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Article

The Importance of the Public Sector in Sustainable Development in Poland

Agnieszka Alińska[1*], Beata Zofia Filipiak[2] and Aneta Kosztowniak[3]

[1] Warsaw School of Economics; aalin@sgh.waw.pl
[2] University of Szczecin; bfilipiak@wneiz.pl
[3] Pułaski University of Technology and Humanities in Radom and National Bank of Poland; aneta.kosztowniak@wp.pl. The views expressed in this paper are the views of the author and do not necessarily reflect those of the National Bank of Poland.
* Corresponding author: aalin@sgh.waw.pl; +4822/5468676

Abstract: The striving for sustainable development has become the goal of actions undertaken not only by representatives of public authorities and institutions representing this sector, but also representatives of private entities who are increasingly recognizing the benefits and sources of long-term development based on the principles and objectives of sustainable development. These are mainly based on the pursuit of synergy in the three basic areas of activities, i.e., in the economic, social, and environmental dimensions as well as in the maintenance of natural resources. The implementation of these activities is connected with the necessity of incurring financial expenditures, which the government (public sector) does not have in the required value. Therefore, in the process of sustainable development for which the government is responsible, the active participation of the financial sector (banks) is necessary. Achieving results within the alliance of the concept of sustainable development requires the setting of a kind of contract, the parties of which are the government, society, and financial institutions. The purpose of the conducted research is to indicate by which means the government can stimulate economic growth towards its sustainable development.

Keywords: public finance; sustainable development

1. Introduction

In recent years, we have observed a growing consensus in the views on the broadly understood economic development. Economists believe that not only does the pursuit of high levels of economic growth, most often measured in terms of GDP, reflect wealth, social well-being, or the development of entrepreneurship, but first of all, that balanced and sustainable economic and social development is the basis for further positive external results in the economy. Such conditions are to a large extent fulfilled by the concept of sustainable development, which aims at obtaining rational benefits for the stakeholders of this approach. In the modern economy, it is important that as many stakeholders as possible benefit from the positive external results of the GDP generated by the economy.

As part of sustainable development, activities based on the inclusive economic development principle are distinguished, where priority is given not only to achieving economic but also social goals, especially in the area of financial inclusion, eliminating social inequalities, and ensuring a high quality of life.

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In addition to the social aspect of sustainable development at the EU level [22], environmental and climate change objectives are becoming increasingly important. In light of climate change, greater importance has also been attached to environmental protection and care for natural resources. The need to implement investments aimed at improving environmental protection and related outlays as well as measures aimed at improving social conditions require not only additional funds, but above all, the alliances between government and financial institutions with regard to achieving positive effects in the implementation of sustainable development. Therefore, within the framework of sustainable development, particular attention is paid to the implementation of policies and initiatives based on the principles of inclusive economic development. The inclusive growth concept is a concept of economic growth with the goal to create development opportunities for all population groups [28]. Inclusive growth development refers to both the pace and the growth pattern, which are considered to be interrelated, and should therefore be analyzed together [64].

Public institutions, national governments, and the EU authorities have a particular role and importance to play in this regard. However, public sector entities are not able to meet the adopted sustainable development objectives on their own and require the support of private sector partners. A special role is assigned to financial institutions and banks in this respect. The public–private alliances should be based primarily on the need to develop a joint strategy of action, define priorities and objectives, and indicate the means of their implementation. Financial outlays are the cash flowing from both the financial sector and public expenditure.

Considering that the public sector, within the framework of alliances with financial institutions, will strive not only to achieve economic but also social goals by affecting the level of income and expenditure. Therefore, it is reasonable to make the following research hypotheses:

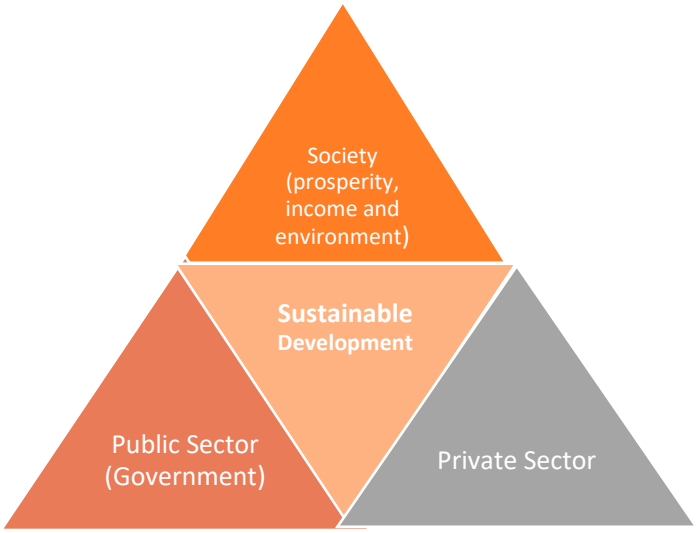
H1: There is a causal relationship between government spending and GDP. This means that a public institution, in order to achieve a higher level of GDP, should plan budgets based on a balanced budget policy in its budgets. This policy should take into account both the feasibility of fiscal revenues as well as sources and methods of indebtedness. For the H1 verification, the Ordinary Least Squares Method OLS (Classical Linear Regression Method, CLRM) was used, which allowed us to estimate significant statistical variables.

H2: Consumer spending is a significant priority in GDP growth. The activity of households in the scope of fitting their needs determines the direction and scope of investment decisions made in the economy. Market responses to household needs may be public or private investments usually financed with the use of loans. Given that in the structure of government spending, the participation and significance of social expenditure in stimulating economic growth processes is important, it constitutes the basis for sustainable development. In the model studies conducted for Poland, this change was not statistically significant, and its influence among the most important variables was the strongest in the analyzed years from 1995 to 2016. This is probably due to differences in the level of development of the economic and economic development between Poland and other EU countries. At the same time, the government's policy based on social and sectoral erosion limits the activity on the labor market.

In order to comprehensively verify the undertaken research, the following research question was formulated: Are there effects (and what) of the impact of the public finance sector alliances on the economy and its sustainable development?

Using the econometric analysis of the OLS method and Vector Error Correction Model (VECM) we tested the relationship between the level of economic growth and the indicators characterizing the situation of the public finance sector and the activity of the banking sector in the performance of their basic functions, i.e., the collection of savings and financing of social needs. Economic growth measured by the value of GDP is determined by the direction adopted for implementation of public policy and the instruments used to stimulate consumption in society and investment among entrepreneurs. These activities require financial resources. Therefore, it is important to obtain answers to the questions to what extent the GDP growth results from the public policy of the state with the involvement and participation of the banking sector, i.e., developed and adopted public–private alliances. It can therefore be said that sustainable development is a kind of contract to which the government, society, and financial institutions are parties. In the authors' opinion, such an approach to the analysis of sources of economic growth in the country may constitute a basis for obtaining results in the implementation of the sustainable development concept.

One of the main difficulties in the implementation of alliances between financial institutions and the government is the objectives of their activities. Financial institutions (in Europe these are mainly banks), as private commercial institutions, are focused on maximizing profits and therefore look for investments which, on the one hand, are safe, and on the other hand, bring the highest possible rate of return on invested capital. Public institutions, in contrast, perform social tasks, provide public goods, and ensure the long-term sustainable social and economic development of the country. The society (households), in turn, despite different objectives of each of these sectors: private and public, the institutions comprising them benefit from achieving sustainable social and economic development of the country. The basis for establishing close cooperation between these sectors, in the form of an alliance, is the possibility of achieving specific benefits by each of the parties to the contract, i.e., financial institutions, public institutions and, above all, the society, which is more than the beneficiary of the effects of an appropriately developed and effectively implemented public–private alliance for sustainable development in the sphere of finance.



