LIS
Working Paper Series

No. 798

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July 2020
(revised in September 2021)

CROSS-NATIONAL
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in Luxembourg

Luxembourg Income Study (LIS), asbl

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

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September 10, 2021

Abstract

Income distribution is instrumental in improving living standards and it is part of the UN's SDG 10 on the *reduction of inequality within and among countries*. Yet existing 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 a country presents large regional variations, where very unequal regions coexist alongside relatively equal ones. This paper contributes to filling this gap with a case study on Egypt. It also adds to our knowledge of income inequality in the Arab region, an area that has not seen extensive empirical analysis. Using newly assembled Luxemburg Income Study (LIS) data and a range of inequality measures, the analysis offers three findings. First, the distribution of income within Egyptian regions has become more unequal during 1999–2015. Second, there has been convergence: differences in income inequality within Egyptian regions tended to reduce, but less unequal regions are converging to similar levels of inequality with more unequal regions. Third, 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, supporting geographically diffused progress on the first two targets of SDG 10 may crucially depend on reversing the trend of increasing income inequality of the pre-SDG period.

Keywords: Income distribution; convergence; regional disparities; SDG Goal 10; Sustainable Development Goals; social conflict.

JEL Classification: O15, D63.

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 (under SDG 10) testifies that there is also an increasing realisation that income distribution is important in itself. Yet the debate on the evolution and consequences of income distribution in developing economies has scarcely looked at the regional dimension so far.[1] Studying income inequality at the regional level is important. By studying how income is distributed *within* each region, we can more accurately understand whether the benefits of economic development are widely shared across a particular nation. Conversely, progress in reducing inequality within countries, as per the requirements of SDG 10, can only be partially successful if a country presents large regional variations, with very unequal regions coexisting alongside relatively more equal ones.[2]

This paper offers evidence on how income is distributed within Egyptian regions and how regional disparities in their level of income inequality have evolved. This serves a dual goal. First, we contribute to the broader debate on convergence in living standards across countries or regions: its existence, nature and speed. This is an understudied area, where empirical research is still in its infancy and in need of more stylised facts on whether disparities across countries or regions in many important development goals tend to fall over time. 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 (e.g., Johnson and Papageorgiou, 2020; Sala-i-Martin, 1996). Recent analysis of convergence has also focused on the evolution of other important development outcomes

[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 (e.g., see 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. The literature on distributive justice has provided further insights on when, on the basis also of ethical considerations, economic inequality is or is not acceptable (e.g., Lamont and Christi, 2017; Solimano, 1998). Finally, proof of the policy relevance of economic inequality can also be found in its routine inclusion in the Human Development Index (see http://www.hdr.undp.org/en).

[2] Apart from its policy relevance, how income is distributed within a given region is also an important part of the inequality individuals' experience, and may affect their wellbeing (see Easterbrook, 2021).

across countries and it is developing into an independent area of research.[3] This has included income inequality. Benabou (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 estimated speed of convergence seems to be sensitive to the dataset chosen (Lustig and 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. 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. Within the European Union (EU) context, a representative case of economic and political integration, 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 on less developed economies yet.

Second, with this paper we hope to enrich the literature on the state of income inequality in the Arab world, a sensitive geographical area that has not hitherto attracted extensive empirical attention regarding national or domestic income disparities (Hassine 2015; Alvaredo and Piketty, 2014). 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 has reportedly recorded the highest level of income inequality worldwide (UN ESCWA, 2019). This paper is the first systematic attempt to study the evolution of income inequality across geographical entities in the largest country of the Middle East and North Africa (MENA) region, Egypt.[4] Moreover, looking at the regional variation of income within the MENA context may also

[3] For example, Deaton (2004) and Canning (2012) looked at 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.

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

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 case of Egypt would seem to be a paradox, since the national inequality level has been found to be relatively low and stable in existing studies (Al-Shawarby et al., 2014; Said et al., 2019).[5] Nonetheless, the pattern of national income inequality might be providing only 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 remarkably high over 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 entities.

