Government expenditures on education and economic growth in the UK

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Government Expenditures on Education and Economic Growth in the UK

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Abstract

This paper investigates the impact of government expenditures on the main tiers of education on economic growth in the UK. Using annual data spanning from 1971 to 2019, we employ the vector autoregression (VAR) model to examine the relationship between the variables. Our findings indicate that the UK government expenditure on secondary education has a positive and statistically significant impact on economic growth in the country. Further findings show a unidirectional causality running from economic growth to government expenditure on pre-primary education in the UK, while a bidirectional causality exists between government expenditure on secondary education and economic growth in the UK.

Keywords: secondary education, pre-primary education, economic growth, VAR
JEL Classification Codes: C32, E62, I21, O47

I. Introduction

Education is a key driver of human capital and economic growth. This idea can be traced back to the early work of Smith (1776) which posits that an educated individual can be compared to an expensive machine and the benefits for the work performed should outweigh the whole cost of education. In this line of reasoning, Hanushek and Woessmann (2023) asserts that education equips people with the competencies and knowledge that facilitate the generation and adoption of new ideas which spur technological progress and innovation to ensure future prosperity. Consequently, investment in human capital has necessitated policy makers and researchers to concentrate on valued skills and proxies related to school attainment levels - secondary completion for developed countries with recent attention on access to colleges and universities; while access and completion of lower secondary schooling is applicable to developing countries (Hanushek and Woessmann, 2023).

Despite the increasing importance of education in enhancing economic growth, limited existing studies have investigated the impact of government's expenditure on education across countries using different empirical models (Coman, Lupu and Nuţă, 2023; Krizek et al. 2022; Le and Tran, 2021; Maneejuk and Yamaka, 2021; Wang and Zhang, 2024). This study contributes to the empirical evidence on the topic by examining the impact of government expenditure on the main tiers of education on economic growth in the UK. To the best of our knowledge, this paper is the first to focus on the UK which is the motivation and novelty of the research. According to IFS (2025), expenditure on education is the second-largest government spending in the UK behind health as it represents £116 billion in 2024-25. Thus, the findings of this study would be beneficial to policy makers in the UK to evaluate the implementation of fiscal policy, especially the boards and committees of the Department for Education (DfE). Figure 1 shows the trends of government expenditures on the main tiers of education in the UK and economic growth as further described in Table A1 (appendices).

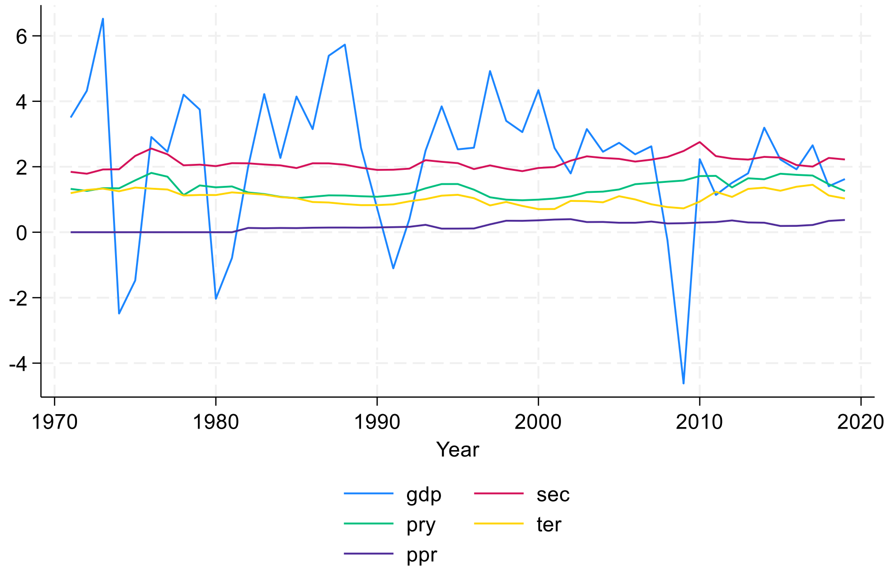

Figure 1. The trends of government expenditures on education and economic growth in the UK (1971 to 2019).
Source: Authors' computation

