Article

Linking Sweden's Education Spending Growth with Higher Education Enrolment Using the ARDL Model from 2000 to 2021

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Abstract: If a nation wants to be considered developed, it needs to do more than just have a lot of natural resources; it needs to work on developing its human capital so that it can manage its natural resources well. This study aims to shed light on how much of an impact education spending has on increasing enrolment in higher education and how development in general affects a country's level and position in the world. In addition, we used the ARDL model to examine Swedish higher education enrolment from 2000 to 2021 and draw a number of conclusions, the most crucial of which was the presence of a long-term relationship between education spending and enrolment.

1. Introduction

Education is one of the most essential foundations for measuring the development of any country, as it determines its level and position among the world's nations because progress in the education system means progress in all sectors. More is needed for the country to have significant natural resources for development. Still, it must also work constantly to develop Human capital and qualify it to manage these resources efficiently because it is the strategic resource in the production process. It is a resource whose replacement is difficult to find from any institution or country other than the one in which it works, which requires attention to educational and training activity. Education is one of the sources of wealth, especially in those countries that suffer from limited natural and economic resources. The right to education is considered one of the economic and social rights stipulated in international charters and the constitutions of most world countries. Spending is a powerful financial tool to achieve a fair distribution of income and wealth and meet many needs, most importantly—spending on education, health, and social care.

1- Research problem: The research problem lies in the following question: Does government spending in Sweden have a role in improving the growth of higher education?

2- The importance of the research: The research shows the paths of government spending and its impact on the educational process based on a standard model that includes a set of tools.

3- Research hypothesis: The research hypothesis is based on the existence of a long-term relationship between spending on education and enrollment in higher education in Sweden.

4- Research objective: The research aims to clarify the concept of spending and its role in improving and developing the outcomes of higher education.

5- Spatial and temporal limits of the research:

1. Spatial borders: the State of Sweden

2. Time limits: represented by the period (2000-2021)

The first axis

Conceptual framework (public spending and higher education)

First: The concept of public spending

Public spending, or expenditures by the government, are not defined in any one way. Rather, there are a number of meanings, but they all essentially mean the same thing but use various words to convey it. According to P3: 2004: Stephen J., "public spending" is the sum of money that the state takes in and uses for the benefit of the general populace. Similarly, D.M. Mithan (1998) states that the purpose of public expenditure is to do just that.

Some think of it as the sums of money that a public official may spend on things like public goods and services, as well as on economic and social initiatives, after receiving approval from the relevant legislative bodies. According to some sources, it is a sum of money that a layperson may assess as being necessary to meet a public demand (Hamid et al., 2003, p. 251). Another definition of public spending is the outlay of funds by the state or an entity inside it (a public person) for the benefit of the general populace. A second definition of public spending is the total amount that the government spends on goods and services to meet public needs, with the money coming from the public. Expenditures on security and defence, education, health, social programs, and infrastructure are all part of this category, as are all other forms of public sector spending that do not come from private companies but are essential to society as a whole (Al-Zuhairi & Murad, 2023, p. 56). A monetary quantity, a public individual who agrees to spend it, and a societal benefit are the components of public spending, according to the preceding criteria.

Second: The concept of higher education

Postsecondary education is another name for higher education. There is a conceptual distinction, however; post-secondary education encompasses not just university education but also technical and vocational training and all levels of education that follow secondary school. Hence, the phrase post-secondary education is omitted. Typically, both technical and vocational education and training (TVET) and higher education are referred to in international human rights legislation. Adam Smith's discussion of education's function in productive investment in "The Wealth of Nations" is only one of several works by ancient economists who have shown an interest in the topic of education. Nonetheless, American economist Schultz introduced his research on investment in human capital in 1960, which started the study of the economic returns to education. The focus of educational policymakers and analysts moved from documenting education's real effect on economic development to calculating its monetary worth.

