Eurasian Journal of Social Sciences, 7(2), 2019, 48-55
DOI: 10.15604/ejss.2019.07.02.004

EURASIAN JOURNAL OF SOCIAL SCIENCES

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REDEFINING NATURAL RESOURCES IN ECONOMIC RESEARCH

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Abstract

Natural resources and their rents have become critical as explanatory factors in economic research, most popularly with measures made available by the World Bank. However, the used definition of natural resources seems to miss out on the two natural resources: water and fertile land. This paper argues the importance of these two natural resources, with an emphasis made on the natural resource "land". The paper argues how land could be seen as a natural resource yielding economic rents through "real-estate land", "land as energy" and "land in conflict". It then shows how the calculation of population density can be improved upon by using improved measures of land instead. This is applied to a world sample and shows how the original measure of population density can be misleading if a deeper understanding of usable land is not employed. The disparity in population density measures is most severe in island nations and MENA (Middle East and North Africa) countries. As a result of this paper, we recommend that researchers and policy makers be more aware of what passes as natural resources and natural resource rents, and to integrate a more accurate measurement of the latter into their empirical models.

Keywords: Natural Resources, Rents, Population Density, MENA Region

1. Introduction

Natural resources and natural resource rents have become important factors that are being used to explain different things in the literature such as economic development (Auty, 2004), stock market development (Billmeier and Massa, 2009), institutions (Mehlum *et al.* 2006) human capital accumulation (Stijns, 2006), governance, conflict and wars (Bannon and Collier, 2003; Collier and Hoeffler, 2005; De Soysa and Neumayer, 2007; Bjorvatn and Farzanegan, 2013; and Farzanegan *et al.* 2018) as well as economic growth in the sense of the resource blessing or curse (Sachs and Warner, 2001; Guetat, 2006; Makdisi *et al.* 2006; Brass, 2008) among many other uses of natural resources and natural resource rents in the economic literature. The World Bank (2019) offers reliable data with regards to natural resource rents and defines them as "Total natural resources rents are the sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents".

The World Bank (2019) offers data to the single components mentioned in the definition, namely oil rents, natural gas rents etc. as percentages of GDP. This data is very helpful in determining the reliance of countries on natural resources and can help research the effect of such reliance on different economic aspects as it has been done in the literature. It is, however, important to take a step back and reflect on how accurate such a definition is since it is clear that natural resources are not only limited to those encompassed in the World Bank's definition mentioned above.

It is therefore the aim of this paper to highlight the gap in the World Bank's definition of natural resource rents, namely that it misses out on the natural resources: water and land. We then focus on land as a natural resource and show how important correct measurements of land can be for economic research especially in the context of the MENA (Middle East and North Africa) region. For our example, we use the commonly used measure of population density and show how the availability of land can greatly influence measurements of population density in the MENA region much more than in other countries in the world. It is therefore the main contribution of our study to show that the missing part of the World Bank's definition may not be equally important to all regions in the world, but when researching MENA countries, it may greatly bias one's results. The evidence given here is anecdotal and should be seen as a motivation to revisit studies of the MENA region that have relied on natural resources or population density and attempt to review whether the analysis was conducted taking into consideration the special circumstances of land in the context of the MENA region.

2. Re-Defining Natural Resource Rents

Before we move to the definition of natural resource rents, we take a step back and attempt to build a common base for all researchers by looking at the Oxford Dictionary definition of "Natural Resources" first. The Oxford Dictionary defines "Natural Resources" as "materials or substances such as minerals, forests, water, and fertile land that occur in nature and can be used for economic gain" (Lexico, 2019), while "Natural Resource Rents" defined by the World Bank as "the sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents", and are calculated by the World Bank as "the (positive) difference between the price of a commodity and the average cost of producing it" (World Bank, 2019).

