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Simple four-step procedure of parabolic B curve determination for OECD countries in 1990Q1–2015Q4[1]

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Abstract: In theory the short-term relationship between inflation and GDP rate is known as the positive slope straight line SAS. In practice it is reflected by a concave non-monotonic function.

The results of estimation depend on unusual observations. We propose a simple four-step procedure: first, basic estimation based on all observations; then estimation having ignored outliers; next, estimation on the average GDP rates for given inflation rates for the same observations; lastly, estimation skipping outlying averages.

Empirical analysis for 26 OECD countries on quarterly data brought satisfactory results. They justified the determination of optimal GDP rate and corresponding inflation for every country. Finally, recommendations for policymakers have been formulated.

Keywords: simple three-step procedure, parabolic B curve, optimal inflation, neutral inflation, inflation rate, GDP rate, relationship between inflation and GDP rate, OECD countries.

JEL codes: B22, B23, B41, C13, C20, C81, C82, E31, E61, N10, O11, O23, O41, O50, P52.

Introduction

The aim of the paper is to present and assess the results of an empirical analysis using a simple four-step procedure of the parabolic relationship between the rate of inflation and the GDP growth rate in every OECD country in 1990Q1–2015Q4 and to offer recommendations for economic policy makers of the respective countries formulated on the basis of this results.

In the 1950s and 60s and at the beginning of the 70s there were no reported significant relationships between the inflation rate and the GDP growth rate, even in Latin American countries, where inflation rates were double-digit. The situation has been changed drastically since late 70s when the coexistence of high inflation rates and falls in economic activity have been confirmed empiri-

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cally. As a result more and more countries have introduced the independence of their central banks with the aim of keeping inflation within specific limits. Taylor's rule has become an often used instrument. There has also been a question: what should the inflation rate be? In this connection, a variety of negative and positive effects caused by both high inflation and deflation have been pointed out. More recently there has also been a fear of deflation measured by the index of prices of consumer goods and services.

In view of the above both theoretical studies as well as empirical ones for different countries at different time periods have been published on this subject. One has assumed both monotonic and non-monotonic dependencies. Different one-factor models as well as multi-factor ones have been applied and both linear and non-linear in their analytical forms have been assumed. Initially cross-section data, and later, panel ones have been used in empirical studies. However deflation has been generally overlooked in spite of the fact that it has coexisted with low (or even negative) GDP growth rates in many countries in recent years (for the first time since the great depression of 1929–1933).

In the case of a concave non-monotonic function there has been a problem of the maximum level of GDP rate, r*(GDP), and of the corresponding optimal inflation rate, r*(p). One can easily determine these levels if a function describing the respective dependence and other explanatory variables in the case of multi-factor model are known. One has to admit, however, that the GDP growth rates have depended on factors specific to different countries at different times. Therefore, in the case of cross-section or panel data or when multi-factor models have been used, only r*(p) have been computed. In spite of that r*(p) and sometimes r*(GDP) were determined for individual countries.

Nevertheless the differences between the estimates of these variables resulting, amongst others, from various periods of studies, have not been interpreted. All in all it is reasonable to compare the optimal inflation and the coexisting maximum GDP growth rate between the countries if they are determined for each country for the same period and on the basis of the identical one-factor models.

In the article in view of the above both increasing and decreasing monotonic relationships between inflation and the GDP growth rates are criticised based on the results of empirical studies of the author. Then a simple four-step procedure for determining the relationship between the variables is proposed. Subsequently this procedure is used for the determination, on the basis of quarterly data for 26 OECD countries in 1990–2015, of the parabolic (concave and non-monotonic) relationships between the inflation and GDP rates in different countries. On basis of the results it is concluded that the estimated relationships between the variables were statistically significant in all cases and, moreover, reliable economically for 25 countries.

Then the optimal inflation and the corresponding maximum GDP growth rate for every country have been computed. Moreover it has been concluded that in the case of the analysed countries in the period considered there had been a noticeable linear relationship between r*(p) and r*(GDP). On this basis, recommendations for economic policy makers of the countries with the maximum GDP growth rate definitely lower than in other countries with the similar optimal inflation have been formulated.

The paper is divided into three sections. Section 1 contains theoretical considerations on the relationship between inflation and the GDP rate whilst the second is devoted to empirical studies of this relationship. The analysis of the relationships between inflation and GDP rates in OECD countries in 1990–2015 is presented in the last section. Data sources, assumptions and method of analysis, results of the study as well as recommendations for policymakers are provided in its subsections. The paper is closed with conclusions.