II. Data and Methodology

Data

Based on data availability, we obtained UK's annual country-level data from World Bank database for the period 1971 to 2019 and analysed the collected data using STATA 18. Our empirical model follows existing studies such as Le and Tran (2021), Krizek et al. (2022), and Wang and Zhang (2024) to include government expenditures on the main tiers of education in the UK. Thus, the empirical model for this study is expressed in Equation 1 as:

$$GDP_t = f\,(PPR_t\,,\,PRY_t\,,\,SEC_t,\,TER_t,\,Z_t) \qquad (1)$$

Z is the vector of other possible determinants relevant to economic growth in the UK and t is time period. We convert Equation 1 into an econometric model, to form Equation 2:

$$GDP_t = b_0 + b_1 PPR_t + b_2 PRY_t + b_3 SEC_t + b_4 TER_t + \mu_t \qquad (2)$$

where b_0 is the intercept, the parameters $b_1, \ldots, b_4$ are the slope or coefficients of the independent variables and μ is the error term.

Methodology

We examine non-stationarity among the variables in our empirical model using Phillips-Perron unit root test (Phillips and Perron, 1988) as shown in Table A2 in appendices. The initial Phillips-Perron tests suggest that *GDP* and *SEC* are $I(0)$ while other variables are non-stationary. To avoid spurious regression, we take first difference of the variables, and the unit root tests show that all the variables at $I(1)$ or integrated of order one. Due to the non-existence of cointegration among the variables in our model as shown in Table A3, we apply the vector autoregression (VAR) as introduced into empirical economics by Sims (1980) in this study. Thus, our VAR model follows the Cholesky decomposition as specified in Equation 3.

$$dGDP_t = \beta_0 + \sum_{i=1}^{k} \alpha_i \, dGDP_{t-i} + \sum_{j=1}^{k} \alpha_j \, dPPR_{t-j} + \sum_{l=1}^{k} \alpha_l \, dPRY_{t-l} + \sum_{m=1}^{k} \alpha_m \, dSEC_{t-m} + \sum_{n=1}^{k} \alpha_n \, dTER_{t-n} + e_t \tag{3}$$

where dependent and independent variables remain as defined in Table A1; β_0 is the intercept or constant; parameters α_s where $s = i, j, l, m, n$ are short-run coefficients; k is the maximum lag length; e_t is the stochastic error terms, often regarded as impulses or shocks or innovations in the VAR language.

III. Empirical Results

Our VAR estimates are shown in Table 1. We focus on the $dGDP$ equation as it considers economic growth as the dependent variable and UK government expenditures on education as the independent variables. The $\overline{R}^2$ (coefficient of determination) value of 0.3730 denotes that UK government expenditures to the four tiers of education as specified on our empirical model jointly account for 37.30% total variation in $dGDP$. Therefore, other variables not explicitly specified in our empirical model account for 62.7% of total variation in $dGDP$. Additionally, the low standard errors values imply that the estimated VAR coefficients are fit to make predictions about $dGDP$ in the UK. Table 1 further shows that lag 2 of $dSEC$ has a positive and statistically significant relationship with economic growth at 1% level. As such, a 1% increase in UK government expenditure on secondary education would increase economic growth in the UK by 8.72%. Nonetheless, our findings show that the UK government expenditure on other education tiers are not statistically significant. We further conduct Granger causality tests to examine the direction of causality among the variables. Our findings as shown in Table A4 in appendices show that the Chi-square estimates of $dGDP$ to $dPPR$, $dSEC$ to $dGDP$, and $dGDP$ to $dSEC$ are statistically significant at 1%, 5% and 1%, respectively. Thus, we reject the null hypotheses which indicates the existence of a unidirectional causality running from $dGDP$ to $dPPR$ in the UK. However, a bidirectional causality exists between $dSEC$ and $dGDP$ in the UK.