It may be worthwhile here to note that "Artificial Resource Rents" would be calculated in exactly the same way, rendering the above-mentioned calculation of the World Bank rather as the calculation of "Economic Rents" in general and not specifically that of "Natural Resource Rents". One may correctly ask why the literature never speaks of these "Artificial Resource Rents". The reason is that artificial resources are simply another way of saying "goods & services" which are produced, and rents cannot exist in the case of goods and services since (assuming a free competitive efficient market) competitive forces expand supply until economic profits (rents) are driven to zero. This makes "Artificial Resource Rents" unsustainable and therefore of little interest to the literature (except when analyzing inefficient markets). On the other hand, natural resources give rise to economic rents because their supply is "relatively" fixed and geographically limited. Therefore, it would be accurate to say that those natural resources in fixed supply earn sustainable returns well in excess of their cost of production, and these would be what we refer to as Natural Resource Rents.

When going back to the World Bank's definition of Natural Resource Rents, we find that it does not completely match that of the Oxford Dictionary since it misses out on the last two resources, namely "water" and "(fertile) land" although these do also occur in nature. One argument for not including them might be that they are not limited enough in supply to allow economic rents (in the same sense produced goods and services were not considered able to earn economic rents). This is currently up for debate when it comes to "water" as countries that are able to combine renewable energy with desalination techniques such as Israel (Meindertsma *et al.* 2010) can indeed endlessly produce water rendering water a natural resource that does not produce economic rents. However, these techniques are the exception rather than the rule and are indeed still a work in progress.

The same debate cannot be applied to "(fertile) land". Land is definitely not renewable. It may be fertilized and improved to change the portion of fertile land in a country, however, for a specific country, the total land area is normally limited and therefore can indeed yield economic rents. In the case of land, economic rents are not very clear (as is the case in extractable fossil fuels or forests). We argue that land can generate rents in a number of ways: First, it can generate large non-tax income for the governments that control the territory by selling it to private persons or corporations for real-estate development, whether commercial (including tourism) or residential (land as real-estate). Additionally, land can yield rent if it is of strategic value in terms of lending

a country access to specific coasts or waterways among other reasons (land in conflict). Land is now also a valuable resource that can be used to generate renewable energy through solar or wind farms (land as energy).

3. A New Measurement for Land

A lot data is available from the World Bank to measure land. The suitability of the data depends on the research objective. For example, if the aim is to measure land in its capacity for energy production, one can simply use the measure of "Land Area (in square km)". If one wishes to measure land in its capacity for use as real-estate for development, a measure of "usable" land would be more appropriate. One can argue here that the same measure of "Land Area (in square km)" could be also used, however, this may be true in most regions of the world, but for the MENA region this can be quite misleading. Taking for example the famous measure of population density (Total Population divided by Total Land Area) where a measure of "usable" land would be most appropriate, one would obtain false data by using "Land Area (in square km)".