Using newly assembled data from the Luxemburg Income Study (LIS), which provides a rich geographical disaggregation, we first constructed regional inequality measures comparable across statistical units and provided evidence on the evolution of income inequality across Egyptian Governorates over time during the period 1999–2015. Then we look 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% 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

[5] One way to reconcile this apparent paradox is purely on technical grounds. This is to say that there may be substantial discrepancies between the way income inequality is measured and its true extent, such that the official inequality statistics are far from being regarded as accurate. For example, World Bank estimates for income inequality are drawn from household surveys that embody various defects, especially as far as the true income of top income earners is concerned (Achcar, 2020). Recently, Hlasny and Verme (2018) addressed this issue by evaluating income inequality looking at the distribution of top incomes. 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 4.1 percentage points. Similarly, Van der Weide et al. (2018) indicated that top income shares in Egypt are highly underestimated; they employed house prices to re-estimate the top tail of the income distribution. The revised Gini index was found to be 25% higher than the official value reported in the World Bank's statistics.

unfavourable trends of both the income share of the bottom 40% and the proportion of people living below 50% of the median income during the pre-SDGs period.

The paper proceeds as follows. Section 2 presents data and provides evidence on the evolution of income inequality in Egypt at the regional level. Section 3 introduces the methodology and section 4 presents the results on regional inequality convergence. 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.

2.2 Income distribution measures and data

We focused on a set of core income inequality measures, using a sample of 27 Egyptian regions over the 1999–2015 period. For each region, we computed the Gini index and quintile income shares. The income share of the bottom 40% is of particular interest, thanks to its clear policy relevance, 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 per cent of median income*. This is a measure capturing relative poverty and income inequality, adopted as an official indicator for Target 10.2.[6]

We used the LIS database, which compiles and harmonises social and income data for a growing number of developing and emerging economies, now including Egypt. The LIS database 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

[6] 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, i.e., 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. Refer to https://sustainabledevelopment.un.org/sdg10. See Lang and Lingnau (2015) for a discussion of inequality in the SDGs and an assessment of its measurement.

clear comparability of inequality statistics over time.[7] 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. Then we equivalised the variable using the LIS equivalence scale (i.e., the square root of the number of household members).[8] Note that data are representative of the population even when disaggregated at the regional level (i.e., at Governorates level), as LIS have retained in the datasets the same weights provided by the Egyptian national statistical office (Central Agency for Public Mobilisation and Statistics), such that the sample has been proportionally distributed at the Governorate level between urban and rural areas, in order to make the sample representative even for small Governorates. Table A1, in the Appendix, gives 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 LIS database. 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 variation is indicative of a convergence process, which occurred in Egypt from 1999 to 2015. However, average values

[7] LIS collects information from institutes of national statistics and then implements an ex-post harmonisation to make them comparable across countries and over time. LIS variables are standardised along two dimensions: continuous variables (income, wages, hours worked, etc.) are reported in the same unit across different data sets, while categorical variables (geographical region, educational level, etc.) follow the same coding and labelling. This implies that available data can be compared across countries and over time. LIS also conducts further checks for consistency, in order to mitigate possible anomalies (non-respondents, data errors, extreme values etc.) that might exist in the raw data provided by the statistical authorities (see LIS, 2019).

[8] 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*). 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.

may still hide considerable regional variation (as differences between minimum and maximum levels suggest), which we will explore next.

