Astronomy in Focus - XXX
Proceedings IAU Symposium No. XXX, 2018
M. T. Lago, ed.

doi:10.1017/S1743921319005568

Applying astronomy tools in the field of development economics

T. Chingozha[1] and D. von Fintel[1,2]

[1]Department of Economics, Stellenbosch University, Private Bag X1, 7602 Matieland, South Africa email: tchingozha@gmail.com
[2]Research affiliate, Institute of Labor Economics (IZA), Bonn, Germany

Abstract. Astronomy has largely relied on imagery and innovative data mining techniques. This article briefly illustrates the use of machine learning to create agricultural production data sets from satellite imagery to answer different development questions. Of late, astronomy has also relied on citizen science in the identification of new galaxies (a case in point is the Galaxy Zoo project). The use of citizen science in the examination of changes in urban informality patterns in developing countries (another development question) is also discussed.

Keywords. astronomy, development, multi-disciplinary, very high resolution, citizen science, machine learning

1. Introduction

The Sustainable Development Goals (SDGs) are an important yardstick through which the world's different societies can evaluate progress towards bettering the lives of their citizens. Within sub-Saharan Africa (SSA) and other developing nation contexts, the development of the agricultural sector is of paramount importance given that the majority of people live in rural areas and depend on land. Against the background of limited availability of data at sub-national level in SSA, remotely sensed data and related information extraction and analysis techniques become indispensable. This emphasises the importance of multi-disciplinary research and skills sharing amongst disciplines. Astronomy has an important part to play because it has traditionally centred on image analysis and has developed techniques and infrastructures for handling computationally intensive problems.

Devarajan (2013) observes the phenomenon of a "statistical tragedy in Africa" where governments are unable or do not have the political will to provide accurate, objective and accurate statistics that can be used by researchers to inform relevant policy. This therefore calls for multi-disciplinary approaches to data gathering and empirical analysis. Employing machine-learning techniques (borrowed from geographers and astronomers) to classify Landsat imagery and generate agricultural data illustrates benefits of multi-disciplinary research. Aside from the rural (agricultural) sector, citizen science may help identify and measure phenomena such as urban informality from Very High Resolution (VHR) imagery.

Urban poverty and high informality characterise developing countries and citizen science can help create a novel dataset on informality out of VHR satellite imagery so that policy makers may have an idea about the size and growth patterns of the shadow economy. The Zooniverse.org platform (originally "Galaxy Zoo") was developed by astronomers and physicists to harness the power of internet crowdsourcing and help in the discovery of new galaxies from images. The Zooniverse platform has successfully

hosted different projects, and it could also help in creating a dataset on informality from VHR image classification as discussed in the next section.

2. Investigating size and growth patterns of the informal sector in Developing countries

Efforts to effectively reduce poverty and achieve inclusive growth largely depend on the availability of data on small-holder agriculture, informality and migration as these are intricately related to development. For instance, Bhattacharya (1995) criticises dualistic development models (Harris & Todaro 1970; Lewis 1954) in that they simplistically assume that ancient societies were solely engaged in food production yet there existed an informal economy in which they produced different goods and services. This highlights the informal sector as a pre-requisite for industrialization. Yet, by definition, the informal sector is unrecognized and there are no reliable estimates on its size.

We conduct a pilot study (with Stellenbosch University students) on the Zooniverse.org platform to test whether citizen science can be relied upon to accurately measure the size of the informal sector in developing countries. After viewing some tutorials, participants were asked to identify different land use types from VHR satellite imagery over Harare, the capital of Zimbabwe. Classification accuracy depends on a number of parameters. Thus, various parameters were manipulated in order to identify the best settings under which higher classification accuracy may be achieved. In citizen science, the end decision depends on consensus, thus the number of participants classifying a single image was varied in order to achieve the best threshold. The study takes advantage of a 2005 clean-up operation that destroyed informal structures in Harare. Thus, we are able to test whether or not volunteers can accurately identify *no changes* for 2004 and 2006 images for areas not affected (placebo) and accurately identify *changes* in areas affected (treatment) by the operation. This study is ongoing.

3. Conclusion

As development questions become complex, or where there are challenges, this study argues that multi-disciplinary approaches and collaboration are key to unlock value. It discusses techniques that have traditionally been employed by geographers, astronomers and others and makes an important case for multidisciplinary research. This is important if the SDGs can be achieved and the world can be a better place for everyone.

References

Bhattacharya, P. C.,1995. The economics of development: A review article. *Journal of Economic Studies* 22(2), 59-74

Devarajan, S., 2013. Africa's statistical tragedy. *Review of Income and Wealth*, 59(S1)

Harris, J. R., & Todaro, M. P. (1970). Migration, unemployment and development: a two-sector analysis. *American Economic Review*, 126-142

Lewis, W. A. (1954). A model of dualistic economics. *American Economic Review*, 36(1), 46-51

https://doi.org/10.1017/S1743921319005568 Published online by Cambridge University Press