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The causal relationship between urbanization and economic growth in US: Fresh evidence from the Toda–Yamamoto approach

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ABSTRACT

This study aims to investigate the causal relationships between urbanization and economic growth for United State during the period 1960- 2017. We utilize the time series technique known as Toda-Yamamoto method, which efficiently works even with the variables co-integrated of an arbitrary order. Empirical findings suggest a unidirectional Granger causality running from urbanization to economic growth, and no Granger causality detected from economic growth to urbanization for the long run. The findings prove that urbanization is nominated as a main driving force of economic growth.

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1. Introduction

In the human literature, one of the most significant key factors in the development process is urbanization (Bairoch, 1988). In fact, urbanization and development are regarded as two interrelated and interdependent processes that cannot take place without each other. In spite of having such dependent relationship, the causal link between these two variables has not been truly clarified (Jacobs, 1969). Urbanization is regarded as both result and cause for the economic development (Gallup et al., 1999). It was proved that the proportion of the urban population in the world

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had a 30-percent rise in 1950 and it was gradually increased up to 50 percent in 2010 (United Nations, 2007).

Nowadays, urban areas have about 54 percent of world population with an on-going expectation. This number will increase up to 6 billion by 2045 in cities and 2 billion in urban areas according to the World Bank (2015). By generating more than 80% of global GDP by cities, urbanization will chip in to the sustainable growth in case of well managing of the increasing productivity; therefore, innovation and implementation of new ideas are enabled. A significant link between urbanization and economic development has been proved many times among different countries but there is still an outstanding question about which stimulates the other or which is regarded as in independent. There are many insights about the expansion in the nexus between urbanization and output over time. It has been illustrated that the rate of urbanization and per capita income are positively correlated (until 1940) in USA, in a way that by rising in the urbanization rate until 60% the output per capita will be increased faster.

Based on the report of "World Development Indicator" between 1980 and 2006, two countries of China and India faced deterioration in terms of population for rural of 26% and 8% respectively, but they have a rise the output per person to 88% and 65 %, respectively (Tamang, 2013). In spite of all mentioned above and based on the findings of Fay and Opal in 2000, the process of urbanization in Kenya was without witnessing growth. In 1960, the urbanization level in Kenya was only seven percent that was very low. By 2000, this level was about increasing up to 20 percent due to rapid urbanization but it was still low.

According to Collier (2006), geography and national boundaries' factors are a significant determinant in small countries in Africa that are following the urbanization process without growth. Urbanization is known as an on-going global trend. This trend has various speeds in various continents based on some factors such as the geographic region, development level and country size. There are many limitations related to the environmental and ecological connected with the urbanizing the big cities such as pollution, crime and traffic. On the other hand, urbanization can provide great opportunities for having economic, cultural and institutional issues. There are three concepts commonly used in order to recognize complexities of all areas. These concepts are presented in the following manner: 1-urban agglomeration, and 2-metropolitan area. The corresponding area for cities is identifiable based on the legal and administration criteria. This area is a legally recognized geographical area that includes the executive parts accepted in history.

According to the world nation definition in 2007, an urban agglomeration is being regarded based on the density of population; therefore, it ends in case of any drop of density less than a significant edge level. While the metropolitan area, is an inclusive term that contains urban agglomeration and any" surrounding areas of lower settlement density that are also under the direct influence of the city" (United Nations, 2007). Moreover, it is notable to stress that gathering a proper and precise data set regarding to the city's population as well as classification of them are dissuaded as the most challenging issues in the literatures (Cohen, 2004).

According to many studies, it has been proved that the urbanization and output per person are closely correlated (Henderson, 2003). It is clear that the output development can make rises to the more modernization in the industry and then lead to the rise level of people who are living in urban area. Developing countries has policies with the aim of rising economic growth due to the positive urbanization rate (Friedmann, 2006).

In today's world of globalization, the world is changing fast because of urbanization that has a faster change rate in the past three decades. Meantime, the urbanization process would rather focus on developing countries than developed ones. The nexus between urbanization and growth has been recently asserted by many global organizations and they believed that it should be encouraged as well. Bertinelli and Black (2004) believed that urbanization can affect economic growth through different channels considered as significant factors in the form of economy and country of either developed or developing countries. As the first channel, cities play significant roles in growth because they provide many public services (Aghion and Howitt, 2009).