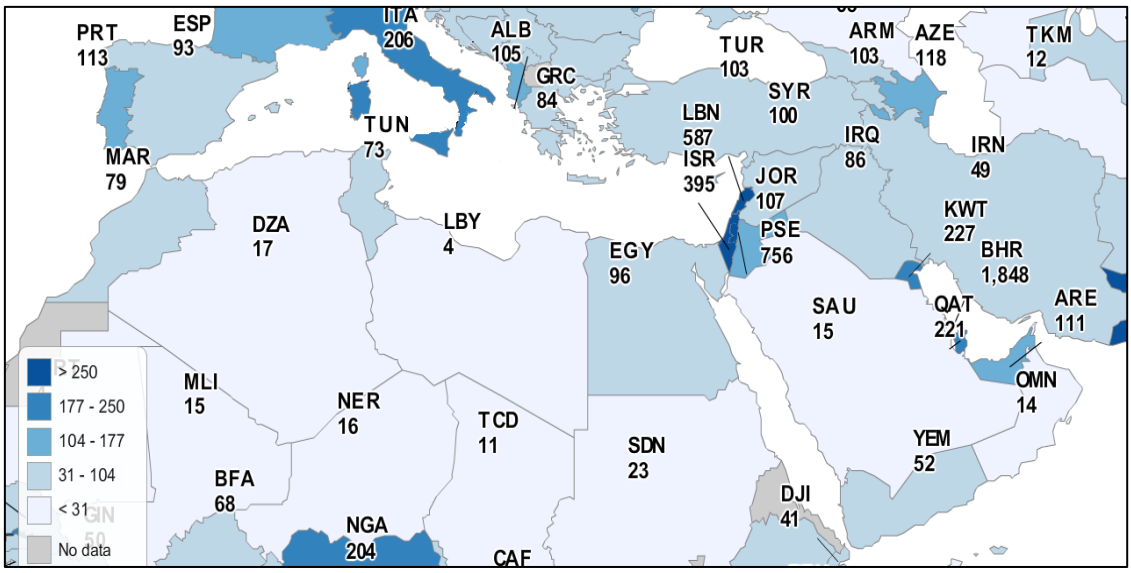

Figure 1. Population Density (Classic definition using Land Area in square km) for the MENA region and surrounding countries in 2016

Source: Own calculations based on World Bank (2019) and map created using StatPlanet by Statsilk (version 2013)

In Figure 1, one can see that population density in a country like Egypt is 96 people per square km. This is significantly misleading as can be shown using Center for International Earth Science Information Network - CIESIN – Columbia University's (2016) population density estimations, which show that the population distribution in Egypt, as well as many countries in the MENA region is heavily affected by the presence of large areas of desert, leaving the detailed population density in some areas surpassing 1000+ persons per square km.

As a result, using the classic population density measurement without further knowledge of the distribution of the population is misleading for researchers using a country-level analysis. We therefore introduce here a simple solution for this problem that allows researchers to modify the classic population density measurement to account for the distribution of the population without needing to go into detailed population densities of specific areas of a country. We do this by altering the denominator of population density, substituting "Land Area per square km" with measures of suitable land. However, to ensure ease of use, we narrow our measurements to

those readily available through the World Development Indicators, and thus find the best proxies in this case to be Agricultural Land and Arable Land[1].

These two measurements of land are readily available for most countries and can thus be used freely to measure suitable non-desert land. It is important however to highlight here that some data may not be entirely accurate as can be seen in the example of the MENA region, where it is somehow shown that a country like Saudi Arabia which would be expected to have less than 15% of its land area being categorized as agricultural, is indeed shown to have over 50% in 2013.

By obtaining the data for total land area in square km, and the percentages of agricultural and arable land, one can easily calculate the size of agricultural or arable land in square km, which can then be used as the denominator of the population density equation. We do this for data of the entire world calculating population density using agricultural land, arable land, and the sum of both agricultural and arable land (to somehow account for the fact that people do not actually live on agricultural land, but it is a good proxy of how much land is suitable for living – not ignoring the fact that people can and do live in desert areas). The results for the MENA region and surrounding countries for the year 2016 can be seen in Figures 2, 3 and 4.