1. Theoretical considerations on the relationship between inflation and the GDP growth rate

The relationship between inflation and the GDP growth rate is the subject of theoretical considerations primarily associated with many (the majority of?) economic policy aspects. Its shapes are different in the short term and in the long. Of greater interest is the short-term relationship – Short-Term Aggregated Supply Curve (SAS). Much attention is paid to this curve in macroeconomics, especially in conjunction with the curve of aggregate demand [Ball, Mankiw, and Romer 1988].

SAS can be estimated directly from empirical data. It can also be derived indirectly by inserting the reverse of the Phillips curve, r(p) = g(UNR), into Okun's, r(GDP) = f(UNR), yielding r(GDP) = f{(G)[(p)]}. A common assumption is that Okun's and Phillips functions are monotonic and have positive slopes. The SAS curve when both functions are linear is presented in Figure 1a) and when both functions are convex – in Figure 1b).

The SAS values rise with the increase in inflation. Depending on the shape of the SAS curve they grow faster and faster or more and more slowly. The shape of the SAS curve, in turn, depends upon its characteristics, which are influenced by analytic forms of Okun's and Phillips functions. If both functions are linear SAS is also linear. In addition it is linear in some other special cases, for example, if both functions are hyperbolic, or when both are logarithmic. In turn if the Okun's curve is a hyperbolic function and the Phillips curve is logarithmic the SAS values grow faster and faster. On the other hand if the Okun's curve is a logarithmic function and the Phillips curve is hyperbolic the SAS values grow more and more slowly and it has a horizontal asymptote and it also has the left-hand lower border.

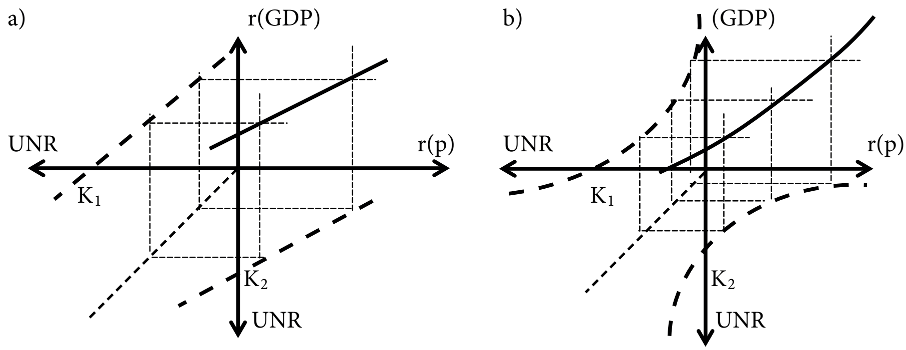


Figure 1. Linear (a)) and nonlinear (b)) Okun, Phillips and SAS functions

In addition, allowing for high unemployment rates, both negative GDP rates (with unemployment rates on the left from the point K_1) and deflation (with unemployment rates below the point K_2) occur. Depending on the relative positions and shapes of the Okun and Phillips curves there are different special cases regarding the SAS values. If K_1 and K_2 are equally distant from the origin of coordinates (when the negative GDP rate and deflation occur at the same unemployment rate), the SAS value is equal to 0. In turn, when K_1 is more distant than K_2, deflation is accompanied by a positive GDP growth rate. On the other hand when K_2 is more distant than K_1, a negative GDP rate coexists with deflation.

Notwithstanding the foregoing and alluding to the hypothesis of Friedman's optimal inflation [eg. Baranowski 2008b], the concave non-monotonic relationship between inflation and GDP rate is shown (see Figure 2).

In such a situation the maximum rate of GDP, r*(GDP), coexisting with the optimal rate of inflation, r*(p) is also examined [Kimbrough 1986; Diamond 1993; Akerlof, Dickens, and Perry 1996, 2000; Andersen 2002; Devereoux and Yetman 2002].

Bednarczyk [2011], who calls the optimal rate of inflation the neutral inflation, considers that its level is different for different countries and in different periods. In addition, in his opinion, it does not have to be close to any level, designated in any arbitrary manner [Bednarczyk 2012].