Table 1. VAR Estimates

	$dGDP$ eq.	$dPPR$ eq.	$dPRY$ eq.	$dSEC$ eq.	$dTER$ eq.
$\Delta dGDP_{t-1}$		0.00009	-0.012	-0.04	-0.007
		(0.003)	(0.009)	(0.008)***	(0.007)
$\Delta dGDP_{t-2}$		-0.010	-0.014	-0.02	-0.002
		(0.003)***	(0.011)	(0.009)**	(0.009)
$\Delta dPPR_{t-1}$	12.31		-0.86	0.18	-0.42
	(0.19)		(0.54)	(0.48)	(0.46)
$\Delta dPPR_{t-2}$	-5.96		0.13	0.70	-0.68
	(0.90)		(0.53)	(0.46)	(0.45)
$\Delta dPRY_{t-1}$	-3.00	0.05		0.11	-0.29
	(0.53)	(0.07)		(0.21)	(0.20)
$\Delta dPRY_{t-2}$	-2.86	-0.14		0.02	-0.16
	(0.50)	(0.07)**		(0.20)	(0.20)
$\Delta dSEC_{t-1}$	-1.55	-0.19	0.41*		0.36
	(0.15)	(0.06)***	(0.21)		(0.18)**
$\Delta dSEC_{t-2}$	8.72	0.14	-0.27		0.14
	(0.21)***	(0.07)**	(0.21)		(0.18)
$\Delta dTER_{t-1}$	2.31	-0.12	0.18	-0.005	
	(0.28)	(0.07)***	(0.22)	(0.19)	
$\Delta dTER_{t-2}$	4.50	0.04	0.02	0.12	
	(0.26)	(0.07)	(0.22)	(0.19)	
$\overline{R}$	0.3730***	0.2824*	0.2943**	0.4205***	0.1776

Lagrange-multiplier test (p-values)	
Lag 1	0.27034
Lag 2	0.57461

Notes: ***, ** and * represent significance at 1%, 5% and 10% levels, respectively. The standard errors in parentheses.
Source: Authors' calculations.

We follow the work of Johansen (1995) to conduct model diagnostics using Lagrange multiplier (LM) test to examine autocorrelation in the residuals of our VAR model as shown in Table 1. The LM test considers the null hypothesis of no autocorrelation at lag order and the p-values in Table 1 are not statistically significant. Thus, we fail to reject the null hypothesis that there is autocorrelation in the residuals for any of the two orders tested which further gives no indication of model misspecification. Furthermore, we check the eigenvalue stability condition of the estimates of our VAR model. Figure A1 in appendices visually indicates that the eigenvalues are well inside the unit circle, which indicates that our VAR model satisfies the eigenvalue stability condition.

Orthogonalized Impulse Response Functions (OIRFs)

As the variables in our model are not cointegrated; then the OIRFs from a VAR model must die out over time (transitory). This is because each variable in the model has a finite and time-variant mean; hence, the effect of orthogonalized shock to any of the variables must die out for the variable to revert to its mean (Hamilton, 1994; Lütkepohl, 1993). Table 2 and Figure A2 in appendices show the OIRFs from our VAR model with the cumulative effect after one year to five years to capture short-medium term effects. Our findings show that after one year, increase in orthogonalized shocks to $dPRY$ and $dSEC$ decrease $dGDP$ by 0.63% and 0.14%, respectively, while increase in orthogonalized shocks to $dPPR$ and $dTER$ increase $dGDP$ by 0.32% and 0.29%, respectively. We observe similar trends after five years, orthogonalized shocks to $dPRY$ and $dSEC$ decreases $dGDP$ by 0.06% and 0.14%, respectively, while orthogonalized shocks to $dPPR$ and $dTER$ increases $dGDP$ by 0.01% and 0.06%, respectively, that die out after five years.

Forecast Error Vector Decompositions (FEVDs)

Our empirical findings in Table 2 further show the FEVDs for the VAR model. In period one, 100% of forecast-error variance in $dGDP$ is attributed to orthogonalized shocks in itself, thus, other variables in the model are strongly exogenous with 0% contributions. However, the impact of other variables becomes apparent from period two. From periods two to five, 2% of forecast-error variance in $dGDP$ is attributed to orthogonalized shocks in $dPPR$. In period five, forecast-error variance in $dGDP$ is attributed to orthogonalized shocks in $dPRY$, $dSEC$ and $dTER$ by 9%, 8%, and 3%, respectively.