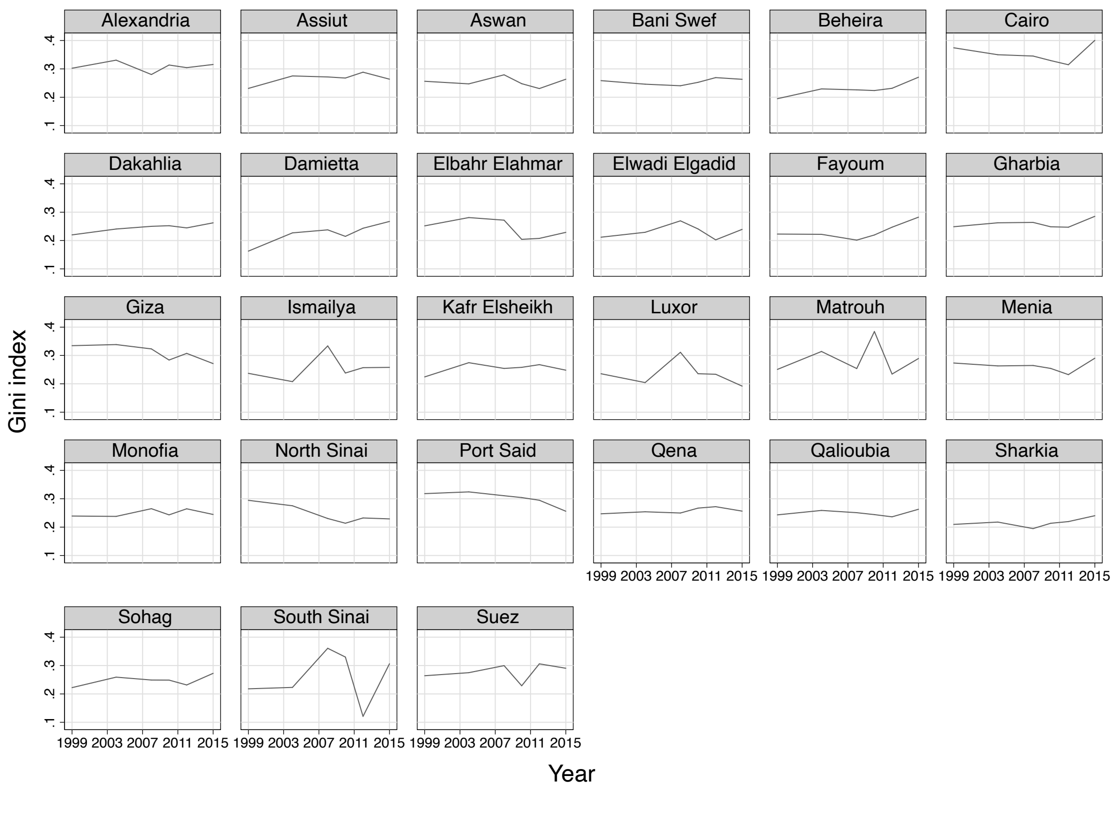
Table 1 – Income inequality within Egyptian regions: summary statistics

		1999	2004	2008	2010	2012	2015
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
	N	27	27	27	27	27	27
	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
	N	27	27	27	27	27	27
	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
	N	27	27	27	27	27	27
	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
	N	27	27	27	27	27	27
	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
	N	27	27	27	27	27	27
	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
	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
	N	27	27	27	27	27	27
	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
	N	27	27	27	27	27	27
	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
	N	27	27	27	27	27	27
	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 LIS data on equivalised disposable household income. *Poverty rate* refers to the proportion of households living below the poverty line, defined as 50% of median equivalised 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). 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 (e.g., Cairo, Fayoum, South Sinai, Elbahr Elahmar and Damietta). However, regions with low levels of inequality either experienced very minor fluctuations or none at all (e.g., Sharkia, Elwadi Elgadid, Qena, Qalioubia, Monofia, and Bani Swef).