Regardless of the scale or area, the university's mission is to assist society (Jaroslav, 1992, p. 138). Without invading the privacy of any nation or institution, this educational level improvement is essential to fulfil worldwide criteria. All of these requirements must be met in order for something to happen. Among the resources that institutions possess are human and monetary capital (UNESCO, 1998).

Building up human capital is therefore beneficial to technological advancement. This contributes to long-term growth. Education has been a central tenet of most Arab nations' development goals over the last twenty years. Not only has the quantity of schools and other educational institutions grown, but so too has the quantity of students enrolled and those who have earned degrees. Using the Framework for Action for Education up to 2030 (FFA), which encompasses higher education in accordance with UNESCO's definition,

UNESCO takes the lead in organising and monitoring the worldwide education agenda in pursuit of the Sustainable Development Goals' fourth objective. All forms of higher education (academic, vocational, technical, pedagogical, etc.) provided by institutions like universities, technical institutes, teacher training colleges, etc., typically targeted at students with a high school diploma or equivalent who want to earn a degree, certificate, or other credential (UNESCO Search (bing.com)).

One of the most important metrics is expenditure on education, which may tell us a lot about the priorities of different governments and how much they care about human growth. Since more education improves people's circumstances and makes them better, the stock of knowledge is another indicator of a developed nation's capabilities. Compared to their classmates, students have a better chance of finding gainful employment, earning a higher salary, and making positive contributions to their communities in every way possible. As a result, gaining knowledge, competence, and insight into the world is possible via financial support for higher education. An increase of only one year in the average education level of the workforce is associated with a nine percent rise in GDP (Hamad et al., 2021, p. 61), demonstrating the strong correlation between educations and enhancing human development.

2. Materials and Methods

This study examines the relationship between Sweden's education spending growth and higher education enrolment from 2000 to 2021 using the Autoregressive Distributed Lag (ARDL) model. Annual data on education spending and higher education enrolment were sourced from the OECD, World Bank, UNESCO, and Sweden's national statistics agency. Monetary variables were adjusted for inflation using the Consumer Price Index (CPI), and the data were log-transformed to stabilize variance and enhance interpretability. The ARDL model was chosen due to its flexibility in handling both stationary and non-stationary data, allowing for an exploration of both short- and long-term relationships. The model specification included higher education enrolment as the dependent variable and education spending growth as the independent variable, with both short-run and long-run dynamics captured through lagged differences and levels.

Stationarity tests, including the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests, were conducted to ensure that none of the variables were integrated at the second difference, which is critical for the validity of the ARDL model. The Bounds Test for Cointegration was used to identify the presence of a long-term relationship between the variables, followed by an estimation of long-run coefficients and an Error Correction Model (ECM) to measure the speed of adjustment towards equilibrium. Diagnostic tests, such as the Breusch-Godfrey LM Test for serial correlation, White's Test for heteroscedasticity, Jarque-Bera Test for normality, and CUSUM and CUSUMSQ Tests for model stability, were conducted to validate the robustness of the results.

The analyses were performed using EViews and R Studio to ensure precision and reliable visualization. By employing this comprehensive methodological framework, the study provides valuable insights into the interplay between education spending and higher education enrolment in Sweden, highlighting both short-term dynamics and long-term equilibrium trends. This approach ensures that the findings are robust and reflective of real-world phenomena, offering significant implications for policy and educational planning.

3. Results and discussion.

Educational spending or spending on education is one of the types of spending on social services. It was considered consumption spending in the past until economists, especially

after the middle of the last century, agreed that it is investment spending in human capital and that it has great importance in the field of raising the productive efficiency of the workforce and increasing... Production and achieving high rates of economic growth, as the relationship between education and economic spending on it, was the subject of interest to economists in the eighties of the last century, where Romer emphasized that investment in education, training, research, and other forms of education may help achieve long-term growth. In 1988, Lucas emphasized that the level of production for any country is a function of the spending on education and that it is a model based on the accumulation of knowledge (Hamid & Fareh, 2019 p. 33).