Scheme 1. Parties to the contract under sustainable development. Source: own illustration.

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In this publication, a holistic approach will be applied to assess the level of socio-economic development in a sustainable way [17]. According to the authors, in this way it is possible to create a lasting value in the economy, which in the long run will benefit a wider group of stakeholders. Based on the assumptions developed and implemented in such a way, both the parties to the contract and other stakeholders will benefit from the positive external effects of economic growth [49]. Such an approach can be described as the social dimension of sustainable development or as a social contract for sustainable development. The parties to the social contract are governments, financial institutions, and society. Each of these parties has its own objectives: the government strives to ensure the social and economic development of the country by providing public goods; the main objective of financial institutions is to maximize profits; and society strives to increase prosperity. It is important is to set up an alliance that will fulfil all these goals.

2. State of the Art

Research carried out in Keynesian economics indicate the influence of the public sector on social and economic development. From the point of view of public and financial sector alliances, the important factors are the expenditure and revenues of the public sector, the debt level, and public policy focused on the effects of sustainable development. Transfers and expenditures related to the implementation of public tasks (both current and investment) may be of particular importance for the alliances. The implementation of public tasks should ultimately bring the effects desired from the point of view of assessing the needs of society for which the state performs its functions.

In addition to the public sector, there is also a financial system (in Europe based on banks) operating on market principles, aiming to achieve its economic goals through the use of basic instruments, i.e., savings products, payments, and loans.

The financial system provides services allowing for money circulation in the economy and is thus closely linked to other systems distinguished in the economy. The overarching objective of the entities of the financial system is to provide services to the society, thus creating a social system. The financial system should serve other market participants.

2.1. Institutional Approach to Sustainable Development

The pursuit of sustainable development has become the goal of actions undertaken not only by representatives of public authorities, but also owners of private entities who are increasingly recognizing the benefits and sources of long-term development based on principles and objectives characteristic of sustainable development. Initiatives undertaken by the government, adopted strategies, and directions of actions are mainly based on the pursuit of synergy in the scope of three basic areas of activity, i.e., the economic, social, and environmental aspects, and the maintenance of natural resources, which requires incurring financial expenses. The concept of sustainable development exposes the need to care for the natural environment and the possibility of using natural resources for the next generations of society.

The role of the state (the public sector) manifests itself above all in creating the foundations and effective use of legal regulations and financial resources. An important role in shaping sustainable development is played by individual institutions (public and private) as well as alliances concluded in order to stimulate sustainable development. The most important in the implementation of sustainable development are: institutions, instruments, regulations, and finances. To obtain the

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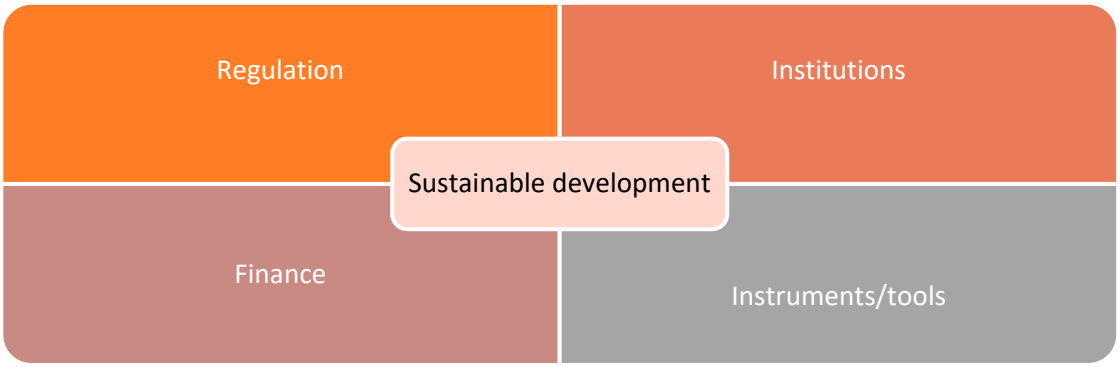
effects, a social contract should be developed, adopted, and implemented between the basic market participants.

Effective implementation of the concept of sustainable development requires the adoption of specific organizational principles, division of work, and responsibility between all market participants. In the general scheme of organization and financing of sustainable development, one can distinguish the following essential components of the whole process: institutions, tools, objectives, principles of financing, and means of implementation [56].

An institutional approach to the dependencies that determine sustainable development is shown in Scheme 2.



Scheme 2. Elements determining sustainable development–institutional approach. Source: own illustration.

Sustainable development requires that institutions create alliances using tools and instruments as well as financing dedicated to sustainable development. Thanks to the included alliances, a synergy effect is achieved in stimulating sustainable development and the regulations created are conducive to the sustainability of the alliances included.

2.2. Government Spending, Revenue, Economic Growth as Indicators Of Alliance in Sustainable Development

The research conducted by Abu-Bader and Abu-Qarn [1] indicated both positive and negative effects of the active role of the public sector in the economy. They pointed out that public sector actions based on adopted programs and financed from the budget could have a positive impact on GDP, because: (a) the State provides pure public goods, which account for a significant share of global demand; (b) the State may own or manage enterprises and institutions providing quasi-public or private goods; (c) State regulation and control facilitates the protection of property rights and improves the efficient allocation of resources in case of externalities; (d) the income taxes and transfers affect income distribution and can create a fairer society; and (e) the State often facilitates the functioning of markets dealing with asymmetric and imperfect information.

The relationship between the public finance sector's expenditure and GDP growth has been considered in numerous studies. The impact of government spending on GDP in the context of development factors was examined by Dao [15,16]. Dao confirmed Barro's research [9], stating that the implementation of public policies as well as the institutions implementing them are key factors (indicators) for economic growth. Barro stated that an important aspect of public sector actions is that in society, there is a tendency to assess the well-being of the individual compared to other individuals [9]. Additionally, Dandan [14] and Garba [26] have shown that public spending maintains a positive

long-term relationship with economic growth, and that a long-term policy (recurrent expenditure) is important for growth and development of the economy [6060,5].

Nordhaus and Tobin's studies [40] and the subsequent Daly and Cobb studies [13,12] provided a basis for determining the positive impact of consumer expenditure [5].

It should be stressed that the classic approach indicates that it is necessary to balance consumer expenditure by such factors as revenue distribution, costs related to environmental pollution, and other undetectable, intangible costs. For the modern citizen, the issues related to environmental protection, actions for sustainable development, and respect of the principles of social responsibility are of particular importance and have often become a priority, as demonstrated by Cobb, Glickman, and Cheslog [12]. Therefore, the public sector, in pursuing its policy of influencing GDP growth, refers to the protection of the natural environment through the prism of measures for sustainable development [38,23].