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



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

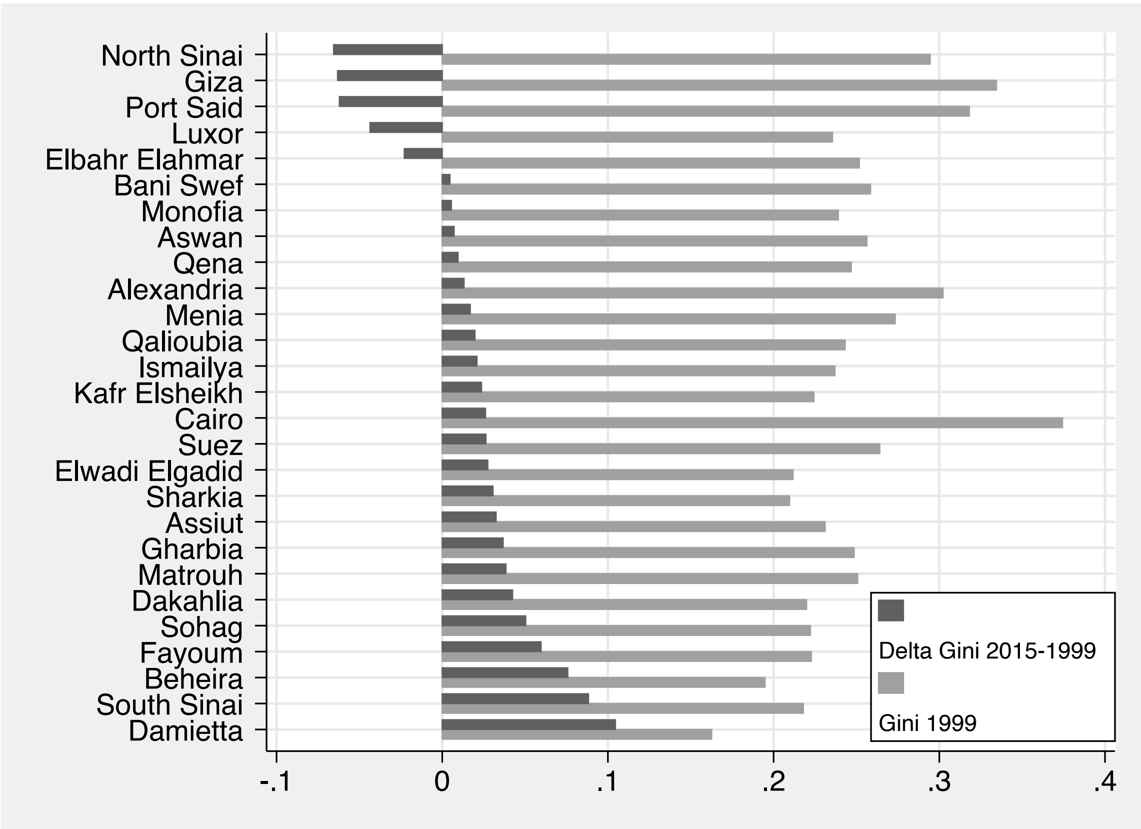
2.3 Change in regional income inequality during 1999–2015

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 income inequality. 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 Figure A1 in the appendix).

Five regions, however, have seen significant reductions. Interestingly, the 'best performing' 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 'worst performing' regions, which experienced an increase in inequality by up to 10 percentage points (e.g., the region of Damietta), were also those with the lowest initial level of inequality in 1999. This preliminary evidence indicates that a convergence process is at work.

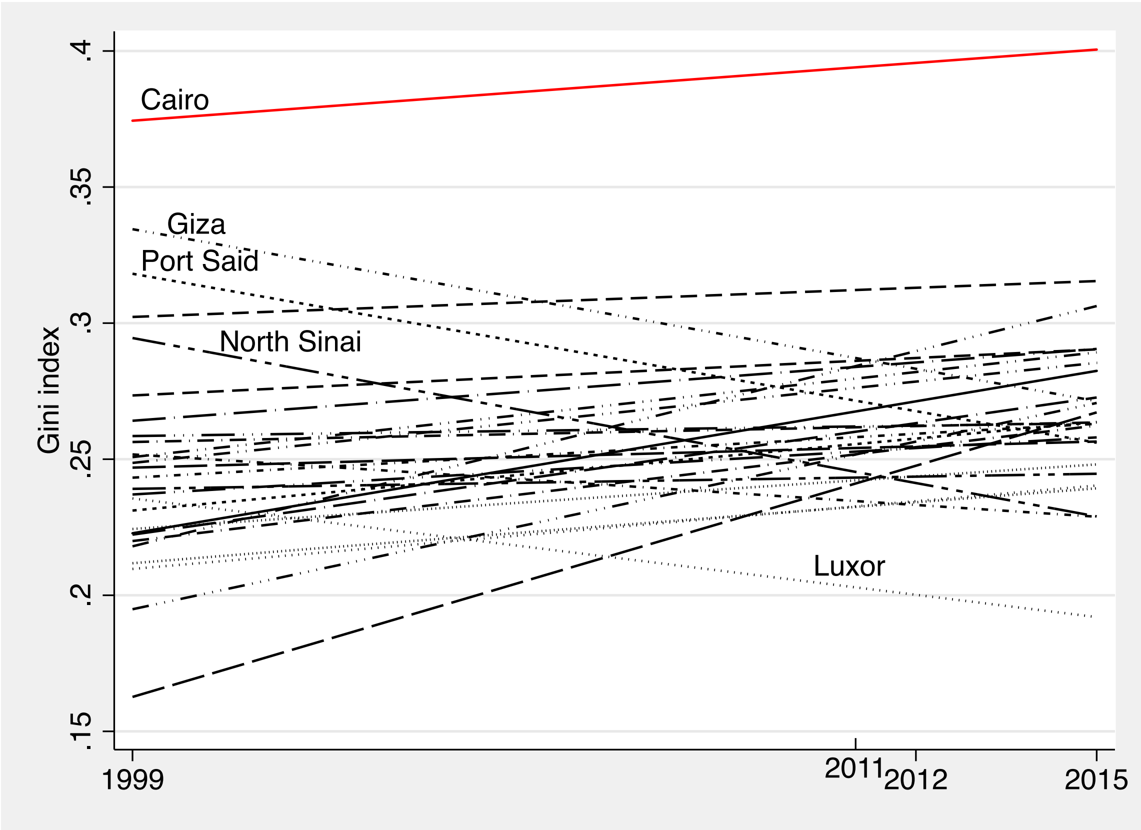
Figure 2 - Initial level of inequality and change over time: Gini 1999–2015