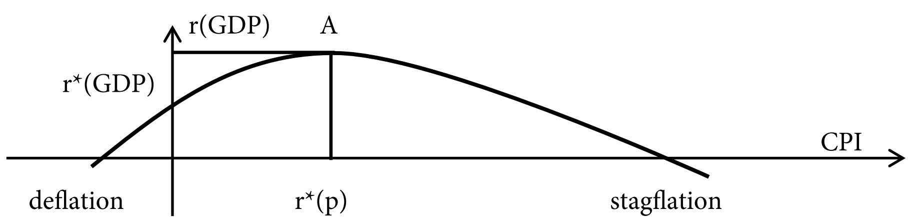


Figure 2. Non-monotonic concave relationship between inflation and the GDP rate

2. Empirical studies of the relationships between inflation and GDP rate

As it seems the first empirical study related explicitly to the SAS curve was performed by Lucas [1973, 1976] who used a power model (of classical Phillips curve). The purpose of his analysis was to investigate whether the relationship between the variability of inflation expectations and the volatility of supply associated with the business cycle are consistent with the theory. The test was based on data for 18 countries between 1953 and 1967. Summing up the investigation he stated that real GDP was more sensitive to changes in nominal GDP in countries with more stable inflation. So the results were basically in line with expectations. Similar results were achieved by the authors for other countries and other periods.

Sargent [1973] also applied the power model of aggregate supply. The real national income he expressed as a function of the capacities (measured by the capital or labour resources or their linear combination) and of a ratio of current inflation to inflation expectations in the previous period. A slightly modified version of this model was built by Sargent and Wallace [1975]. They claimed that only unexpected changes in inflation affect the supply. Similar results were obtained by Barro [1978]. The results of subsequent tests allowed him, however, to conclude that both the expected and unexpected changes affect the level of output.

A power model of aggregate supply for 43 countries on the basis of the available data after World War II was estimated by Ball, Mankiw, and Romer [1988]. In this model (New Keynesian Phillips Curve – NKPC) real GDP was explained by its level in the previous period, nominal GDP in the current period and time. They stated that inflation had a significant impact on the SAS elasticity and that this elasticity was negative except for the cases of high inflation (according to the polynomial equation of the second order this relationship would become negative when inflation was above 34%). In addition they demonstrated the superiority of the NKPC model over that proposed by Lucas.

Stanners [1993] examined both linear and parabolic relationships between the growth rate of GNP *per capita* and inflation. In one-factor models based on average values for different years for different groups of countries, parabolas have been, on the whole, convex but there were no relevant relationships between the variables analysed. Statistically significant dependence of inflation on global and regional common factors has been proven in later studies, [e.g. Ciccarelli and Mojon 2010; Hałka and Szafrański 2015].

Barro [1995] studied the influence of inflation on growth in about 100 countries in 1960–1990. He applied the instrumental variables estimation method and used several different instruments for inflation. Based on the results of the estimation for several different measures of inflation he stated that the increase in inflation by 10 percentage points caused the decline in the growth rate of GDP *per capita* of 0.2–0.3 percentage points.

Gamber [1996] built the two-equational VAR model with four quarters lag. The factors causing changes in production and changes in the prices he disaggregated as related to demand and related to supply. He estimated the model for the economy of the United States after World War II (1949Q1–1992Q4 in 1987 prices). Results of the model demonstrated, amongst others, that the aggregate supply curve was growing and that its slope was related to inflation (small in the 60s, large in the 70s, and a bit smaller in the 80s). Both the rapid increases in oil prices and the restrictive monetary policy had an impact on the aggregate supply.

Liberda, Rogut, and Tokarski [2002] analysed relationships between inflation and economic growth on the basis of the data for 19 OECD countries between 1982 and 1999 using a three-equational model (economic growth rate, investments and savings). They claimed that the increase in inflation by 10 percentage points caused a reduction in growth rate of GDP *per capita* by 0.5 percentage points.

Other conclusions were reached by Sarel [1996]. They were based on his research for 87 countries in the years 1970–1990 (divided into four five-year periods) and 12 levels of inflation. (Amongst 348 observations there were only two cases of deflation. The author has substituted them by the smallest observed positive values (0.1%). In addition, given the very strong asymmetry of the distribution of inflation rates the author used the logarithms of the inflation which were much closer to the normal distribution). He stated that zero, very low and low inflation had no significant effect on the GDP growth rate and that further increases in inflation – especially over 8% per year (named structural break point, nowadays known as optimal or neutral inflation) – resulted, mainly through a negative influence on efficiency and performance, in a strong reduction in the GDP growth rate (doubling the rate of inflation caused decrease of GDP rate by about 1.7 percentage points i.e. equal to the global average of GDP *per capita* growth rate over the period of investigation; in other words equal to the difference between the sustainable growth rate and stagnation). In the case where (important at the level of 1%) variables corresponding to particular countries were missed the level of structural change amounted to 10.1% and the negative impact of the increase of inflation above the structural change was about 35% weaker. In addition he showed that the absence of structural change in previous studies led to incorrect conclusions not only as to the strength of the relationships between inflation and GDP growth rate but also as to its direction that at lower levels of inflation was close to zero or even positive. This was particularly evident when the period analysed had been divided into five four-year periods. Then the level of structural change was 7.9%. The effect of inflation without accounting for structural change was about 4/5 lower and the positive impact of low inflation on the rate of GDP growth was statistically significant. Therefore Sarel's model built for inflation consists of two linear functions: increasing for inflation rates below the structural change and decreasing – above it. I It was the first empirical study confirming the validity of one of the assumptions of M. Friedman's optimal inflation hypothesis.