According to Loughran and Schultz (2005), company performance can be affected by geography in the ceteris paribus condition. For instance, urban firms have more profit compared to the rural ones. Therefore, urban zones seem much more interesting for the firms and companies. In addition, the achievement success of a city and its development is highly

dependent on some factors such as the capacity for absorbing labors in the manufacturing sectors, to devote profit job vacancies for them, and to keep their skill's growth (Bacolod et al., 2010).

The urban economy has highlighted the importance of skills as it began to develop. Urbanization can also be remarked as reason for transferring the high skilled labor to the big cities that influences the level of skills and information. Fourth channel is an unexpected consequence which called as a positive externality (Cali and Menon, 2009). Migration positively affects urbanization in different aspects such as finance and human resource because it is an active interaction through which the information and technology as well as finance transferring are occurred and reinforced (McKenzie and Sasin, 2007).

Since urban population has a rapid growth, many researchers are becoming motivated to concentrate more on urbanization and economic growth studies. Ciccone and Hall (1996) illustrated that there is a positive effect between the population and the level of productivity in US, and growing urban population in double would lead to 6% increase in productivity. Based on the Ciccone (2002) findings, doubling the urban population in some European countries like Germany France, Spain, Italy, and England would increase the productivity by 4.5 %.

Cali (2008) has discovered a non-strong and non-negative link for the level of urbanization and output development in India. In China, Chang and Brada (2006) has investigated the concept of urbanization and found that less-urbanized countries have prevailed world economic growth. In a similar study, Da Mata et al. (2007) worked on economic growth and its effects on the level of urbanization in Brazil, and inferred that a vast categories of economic structures such as opportunities for revenue generating, the capacity of market and the quality of worker, play significant roles in the development of cities. Later on, in 2009, Brulhart and Sbergami (2009) illustrated that agglomeration raises economic development until a known degree that prevents the economic development in European countries. The urbanization -output growth nexus was investigated by Lewis (2014) in Indonesia. According to the results, urbanization positively affects economic growth; while the percentage change of urbanization is negatively connected to the economic growth.

In another study by Arouri et al. (2014), a probable and causal link between urbanization and economic development and the formation of the human capital was investigated in Africa. They indicated that the variables connection is non-linear. Besides, the result proved that high urbanization is linked with per capita GDP. These issues were examined in a different region like USA, Europe, Japan, New Zealand and Mexico from 1990 to 2008 by Leitao (2013). Based on the findings, urban accumulation boosts the economic growth.

The literatures on the urbanization-growth nexus are vast. While, most of them examined the casual link between the series using the standard linear Granger model. However, due to the existence of possible structural breaks and different integration order of the time series data, the validity of the parametric methods like standard Granger is in doubt. Against of this backdrop this study contributes to the literatures by applying the adjusted framework of Granger causality test introduced by Toda and Yamamoto (1995).

The layout of the study is presented as follows: In section 2 we provide the description of the data and applied methodology, while in section 3 the empirical analysis is presented and in the final section we provide a conclusion of the study.

2. Data and Methodology

2.1 Data

The data set of the paper includes a growth in real gross domestic product proxy for economic development[1]and urbanization growth in US over the period from 1960-2017 on annual basis.

This study adopts the ratio of the urban population to the total population as a proxy for the urbanization rate. This proxy is a commonly used measure in the literatures (Nguyen, H. M., Nguyen, L. D., 2018). All data are collected form the World Bank data center. Table 1 and Figure 1 both present a brief description of the data set used in this study.

[1] The average annual rate of real GDP growth is a standard measurement of economic growth in the literature.

