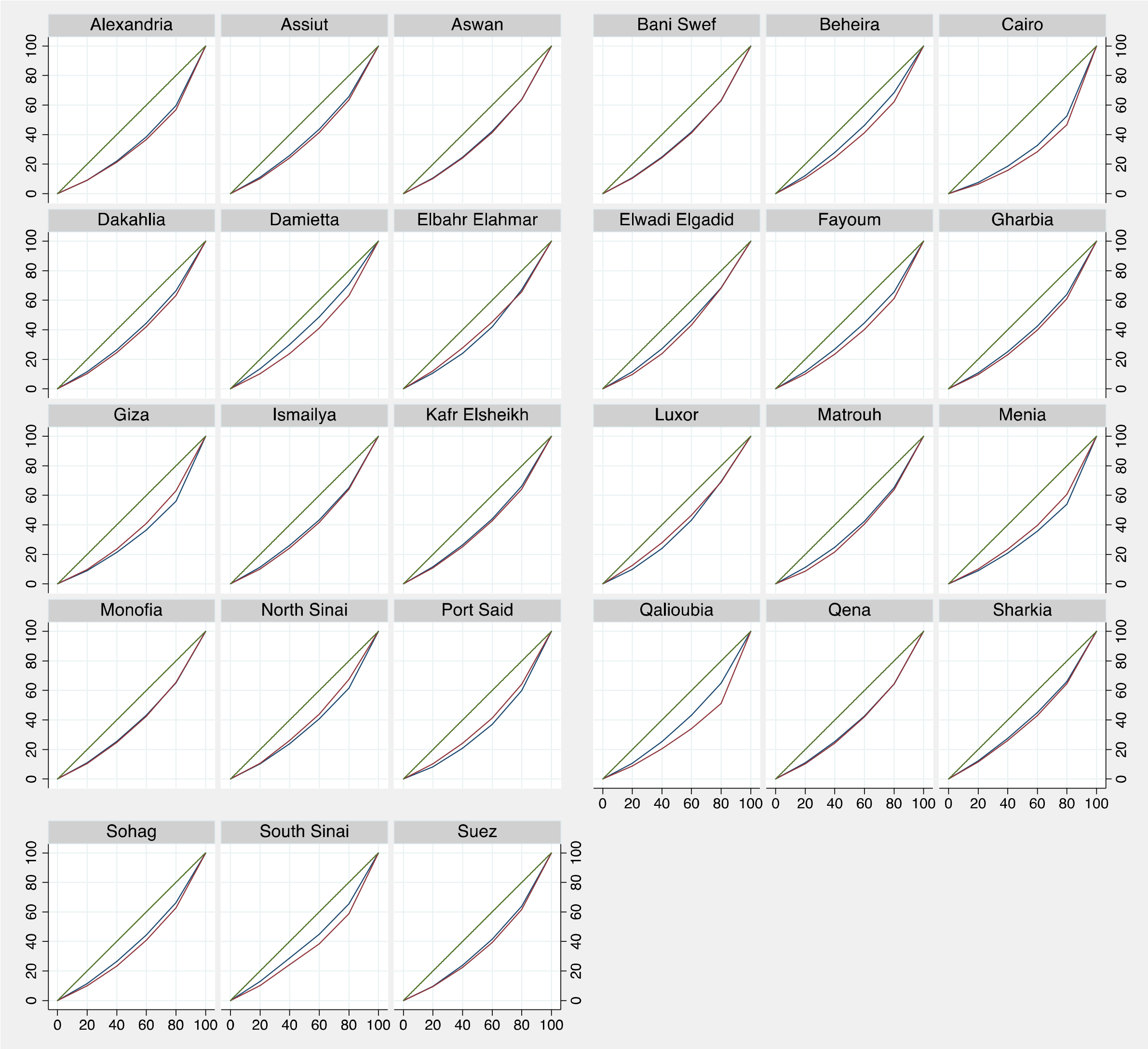
Further results on trends in regional income inequality

Figure A1: Initial level of inequality and change over time: quintile shares and poverty rate, 1999–2015





Note: Quintile shares and poverty rate are calculated using equivalised disposable household income.***Figure A2: Lorenz curves comparison, 1999 vs 2015***



Note: The blue curve indicates 1999, while the red curve is 2015.