In this respect, the expenditure structure has a special meaning. An analysis of the Polish example showed that the largest share in this structure (in the countries of system transformation and development disproportions existing) is social expenditure, playing a key role in stimulating consumption growth. As emphasized by the economist from Cambridge in the report for the EC [44] the time is now ripe to develop a new macro-economics for sustainability that does not rely on its stability for relentless growth and expanding material throughput. Four specific policy areas have been identified to achieve this:

- Developing macro-economic capability
- Investing in public assets and infrastructures
- Increasing financial and fiscal prudence
- Reforming macro-economic accounting

In addition, since 2016, Poland has been implementing a strategy of responsible sustainable development; paying special attention to spending funds for investments as well as within public policies on the impact on sustainable development and low-emission economy [55]. As part of the implementation of the strategy of sustainable responsible development in Poland, the model of current consumption has changed, attaching greater importance to the financing of expenses consistent with the idea of sustainable development on both the public and private (society) sides. The public sector in the Polish economy, through alliances with the financial sector, activates both raising funds for financing expenditures related to the implementation of a responsible and sustainable development strategy, and stimulates consumer behaviors focused on the goals set in the strategy. In addition, the public sector, in order to implement the strategy of responsible and sustainable development, shapes tax policy (the side of state budget revenues) by increasing the importance of proecological taxes. The public sector, in order to fulfil its task of influencing sustainable development through the stimulation of economic growth, has an impact on taxation, which is public revenue. A good approach to the analysis of this issue was presented in the works on the relationship between taxation and economic growth by Myles [36], Stoilova [53], and Stoilova and Patonow [54]. Literature sources differ in evidences concerning the level and growth of taxes and tax structure. Arnold notes that research results analyzing the link between growth and tax structures provided slightly more conclusive answers than research focusing on the level of taxation. The results of the empirical analysis conducted by Schwellnus and Arnold [51], Vartia [6262], Stoilova and Patonov [54] are considered in the literature to be sufficiently reliable for the nature of the examined

compound. A recent study has shown a very strong link between taxation (government revenue) and economic growth [53]. Empirical studies have also confirmed the relationship between expenditure and tax revenue (which is public revenue) and expenditure and growth. The studies carried out showed various relationships depending on the level of development of the economy [15,16,39], which requires deepening the research to precisely determine the strength and direction of these relationships. Studies have confirmed that public finances have an impact on growth through taxation, which confirms the alliance between sectors. These alliances are used to shape the sustainable development policy through the application of government expenditure and ecological taxation by the public finance sector. Their impact is constantly analyzed in the literature [45,23,1818], due to the so-called "crowd-in effect", which occurs especially in relation to the expenditures affecting sustainable development. The starting point for further analysis is research [63]. They included the following policy measures: Investment, Labor force, Population, Poverty, Technological Change, Government Expenditures, Trade, Work Week, Greenhouse Gases, Consumption, Environment and Resources, and Localization. From this set of important indicators (macroeconomic values), those that have the most significant importance in Poland were selected. Below summarized actions require large state activity and public facilities (see Table 1).

Table 1. Structure of central government expenditure in Poland from 2007 to 2015 (%).

	2007	2008	2009	2010	2011	2012	2013	2014	2015
General public services	18.54	17.24	19.88	19.40	19.71	20.92	21.95	20.26	19.12
Defense	7.90	7.47	5.92	5.95	6.10	5.94	6.91	6.49	6.83
Public order and safety	8.40	8.49	8.66	8.13	8.21	8.46	8.71	9.15	9.06
Economic affairs	12.77	13.54	13.53	13.03	13.71	12.98	9.54	12.58	13.16
Environmental protection	0.41	0.58	0.46	0.56	0.75	0.65	0.83	1.02	0.82
Housing and community amenities	0.85	0.84	0.66	0.39	0.97	0.80	0.93	0.75	0.75
Health	4.27	4.52	4.31	4.27	4.41	4.78	5.10	5.33	5.16
Recreation; culture and religion	1.46	1.63	1.33	1.40	1.23	1.19	1.18	1.22	1.25
Education	19.07	18.53	15.33	15.01	16.09	16.42	16.60	17.67	17.35
Social protection	26.31	27.17	29.92	31.85	28.83	27.85	28.24	25.53	26.48
Total	99.98	100,.01	100,.00	99,.99	100,.01	99,.99	99.99	100.00	99.98

Source: OECD Stat. [41].

The policy of alliances between the private sector and financial institutions may, as a result of the budget deficit and public debt caused by the expansionary fiscal policy, result in the necessity to supplement private expenditure by public expenditure [2525]. The research indicates that the economic growth rate will depend i.a. on the rate of return on private capital and the households' propensity to save. Greiner and Semmler [26], among others, assuming that the public debt is incurred exclusively to finance the public investment, proved that the increase in the budget deficit and the public debt could accelerate the long-term economic growth rate. Xu and Yan, on the other hand, [62] proved that investment expenditure from the state budget (government investment expenditure) in public goods contributed to economic growth by achieving a positive complement effect through the involvement of the private sector. To ensure future economic growth, the government should increase expenditure in public investment and reduce the investment in those sectors that compete directly with the private sector.

2.3. The Importance of the Financial Sector in Sustainable Development

The financial system could be a very important factor to promote sustainable development as it could foster economic growth and development, efficient resource allocations, the protection of the environment, and social responsibility. The financial system is an element of the economic system, which consists of two principal components: the public finance sector and market-based finance system. Actions undertaken as part of the sustainability finance concept could contribute to changing the orientation of finance measures and to strengthening efforts to generate a long-term positive impact on socio-economic development. A particular role and importance in this respect is ascribed to public authorities, which use public finance to achieve sustainable development.

The role of the financial system in promoting economic growth has been the subject of many works. Numerous econometric analyses have found a positive link between financial development (market-based finance system)and economic growth [29,11,42,34] and stresses that the availability of loans and the stock market situation determines positive decisions concerning investments in the economy, consequently supporting cyclical growth in the economy. Financial intermediation may, in the short term, cause imbalance, but is beneficial for economic development in the long term [10].

Amit, Brander, and Zott [2] highlighted the growing role of the market system, primarily the specialized financial institutions such as investment funds (venture capital) who not only provide capital, but also assist in the development process, which reduces information asymmetry in the initial period of a company's life, enabling them to finance and support innovative activities.

The increase in the size of the financial system leads to economic growth, but at the same time, it is also conducive to higher volatility and banking crises [47]. The balance of the impact of the factors seems to depend on the development stage of the financial system. The positive impact of the financial system on economic growth only starts to occur in the case of financial systems of medium size. It cannot be excluded that the benefits from the functioning of the financial system, after exceeding a certain threshold, may drop more rapidly than they were initially increasing.

Numerous studies also point to the negative impact of the financial system on economic growth. The research in this area was conducted i.a. by Barajas [8]. Tobin in 1984 [58] emphasized that a large financial sector can have a direct negative impact on the average economic growth rate as it attracts people with high intellectual potential by offering high salaries, while the added value of part of their work is low. Doubts were raised about the benefits of the active management of the investment

293 portfolio, which absorbs an increasing share of resources in finance [10]. Arcand et al. [3] proved in
294 their research that the debt structure in the financial sector could have a negative effect, which
295 reflected a shift in corporate and household financing and an increase in the share of mortgages in
296 global bank balance sheets. This situation did not increase productivity and innovativeness, leading
297 rather to the property market bubble. Banbuła [7] identified the decreasing impact of the financial
298 system on economic growth due an increase in the risk of crises. When the financial system is
299 developing, the value of assets increases (financialization), but this has not been accompanied by an
300 acceleration in economic growth, but rather by its slowdown.
301 The results of these studies confirm the thesis that in order to achieve the objectives resulting
302 from sustainable development, active participation and involvement of the state is necessary.
303 Moldovan distinguished several key functions that the financial system should perform in
304 the economy. Through these functions, the importance of the financial system in supporting
305 the economic development can be identified in three key areas of activity [35]:
306 • Accumulation and mobilization of savings, accumulation of capital, and the allocation of
307 investment funds.
308 • Effective allocation of financial resources and their utilization to finance environmental
309 projects, and
310 • Incorporating socially responsible activities (CSR) into their strategies and basing their
311 investment policy on these principles.
312 The importance of the financial system in promoting economic growth has been the subject of
313 a great number of papers and still lacks a clear answer. Numerous econometric analyses have
314 captured a positive relationship between financial development and economic growth. This is
315 reflected in the research of King [29] and Bencivenga [11]. In 2015, the IMF published the results of
316 research [50] indicating that the size and structure of the financial system in Poland, consisting of the
317 banking sector, has proved to be optimal in relation to the size and potential of the Polish economy.
318 Research conducted by the IMF indicated that Poland has an optimal financial structure, supporting
319 economic development [37].