Khan and Senhadji [2001] studied 26 industrialized countries between 1960 and 1998. They received the optimal inflation rate, measured by CPI, equal to 1–3%. Raczko [Baranowski 2008b] estimated its level for 22 OECD countries in 1972–2003 at 4% and Vinayagathasan [2013] found its level for 32 Asian countries in 1980–2009 at 5.43%. In contrast, Chang and Black [Baranowski 2008b] determined its level for the United States in 1929–1999 at 2.1% and Banasik [Baranowski 2008b] set the optimal rate of inflation (measured by the deflator of GDP) for Japan in 1972–2003 as equal to about 4.4%.

A number of studies of the discussed relationship were performed Baranowski [e.g. 2008a, 2008b]. He determined using the annual data for 15 OECD countries in 1972–2007 four types of non-linear functions: parabola, complex logarithmic function, complex exponential function and complex inverse trigonometric function. The first three have maximum; in addition, the exponential function has a horizontal asymptote (and therefore the impact of the marginal changes in the rate of inflation at its high levels on the GDP rate is negligible), logarithmic – slash, and the parabola does not have any. The author said that in the first three cases the short-term relationship was statistically irrelevant whilst the long-term relationship was important. The relationship was almost the same no matter what type of function (all three theoretical lines differed very slightly) but the estimates of the structural parameters were the most important in the exponential function, and the least – in the parabola. The optimal inflation remained within the limits of 3.9–4.3%. In addition the author stated that for the rates of inflation in the range of 1–7% the GDP rate was lower than the maximum of not more than 0.1 percentage points per year. The author did not state clearly whether he studied cases of deflation. However graphs showing the theoretical curves have indicated deflation of up to 2%.

In addition many of the issues concerning the empirical relationships between the GDP rate and inflation were treated in course of the short-term Phillips' curve analyses [eg. Błaszczuk 2015b; Błaszczuk 2015c, Chapter II]. In particular they were investigated when inflation was a function, inter alia, of the GDP growth rate expressed, for example, by the supply gap. Sometimes it was the relationship between real GDP and the deflator of GDP. Such a solution was criticised by M. Sarel [1996] who proved that CPI is a better regressor.

Notwithstanding the foregoing four empirical relationships between inflation and the GDP growth rate, that is SAS curves, have been derived from the empirical Okun's and Phillips curves. None of the respective SAS curves reflected, however, the distribution of the empirical data and the results differed, usually to a great extent, from the results of a direct estimation of SAS curves based on the same data [eg. Błaszczuk 2015a; Błaszczuk 2015c, Chapter III].

Summing up different theoretical and empirical versions of SAS were developed. In particular linear increasing or decreasing functions or non-linear non-monotonic functions or non-linear functions increasing at an increasing rate have been assumed. Supply used to be a function of only one variable (inflation) or a greater number of variables (including inflation) In the case of non-linear functions or functions with more explanatory variables goodness of fit was, of course, the better. Studies have been carried out for many countries in one period (typically on the average data for several years) or on the basis of panel data, sometimes for individual countries. Data for different subperiods (months, quarters, years) were used in the analyses.

3. Analysis of relationships between inflation and GDP rates for OECD countries in 1990–2015

3.1. Data sources, assumptions and method of analysis

We assume that both high and low inflation rates coexist with low GDP rates and that the respective function has a single maximum. Let us call this function the B curve. In the first approximation we assume that this is a polynomial of the second degree (parabola). These functions have been estimated on the OECD quarterly data [stats.oecd.org] separately for every one of the 33 OECD countries for which data on the CPI and for every one of the 25 countries for which data on the HCPI were known in spring 2014 [Błaszczuk 2014; Błaszczuk 2015c, Chapter IV]. Goodness of fit of these curves to the empirical data was not satisfactory although it was clearly better than in the case of linear functions, and the more than SAS functions based Okun's and Phillips' curves.