Notes: 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)



Notes: Gini index calculated using equivalised disposable household income.

3 Are differences in income inequality levels among regions narrowing?

Stylised facts, in the previous section, on the evolution of income inequality suggest that there may have been regional convergence in income inequality. This section introduces the methodology used to provide 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.[9] 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 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 $t = T$, i.e., in the first and last year of the period considered, respectively. A test equation for regional convergence is then:

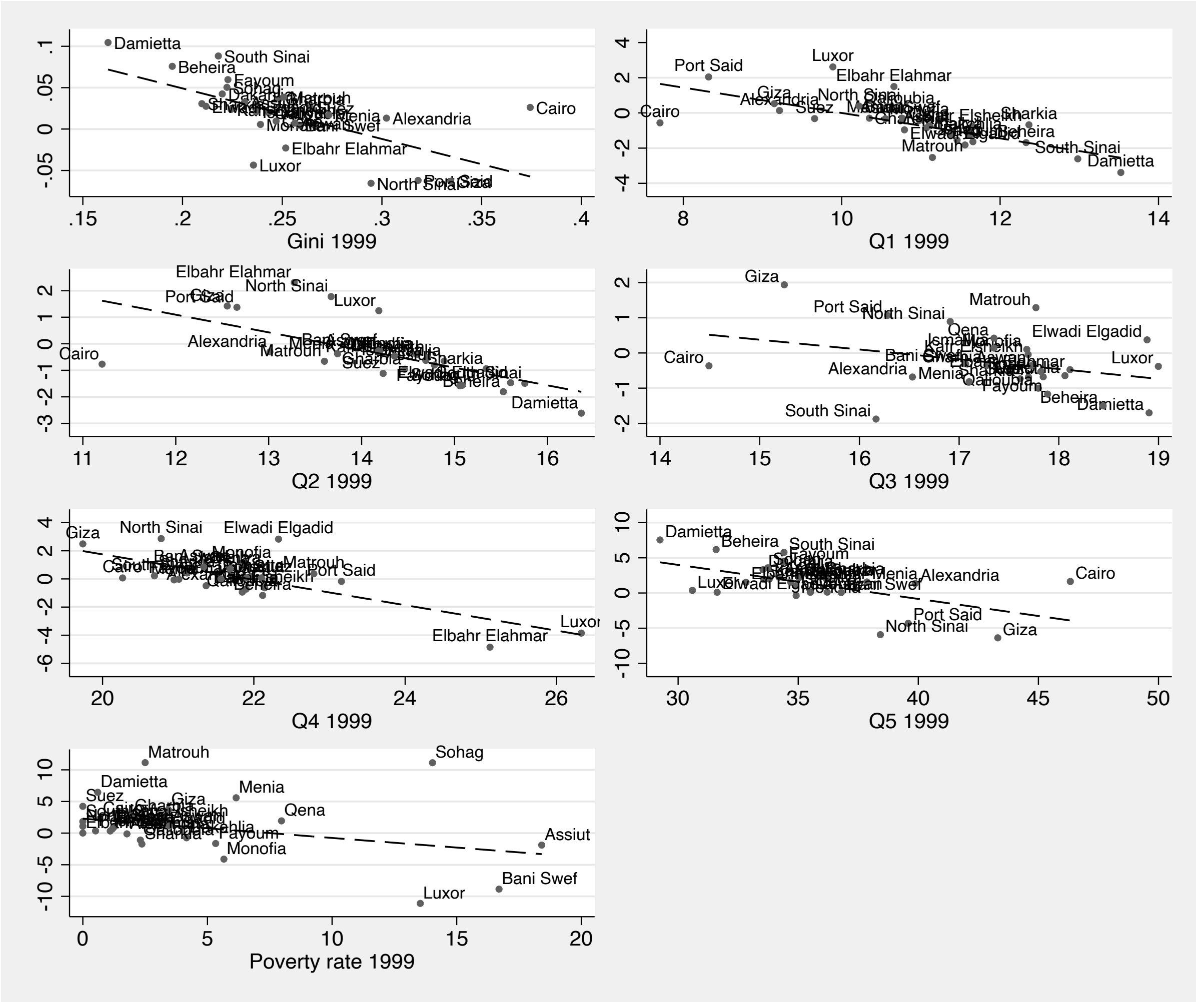
$$I_{iT} - I_{i0} = \alpha + \beta \cdot I_{i0} + \varepsilon_i \qquad (i=1\ldots27) \qquad (1)$$