Appendix 3

Further convergence tests

Table A2: Unconditional convergence, 1999–2015, OLS estimates without Cairo

PANEL A: CROSS-SECTION OLS ESTIMATES							
	1	2	3	4	5	6	7
	Dep variable is the 1999–2015 change in:						
	Gini index	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5	Poverty
Gini index, 1999	-0.915***						
	(0.121)						
Quint 1, 1999		-0.933***					
		(0.121)					
Quint 2, 1999			-1.012***				
			(0.147)				
Quint 3, 1999				-0.424			
				(0.282)			
Quint 4, 1999					-0.958***		
					(0.165)		
Quint 5, 1999						-0.755***	
						(0.181)	
Poverty, 1999							-0.303
							(0.252)
Constant	0.243***	9.615***	14.177***	7.143	21.070***	27.822***	2.265**
	(0.029)	(1.400)	(2.221)	(5.012)	(3.588)	(6.386)	(0.861)
F-stat	56.68***	59.06***	47.56***	2.26	33.52***	17.33***	1.44
Adj R-Sq	0.624	0.621	0.641	0.127	0.573	0.488	0.075
Obs.	26	26	26	26	26	26	26
RMSE	0.026	0.842	0.707	0.845	1.078	2.298	4.642
Converging to:	0.266***	10.305***	14.009***	16.847	21.994***	36.850***	7.475
PANEL B: POOLED OLS ESTIMATES							
	1	2	3	4	5	6	7
	Dep variable is the five-year change in:						
	Gini index	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5	Poverty
Gini init	-0.739***						
	(0.157)						
Quint 1, init		-0.797***					
		(0.099)					
Quint 2, init			-0.738***				
			(0.108)				
Quint 3, init				-0.756***			
				(0.048)			
Quint 4, init					-0.819***		
					(0.083)		
Quint 5, init						-0.871***	
						(0.185)	
Poverty, init							-0.177**
							(0.075)
Constant	0.192***	8.508***	10.362***	13.326***	17.772***	31.279***	1.063***
	(0.040)	(1.149)	(1.550)	(0.900)	(1.931)	(6.515)	(0.275)
F-stat	22.22***	64.39***	46.64***	244.03***	97.66***	22.28***	5.56**
Adj R-Sq	0.393	0.403	0.387	0.368	0.411	0.445	0.074
Obs	130	130	130	130	130	130	130
RMSE	0.035	1.643	0.968	1.974	2.124	3.436	3.464
Converging to:	0.260***	10.675***	14.041***	17.627***	21.699***	35.912***	6.006***

Notes: Significance levels: 10% (*), 5% (**) and 1% (***). Cross-section estimates report heteroscedasticity-robust standard errors in parentheses. In pooled OLS estimates, standard errors are clustered at region level.

Table A3: Unconditional convergence over time: speed of convergence during 1999–2015

PANEL A: POOLED OLS ESTIMATES							
	1	2	3	4	5	6	7
	Dep variable is the five-year change in:						
	Gini index	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5	Poverty
Initial value	-0.262***	-0.382***	-0.319***	-0.217	-0.907***	-0.254***	-0.123
	(0.081)	(0.081)	(0.092)	(0.148)	(0.108)	(0.089)	(0.249)
Dummy, 2012/15	0.127	5.929***	4.232	12.727***	-0.186	20.780**	-0.118
	(0.081)	(1.118)	(3.126)	(2.384)	(2.374)	(9.560)	(1.104)
Dummy, 2010/12	0.141*	2.072	7.907***	-8.331	-12.718	29.899**	-0.478
	(0.071)	(2.022)	(2.446)	(14.110)	(22.244)	(12.313)	(0.991)
Dummy, 2008/10	0.044	1.128	2.703	5.024	-13.154	10.751	-1.611**
	(0.049)	(2.863)	(3.979)	(6.812)	(9.262)	(7.429)	(0.771)
Dummy, 2004/08	0.111	4.115*	6.507	6.028*	1.917	15.750	-1.467
	(0.074)	(2.299)	(3.876)	(3.508)	(6.667)	(9.682)	(0.933)
Dummy 04/08 * Initial val	-0.425	-0.360	-0.469	-0.358*	-0.108	-0.426	-0.032
	(0.260)	(0.220)	(0.284)	(0.202)	(0.311)	(0.255)	(0.247)
Dummy 08/10 * Initial val	-0.233	-0.003	-0.160	-0.262	0.576	-0.335	0.094
	(0.180)	(0.287)	(0.291)	(0.394)	(0.425)	(0.204)	(0.212)
Dummy 10/12 * Initial val	-0.615**	-0.084	-0.544***	0.481	0.589	-0.887**	-0.212
	(0.291)	(0.190)	(0.177)	(0.812)	(1.016)	(0.357)	(0.282)
Dummy 12/15 * Initial val	-0.483	-0.548***	-0.303	-0.751***	0.006	-0.565**	-0.062
	(0.322)	(0.102)	(0.214)	(0.129)	(0.108)	(0.271)	(0.320)
Constant	0.077***	3.506***	4.295***	3.830	19.963***	9.800***	1.726**
	(0.022)	(0.890)	(1.310)	(2.610)	(2.370)	(3.214)	(0.745)
F-stat	10.30***	94.95***	8.05***	352.30***	586.40***	10.96***	2.31**
Adj R-Sq	0.366	0.439	0.347	0.478	0.412	0.442	0.079
Obs	135	135	135	135	135	135	135
RMSE	0.036	1.568	0.997	1.766	2.085	3.415	3.391
$\beta_{2004\text{-}2008}$	-0.687***	-0.742***	-0.788***	-0.575***	-1.015***	-0.681***	-0.154
$\beta_{2008\text{-}2010}$	-0.495***	-0.385	-0.479*	-0.479	-0.331	-0.589***	-0.028
$\beta_{2010\text{-}2012}$	-0.877***	-0.466**	-0.863***	-0.265	-0.318	-1.141***	-0.334***
$\beta_{2012\text{-}2015}$	-0.744**	-0.930***	-0.622***	-0.968***	-0.901***	-0.819**	-0.184