320 ## 3. Materials and Methods

321 *3.1. Data*

322 Considering that the basic goal of our research was to assess the impact of financial institutions'
323 and government's alliances on sustainable development, we needed to select a representative set of
324 variables to study. The classic approach to the GDP survey including major aggregates shows
325 development as including household spending on consumer goods (C), gross fixed capital formation
326 (I), and inventory growth (ΔR), government expenditure (G), and net exports (En).
327 The classic approach to stimulating economic development does not take into account differences
328 between sectors in the form of impact instruments and does not take into account alliances and their
329 impact on the possibility of creating sustainable development. Therefore, these variables were
330 included in the presented econometric models. Table 2 presents the categorization of key indicators
331 included in the study along with justification.
332
333

Table 2. Explained variables included in econometric models.

Indicators		Justification for the choice
TGGE	Total General Government Revenue	The latest research on the impact of TGGE on GBP is presented by Ullah [61], the importance of this indicator is also indicated by Stiglitz [52], income policy, especially in the area of taxation is an important factor affecting the behavior of society, and is the basis for the implementation of expense policy. Studies show a relationship between GDP and TGGE [15,51, 53–54,36].
TGGR	Total General Government Expenditure	The importance of this indicator is indicated, among others, by Stiglitz [52]. Research indicates expenses as important factors in shaping the policy of sustainable development [1,40,13,14] as well as consumption of the society
GGGD	Gross General Government Debt	The indicator points to alliances between financial institutions and the public sector. The rules in force in Poland indicate that among debt instruments, over 90% are instruments acquired from the financial sector. This fact, as well as dependence, are confirmed by research [56,26].
GFCF	Gross Fixed Capital Formation	Public investments have a direct impact on the directions of spending through implemented policies. For many years, Poland has been implementing a policy of sustainable development through investment expenditures. The basic factor affecting GDP in the classic approach [24,63]
GDERD	Gross Domestic Expenditure on R&D	The factor responsible for sustainable development as the policy of responsible financing of R&D spending implements the policy of sustainable development in many areas of the economy. The programs existing in Poland direct government spending to achieve the goals of responsible sustainable development. Particular importance for spending on sustainable development (development of green technologies) is demonstrated in the paper of Ardito et al. [4].
GGST	General Government, Social Benefits other than social transfers in kind, payable	This influence was analyzed in the literature on the subject [59].
GCEH	Final Consumption Expenditure	Consumption includes the value of products used to meet the direct, individual and collective needs of the population. The basic factor affecting GDP in the classic approach [13,0].

	of Households

Source: own work.

5.1. Modelling of Sustainable Development for Poland

In order to analyze the interrelations between economic growth, the area of public finances, and financial institutions, we prepared two models of economic growth (CLRM, VECM) and analyzed the activity of monetary financial institutions (MFIs).

- In the first model, we used a classic linear regression model (CLRM) to statistically estimate significant macroeconomic variables affecting GDP changes.
- In the second model, we used the VECM model (Vector Error Correction Model) to examine the interrelations between GDP and selected macroeconomic variables. In the modelling, the impulse response functions were used to diagnose the impact force and direction as well as the decompositions of the random component variance to assess the degree of explanation of individual variables.
- Another analysis concerned the assessment of the activity of MFIs in the scope of loans granted and deposits accepted for corporations and households from 1996 to 2018.

5.2. Model Approach

In this study, we used methods known from the literature on international economics and international finance, and econometric methods like the basis of the Ordinary Least Squares (OLS) model [66] and next VECM model (Vector Error Correction Method) [32,21] with impulse responses and variance decomposition analysis [33] . In order to analyze the significance of macroeconomic factors on economic growth for Poland from 1995 to 2016 [28,30], the final formula for the production function was developed as follows:

Model I (CLRM, OLS)

In order to estimate the factors of economic growth, we used the OLS method.

$$\boldsymbol{y_t} = \propto_{\boldsymbol{0}} + \propto_{\boldsymbol{1}} \boldsymbol{x_{1t}} + \propto_{\boldsymbol{2}} \boldsymbol{x_{2t}} + \cdots + \propto_{\boldsymbol{k}} \boldsymbol{x_{kt}} + \boldsymbol{\xi_t}$$

where n is the number of estimated units; k is the number of independent variables X_i; $\propto_0, \propto_1, \ldots \propto_k$ are the parameters; t = 1,2, …, n; and ξ_i is the random component.

We used the model consisting of the dependent variable (GDP) and the seven independent variables.

$$\text{l\_}GDP_t = \propto_0 + \propto_1 \text{l\_}TGGR_t + \propto_2 \text{l\_}TGGE_t + \propto_3 \text{l\_}GGGD_t + \propto_4 \text{l\_GFCF}_t + GDERD_t + \propto_6 \text{l\_}GGST_t + \text{l\_FCEH} + \xi_t \quad (1)$$

where

GDP: Gross Domestic Product, GDP (USD millions, PPPs)
$TGGR$: Total General Government Revenue (USD millions)
$TGGE$: Total General Government Expenditure (USD millions)
$GGGD$: Gross General Government Debt (USD millions)
$GFCF$: Gross Fixed Capital Formation (USD millions)
$GDERD$: Gross Domestic Expenditure on R&D (USD millions)
$GGST$: General Government, Social Benefits other than social transfers in kind, payable (USD millions)
$FCEH$: Final Consumption Expenditure of Households (USD millions, PPPs)

375 *t:* period.

376 The time series of variables were taken from the OECD Internet databases and were annual data.
377 These variables respond to the basic aggregate of GDP. Variables such as TGGE, GGST, and FCEH
378 represent demand. Domestic capital is represented by GFCF. The R&D variable responds to
379 expenditure on information and telecommunication technologies (ICT).

380 The summary statistics including the values of the standard deviation (Std. Dev.) showed that
381 the biggest changes were shown by the variable GGGD (0.60971), while the lowest change (the most
382 stable) was FCEH (0.22928). Similar variability was shown by the dependent variables TGGR
383 (0.47360) and TGGE (0.47602). Coefficients of variation (C.V.), that is, the measures of differentiation,
384 confirmed that the highest level of this differentiation occurred for the variable GGGD (0.051494)
385 against the lowest for FCEH (0.017772) (Table 3).

386 **Table 3.** Summary statistics using the observations from 1995 to 2016.