Fourth: The role of spending on education in enrolling in higher education in Sweden:

This can be clarified by examining the following data related to the country sampled in the research, as shown in Table (1) below:

Table (1)

Public spending on education out of total government spending (%), and school enrollment out of total higher education (%) in Sweden for the period (2000 – 2021)

School Enrollment Out Of Total Higher Education(%)	Public Spending On Education Out Of Total Government Spending (%)	Year
67.07	12.91	2000
70.27	12.81	2001
75.28	13.14	2002
81.42	12.85	2003
83.76	12.98	2004
81.95	12.69	2005
79.32	12.74	2006
74.84	12.77	2007
70.74	12.94	2008
70.74	13.18	2009
73.67	13.22	2010
72.83	13.10	2011
68.82	15.14	2012
63.22	15.06	2013
62.18	15.25	2014
62.28	15.38	2015
63.55	15.62	2016
66.99	15.69	2017
72.46	15.67	2018
77.33	15.90	2019
84.52	13.64	2020
85.77	14.56	2021

Through Table (1) and after using descriptive statistical measures in order to know the normal distribution of time series data for the two variables [for public spending on education (GO, school enrollment, higher education (H)] and using the (EViews) program), as follows: -

Table (2)

Some descriptive measures: Public spending on education, total (% of government spending) and school enrollment, higher education (% of total) in Sweden for the period (2000 – 2021)

The scale	GO	H
Mean	13.96512	73.13663
Median	13.20169	72.64328
Maximum	15.89514	85.76622
Minimum	12.68762	62.18059
Std. Dev.	1.231708	7.411567
Skewness	0.415952	0.147021
Kurtosis	1.386565	1.937542
Jarque-Bera	3.020634	1.114005
Probability	0.220840	0.572924
Sum	307.2327	1609.006
Sum Sq. Dev.	31.85918	1153.558
Observations	22	22

Source: Prepared by researchers based on the analysis results of the (EViews) program.