Notes: Significance levels: 10% (*), 5% (**) and 1% (***). Standard errors are clustered at region level (in parentheses).

Appendix 4

Decomposing income inequality in Egypt

We extended the analysis by applying a decomposition of income inequality by population subgroups using their geographical location. To this end, we calculated inequality within each sub-sample and between the means of the sub-samples, in order to identify the influence coming from specific subgroups.

We calculated the class of additively decomposable Theil indices, as they allow an estimate of the contribution of each subgroup to total income inequality within a population (see Cowell, 2000, p 109).[17] In our case, the between-group and the within-group components measure the inequality contribution coming, respectively, from the differences in governorate means and the income differences inside each governorate.

The total patterns and subgroup decomposition are illustrated in Table A4. The results generally reveal that within-region inequality explains most of the overall inequality. Looking at the Theil index in 2015, the contribution of the 'within' component (or intra-regional inequality) amounts to 90.8% of the total, whereas the 'between' component (or inter-regional inequality) accounts for the remaining 9.2%. Further, the within component increased significantly over time, indicating that overall inequality in Egypt is driven by specific regional dynamics.

[17] Cowell, F. (2000). 'Measurement of inequality'. In Atkinson, A. and Bourguignon, F. (eds), *Handbook of Income Distribution*. Amsterdam: Elsevier Science. An inequality index can be decomposed only if total inequality is expressed as an aggregate function of each inequality's subgroup, mean income and population. Inequality indices additively decomposable by population subgroups belong to the family of Generalised Entropy Indices GE(a), with (a) indicating income difference sensitivity parameter: GE(0) is the mean logarithmic deviation (MLD); GE(1) is the Theil index; and GE(2) is half the square of the coefficient of variation.

Table A4: Income inequality in Egypt 1999–2015: total patterns and subgroup decomposition by governorate

Year	ABSOLUTE VALUES			PERCENTAGE VALUES		
	Theil within	**Theil between**	**Theil**	**Theil within**	**Theil between**	**Theil**
1999	0.1873	0.0489	0.2362	79.3	20.7	100
2004	0.1753	0.0392	0.2145	81.7	18.3	100
2008	0.1763	0.0273	0.2036	86.6	13.4	100
2010	0.1437	0.030	0.1738	82.7	17.3	100
2012	0.1418	0.0157	0.1575	90.0	10.0	100
2015	0.2745	0.0277	0.3022	90.8	9.2	100

	ABSOLUTE VALUES			PERCENTAGE VALUES		
	MLD within	**MLD between**	**MLD**	**MLD within**	**MLD between**	**MLD**
1999	0.1283	0.0458	0.1741	73.7	26.3	100
2004	0.1316	0.0379	0.1694	77.7	22.3	100
2008	0.1296	0.027	0.1566	82.8	17.2	100
2010	0.1164	0.0287	0.1451	80.2	19.8	100
2012	0.1184	0.0156	0.134	88.4	11.6	100
2015	0.1605	0.0271	0.1876	85.6	14.4	100