Variable	Mean	Median	Minimum	Maximum	Std. Dev.	C.V.	Skewness	Ex. kurtosis
l_GDP	13.399	13.392	12.954	13.770	0.25281	0.018869	–0.12531	–1.2526
l_TGGR	11.704	11.794	11.037	12.288	0.47360	0.040465	–0.11570	–1.7257
l_TGGE	11.803	11.882	11.128	12.373	0.47602	0.040331	–0.13582	–1.6934
l_GGGD	11.840	11.930	11.046	12.584	0.60971	0.051494	–0.11733	–1.7024
l_GFCF	11.754	11.706	11.041	12.210	0.32892	0.027983	–0.36728	–0.86071
l_GDERD	8.4059	8.2007	7.8678	9.1509	0.41200	0.049013	0.63344	–1.0414
l_GGST	10.749	10.823	10.080	11.271	0.43098	0.040094	–0.19200	–1.6201
l_FCEH	12.901	12.891	12.449	13.230	0.22928	0.017772	–0.28431	–1.0388

387 Source: Own calculations on the basis of OECD [41], GRETL program.

388 Prior to the estimation of the model, the variables were logarithmed, the significance of structural
389 parameters (t-distribution, F-Snedocor test) was examined as well as the goodness of fit of the model
390 (the coefficient of determination, R^2) and selection of variables for the model (correlation matrix). In
391 order to analyze the correlations between the dependent variable being GDP and independent
392 variables, the Pearson's correlation coefficient was calculated. The highest positive linear correlation
393 occurred between GGST and GDP (R^2 = 0.9670), next between GFCF and GDP (R^2 = 0.9616),
394 compared with a lower correlation between expenditure on R&D and the GDP value (R^2 = 0.9314)
395 and between TGGE and GDP (R^2 = 0.9418).

396 The model's verifications were based on the assessment of the structural parameters' significance,
397 Student's t test, F-Snedecor test, and White's test for heteroskedasticity.

398 In the input version of the estimated model, the variable significant at the 1% significance level
399 was FCEH, by 5% were GDERD, TGGE, and TGGR, whereas GGGD, GFCF, and GGST turned out to
400 be insignificant. The coefficient of determination equaled $R^2 = 0.998772$, which proved a high level of
401 explanation. The F-Snedecor test performed confirmed the overall suitability of the model, because
402 $F(7, 14) = 1626.859 > F^* = 2.7642$. The Durbin-Watson autocorrelation test (DW) at $d_L = 0.6772$
403 and $d_U = 2.2465$ confirmed the relations $2.2465 \leq DW \leq 1.7535$ (Table 4).

404

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Table 4. Estimation of GDP values in Poland by the OLS method for the period 1995–2016 (input data, dependent variable: l_GDP).

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	α
const	1.07607	0.763964	1.409	0.1808	
l_TGGR	0.258227	0.0961620	2.685	0.0178	**
l_TGGE	−0.278215	0.100377	−2.772	0.0150	**
l_GGGD	0.0841720	0.0495928	1.697	0.1118	
l_GFCF	−0.0257589	0.0415463	−0.6200	0.5452	
l_GDERD	0.0563928	0.0208750	2.701	0.0172	**
l_GGST	−0.0134754	0.134321	−0.1003	0.9215	
l_FCEH	0.896105	0.113199	7.916	<0.0001	***
R-squared	0.998772	F(7,14)	1626.859	DW	2.244204

where $\alpha = 0.01$ (***), where $\alpha = 0.05$ (**).Source: Own calculations on the basis of OECD [41], GRETL program.

In order to analyze the stationarity of the analyzed variables, an augmented Dickey-Fuller test (ADF) was employed. For all analyzed variables, a unit root a = 1 was noted; integration row I(1) indicated the non-stationarity of the time series. Normality of the distribution of residuals was assessed with the use of the Doornik–Hansen test, which confirmed that the distribution of residuals had the features of normal distribution. White's test for non-linearity (logarithms) was used for the assessment of the linearity of the analytical form of the model and confirmed the validity of the linear form model.

Factual verification of the final model of economic growth for Poland in the period 1995–2016 estimated the ultimate results. The significant independent variables for GDP became the variables FCEH, TGGE, TGGR, GDERD (α = 0.01), and GGGD (α = 0.05). The coefficient of the model determination was maintained at a level $R^2 = 0.998737$. The F-Snedecor test performed confirmed the overall suitability of the model as $F(5,16) = 2530.486 > F^* = 2.85241$. The Durbin-Watson autocorrelation test (DW) at $d_L = 0.8629$ and $d_U = 1.9400$ confirmed the relations $1.94000 \leq DW \leq 2.100$ (Table 5).

Table 5. Estimation of the GDP value in Poland by the OLS method, for the period 1995–2016, final data (Dependent variable: l_GDP).

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	α
const	1.29689	0.322453	4.022	0.0010	***
l_TGGR	0.234262	0.0719700	3.255	0.0050	***
l_TGGE	−0.287453	0.0882478	−3.257	0.0049	***
l_GGGD	0.103553	0.0360383	2.873	0.0110	**
l_GDERD	0.0513640	0.0163736	3.137	0.0064	***
l_FCEH	0.859975	0.0399160	21.54	<0.0001	***
R-squared	0.998737	F(5,16)	2530.486	DW	2.057113

where $\alpha = 0.01$ (***), where $\alpha = 0.05$ (**). Source: Own calculations on the basis of OECD [41], GRETL program.

According to White's test for heteroskedasticity, the p-value = P(Chi-square(20) > 21.921981) = 0.344759. The condition of maintaining the linear form of the model has been fulfilled because $TR^2 = 21.921981 < 28.412$. In addition, the results of White's test for heteroskedasticity (squares only) with

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the p-value = P (Chi-square (10) > 14.166091) = 0.165550 also confirmed the validity of the linear model, with $TR^2 = 14.166091 < \chi^2$ (10%, 10) = 15.9872.

The equitation for the final model estimated economic growth for the years 1995–2016 (Table 4) was as follows:

$$L_{GDP} = 1.29689 + 0.234262 l_{TGGR} - 0.287453 l_{TGGE} + 0.103553\, l_{GGGD} + 0.0513640 l_{GDERD} + 0.859975 l\_FCEH$$

This equitation could be interpreted as:

1) a 1% increase in TGGR would lead to a 0.23% increase GDP.
2) a 1% increase in TGGE would lead to a 0.29% decrease GDP.
3) a 1% increase in GGGD would lead to a 0.10% increase GDP.
4) a 1% increase in GDERD would lead to a 0.05% increase GDP.
5) a 1% increase in FCEH would lead to a 0.86% decrease GDP.

The results of the OLS model confirmed that the FCEH variable was statistically significant and had the largest share in the explanation of the GDP changes. This means a positive verification of the H1 hypothesis.

Model II (VECM)

The next step used was VECM, which was estimated on the same factors as model I (OLS), with the aim to verify the interrelations between GDP and selected macroeconomics variables. The adoption of the above-mentioned explanatory variables for GDP results from the make-up of the Cobb-Douglas component functions and research methodology adopted by many authors, among others, Dimelis–Papoioannou [19], Roman–Padureanu [48], and Driffield–Jindra [20], Kosztowniak [31].

The preparation of the VECM model was preceded by numerous tests (Asteriou, Dimitrios; Hall, Stephen (2011). For all analyzed variables, it was found that they lacked stationarity of time series, but a unit root a = 1 occurred at process I(1). For each sequence separately, the ADF test was carried out with an absolute term and with an absolute term and a linear trend (Annex, Table 1). The test results confirmed the non-stationarity. Assuming that the null hypothesis is true, the empirical significance levels (p-values of the tests) proved that the probability of obtaining ADF test statistics was high for the majority of variables. Thus, there were no reasons for rejecting the hypotheses that the examined sequences were non-stationary. To verify the conclusions drawn on the basis of the ADF test, the KPSS (Kwiatkowski–Philips–Schmidt–Shin) stationarity test was carried out, where the null hypothesis assumed a sequence stationarity, whereas the alternative hypothesis assumed the occurrence of the unit root (Annex, Table 2).