From Table (2), it is clear to us from the descriptive measures of the variable (GO) that the value of Mean reached (13.96512), meaning that it is greater than the value of Std. Dev amounted to (1.231708), while the value of the Jarque-Bera statistic was (3.020634) at Probability amounted to (0.220840), which is greater than 0.05, which indicates that the data for this variable is distributed normally. As for the variable (H), the value of the Mean was (73.13663); that is, It is greater than the value of Std. Dev of (7.411567) and the value of the Jarque-Bera statistic was (1.114005) with a Probability of (0.572924), which is also greater than 0.05. This indicates that the time series data for this variable is distributed normally, and we also notice that the two series are increasing over time, as in the two figures. (1) and (2) as follows:
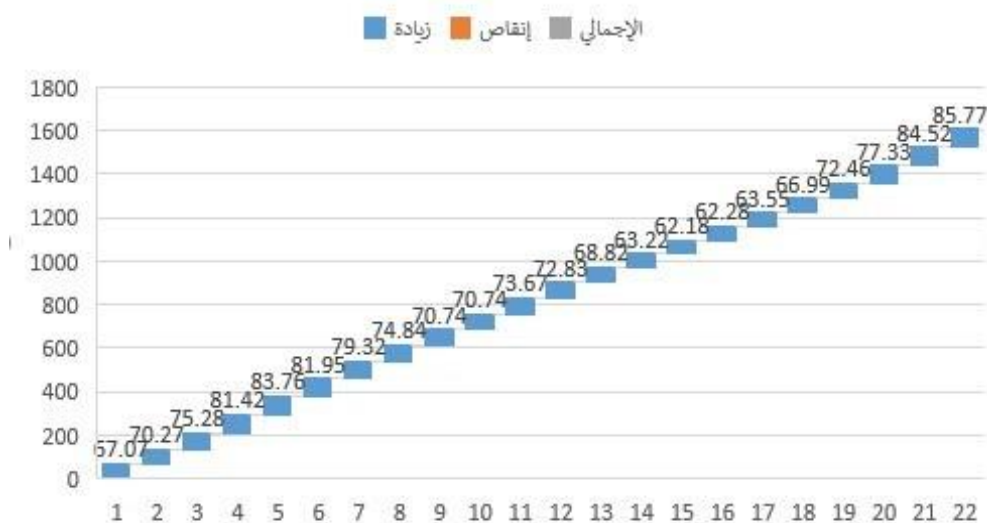
Figure (1)
A chart showing the growth of public spending on education in Sweden for the period (2000 – 2021)
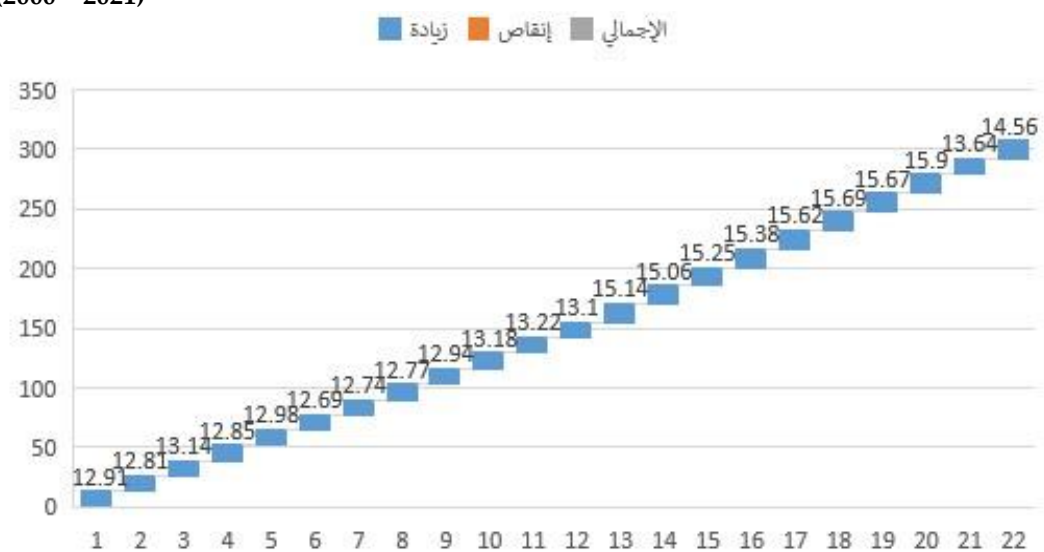
Source: Prepared by the researchers based on data from Table (1).
Figure (1)

A chart showing the growth of public spending on education in Sweden for the period (2000 – 2021)

Source: Prepared by researchers based on data from Table (1).

The second axis: Measuring the relationship between the growth of spending on education and enrollment in higher education using the ARDL model in Sweden for the period (2000 - 2021)

First: Description of the model

The autoregressive distributed lag (ARDL) model is one of the dynamic methods of cointegration, as this model provides a way to introduce time-lagged variables as independent variables in the model. One of the advantages of this model is that it is not required that the variables included in the model be integrated of the same order, as it can be used if they are The variables are zero-degree integrated, I(0), one-degree integrated, I(1), or a combination of both.

We will conduct tests of the expanded Dickey-Fuller unit root test. This test demonstrates the stability of time series and determines the order of their integration, and then we test (VAR) to determine the optimal lag periods using the autoregressive model. In light of this test, the optimal method for testing has been determined. The most appropriate model here is the (ARDL) model. Testing the existence of a long-run cointegration relationship using the Boundary Test.

Using the program Eviews 9, we will test the data in Sweden for the period (2000 - 2021) according to the autoregressive distributed lag (ARDL) model between spending on education and enrollment in higher education. Given the importance of enrollment in higher education, spending on education was used in particular from public spending because of its influential role on enrollment in education in general and university education in particular, according to the researcher's point of view, as follows:

Education spending = GO

Enrollment in higher education = H

The variable (GO) is the independent variable, and the variable (H) is the dependent variable.