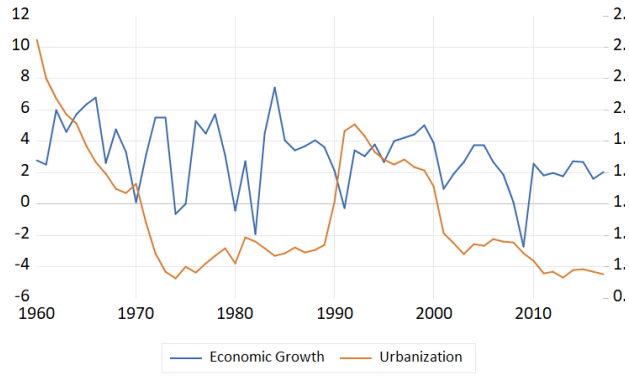

Figure 1. Economic Growth (Left Vertical Scale) and Urbanization (Right Vertical Scale)

In Table 1, EG stands for economic growth and UR denotes urbanization and p-value is in harmony with the test of normality based on the Jarque-Bera test. As observable in Table 1, the urbanization growth rejects the null hypothesis of normality based on the Jarque-Bera test. Moreover, the existence of fairly trend is clear in this series. However, the growth rate is distributed normally with negative Skewness. Figure 1 signs the relationship between the series.

Table 1. Summary Statistics

Statistic	EG	UR
Mean	3.065027	1.332478
Median	3.137432	1.152302
Maximum	7.414234	2.449104
Minimum	-2.72193	0.92724
Std. Dev.	2.071916	0.375682
Skewness	-0.48614	0.97701
Kurtosis	3.33879	3.029254
Jarque-Bera	2.561921	9.229375
Probability	0.27777	0.009905

Over the period 1970-1990, the correlation between the series seems to be negative while this link will get the positive sign after the period of 1990, such that, as the urbanization rate declines the economic growth decreases as well.

2.2 Methodology

As mentioned earlier, this study applies the methodology proposed by the Toda and Yamamoto (hereafter TY). This approach is proper for any type of integration order. This method estimates a VAR model of $(p + d)$ where p stands for the lag order selected using available information criteria (like AIC or SIC) and d denotes the maximum order of integration of the series.

Accordingly, the Granger causality can be examined in the VAR, while the additional lags are ignored. Since the methodology of TY captures the low power unit root introductory, thus it's application is in matter of attention in many studies.

The outline of TY method is as follows: First, we need to define the maximum order of integration between the series using standard unit root test. Second, the optimal lag length of VAR model is defined. Third, the following model must be estimated.

Let specify y_t as an economic growth and x_t as an urbanization rate. Then the VAR $(p + d)$ model can be specified as:

$$\begin{pmatrix} y_t \\ x_t \end{pmatrix} = \begin{pmatrix} \alpha_1 \\ \alpha_2 \end{pmatrix} + \sum_{i=1}^{k} \begin{pmatrix} \beta_{11,i} & \beta_{12,i} \\ \beta_{21,i} & \beta_{22,i} \end{pmatrix} \begin{pmatrix} y_{t-i} \\ x_{t-i} \end{pmatrix} + \sum_{j=1}^{dmax} \begin{pmatrix} \beta_{11,k+j} & \beta_{12,k+j} \\ \beta_{21,k+j} & \beta_{22,k+j} \end{pmatrix} \begin{pmatrix} y_{t-k-j} \\ x_{t-k-j} \end{pmatrix} + \begin{pmatrix} \varepsilon_1 \\ \varepsilon_2 \end{pmatrix} \quad (1)$$

where ε_1 and ε_2 both denote a white noise residuals. In order to designate the causality running from y_t to x_t (and vice versa), the parameter restriction is applied based on the usual Wald test using the least-squares estimates. However, the robustness check for the estimated VAR model also must be taken into account for the validity of results.

3. Empirical Findings

In the first step for applying the TY method, the maximal order of integration between the two variables has to be examined. To that end, we apply a two popular unit root tests, namely Augmented Dickey Fuller (ADF) test (1981) and Z_α unit root test of Philips and Perron (1988). Given the observable trend in the urbanization growth rate, for the sake of reliability of results, we apply these two test based on the two different scenarios which are differing based on the deterministic components included in the autoregressive function.