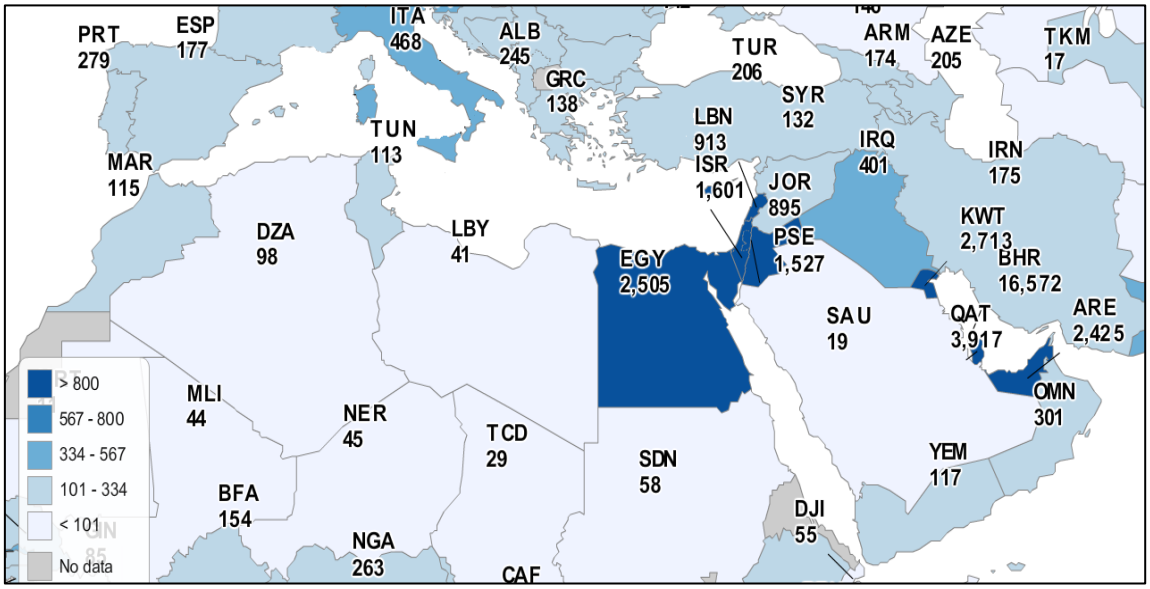

Figure 2. Population Density (Modified definition using Agricultural Land Area in square km) for the MENA region and surrounding countries in 2016

Source: Own Calculations based on World Bank (2019) and map created using StatPlanet by Statsilk (version 2013)

From Figures 2, 3 and 4, one can gain a number of insights. First, by looking at some of the European countries that are visible in the figures, a country such as Italy is not affected dramatically by the change in measurements compared to the classic definition of population density (shown in Figure 1). Classic population density in Italy was around 200 persons per square km, and more than doubles to around 460 persons per square km of usable land when using agricultural land as the proxy for usable land. It increases to its maximum when using arable land as the proxy for usable land reaching an average of 918 persons per square km of arable land. Therefore, the first conclusion we obtain is that changing these measurements does indeed result in changes in population density measurements, even in countries that are not majorly covered in desert. The reason for this, in the case of Italy for example, is the removal of uninhabitable areas such as the Italian Alps.

[1] The definitions used by the World Bank for these two terms can be found in the Appendix.

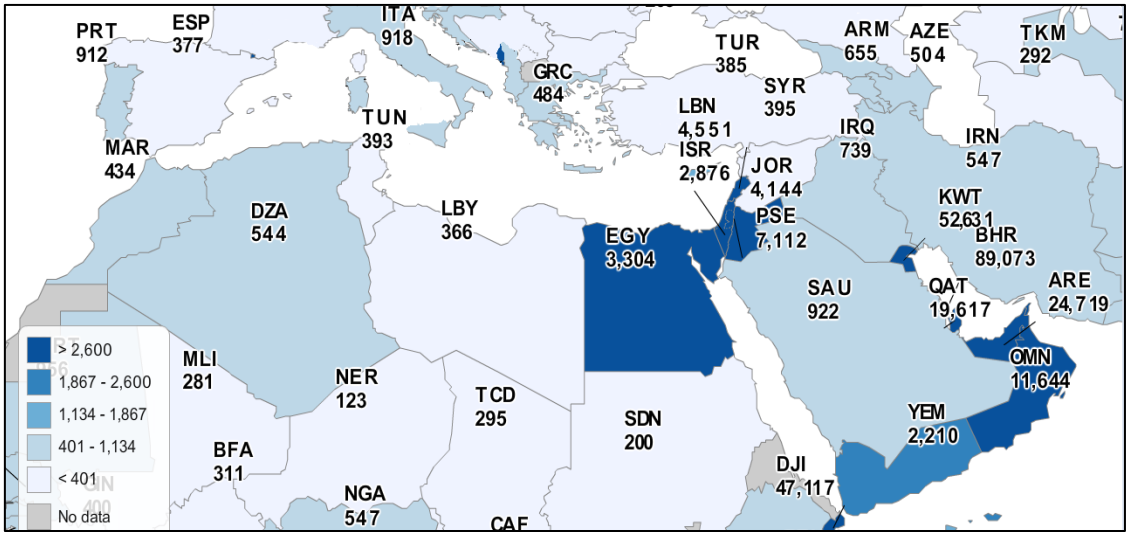

Figure 3. Population Density (Classic definition using Arable Land Area in square km) for the MENA region and surrounding countries in 2016