Second: Test results

1- Unit root test (stability of time series)

<p align="center">Dickey Fuller Test for the Expanded Unit root
In Sweden for the period 2000-2021</p>

	At Level		
		H	GO
With Constant	t-Statistic	-3.2444	-1.4271
	Prob.	*0.0322*	*0.5494*
		**	n0
With Constant & Trend	t-Statistic	-3.1396	-2.1425
	Prob.	*0.1244*	*0.4945*
		n0	n0
Without Constant & Trend	t-Statistic	-0.0523	0.3700
	Prob.	*0.6526*	*0.7821*
		n0	n0
	At First Difference		
		d(H)	d(GO)
With Constant	t-Statistic	-1.8107	-5.7109
	Prob.	*0.3648*	*0.0002*
		n0	***
With Constant & Trend	t-Statistic	-1.8657	-5.6313
	Prob.	*0.6343*	*0.0011*
		n0	***
Without Constant & Trend	t-Statistic	-1.8454	-5.7831
	Prob.	*0.0630*	*0.0000*
		*	***

The table was prepared by researchers based on the analysis results of the EViews program.

After conducting a unit root test for the two research variables and by comparing the results of the program (EViews) and Table (3), it becomes clear that the time series for the variable (H) has stabilized at the level, meaning that it is stationary and stable at the original level of the data with the rank [I(0)] and does not contain a root Unit, while the time series of the variable (GO) did not stabilize at the level, but rather stabilized at the first difference in the presence of a secant or secant and a general trend, meaning that it will be integrated of degree [I(1).

2 - ARDL cointegration model
Table (4) Results of the ARDL model for cointegration in Sweden for the period 2000-2021

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
H(-1)	1.422300	0.138545	10.26600	0.0000
H(-2)	-0.829550	0.140249	-5.914855	0.0000
GO	-2.540601	0.719900	-3.529102	0.0033
GO(-1)	0.556056	0.777830	0.714880	0.4864
GO(-2)	1.186152	0.774738	1.531037	0.1480

C	41.13608	13.54782	3.036362	0.0089
R-squared	0.95	**Adjusted R-squared**		0.94
F-statistic	64.68	**Durbin-Watson stat**		2.12

Source: Prepared by researchers based on the analysis results of the (EViews) program.
Table (4) shows us the results of the autoregressive model of distributor slowdown. We note that the explanatory power R-squared was (95R2=0.) That is, the independent variable in the estimated model explains 95% of the changes in the dependent variable, and the value of Adjusted R-squared was (0. 94). The calculated F-statistic value was (68.64), which is significant at the 5% level, meaning that the model is significant, meaning we reject the null hypothesis and accept the alternative hypothesis.

3- Bounds test.

Table (5) Bounds Test in Sweden for the period 2000-2021

Test Stat.	Value	K
F- Stat	10.59017	1
Signi.	I0 Bound	I1 Bound
%5	4.94	5.73

Source: Prepared by researchers based on the analysis results of the (EViews) program.
Table (5), which shows the results of the bounds test, we find that the calculated value of (F-statistics) was (10.59017), which is greater than the minimum tabular value of (4.94) at a significance level of 5%. Therefore, spending on education affects unemployment in the long term.

4 - Testing the problem of autocorrelation and heterogeneity of variance
Table (6) Serial correlation test and heterogeneity of variance in Sweden for the period 2000-2021

Breusch-Godfrey Serial Correlation LM Test			
F- statistic	0.883008	Prop . F	0.4388
Obs*R-squared	2.565762	Prob. Chi-Square	0.2772
Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	0.454381	Prob. F	0.8034
Obs*R-squared	2.792427	Prob. Chi-Square	0.7319
Scaled explained SS	1.739283	Prob. Chi-Square	0.8839

Source: Prepared by researchers based on the analysis results of the (EViews) program.
From Table 6, after conducting the Breusch-Godfrey Serial Correlation LM Test, it becomes clear that the model is sound and free from the problem of autocorrelation, as the Chi-Square value is not significant at the 5% level. The model is also accessible from the problem of heterogeneity of variance, according to the Breusch Pagan test—Godfrey, which was also insignificant at the 5% level.