	ABSOLUTE VALUES			PERCENTAGE VALUES		
	GE2 within	**GE2 between**	**GE2**	**GE2 within**	**GE2 between**	**GE2**
1999	0.5884	0.054	0.6424	91.6	8.4	100
2004	0.4059	0.0416	0.4476	90.7	9.3	100
2008	0.5089	0.0283	0.5373	94.7	5.3	100
2010	0.2725	0.0321	0.3046	89.5	10.5	100
2012	0.2388	0.016	0.2548	93.7	6.3	100
2015	2.2252	0.029	2.2542	98.7	1.3	100

Notes: GE(0) is the mean logarithmic deviation (MLD); GE(1) is the Theil index; and GE(2) is half the square of the coefficient of variation.

Table A5 reports subgroup indices for each governorate in the first and last year of the period considered in the analysis. Theil indices and Gini provide the first evidence indicating that the influence can be explained mainly by urban regions (as shown in Tables A6 and A7). The surge of income inequality in the Cairo and Qalioubia regions is particularly noticeable.

Table A5: Subgroup decomposition by governorate: subgroup indices for initial and final year period

Year	1999				2015			
	MLD GE(0)	Theil index GE(1)	GE(2)	Gini	MLD GE(0)	Theil index GE(1)	GE(2)	Gini
Cairo	0.241	0.286	0.463	0.386	0.362	0.570	2.578	0.462
Alexandria	0.154	0.182	0.293	0.307	0.191	0.254	0.496	0.337
Port Said	0.171	0.179	0.223	0.323	0.115	0.134	0.222	0.263
Suez	0.114	0.120	0.145	0.264	0.141	0.161	0.235	0.293
Damietta	0.043	0.046	0.052	0.163	0.116	0.128	0.165	0.267
Dakahlia	0.082	0.098	0.155	0.221	0.114	0.131	0.180	0.262
Sharkia	0.081	0.114	0.372	0.215	0.095	0.111	0.157	0.240
Qalioubia	0.099	0.114	0.160	0.243	0.322	0.942	2.560	0.400
Kafr Elsheikh	0.082	0.090	0.110	0.224	0.100	0.111	0.142	0.248
Gharbia	0.104	0.123	0.179	0.251	0.147	0.193	0.378	0.294
Monofia	0.095	0.110	0.161	0.239	0.096	0.101	0.120	0.245
Beheira	0.063	0.069	0.089	0.195	0.123	0.152	0.238	0.271
Ismailya	0.094	0.111	0.158	0.237	0.108	0.124	0.198	0.258
Giza	0.198	0.270	0.553	0.343	0.122	0.133	0.186	0.271
Bani Swef	0.116	0.148	0.266	0.261	0.111	0.121	0.152	0.263
Fayoum	0.081	0.091	0.116	0.223	0.128	0.147	0.201	0.282
Menia	0.261	0.597	5.010	0.368	0.138	0.169	0.277	0.290
Assiut	0.088	0.098	0.132	0.231	0.112	0.122	0.150	0.264
Sohag	0.081	0.090	0.116	0.222	0.119	0.128	0.157	0.273
Qena	0.105	0.129	0.210	0.249	0.107	0.119	0.157	0.256
Aswan	0.109	0.125	0.170	0.256	0.112	0.121	0.152	0.263
Luxor	0.091	0.086	0.086	0.236	0.059	0.064	0.074	0.192
Elbahr Elahmar	0.101	0.104	0.118	0.252	0.089	0.106	0.148	0.229
Elwadi Elgadid	0.079	0.092	0.146	0.212	0.099	0.090	0.088	0.239
Matrouh	0.101	0.107	0.127	0.251	0.139	0.137	0.154	0.289
North Sinai	0.143	0.174	0.264	0.295	0.086	0.088	0.098	0.229
South Sinai	0.084	0.106	0.162	0.218	0.172	0.208	0.312	0.317

Notes: GE(0) is the mean logarithmic deviation (MLD); GE(1) is the Theil index; and GE(2) is half the square of the coefficient of variation.

We also explored the role of geographical inequalities between urban and rural areas. We looked at the divide between and within these areas and verified how much they contributed to overall inequality in Egypt. Table A6 reports the total patterns and subgroup decomposition between 1999 and 2015, indicating that the within-component of inequality almost entirely explains overall inequality in Egypt.