Next, the Johannes test was carried out, which confirmed co-integration among the examined variables. In the Johansen test, all eigenvalues were significantly different from zero, which meant that all variables were stationary (Annex, Table 3). The next step was to determine the maximum lag order for the VAR model. According to the AIC, BIC, and HQC information criteria, the maximum lag equals 2, at the appropriate lag equals 1.0 (Table 6).

Table 6. Values of the respective information criteria

lags	loglike	p(LR)	AIC	BIC	HQC
1	69.09266		–6.009266*	–5.561186*	5.921796*
2	69.21381	0.62255	–5.921381	–5.423515	–5.824192

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Source: Own calculations on the basis of OECD [41], GRETL program.

To analyze the VAR model stability, the unit root test was carried out (Figure 2). It revealed that in the analyzed model, all roots of the equations regarding the module were lower than 1.0.

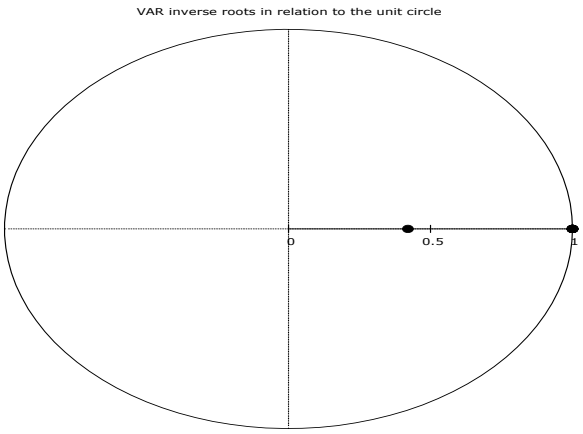

Figure 2. VAR inverse roots. Source: Own calculations on the basis of OECD [41], GRETL program.

Since the roots of the characteristic equation are inside the unit circle (lower than 1), it is possible to supplement the VAR model with the so-called component of error correction expressing the long-term relationship, and the interpretation of impulse responses and variance decomposition will give credible results. Furthermore, in accordance with the Granger representation theorem, if variables are integrated of order one I(1) and are co-integrated, the relationship between them can be represented as the VECM.

The general formula for VECM is presented below [43, 6]:

$$\Delta \boldsymbol{Y_t} = \boldsymbol{\Gamma_1 \Delta Y_{t-1}} + \boldsymbol{\Gamma_2 \Delta Y_{t-2}} + \ldots + \boldsymbol{\Gamma_{k-1} \Delta Y_{t-k+1}} + \boldsymbol{\pi Y_{t-k}} + \boldsymbol{\varepsilon_t} = \\ = \sum_{i=1}^{k-1} \boldsymbol{\Gamma_i \Delta Y_{t-i}} + \boldsymbol{\pi Y_{t-k}} + \boldsymbol{\varepsilon_t}, \qquad (5.6)$$

where $\Gamma_i = \sum_{j=1}^{i} A_j - \mathrm{I}, i = 1,2,\ldots,k-1$, $\Gamma_k = \pi = -\pi(1) = -\left(\mathrm{I} - \sum_{i=1}^{k} A_i\right)$, I is the unit matrix. The Ljung–Box test was used to verify the occurrence of autocorrelation between the variables of the VECM model. The results of the Ljung–Box test for the estimated models, i.e., for all examined variables, showed that the empirical p-levels were higher than the nominal significance level $\alpha = 0.05$. This authorized us to state the lack of autocorrelation in the residual process.

6. Empirical Results: Impulse Response Functions

The graphs of GDP response functions to impulses of the model variables indicated that with time, the impulses of the seven variables exerted both an increasing as well as weakening impact on future values. Responses of the GDP dynamics revealed the increasing/enhancing effect of the impulses of three variables: own GDP, TGGR, GGST and GFCF in the period of one year, followed by the decreasing effect in period 3 and stabilizing effect from period 4 onwards. These results can be interpreted in such a way that the pillars of GDP growth in Poland are: TGGR, consumption demand of households (GGST), and GFCF. The results of research in this respect are important from the point of view of their application and mean that the economic policy should use the tools that support the social policy referring to levels of consumption, taxation, and investment (Figure 3).

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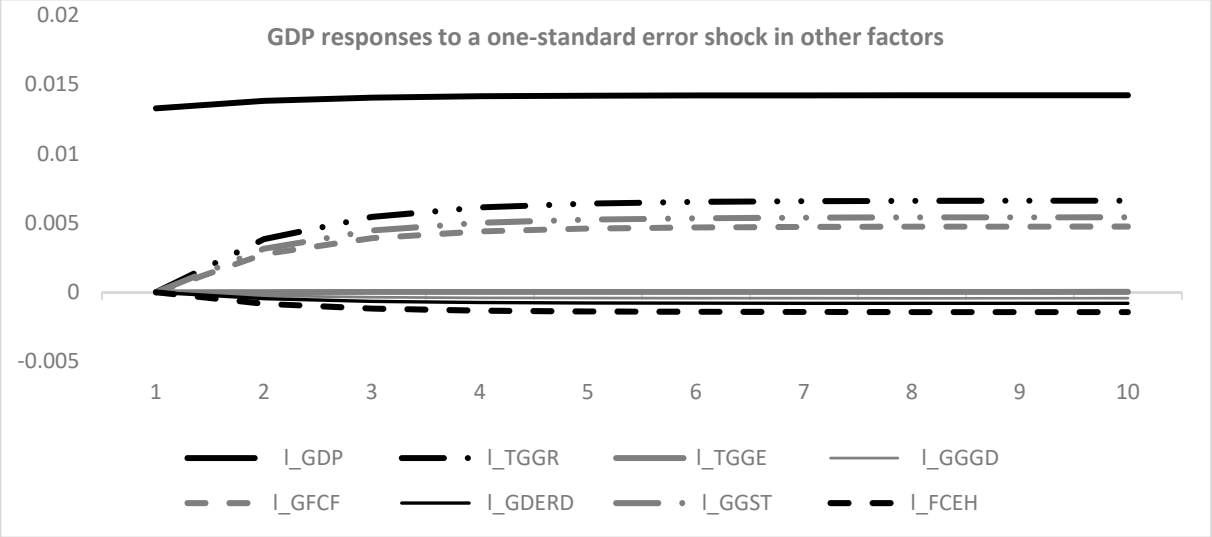

Figure 3. GDP responses to a one-standard error shock in other factors. Source: author's own compilation, OECD [41].

The graphs of the function responses of factors to one-standard error shock in I_GDP indicate that they increased as a result of the impulses coming from GDP in the period of the first two years, weakened in periods 3–4 and stabilized in the following periods. Changes of GDP influenced the strongest effect on GFCF, TGGR, TGGE (referred to H2) and GGGD. However, these changes of GDP error shock influenced the low effect on GDERD and FCEH (Figure 4). The reaction of explanatory variables to changes in GDP showed that GFCF, TGGR, GGGD, and TGGE were the most sensitive to changes in economic growth both in the short and long term. These results indicate the necessity to include them in the investment and fiscal policy pursued.

