**Nightlight and economic activity**

Existing studies devoted to estimating economic activities for subnational level analysis and specifically in developing countries, over long period of time have been polarized due to data limitation. Kim (2008) and Chen and Nordhaus (2010) indicate that among the main reasons for such polarization has mainly been the lack of reliable and consistent sub-national income data. Despite the polarized data limitation, a sample of studies have attempted to predict economic activities in many folds using nightlight data. In an earlier review of satellite data on economic activity such as urbanization, city dynamics, population movements, economic growth, development indicator (Chen and Nordhaus, 2010), Henderson et al first show that nightlight has been used as proxy to measure economic activity. In a similar study, William Nordhaus adds that about 3,000 empirical studies have employed nightlight to measure economic activity since the early 2000s. In an attempt to investigate how well nightlight measure economic activity, Mveyange (2015) uses nightlight to investigate regional inequality in income in Africa. The finding of the paper shows a positive association between nightlights and income and conclude that there was evidence of increasing regional inequality trends between early years (1992 and 2003) and declining regional inequality trends in later years (2004 and 2012). Other existing studies have shown a strong positive relationship between nightlights and GDP at national and at sub-National levels for an economy over a range of spatial scale (Doll et al. 2006, Bundervoet et al. 2015, Pinkovskiy and Sala-i Martin 2014, Bhandari & Roychowdhury 2011, Singhal et al 2020, Weidmann and Schutte 2017).

**Pollution and economic activity**

Exposure to air pollution can have a myriad effect on economic activity. Smulders and Gradus investigate pollution abatement and long-term growth and explored conditions under which sustained economic growth and preservations of environmental quality are optimal, and to what extent economic growth is affected by environmental policy. The study concludes that failure to take into account pollution cost (private abatement activity) on environmental quality and productivity can negatively affects economic growth. Zhu et. al (2019) use a panel data of 73 cities from the period of 2013 to 2017 to investigate whether there is a bicausal relationship between air pollution and economic activity. The authors result indicates that there is a unidirectional causality between pollution measured by PM2.5 and economic activities such as economic growth, foreign direct investment, and industrial structure in the long-term. In a similar vein, Liang and Yang (2019) find environmental pollution to have a negative and a significant effect on urbanization and economic growth. Davis et al (2010) uses a long-term economic activity and related it to air pollution from vehicle related particulate matter (PM) over a 30-year period to offer understanding into probable historical surrogate markers of air pollution. The authors using a mixed-modeling approach conclude that higher concentration of pollution in the long-run can adversely impacts economic activities. Koop et. al (2010) report evidence of air pollution, economic activity and respiratory illness using a historical data from Canadian cities. In their study, the authors note that there exist notable variations in previous studies that report relationship between urban air pollution levels and respiratory health problems and the type of model used. By comparing two estimation approaches: model selection and Bayesian model averaging, the authors conclude that air pollution impact respiratory illness could be dependents on the control of socioeconomic covariates.

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