Chapter 12
Using Night-Time Lights and Statistical Data to Measure Regional Inequality in Turkey

Eda Ustaoglu
Abdullah Gul University, Turkey

ABSTRACT

Poverty and inequality are the outstanding challenges in both developing and developed countries in the globe. Using Suomi National Polar-orbiting Partnership (NPP)-Visible Infrared Imaging Radiometer Suite (VIIRS) nighttime light (NTL) images and socio-economic data from administrative sources, this chapter focuses on the association between nighttime lights and economic activities with an aim of computing regional income inequality indices for the year 2015 in Turkey. Gini, the Atkinson and Theil statistics were used to establish regional inequality indices using both NTL and statistics data. The findings indicated that urban NTLs are strongly correlated with economic activity while the correlation is much weaker regarding rural nightlights and agricultural output. It can be noted that there was increasing regional inequality in north-west, south, and south-east regions whereas regional equality was more homogeneously distributed. The results indicated that NPP-VIIRS nightlight data can help to perform regional inequality assessments for the urban areas in Turkey.

1. INTRODUCTION

Income inequality is a growing concern for both the advanced economies and developing countries. The risks of divisions are sound in the former case while the inequality trends are mixed in the latter with some countries associated with declining inequality whereas others are experiencing the growing trend. OECD reported that '*the average income of the richest 10% population is about nine times that of the poorest 10% across the OECD countries…'* (Keeley, 2015) and that '…in Turkey, Chile and Mexico has inequality fallen but in the latter two countries the upper-group incomes are still more than 25 times those of the poorest' (OECD, 2019). Widening inequality has significant implications on economic and social development. It can cause macroeconomic instability, lead to sub-optimal use of human resources,

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cause investment-reducing political and economic instability and raise crisis risk (Dabla-Norris et al., 2015). Therefore, it has received considerable attention from theoretical and empirical research and policies to address poverty and disparities.

In the literature there are various studies focusing on measuring inequality, its mechanism and consequences and its policy implications. The measures and methods that are commonly used in the analysis of inequality are explained in Jenkins (1991), De Maio (2007), and Cowell (2011). The regional inequality has been researched employing the traditional inequality measures based on geographical variations across countries and regions (Piketty and Saez, 2003; Anand and Segal, 2008; Reardon and Bischoff, 2011; Xie and Zhou, 2014; Han et al., 2016; Solt, 2020). The causes and consequences of inequality were covered internationally (Bergh and Nilsson, 2010; Agnello et al., 2012; Dabla-Norris et al., 2015; Roser and Cuaresma, 2016; Buttrick and Oishi, 2017; Furceri and Ostry, 2019) whereas policy implications were examined in a more local context (Fortin et al., 2012; Franzini and Raitano, 2015; Shahbaz et al., 2017).

The summarised literature is based on statistical data published by government agencies or other public bodies provided at the country or administrative regional, county or city levels. In fact, there is growing body of literature pointing to Earth Observation data that is of importance to provide information in cases where national data is not available or are costly (Mellander et al., 2015). Gibson et al. (2020) claimed that more than 150 studies in economics used Defense Meteorological Satellite Program (DMSP)-Operational Linescan System (OLS) data even though the quality of the subject data is poor in comparison to the newly released Visible Infrared Imaging Radiometer Suite (VIIRS) data carried by the Suomi National Polar-orbiting Partnership (NPP) satellite. There are quality issues arising with the DMSP-OLS images due to blurring or blooming (Abraham et al., 2018), coarse resolution (Sutton, 2010), lack of on-board calibration (Pandey et al., 2017), limited dynamic range (Elvidge et al., 1999), top- and bottom-coding (Weidmann and Schutte, 2017) and unrecorded changes in sensor amplification (Gibson, 2021a). By contrast to DMSP-OLS data, NPP-VIIRS have higher spatial resolution, providing a wide range of lighting conditions together with temporally comparable data and do not have the issues of over-saturation, blooming and lack of on-board calibration. Therefore, there is recently growing body of literature focused on the use of NPP-VIIRS data to estimate economic activity and to investigate economic status of a country with varying methods and data, spatial scales and study areas (Ma et al., 2014; Zhao et al., 2017; Wang et al., 2019). The NPP-VIIRS data have also been employed to estimate CO_2 and other particle emissions (Zhao et al., 2016), transport mapping and modelling (Shi et al., 2015), built-up land and urban expansion (Dou et al., 2017), seasonal changes and patterns of nightlights (Zhao, 2018) and electric power consumption (Cole et al., 2017) at national, regional or local scales. Others focus on spatio-temporal analysis of socio-economic activities and urban development through comparing DMSP-OLS and NPP-VIIRS data (Shi et al., 2014; Zhao et al., 2017). It is verified in the literature that in comparison to DMSP-OLS data, use of NPP-VIIRS data gives more precise estimates for the detection and estimation of socio-economic dynamics at multi-level analysis. The studies have also demonstrated that NPP-VIIRS data can be considered as a proxy measure of economic activity, particularly in developing countries and more developed economies (Wu et al., 2018). Elvidge et al. (2012) showed that population and nighttime lights show a weaker relationship in case of poor countries whereas the relationship is stronger in case of more developed and high-income level regions.

A major problem with the sensors is that both DMSP-OLS and NPP-VIIRS have limited ability to detect the dim lights of the low population densities usually found in rural areas. The reason is that dim lights that are observed in rural villages are not the type suitable for detection from the space. Tuttle et