In view of the above we derive the relationship between the variables analysed using the following simple four-step procedure:

1. We estimate the B curve using all observations (step I) and we look for unusual observations (outliers).
2. We skip the outliers and estimate the B curve on the remaining observations (step II).
3. We estimate the B curve on average values of r(GDP) corresponding to the same individual levels of HCPI as in step II (step III).
4. We skip the outlying average observations and estimate the B curve on the remaining average values of r(GDP) corresponding to the individual levels of HCPI (step IV).

This procedure was used to estimate the B curve for every one of the 26 OECD countries for which data on HCPI were available in spring 2016. In many countries the number of observations in relation to the previous research has increased by much more than eight (for years 2014–2015) because of the availability of information for quarters prior to the periods of the previous investigation. As a result the number of observations, even after removal of the outlying observations and outlying average observations, in the vast majority of cases exceeded 60. There were smaller number of observations in case of the Czech Republic (59), Hungary (54) and Turkey (29). In case of Turkey only 54 newest observations (out of 103) were accepted at the first step because observations for this country can be generally divided into two not overlapping sets: 1990Q1–2002Q1 with inflation generally between 10% and 20% (but 38.8% in 1994Q2), and later on – with inflation as a rule less than 10% (see Figure 3 and Appendix, column 4).

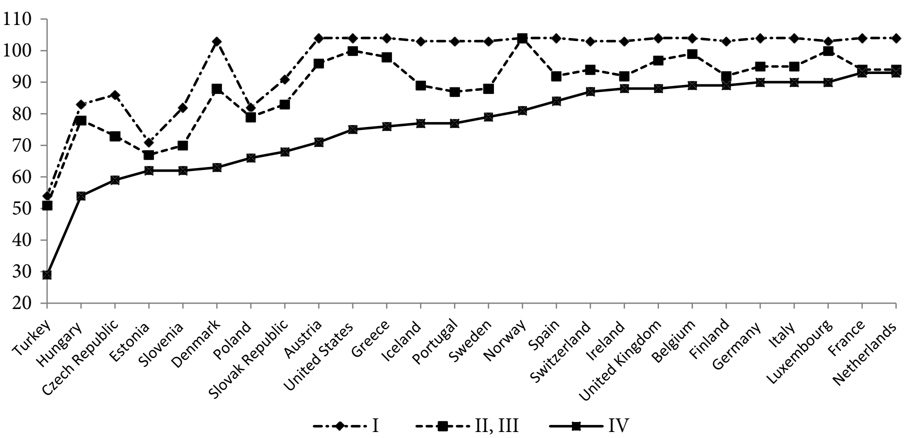


Figure 3. The number of observations in the subsequent steps of estimation of the linear SAS function and the parabolic B curve

The next step of the study is to compute the level of optimal inflation for each country and the corresponding maximum GDP growth rate as well as an estimation of the functional relationship between these variables.

3.2. Results of the study

As expected the values of the determination coefficients obtained are definitely higher than in a previous study and in addition are by far larger for quadratic than for linear functions. The highest values (generally above 0.5, in nine cases at least 0.68) have been obtained in the fourth stage of the procedure (see Figures 4 and 5, and Appendix, columns 5–12).

Relatively high levels of goodness of fit justify computation of coordinates of point A for every country under analysis, with the exception of Poland for which the B curve has the unusual (convex) shape. In the previous investiga-