Source: Own calculations based on World Bank (2019) and map created using StatPlanet by Statsilk (version 2013)

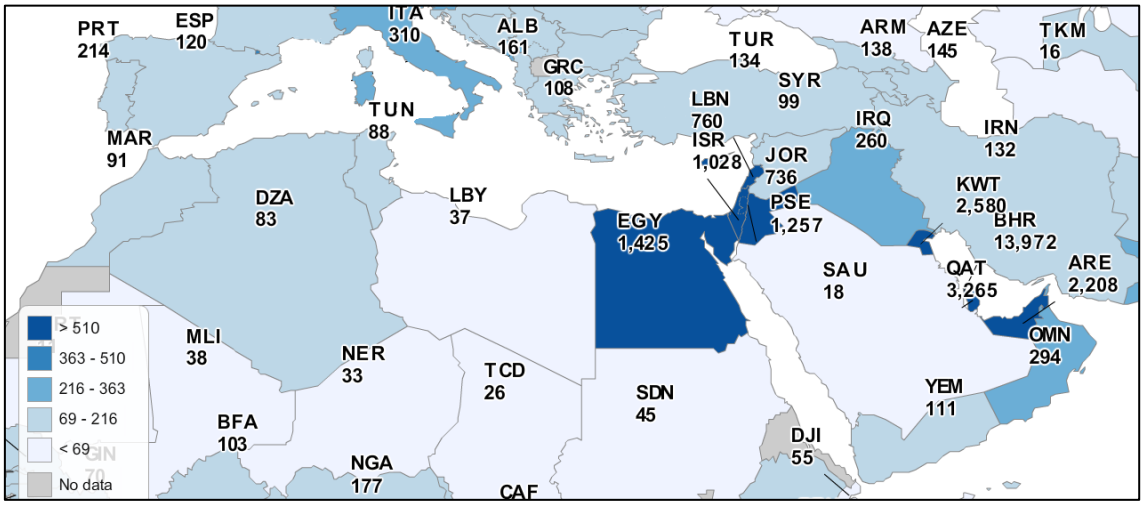

Figure 4. Population Density (Classic definition using Agricultural and Arable Land Area in square km) for the MENA region and surrounding countries in 2016.

Source: Own calculations based on World Bank (2019) and map created using StatPlanet by Statsilk (version 2013)

Second, when looking at the MENA countries, one witnesses very large changes when looking at a country such as Egypt rising to 3,304 persons per square km of arable land up from that shown in Figure 1 of 96 persons per square km. This is even more pronounced in the GCC (Gulf Cooperation Council) countries such as Bahrain or the United Arab Emirates which rise from 1,848 and 111 persons per square km respectively, to 89,073 and 24,719 persons per square km of arable land. We argue however that these modified measures of population density are much closer to the accurate figures one would witness in these countries. These measures would also reflect much better the problems facing policy makers in these countries. Taking an example from Israel, three-quarters of which is covered by the Negev desert. The classic definition shows population density to be around 400 persons per square km, while the modified definitions bring this number much higher up to almost 2,900 persons per square km of arable land. This latter

figure of 2,900 persons on average per square km of arable land is a much better explanatory variable of the increase in real-estate prices in Israel and the increase in settlement activity (Jones and Hirschauge, 2016).

It is worth noting here once again that these measures must be taken as an average of population densities in usable land, and the variety of measures (agricultural only, arable only, or the sum of both) allows for a bit of flexibility into how conservative a measure one wishes to use. We do argue however that they are all superior to the classic measurement of population density and reflect much more information.

Having shown how misleading using the classical definition of population density is, we further test which countries are most affected by the change in definition. We test this selecting out all countries where the change in definition from the classical, to that using the sum of agricultural and arable land, results in an increase of 1,000% in population density. The results are shown in Table 1.