Table A6: Income inequality in Egypt 1999–2015 – total patterns and subgroup decomposition by rural and non-rural areas

Year	ABSOLUTE VALUES			PERCENTAGE VALUES		
	Theil within	**Theil between**	**Theil**	**Theil within**	**Theil between**	**Theil**
1999	0.2043	0.0319	0.2362	86.5	13.5	100
2004	0.1878	0.0267	0.2145	87.6	12.4	100
2008	0.1868	0.0168	0.2036	91.7	8.3	100
2010	0.1555	0.0182	0.1738	89.5	10.5	100
2012	0.1458	0.0117	0.1575	92.6	7.4	100
2015	0.2882	0.014	0.3022	95.4	4.6	100

	ABSOLUTE VALUES			PERCENTAGE VALUES		
	MLD within	**MLD between**	**MLD**	**MLD within**	**MLD between**	**MLD**
1999	0.1425	0.0316	0.1741	81.8	18.2	100
2004	0.1428	0.0266	0.1694	84.3	15.7	100
2008	0.1401	0.0166	0.1566	89.5	10.5	100
2010	0.127	0.0181	0.1451	87.5	12.5	100
2012	0.1225	0.0115	0.134	91.4	8.6	100
2015	0.1737	0.0139	0.1876	92.6	7.4	100

	ABSOLUTE VALUES			PERCENTAGE VALUES		
	GE2 within	**GE2 between**	**GE2**	**GE2 within**	**GE2 between**	**GE2**
1999	0.6099	0.0325	0.6424	94.9	5.1	100
2004	0.4205	0.027	0.4476	93.9	6.1	100
2008	0.5202	0.017	0.5373	96.8	3.2	100
2010	0.2861	0.0185	0.3046	93.9	6.1	100
2012	0.243	0.0118	0.2548	95.4	4.6	100
2015	2.2401	0.0141	2.2542	99.4	0.6	100

Notes: GE(0) is the mean logarithmic deviation (MLD); GE(1) is the Theil index; and GE(2) is half the square of the coefficient of variation.

Finally, Table A7 shows the extent to which income disparities in each area contribute to overall Egyptian inequality in the first and last years of the period considered in the analysis. Theil indices and Gini indicate that the influence is mainly from non-rural areas, except for GE(2) index (which is higher for rural areas in both years). This is in line with the results from Verme et al (2014, p 79), indicating that "the gap is more geographical: it is between the four main Egyptian cities, and the rest of the country, than properly urban–rural".[18] However, looking at the Gini index for each subgroup, although interpersonal inequality in the non-rural areas (as a whole) is significantly higher than interpersonal inequality in the rural areas (as a whole), the gap reduced over time.

[18] Verme, P., Milanovic, B., Al-Shawarby, S., El Tawila, S., Gadallah, M. and El-Majeed, E.A.A. (2014). *Inside Inequality in the Arab Republic of Egypt: Facts and Perceptions across People, Time, and Space*. Washington DC: World Bank [available at https://doi.org/10.1596/978-1-4648-0198-3].

Table A7: Subgroup decomposition by rural and non-rural area– subgroup indices for initial and final year period

Year	1999				2015			
	MLD GE(0)	Theil index GE(1)	GE(2)	Gini	MLD GE(0)	Theil index GE(1)	GE(2)	Gini
Non-rural area	0.2073	0.2559	0.4503	0.3556	0.2242	0.3319	1.3069	0.3635
Rural area	0.0973	0.1445	0.8073	0.2361	0.1354	0.2419	3.4677	0.2773

Notes: GE(0) is the mean logarithmic deviation (MLD); GE(1) is the Theil index; and GE(2) is half the square of the coefficient of variation.

Appendix 5

Income inequality at national level during 1999–2015

Table A8: National-level income inequality in Egypt during 1999–2015

Year	Gini index	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5	Bottom 40%	Poverty rate
1999	0.31	9.32	12.87	16.04	20.68	41.10	22.18	4.48
2004	0.31	9.03	12.89	16.36	21.03	40.69	21.92	6.00
2008	0.30	9.36	13.25	16.62	21.29	39.47	22.62	5.35
2010	0.29	9.44	13.40	16.70	21.34	39.11	22.85	5.49
2012	0.28	9.74	13.59	16.93	21.61	38.13	23.33	4.98
2015	0.31	9.20	13.03	16.45	21.15	40.18	22.22	5.05

Notes: Variables are calculated using LIS data on equivalised disposable household income.