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 (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 the 1999–2015 period, 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.

[9] Others have emphasised a different statistical notion of convergence (e.g., 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.

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



Notes: 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): they 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 $0.171 + (-0.611\times0.335) = -0.034$, in the former case, and $0.171 + (-0.611\times0.231) = 0.030$ 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):

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

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 ind., 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 are: 10% (*), 5% (**) and 1% (***). In cross-section estimates, heteroskedasticity robust standard errors are 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 in the appendix, are remarkably similar to the results in Table 3). Similarly, by down-weighting 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 (e.g., 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 SDGs period.

Table 3 Unconditional convergence, 1999–2015: IRLS estimates

	PANEL A: CROSS-SECTION IRLS 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 ind., 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)				
Quint. 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 are: 10% (*), 5% (**) and 1% (***). Standard errors are in parentheses.

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 4 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 the top quintile. Instead, the speed of convergence has changed over time for 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).

Table 4 - 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 are: 10% (*), 5% (**) and 1% (***). Standard errors are clustered at region level (in parentheses).

4 Discussion

From the foregoing analysis, it is apparent that there has generally been an increase in 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. We do not investigate further the mechanisms leading to convergence during this period, leaving this as a task for further research.[10] However, 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 level of income inequality in Egypt at national level, the disaggregate picture

[10] Region-specific characteristics may play a significant role when it comes to explaining why income distribution has changed more in certain regions than in others. We have produced preliminary evidence from Fixed Effects (FE) estimates of the convergence regression in Equation (2). Although further econometric work is needed to shed light on which region-specific characteristics matter (see Durlauf et al., 2009, on the methodological challenges), our FE estimates provide initial evidence indicating that time-invariant regional characteristics significantly affect the speed of convergence. The results are available on request.

told us a rather different story. The gains of economic prosperity kept being distributed unequally across the population, perhaps causing a feeling of social injustice to dominate the public domain.

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 and, 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 would 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 of 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 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 the 1999–2015 period. 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 (2003), 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 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 tend 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 one can reverse an unfavourable trend of rising income inequality during the period leading up to the SDGs.

We hope our 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 opportunities across regions, as well as address the role of social and political inclusion, which are also key elements of SDG 10 in tackling inequalities.