Table 2: OIRFs and FEVDs

Orthogonalized Impulse Response Functions (OIRFs)					
	Period				
Response: $dGDP$	1	2	3	4	5
Impulse/Shock					
$dPPR$	0.32	0.09	-0.13	0.02	0.01
$dPRY$	-0.63	0.38	0.13	-0.07	-0.06
$dSEC$	-0.14	0.59	0.16	-0.34	-0.14
$dTER$	0.29	-0.11	-0.23	0.11	0.06
Forecast Error Vector Decompositions (FEVDs)					
	Period				
Response: $dGDP$	1	2	3	4	5
Impulse/Shock					
$dPPR$	0	0.02	0.02	0.02	0.02
$dPRY$	0	0.08	0.09	0.09	0.09
$dSEC$	0	0.003	0.06	0.06	0.08
$dTER$	0	0.02	0.02	0.02	0.03

Source: Authors' computations.

IV. Conclusion

Based on the empirical findings in this paper, we argue that the UK government expenditure on secondary education boosts economic growth, while expenditure on pre-primary, primary and tertiary education are not statistically significant. This result in consistent with the assertion of Hanushek and Woessmann (2023) that secondary completion signifies valued skills and proxy of school attainment level in developed countries. We further argue that as the UK economy grows this causes further government expenditure on pre-primary and secondary tiers of education. Indeed, our findings reflect the current policy outlook in the UK. With the recent economic recovery and growth forecast of 1.6% in 2025, the UK government has announced a £2bn uplift funding on pre-primary education with 45% increase to early years pupil premium (DfE, 2024).

Disclosure Statement

No potential conflict of interest was reported by the authors.

Data Availability Statement

The data for this study are available on request from the authors.

Declaration of Funding

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Appendices

Table A1. Descriptive Statistics

Variable	Definition	Obs	Mean	Std. deviation	Minimum	Maximum
GDP	Growth in Real GDP (%)	49	2.25	2.13	-4.62	6.52
PPR	Government expenditure on pre-primary education as % of GDP (%)	49	0.19	0.13	0	0.40
PRY	Government expenditure on primary education as % of GDP (%)	49	1.34	0.24	0.98	1.81
SEC	Government expenditure on secondary education as % of GDP (%)	49	2.13	0.19	1.79	2.76
TER	Government expenditure on tertiary education as % of GDP (%)	49	1.06	0.20	0.71	1.45

Source: Authors' calculations.

Table A1 shows the descriptive statistics of the variables under investigation for a period of 49 years (1971 to 2019). The mean values in the fourth column show the midpoints or averages of the variables. Average economic growth in the UK over the years has been quite low with a mean value of 2.25%. Also, the average government spending on secondary education in the UK has been the highest with a mean value of 2.13%, while the average government expenditure on pre-primary education in the UK has been the lowest with mean value of 0.19%. The low standard deviation values in the fifth column are measures of dispersion which denote that the data points for the variables are close to their means and are not spread out. Notably, the minimum and maximum values of 1.79% and 2.76%, respectively in the sixth and seven columns for *SEC* further shows the UK government's priority for expenditure on secondary education above other tiers.

Table A2. Unit root test results

	Phillips-Perron (Test statistic)		
Variable	**$I(0)$**	**$I(1)$**	**Decision**
GDP	-4.782***	-9.066***	$I(0)$ and $I(1)$
PPR	-1.277	-6.262***	$I(1)$
PRY	-2.335	-6.654***	$I(1)$
SEC	-3.078**	-6.311***	$I(0)$ and $I(1)$
TER	-2.346	-6.712***	$I(1)$

Note: ***, ** and * denote statistical significance at 1%, 5% and 10% levels, respectively.
Source: Authors' calculations.

Table A3. Bounds testing cointegration

Model	F-Statistic	Regressors*				Decision
			1%	5%	10%	
$GDP_t = f\ (SEC_t\ , dPRY_t\ , dTER_t,$ $dPPR_t,)$	4.743					No cointegration
		$I(0)$	4.306	3.136	2.614	
		$I(1)$	5.874	4.416	3.746	

Note: *Critical Values based on Narayan (2005)
Source: Authors' calculations.

