TODA YAMAMOTO APPROACH: APPLIED EVIDENCE ON CAUSAL RELATIONSHIP

Besa Xhaferi
Faculty of Economics, University of Tetovo, North Macedonia besa.xhaferi@unite.edu.mk
Jehona Musliu
Faculty of Economics, University of Tetovo, North Macedonia jehona.musliu@unite.edu.mk

Abstract: Education and health expenditure are acknowledged as productive government expenses respectively considering human capital as a factor of growth. Also along with income, education and health are core welfare measures covered in Human Development index. The focus of the analysis is to provide evidence of causality between indicators of human development and economic growth. According to endogenous economic growth health has impact on economic growth. Education investment spillovers are both in micro level resulting to increased return for individuals and in macro level resulting in economic growth. The recent pandemics raised question on public health, health care accessibility and healthcare investment and revealed and acknowledge the importance of health and healthcare investments not limited only for economic impact but for numerous impact for human capital and their well being. Education expenditures and health expenditures have increased in line with GDP growth from the beginning of North Macedonia as an independent country till recent year and comparing both series results that health expenditures are lower than education expenditure. For more the percentage of Gross Domestic Product that these expenses represent has decreasing trend. The evidence provided is based on sample period that covers quarterly data for the period 2001 -2018 extracted data from database: World Development Indicators for North Macedonia. We employ Toda and Yamamoto (1995) in order to investigate for Granger causality. First we check if the series are integrated and whether integration order is the same following Augumented Dickey-Fuller (1979) and Philip –Perron techniques. it is expected that series are not stationary in levels and estimation with stochastic trend results in spurious results therefore before providing results and policy implication we should correct until we attain stationarity. The series since employed in analysis are non stationary in levels which as expected is the case with time series variables and they are integrated of order I(1) after we used differencing. The order of lag-length was determined by Schwarz Information Criterion (SBIC), Hannan-Quinn information *criterion (HQIC)* and Akaike Information Criteria(AIC) and results for our model the appropriate lag is two lags.Accordingly since we get same integration order we follow on cointegration test using Johansen methodology and continue with causality tests. Finally we check the presence of cointegration on VAR model . The existence and direction of causality it is estimated. The results suggest that there is unidirectional Granger causality from health expenditure to economic growth.
Keywords: causality, granger, VAR

1. INTRODUCTION
There is numerous evidence that correlates both in theory and empirically health expenditures and economic development. The starting point of this paper is a follow up on recommendation from the Xhaferi et al (2018) suggesting on further detail analysis on productive expenditures for the case of North Macedonia. Authors conclude that expenses in the case of North Macedonia do not granger cause GDP growth respectively they suggest disaggregating expenses in education expenditures and health expenditures in order not to underline generalized conclusions.

2. EMPIRICAL EVIDENCE REVIEW
Empirical evidence on correlation between economic growth and health expenditure is numerous. Some of the evidence find bidirectional relationship between GDP and health expenditure (Ifa and Guetat, 2019,) no relationship between them (Maduka et al,2016) and most of them find unidirectional relationship from health expenditures to economic growth (Pasara et al 2020); unidirectional relationship from economic growth to health expenditure (Anvari et al, 2020). The table below presents a summary for existing empirical evidence on the causality between economic growth and health expenditures.