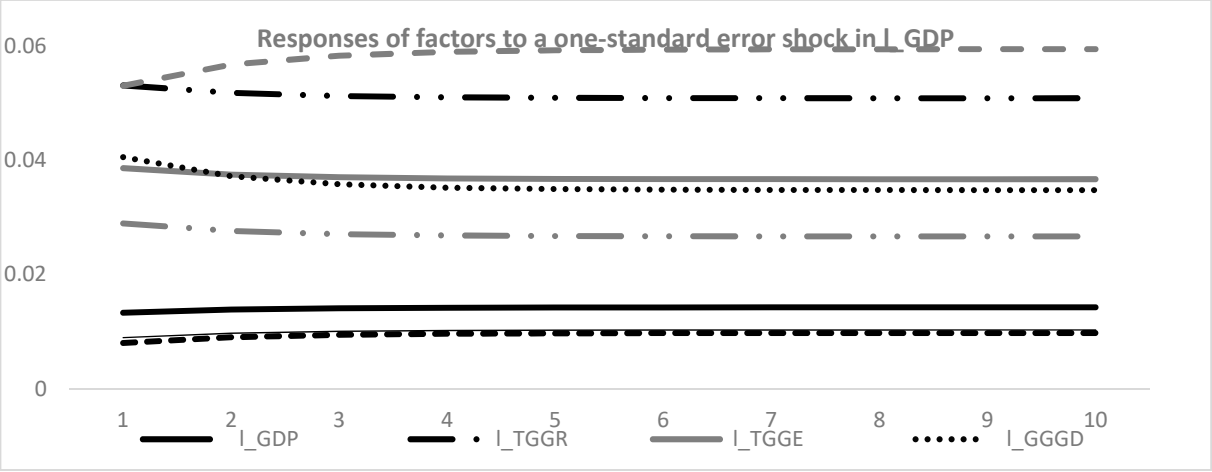

Figure 4. Responses of factors to a one-standard error shock in l_GDP. Source: author's own compilation, OECD [41].

6.1. Variance Decomposition

In order to determine the explanation degree of changes in GDP and the examined remaining seven macroeconomic indicators in Poland from 1995 to 2016, the error variance decomposition was carried out for the VECM model variables. The adopted forecast horizon embraced 10 periods (years). This decomposition allowed us to discover the system dynamics showing the most significant places

in the VAR/VECM structure and shows which shocks have the dominant effect on the standard error of each endogenous variable of the model.

The calculations of the GDP variance decomposition made on the logarithms showed that growth dynamics was explained to the greatest extent by the variances of own GDP forecasts (100.0% in period 1 and 72.13% in period 10) and from period 2–10 by the dynamics of TGGR (3.7%–12.4%), GGST (2.4%–8.3%), and GFCF (1.9%–6.4%) (Table 7).

Table 7. Variance decomposition for the variable l_GDP.

	l_GDP	l_TGGR	l_TGGE	l_GGGD	l_GFCF	l_GDERD	l_GGST	l_FCEH
1	100.0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	91.7437	3.6670	0.0001	0.0160	1.8883	0.0537	2.4584	0.1729
3	84.9908	6.6662	0.0001	0.0291	3.4328	0.0976	4.4691	0.3143
4	80.6068	8.6133	0.0001	0.0375	4.4355	0.1261	5.7745	0.4061
5	77.7600	9.8777	0.0002	0.0431	5.0866	0.1446	6.6221	0.4657
6	75.8374	10.7316	0.0002	0.0468	5.5263	0.1571	7.1946	0.5059
7	74.4802	11.3344	0.0002	0.0494	5.8368	0.1660	7.5987	0.5343
8	73.4824	11.7776	0.0002	0.0513	6.0650	0.1725	7.8958	0.5552
9	72.7226	12.1150	0.0002	0.0528	6.2387	0.1774	8.1221	0.5711
10	72.1266	12.3798	0.0002	0.0540	6.3751	0.1813	8.2995	0.5836

Source: author's own compilation: OECD [41].

Moreover, the decomposition of variance for other factors indicated the crucial part into forecasts for (from the first period to tenth period):

- TGGE had significant meanings from TGGR (81.90%, 77.87%) and GDP (11.67%, 12.82%) (refer to H2).
- GGGD had adequate TGGR (50.81%, 19.52%) and GDP (17.04%, 16.75%).
- GFCF had a GDP (68.96%, 31.81%) and own GFCF (24.08%, 32.12%).
- GDERD had a GFCF (20.07%, 27.72%) and GGGD (10.30%, 10.20%).
- GGST had a TGGR (75.84%, 73.79%) and GDP (10.71%, 13.17%).
- FCEH had a GDP (35.08%, 17.38%; (refer to H1). GGST (18.75%, 40.26%) and TGGR (4.50%, 35.03%).

The decomposition results for TGGE confirmed the validity of H2. TGGR's government revenue dependent on GDP and fiscal revenues had the largest share in their explanation.

Moreover, the significance of cause-and-effect relations between the GDP changes and consumption expenditure (FCEH) was also confirmed by the analysis of the decomposition of these expenditures as well as the results of the OLS model.

Table 8. Decomposition of variance for l_FCEH.

	l_GDP	l_TGGR	l_TGGE	l_GGGD	l_GFCF	l_GDERD	l_GGST	l_FCEH
1	35.0766	4.5034	3.8923	7.1293	15.0766	9.5032	18.7540	6.0645
2	27.5027	20.1342	2.7186	4.3342	5.2181	5.3631	32.0203	2.7088
3	23.2104	26.9274	2.1468	3.1279	3.0982	3.6707	36.2689	1.5496

4	20.9490	30.1884	1.8600	2.5506	2.5154	2.8798	38.0036	1.0532
5	19.6463	31.9895	1.6983	2.2321	2.3097	2.4487	38.8804	0.7951
6	18.8294	33.0961	1.5979	2.0366	2.2188	2.1856	39.3941	0.6414
7	18.2807	33.8320	1.5308	1.9066	2.1702	2.0112	39.7275	0.5408
8	17.8912	34.3519	1.4833	1.8148	2.1400	1.8882	39.9601	0.4704
9	17.6022	34.7368	1.4481	1.7469	2.1191	1.7972	40.1313	0.4184
10	17.3799	35.0325	1.4210	1.6947	2.1036	1.7273	40.2624	0.3785

Source: author's own compilation: OECD [41].

The analysis of FCEH decomposition indicated that the largest share in the explanation of these expenditures were GDP (from 25.08% to 17.38%) and GGST (from 18.75% to 40.262%). This means that social expenditures have a significant share in explaining changes in the consumer demand of households, and importantly, that their importance is growing over time. It is also worth noting that GFCH was largely explained by TGGR (from 4.50% to 35.032%). Thus, it is important to redistribute budget revenues including GGST, but also the sources of obtaining income by the state (taxes, budget deficit, and public debt).

7. Conclusions

Sustainable development signifies a new approach and new ways of forging alliances between the public and the financial sectors. This study had two objectives, achieved by the authors through the use of econometric models and the analysis of financial institutions (MFI). The first objective was to demonstrate the impact of public sector institutions and financial sector institutions on sustainable economic growth through public policy instruments. The second objective was to indicate that without mutual alliances (cooperation and interpenetration of activities and policies pursued), this increase would be possible.

