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Measuring the size and growth of cities using nighttime light☆

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A B S T R A C T

This paper uses nighttime luminosity to estimate a globally comparable measure of the size of metropolitan areas around the world for the years 2000 and 2010. We apply recently-proposed methodologies that correct the known problems of available nighttime luminosity data including blurring, instability of lit pixels overtime and the reduced comparability of night light images across satellites and across time. We then develop a protocol that isolates stable nighttime lit pixels that constitute urban footprint. When analyzed together with existing geo-referenced population datasets, our measure of the size of metropolitan areas can be used to compute urbanization rates, urban densities, and study the size distribution of cities. We show these applications and discuss how they compare with other available figures.

1. Introduction

The process of economic growth usually involves structural changes, of which urbanization is the most important one (Kuznets, 1968). In fact, for many social scientists urbanization is the hallmark of economic development. For example, in the absence of historical information on per capita income, several authors have used historical urbanization rates as a proxy of economic prosperity.[1] This implies that cities, as nuclei of the urbanization process, are the main drivers of economic growth.

But what is a city? Conceptually, cities -or metropolitan areas-[2] are the spatial integration of social and economic activity, and the higher the geographical concentration of households and firms, the greater the potential economic benefits net of congestion costs (Combes et al., 2019; Duranton and Puga, 2014; Rosenthal and Strange, 2004). However, in spite of our relatively consensual theoretical understanding of cities, its empirical measurement has proven more challenging. Empirical definitions usually rely on administrative borders, which do not necessarily correspond by the physical space where interactions between economic and social agents occur. This implies that stylized facts about patterns of urbanization across countries are likely to be biased because of measurement error (Roberts et al., 2016), which may partly explain, for instance, why the available cross-country estimates of the Zipf's law are

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[1] See, for example, Acemoglu et al. (2002) and Dittmar (2011). The historical urbanization data is estimated by Bairoch (1991).

[2] For simplicity, in this paper we refer to cities and metropolitan areas interchangeably. Our data-driven measure or urban agglomeration is arguably closer to what the latter are.

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