The findings are presented in Table 2 and Table 3 respectively. Whereas, Table 2 presents the level investigation and in the same manner Table 3 shows the first difference examination of the unit root properties in the series. As illustrated, the economic growth is stationary at level as the null of unit root is rejected at 5% and 10% levels of significance for both scenarios. Therefore, we conclude that this variable is integrated to the order of the 0 (e.g., I (0). However, urbanization growth contains the unit root based on the two model specifications. Although the Philips and Perron unit root test rejects the null hypothesis at 5% and 10% levels in the constant scenario, however, the presence of the trend in the series motivates us to rely on the constant and trend

scenario. Thus, the variable is integrated into the order of 1 (e.g., I (1)) as is non-stationary.

Table 2. Results of Unit Root tests for variables level

	ADF		PP	
Specification	**C**	**C and T**	**C**	**C and T**
Economic Growth	-5.25***	-5.80**	-5.19***	-4.89**
Urbanization	-2.38	-2.35	-2.94**	-2.64

, and *, shows significance at 5% and 10%, respectively. C shows the constant form while C and T denotes the constant and trend specification.

Table 3. Results of Unit Root tests for variables first difference

	ADF		PP	
Specification	**C**	**C and T**	**C**	**C and T**
Δ Economic Growth	-24.52***	-18.25***	-14.12***	-12.25***
Δ Urbanization	-5.26***	-6.24**	-11.21**	-10.12***

, and *, shows significance at 5% and 10%, respectively. Δ, denotes the first difference of series. C shows the constant form while C and T denotes the constant and trend specification.

In the presence of the mixed order of integration between the series, the TY method is proper as the modified Wald test statistic that follows the asymptotic distribution. Hence, we motivated to apply this method in order to identify the casual link between the economic growth and urbanization rate in US. However, defining the optimal lag order of the model for estimation is also matter of significance. To this end, we select the lag order of 3 (p = 3) based on the Schwarz Information Criteria (SC) since this criterion chooses the most parsimonious model comparing to the sample size. The results are displayed in the following Table.

Table 4. Lag Length Criteria

Lag	LR	FPE	AIC	SC	HQ
0	NA	0.330027	4.567161	4.643642	4.596286
1	92.71310	0.053884	2.754542	2.983985	2.841915
2	14.86721	0.045490	2.584160	2.966564	2.729782
3	1.041928	0.052229	2.719929	3.255295*	2.923799
4	1.316311*	0.059606*	2.847824*	3.536152	3.109943*
5	4.832542	0.062211	2.883912	3.725203	3.204280

*, indicates lag order selected by the criterion.

Given the optimal lag order and level of integration between the variables, a system of VAR model is estimated using lags of 3. We examined the validity of the predicted model using relevant methods and we found that the model is robust and stable[2]. In that vein, we proceed to the Granger causality test.

Table 5. Granger Causality Test (TY based)

Null Hypothesis:	Wald Test
No Causality From Urbanization to Economic Growth	9.567**
No Causality From Economic Growth to Urbanization	2.811

**, indicates significance at 5 % level.

Table 5 shows the results of casual nexus between the series using the TY method. We fail to accept the null hypothesis of the urbanization growth fails to Granger cause economic growth. Accordingly, we find a confirmation regarding the fact that a causality flowing from urbanization to economic growth. However, this causal nexus is not supported for the null of economic growth does not Granger cause urbanization rate. We infer that a unidirectional link between the urbanization and economic growth in US exists. This results support the evidence of the fact that expanding the urbanization in a country leads to have higher level of economic development.

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Conflict of interests
The author declares no conflict of interest.

4. Conclusions

A significant link between urbanization and economic development has been observed many times among different countries but there is still an outstanding question about which stimulates the other or which is regarded as in independent. This study revisited the casual nexus between the urbanization rate and economic development in US using the most available data set from 1960-2017 on annual basis. We used the modified Wald test statistic VAR based model which introduced by Toda and Yamamoto (1995).

Our empirical analysis highlights the expansion of urbanization in a country in order to get higher economic development. We find the unidirectional casualty flowing from

[2] Results are available upon request from the authors.

urbanization growth to income growth as a proxy for economic development while we could not detect the reverse causal link between the variables. Our results are important for the policy makers who design the development programs.

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