Table 1 Summary of empirical evidence review

| AUTHOR	SAMPLE	EXPLANATORU VARIABLE	MAIN RESULTS
Hashim et al 2021	Malaysia 1988-2018	GDP	Education expenditures, capital formation and human capital have significant impact on growth
Odhiambo 2021	2008-2017 sub-Saharan Africa	GDP per capital, public health expenditure	Unidirectional from health expenditure to economic growth
Ozturk and Suluk,2020	1990-2017 Norway	GDP	Unidirectional relationship from Human development Indicator to economic growth
Pasara et al 2020	Zimbabwe	Growth of real GDP, tertiary education enrollment	Education granger causes health; health granger causes economic growth
Anvari et al (2020)	2004-2016 OPEC countries	Government health expenditure, education expenditure and GDP	Unidirectional granger causality from GDP to government spending in education and unidirectional relationship from GDP to health expenditure
Ifa and Guetat 2019	Tunnisia and Moroco 1980- 2017	GDP per capita growth	Bidirectional causal relationship between economic growth and public health spending
Dinicer and Yuksel, 2019	1996-2016 E7 countries	GDP growth	Economic growth is the cause for health care expenditure
Louzano et al 2019	Brazil 2006-2013	Fiscal management	Unidirectional causal relationship between development and fiscal management
Ye and Zhang 2018	OECD countries 1971-2015	Per capita GDP, per capita health expenditure	Six countries there is nonlinear unidirectional relationship; 11 countries there is unidirectional linear relationship and for 3 countries there is neither linear nor nonlinear relationship between health care expenditure and economic growth
Maduka et al 2016	Nigeria 1970-2013	Real GDP	No relationship between real GDP and government health expenditure
Yun and Yusoff 2015	Malaysia 1980-2012	GDP, education	Unidirectional causality

		expenditure, health care expenditure	from GDP to education expenditure; Unidirectional causality from GDP to healthcare expenditure

Source: author's summary

3. DATA AND METHODOLOGY

As data and graphs tend to show is that education expenditures and health expenditures have increased in line with GDP growth from the beginning of North Macedonia as an independent country till 2020. For more education expenditures data are registered until 2012 year while health expenditures data availability is from 2000 year. There are missing data for the beginning period on health expenditures and missing data for education expenditures for the later period. But when we analyze the percentage of GDP that these expenses represent the percentage is decreasing.

Fig 1 Health and Education expenditure
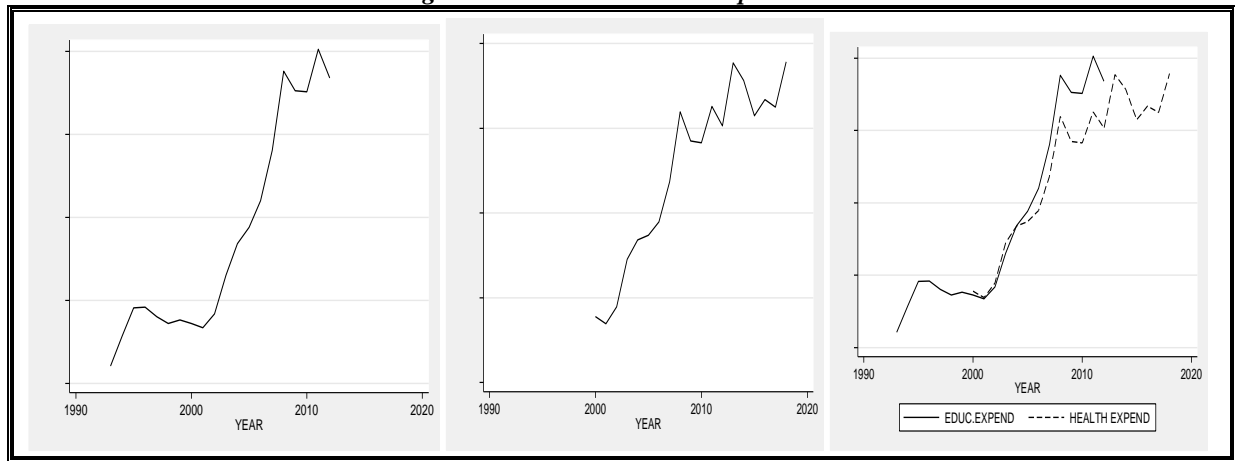
Source: World Development Indicators: Authors' presentation

The evidence on causal relationship between health expenditure and economic growth is trivial respective there is evidence on positive contribution of health expenditure on growth (Bloom et al (2001)), negative contribution of health on economic growth (Granados,2012); no cointegration relationship (Mohesen et al 2011), bidirectional relationship (David 2014). Amiri and Ventelo (2010) and Rahman et al (2011) find unidirectional relationship from health expenditure to GDP.

The evidence on relationship between growth and health expenditure is provided using VAR methodology (Wang et al, 2018), VECM methodology (Mukherje,2017,Wang,2011;) Granger Causality (Leidl, (1998), Ozturk and Suluk,2020). Mohsen et al (2011) find no short or long run cointegration relationship between GDP and public spending on health.