5 - Estimation of the ECM error correction model
**Table (7) Error correction model in Sweden for the period 2000-2021**

Short-term error correction model (ECM)			
Variable	Coefficient	Std. Error	t-Statistic	Prob.

D(H(-1))	0.829550	0.140249	5.914855	0.0000
D(GO)	2.540601	0.719900	3.529102	0.0033
D(GO(-1))	-1.186152	0.774738	-1.531037	0.1480
CointEq(-1)	-0.407250	0.099780	-4.081470	0.0011

Source: Prepared by researchers based on the analysis results of the (EViews) program.
Table (7) shows the error correction model, from which we note that the parameter of the variable GI was significant at the 5% level and according to the value of Prob. We also note that the nature of the relationship between spending on education and Enrollment in higher education was direct, meaning that increasing spending above higher education by one unit will lead to Enrollment in higher education increased by (2.54) units, and this is consistent with economic theory, as in Figure (3), which shows the structural stability of the model.

Figure (3)
Structural Stability
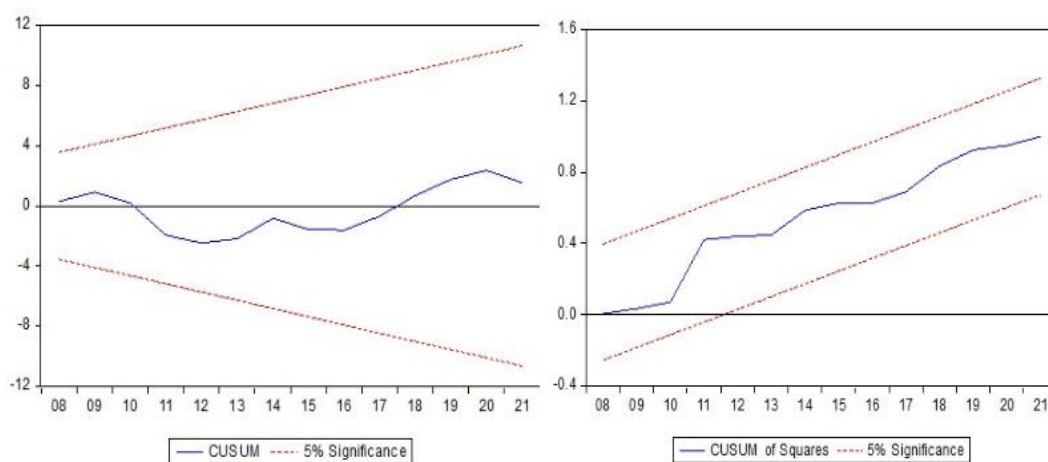
4. Conclusion

The analysis of the relationship between education spending and higher education enrolment in Sweden revealed several key findings. Both variables—spending on education and enrolment in higher education—have consistently increased over time, reflecting Sweden's commitment to expanding access to education. Despite significant population growth due to immigration, particularly in recent years, this demographic shift has not imposed a significant financial burden on the government or hindered the upward trend in education spending. Statistical and econometric results demonstrated a clear long-term relationship between education spending and higher education enrolment, aligning with the research hypothesis. This finding underscores the importance of sustained investment in education as a driver of enrolment growth.

To maintain its position as a global leader in education, Sweden and other Scandinavian countries must continue prioritizing higher education funding. However, it is also crucial for Sweden to carefully regulate immigration policies, given the potential economic and social burdens associated with high levels of immigration. Addressing this issue from both short- and long-term perspectives will help mitigate challenges and maintain economic stability. Furthermore, aligning higher education outcomes with labor market demands should remain a priority. This strategy reduces unemployment, optimizes human potential, and fosters development by ensuring that graduates are

equipped with the skills and knowledge needed to contribute effectively to society and the economy.

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