The research (OLS) carried out showed that the pillars of GDP growth in Poland were the final consumption expenditure of households (FCEH), total general government expenditure (TGGE), and total general government revenue (TGGR). The results of the said research are important from the perspective of their use, and strengthen the claim that economic growth will be significantly influenced by the government's actions in the field of spending policy [1]. This means that economic policy should use the tools supporting social policy regarding the level of consumption, taxation, and investment. The studies presented confirm the previously conducted analyses [5,40,13,36]. In addition, the conducted research (VECM) confirmed that there is a public sector impact on sustainable economic growth through public policy instruments aimed at GDP growth. Studies have shown that the significant factors are expense policy (measured by TGGE) and investment expenditure (measured by GFCF). It is a two-way relationship that, based on alliances with financial sector institutions, can contribute to shaping sustainable, sustainable development in Poland. Thus, the policy of alliances between financial institutions and the private sector may, due to the budget deficit and public debt caused by the expansive policy of stimulating sustainable development, justify the necessity to supplement private expenditure by state expenditure.

The results of the decomposition model carried out under the VECM model indicated a low share of total government expenditure in explaining GDP. However, social spending (GGST) and fixed investment expenditures (GFCF) had a clear pro-growth role and a significanct share in the structure of these expenditures.

Poland is a good example for the analysis of the possibilities of achieving sustainable development based on the use of the potential and capabilities of each party in a social contract. This is due to the fact that, as a country undergoing systemic transformation, it is catching up with development disparities in relation to highly industrialized countries, has an effective and profitable banking system, and has achieved a high level of economic growth. In this context, it is necessary to examine whether the alliance between the banking and public sectors has contributed to the improvement of the social situations of society. One of the measures assessing this condition is the value of deposits collected by the banking sector and the value of loans granted. Banks, as a specialized entity, are able to assess whether a customer (both a natural person and enterprise) has the creditworthiness to settle its liabilities in a timely manner in the future. The government's contribution to this process by increasing external financing from banks is to ensure a minimum (e.g., minimum subsistence level, minimum income levels, and social or welfare benefits) that provides security in the use of external sources of financing. Sustainable development based on government–banking alliances consists of the division of roles and responsibilities between these institutions within the framework of the state's financial policy. The government provides legal regulations, an institutional environment, and financial resources at the level of minimum subsistence and enterprise development, and thus prepares potential customers of financial institutions to use repayable financial instruments (e.g. loans). Such processes will allow for an improvement in the social status, an increase in investments, and obtaining higher income among households and enterprises, and thus will contribute to the growth of GDP and sustainable development.

The model analysis carried out indicates that in countries of systemic trienniformation such as Poland, it is important to stimulate consumer spending, which has about a 40% share in the GDP and positively affects sustainable development. The increase in the intentions of households contributes to the limitation of social spending, which has a limited stimulus effect on GDP.

The impact of financial sector institutions on economic growth should also be emphasized. Banks were supporting corporations in financing their business activities; in this sense, they were participating in the GDP growth rate. Thus, special attention should be paid to the alliances of public and financial sectors.

It has been demonstrated that public sector expenditure, stimulated by the activity of public institutions and public policy applied to consumer spending and investments, have a stimulating effect on economic growth and sustainable development.

Our research provides recommendations to the government regarding corrections to existing public policies, and thus the use of expenditure instruments and profitable public instruments. The results obtained may improve the relationship between the public sector and financial institutions by creating new or modifying existing financial instruments supporting public policies. The results of the research will allow the view on the relationship between GGGE & GDP to be enriched and the impact of the results on the directions of alliances with financial sector institutions.

In a situation where there is no government impulse and no public sources of public financing, households can (and should) use the offer of banking institutions targeted at household demand.

Our research could be extended by introducing into Model I [CLRM, OLS] and Model II [VECM] an aggregate indicator of sustainable development in the economic area. Unfortunately, such research is currently not possible in Poland due to the lack of data continuity. For other countries,

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such a study would give more comprehensive results and would widen the possibility of applying and building recommendations.

Further research in this area should focus on the analysis of income distribution in the national economy and the assessment of the significance of the trade balance with foreign countries. These changes based on the applied gradations of factors at this stage of research were omitted as determinants of the sustainable development phenomenon.

Author Contributions: Agnieszka Alińska contributed to the design of the article title, reviewed the literature and discussion, provided advice on results. Beata Zofia Filipiak joined the literature review and discussion and contributed to writing the paper. Aneta Kosztowniak provided advice of results reviewed the literature, tested the data, carried out model analysis and wrote the part of the manuscript. All authors have read and approved the final manuscript.

Conflicts of Interest: The authors declare no conflict of interest.

Annex

Table 1. Unit Root test – stationarity test results on the basis of the Augmented Dickey-Fuller (ADF) test for the model variables.

Specificatio	GDP	TGGR	TGGE	GGGD	GFCF	GDRR	GGST	FCEH
Null hypothesis: unit root appears	a=1; process I(1)	a=1; process I(1)	a=1; process I(1)	a=1; process I(1)	a=1; process I(1)	a=1; process I(1)	a=1; process I(1)	a=1; process I(1)
ADF test with absolute term(const); Asymptotic	p= 0.9995	p= 0.7206	p= 0.709	p= 0.9854	p= 0.9775	p= 0.949	p= 0.9998	p= 0.8149
ADF test with absolute term(const) and linear trend;	p= 0.286	p= 0.05222	p= 0.7989	p= 0.5435	p= 0.3023	p= 0.2176	p= 0.01164	p= 0.06227

Note: Lag order for ADF test equal 8.

Source: author's own compilation with the use of the Gretl program.

Table 2. Unit Root test – KPSS stationarity test results for the examined sequences

Specification		GDP	TGGR	TGGE	GGGD	GFCF	GDRR	GGST	FCEH
KPSS without a trend	Test statisti	0.8337	0.745952	0.735452	0.76172	0.788668	0.725203	0.780045	0.837419
	Critical value of the	0.356 (10%); 0.462 (5%); 0.6999 (1%)							

KPSS with a trend	Test statisti	0.139867	0.109707	0.115219	0.113131	0.075031 8	0.209524	0.112952	0.065900 1
	Critical value			0.124 (10%);	0.149 (5%);	0.206 (1%)			

Note: Lag order for KPSS test equal 2.

Source: author's own compilation with the use of the Gretl program.

Table 3. Johannes co-integration test results

Number of equations = 8; Lag order = 1; Estimation period: 1996 - 2016 (T = 21)

Case 3: Unrestricted constant; Log-likelihood = 524.016 (including constant term: 464.42)

Rank	Eigenvalue	Trace test p-value	Lmax test p-value
0	0.98423	270.51 [0.0000]	87.145 [0.0000]
1	0.96216	183.36 [0.0000]	68.761 [0.0000]
2	0.84509	114.60 [0.0011]	39.163 [0.0597]
3	0.75079	75.441 [0.0151]	29.179 [0.1674]
4	0.62446	46.262 [0.0687]	20.567 [0.3137]
5	0.55978	25.695 [0.1421]	17.230 [0.1670]
6	0.29781	8.4644 [0.4244]	7.4247 [0.4490]
7	0.048302	1.0397 [0.3079]	1.0397 [0.3079]

Corrected for sample size (df = 12)

Rank	Trace test p-value
0	270.51 [0.6557]
1	183.36 [0.6095]
2	114.60 [0.6789]
3	75.441 [0.5502]
4	46.262 [0.4473]
5	25.695 [0.3502]
6	8.4644 [0.5183]
7	1.0397 [0.3627]

Source: author's own compilation with the use of the Gretl program.

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