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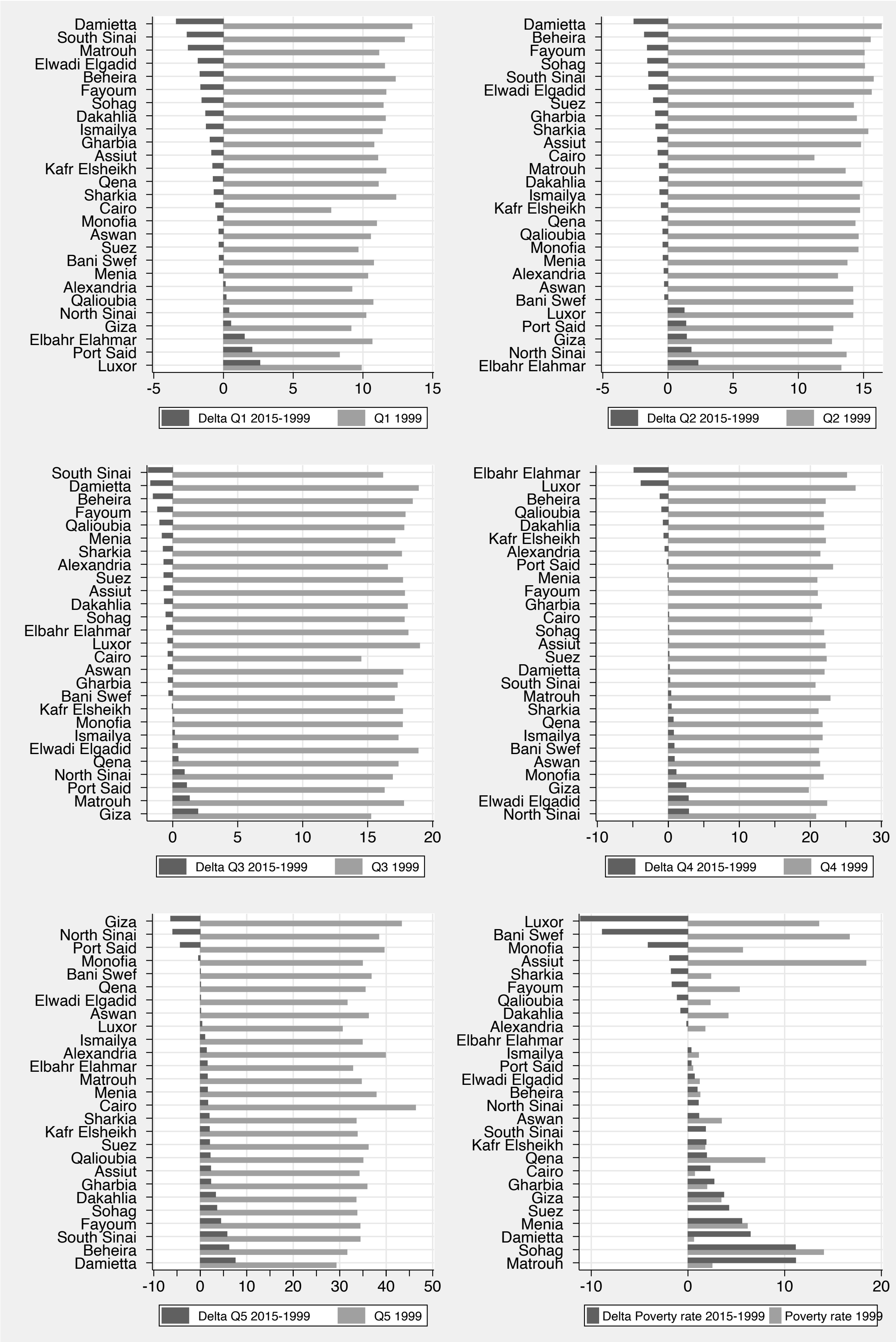
Appendix

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	1,988

Notes: Figures refer to the number of households surveyed by 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.

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



Notes: Quintile shares and poverty rate are calculated using equivalised disposable household income.

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 ind., 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 are: 10% (*), 5% (**) and 1% (***). In cross-section estimates, heteroskedasticity robust standard errors are in parentheses. In pooled OLS estimates, standard errors are clustered at region level.