4. APPLYED EMPIRICAL EVIDENCE

Granger causality test is estimated on sample period that covers quarterly data extracted data from database: World Development Indicators for North Macedonia. First we check if the series are integrated and whether integration order is the same following Augumented Dickey-Fuller (1979) and Philip –Perron –PP techniques. It is expected that series are not stationary in levels and estimation with stochastic trend results in spurious results therefore before providing results and policy implication we should correct until we attain stationarity. The series employed in analysis are non stationary in levels which as expected is the case of time series variables and they are integrated of order I(1) after we used differencing. The results of ADF and PP unit root tests are summarized in the table below for both the level and first difference.

Table 2 ADF and PP unit root test for level

ADF	Level (constant)		Level		PHIPILS-PERRON
	T Statistic	P Value	T Statistic	P Value	
LNGDP	-1,751	0.7281	-1.8	0.3807	LNGDP
LNHEALTHEXPENDITURE	-1.889	0.6601	-1.82	0.3699	LNHEALTHEXPENDITURE

*** significant at 1% level ** significant at 5% level * significant at 10% level
Source: Author's calculation

Table 3 ADF and PP unit root test for first difference

ADF	FIRST difference		FIRST difference		PHIPILS-PER5ON
	T Statistic	P Value	T Statistic	P Value	
LNGDP	-3.338**	0.062	-3.320*	0.01	LNGDP
LNHEALTHEXPENDITURE	-3.128**	0.0998	-3.445**	0.009	LNHEALTHEXPENDITURE

*** significant at 1% level ** significant at 5% level * significant at 10% level
Source: Author's calculation

The order of lag-length was determined by Hannan-Quinn information *criterion (HQIC),*Schwarz Information Criterion (SBIC) and Akaike Information Criteria(AIC) and it results that for our model the appropriate lag is two lags. The test for lag order selection are presented in the table below:

Table 4 Lag order selection

LAG	LL	LR	Df	P	AIC	HQIC	SBIC
0	106.8				-2.95	-2.927	-2.88
1	388.47	563.3	4	0.00	-10.77	-10.668	-10.58
2	442.71	108.47*	4	0.00	-12.18*	-12.062*	-11.87*

Source: Author's calculation

Accordingly since we get same integration order we follow on cointegration test using Johansen methodology and follow estimating usingh Toda-Yamamoto technique. Finally we check the presence of cointegration on VAR model . The existence and direction of causality it is estimated.

Table 5 Granger causality

Independent variable	Dependent variable	NHEALTHEXPEND	LNGDP
LNGDP		[0.14]	
LNHEALTHEXPEND			[0.01]

Note: Numbers in parenthesis represent probabilities

Source: Author's calculation

The results suggest that there is unidirectional Granger causality from health expenditure to economic growth at conventional level of significance.

5. CONCLUSIONS

The evidence provided is based on sample period that covers quarterly data for the period 2001 -2018 extracted data from World Development Indicators database for North Macedonia. We employ Toda and Yamamoto (1995) in order to investigate for Granger causality. Firstly unit root test are performed to ensure stationarity of series

following Dickey and Fuller -ADF(1971), than we follow testing for cointegration (tests whether there is long run equilibrium relationship) following Johansen and Juselius (1990) techniques and at the end apply Granger causality procedure for testing patterns and directions of causality.

The series are integrated of order I(1) because we used differencing since all the series employed in analysis are non stationary in levels which as expected is the case with time series variables. ADF test suggest that data are stationary after first differencing, Johansen test does not find evidence for cointegration therefore we choose the lag length using Akaike Information Criteria and two lags were used in VAR model. The existence and direction of causality it is estimated. The results suggest that there is unidirectional Granger causality from health expenditure to economic growth. The results are in line with Odhiambo (2021). Policy recommendation is that health expenditures are productive in the case of North Macedonia, respectively increasing health expenditures will induce economic growth.This study fails to estimate granger causality of education on growth due to data unavailability on education expenditure but we suggest on further analysis on other quality of education measures.

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