**The Nexus Between Fertility, Literacy and Labour Participation Rates: A Panel Granger Non-Causality Approach among NUTS 2 Regions in Turkey**

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Literacy is usually defined as being able to read and write. UNESCO defines literacy as an ability to identify, perceive, observe, create, communicate and compute via written and printed materials (Montoya, 2018: 1). Literate people would be capable of reading books, newspapers and any type of written materials. They would be more able to communicate with their environment and be more able to understand what is happening around themselves and their society. As a result, they would empower themselves and their families through time. In recent years, governments have been seeking to expand compulsory education policies. These policies are crucial as compulsory schooling results in increasing literacy rate in a country. From a country’s point of view, increased literacy rate has a potential to affect economy through multiple channels. Labour market is one of them. From a country’s point of view, increased literacy rate has a potential to affect economy through multiple channels. Labour market is one of them. As people become more literate and educated, they become more willing to participate in labour market. This leads to development in human capital, reduction in unemployment rate and growth in the whole economic system. Besides, increased literacy rate and educational level lead individuals in each generation to be better off in the long run (Eckstein and Zilcha, 1991: 4).

Women are imposed to certain roles within society. Especially some central roles are associated with women. A literate woman is more capable of reading, thinking, communicating with other people and even more likely to be a part of labour market. On the other hand, as fertility event and child upbringing are at the top of a woman’s major roles. Recent studies from different countries show that there exists a negative correlation between female literacy and fertility rate. This means that as women become more educated, number of children per woman decreases. The negative relation between the aforementioned variables can clearly be explained by the tendency of literate women towards having less number of children. Therefore, one needs to question what really causes the reduction in women’s fertility decisions as they become more educated.

This study investigates if any causal relations exist between fertility, literacy and labour participation rates for females among Turkish NUTS 2 regions between 2009 and 2020 (T = 12). There are 26 NUTS 2 Regions in Turkey. This provides a panel data setting consisting of 312 observations. The data used in this study are collected from the Turkish Statistical Institute (TURKSTAT). In order to investigate the causalty, firstly cross sectional dependency is investigated using Breusch-Pagan (1980) LM test, Pesaran (2004) LM CD test and Pesaran, Ullah & Yamagata (2008) LM adjusted test that the latter two are presented below:

 (1)

 (2)

Test results show that there exists cross sectional dependency among units. Therefore, the alternative hypothesis is accepted at 1% significance level. (p < 0.00 and this holds among all aforementioned tests.)

Secondly, the slope homogeneity is tested via Delta test developed by Pesaran ve Yamagata (2008):

 (3)

The test result shows that the slope coefficients are not homogenous which further suggests that the null hypothesis should be rejected (p < 0.000).

As a result, to investigate panel causality, Dumitrescu ve Hurlin (2012: 5) causality test is employed under the existence of heterogeneous slope coefficients:

 (4)

The bootstrapped p-values (p values for Z-bar and Z-bar tilde) indicate that fertility does Granger-cause labour participation among females for at least one panel whereas labour participation does not Granger-cause fertility at NUTS 2 level. Furthermore, literacy does not Granger-cause labour participation while labour participation rate does Granger-cause literacy for at least one panel. Finally, fertility is found to Granger-cause literacy rate for at least one panel but literacy does not Granger cause fertility at NUTS 2 level. Overall, the bidirectional Granger causality does not exist among these three variables at NUTS 2 level in Turkey as there exists only unidirectional causality.

**JEL codes:** I21, J13, J01, C51, C33

**Keywords:** fertility, labour participation rate, literacy, granger non-causality, panel data analysis, NUTS 2 level.

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