Table 1. Countries where Population Density changes more than 1,000% when using the modified measure of population density (persons per square km of agricultural and arable land) in 2016

Country	Island or MENA	Country	Island or MENA
American Samoa	Island	Korea, Rep.	X
Antigua and Barbuda	Island	Kuwait	MENA
Aruba	Island	Lebanon	MENA
Bahamas, The	Island	Maldives	Island
Bahrain	MENA + Island	Malta	Island
Bangladesh	X	Mauritius	Island
Barbados	Island	Netherlands	X
Bermuda	Island	Mariana Islands	Island
Brunei Darussalam	X	Puerto Rico	Island
Cayman Islands	Island	Qatar	MENA
Channel Islands	Island	San Marino	X
Egypt, Arab Rep.	MENA	Seychelles	Island
Faroe Islands	Island	Singapore	X
French Polynesia	Island	St. Lucia	Island
Grenada	Island	St. Vincent & Grenadines	Island
Guam	Island	Trinidad and Tobago	Island
Hong Kong SAR, China	Island	Turks and Caicos Islands	Island
Israel	MENA	United Arab Emirates	MENA
Japan	Island	Virgin Islands (U.S.)	Island
Jordan	MENA	West Bank and Gaza	MENA

Source: Author's own work

One can recognize a number of observations in the results. First, 40 countries out of our sample of 199 countries and territories witness an increase by over 1,000% in population density. More than half of those were found to be Islands. From the remaining 15 countries, 9 belong to the MENA region (which resemble slightly less than half of the 21 MENA countries as defined by the World Bank). The aim of this test was to show that the MENA region (as well as Island nations) seem to be categorically affected by the change in population density measurements. This is also taking into consideration the fact that unreliable data in the case of Saudi Arabia and Syria (where agricultural land as a percentage of land area as per the World Development Indicators (World Bank, 2019) were larger than 50%). This should be an important warning when researching the MENA region, and implies that any and all previous research that may have used population density with its classic definition to explain economic conditions in the MENA region should be

revised. It is important to note that our threshold of 1,000% difference is rather arbitrary, and using an even lower threshold would yield many more countries.

4. Conclusion

This paper began by highlighting the importance and widespread use of natural resources and their rents as explanatory factors in economic research, most popularly with measures made available by the World Bank. However, the used definition of natural resources seems to miss out on the two natural resources: water and fertile land. It was the aim of this paper to highlight the importance of these two natural resources, with an emphasis made in this paper on the natural resource "land". The paper argued how land could be seen as a natural resource yielding economic rents through "real-estate land", "land as energy" and "land in conflict". We then showed how one very popular measure which integrates land into its calculation, namely population density, can be improved upon by using proxy measures of usable land instead. We presented this new measurement and the results in a world sample and showed how the original measure of population density can be misleading if a deeper understanding of usable land is not employed.

The disparity in population density measurement was further highlighted by filtering out those countries and territories that are mostly affected by this measurement error and identified these to be mostly island nations and MENA countries. As a result of this paper, we recommend that researchers and policy makers be more aware of what passes as natural resources and natural resource rents, and to integrate a more accurate measurement of the latter into their empirical models. In the special case of measures of population density which are quite commonly used in urban planning and development research, this becomes quite important especially when MENA countries are included. Research that has already included the common measure of population density as an explanatory variable for MENA region countries should be revised to ensure the results are robust when using more accurate measurements.

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Appendix

- Agricultural Land is defined by the World Bank (2019) within the World Development Indicators data bank as: "*the share of land area that is arable, under permanent crops, and under permanent pastures. Arable land includes land defined by the FAO as land under temporary crops (double-cropped areas are counted once), temporary meadows for mowing or for pasture, land under market or kitchen gardens, and land temporarily fallow. Land abandoned as a result of shifting cultivation is excluded. Land under permanent crops is land cultivated with crops that occupy the land for long periods and need not be replanted after each harvest, such as cocoa, coffee, and rubber. This category includes land under flowering shrubs, fruit trees, nut trees, and vines, but excludes land under trees grown for wood or timber. Permanent pasture is land used for five or more years for forage, including natural and cultivated crops*".

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