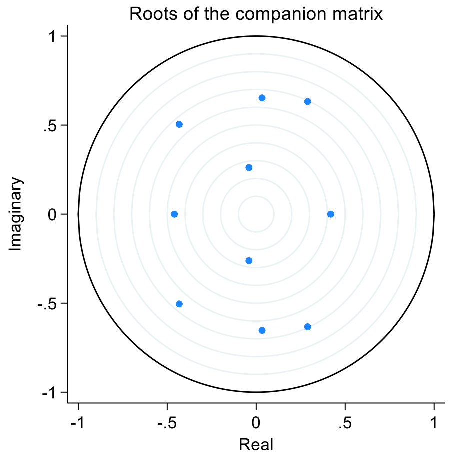
As the variables in our model comprises of $I(0)$ and $I(1)$ regressors, we consider both lower and upper critical values in Table A3. The F-statistic value, $F_{GDP}(.)$= 4.743 is greater than critical values for both $I(0)$ and $I(1)$ regressors at 5% and 10% levels of significance, however, less than $I(1)$ critical value at 1% level of significance. Hence, we fail to reject the null hypothesis of no cointegration or levels relationship, which implies that there is no cointegration among the variables.

Table A4. Granger Causality Tests

Granger Causality Wald Tests	Chi-square	Remark
dPPR does not Granger cause *dGDP*	3.0112	Unidirectional
dGDP does not Granger cause *dPPR*	10.4***	causality
dPRY does not Granger cause *dGDP*	1.0954	No causality
dGDP does not Granger cause *dPRY*	3.1581	
dSEC does not Granger cause *dGDP*	7.3852**	Bi-directional
dGDP does not Granger cause *dSEC*	24.928***	causality
dTER does not Granger cause *dGDP*	2.5201	No causality
dGDP does not Granger cause *dTER*	0.90322	

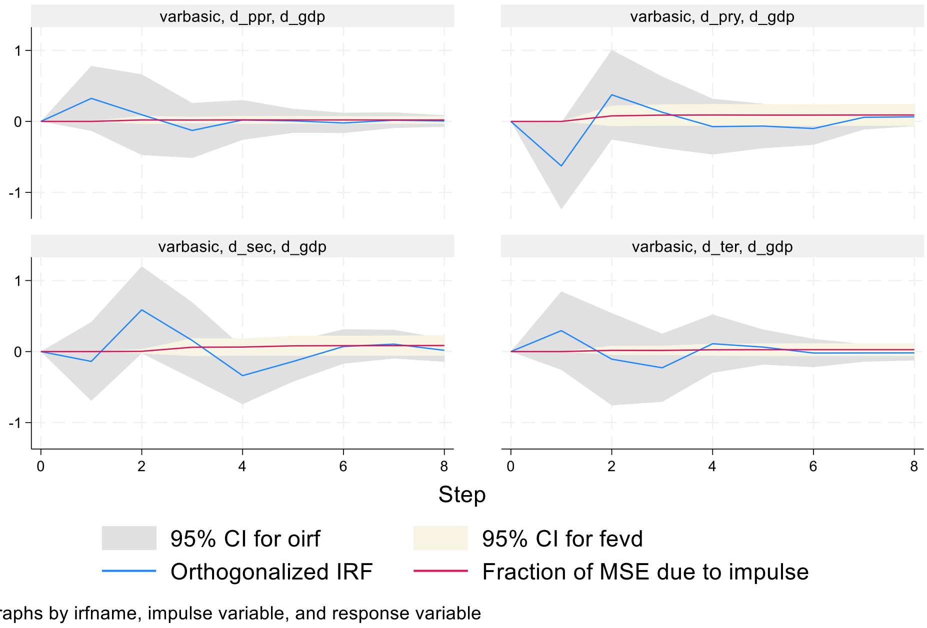
Note: ***, ** and * denote statistical significance at 1%, 5% and 10% levels, respectively.
Source: Authors' calculations.

Figure A1. VAR Stability Condition Graph



Source: Authors' computations.

Figure A2. Orthogonalized Impulse Response Functions (IRFs) Graphs



Source: Authors' computations