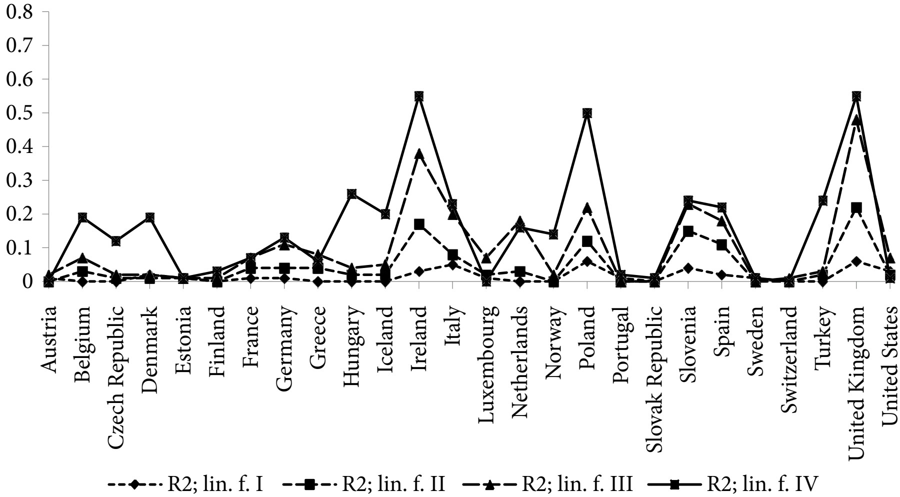


Figure 4. R^2 values for linear functions

tion [Błaszczuk 2014; Błaszczuk 2015c], we received unusual theoretical lines for Denmark, Iceland and Poland, and for Sweden in the case of the HCPI.

Outstanding results have been obtained for Iceland (cf. Figure 6 and Appendix, columns 15 and 18). The optimal inflation (relative to the previous quarter) exceeds 3.1% (approx. 13% per year) and the maximum GDP growth rate amounts to more than 2.6% (about 10.5% per year). High rates (1.9% and 2.1%, respectively) have been reached by Ireland. Turkey has reached a slightly larger GDP growth rate (2.2%) at a much lower inflation (0.9%). Slovakia has a little higher optimal inflation (2.2%) but significantly lower GDP rate (1.35%). GDP rates only a little different from that obtained by Slovakia have

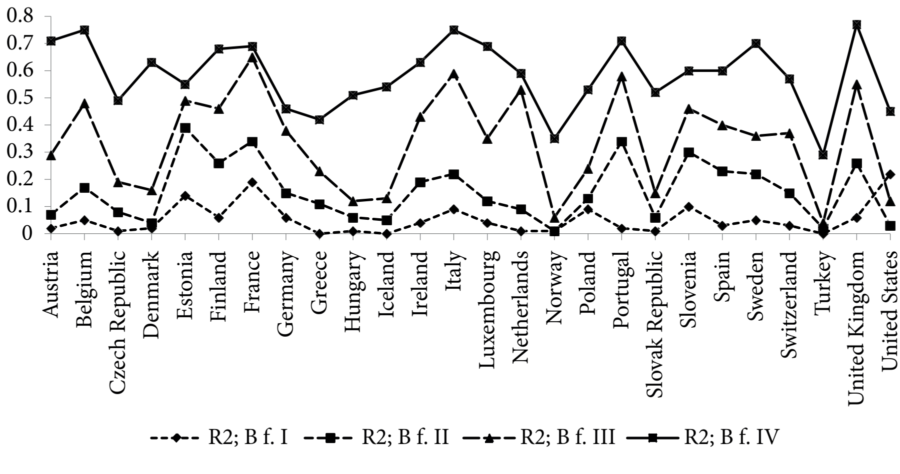


Figure 5. R^2 values for quadratic functions

been reached by Estonia (1.6%), Luxembourg (1.5%) and Slovenia (1.2%), but at much lower optimal inflation rates (respectively: 1.0%, 0.5% and 1.4%). By contrast Hungary with optimal inflation only a little higher than in Slovenia (1.7%) reached the GDP rate equal to only 0.8%.

Other countries have created quite a compact group in terms of the GDP growth rates (from 0.5% to 0.9%), but with very different levels of the optimal inflation rate (from 0.1% to 1.3%). Amongst them Sweden is outstanding with the highest GDP rate (1.1%) and quite a high inflation rate (0.9%).

The remaining countries have formed a few „strategic groups":

a) with low (0.1–0.2%) inflation rates and medium (0.7%) GDP growth rates (The United Kingdom. Austria and the Netherlands);
b) with medium levels (0.6% and 0.8%, respectively) of both variables (Denmark, Finland and the United States);
c) with high levels (1.0–1.1% and 0.8–0.9%, respectively) of both variables (Czech Republic, Norway, Germany and Spain).

The remaining five countries have been characterised by the low GDP growth rates (0.5–0.6%). They have been achieved at medium low (0.4–0.5%) optimal inflation rates in Switzerland and France, the average (0.7%) optimal inflation in Belgium and high optimal inflation in Italy and Portugal (0.9% and 1,1%, respectively).

Furthermore let us note a kind of a functional relationship between the optimal inflation rates and maximum GDP growth rates for the countries analysed in the period under investigation. We see that the linear function only slightly differs from the second-order polynomial (see the lines on Figure 6).

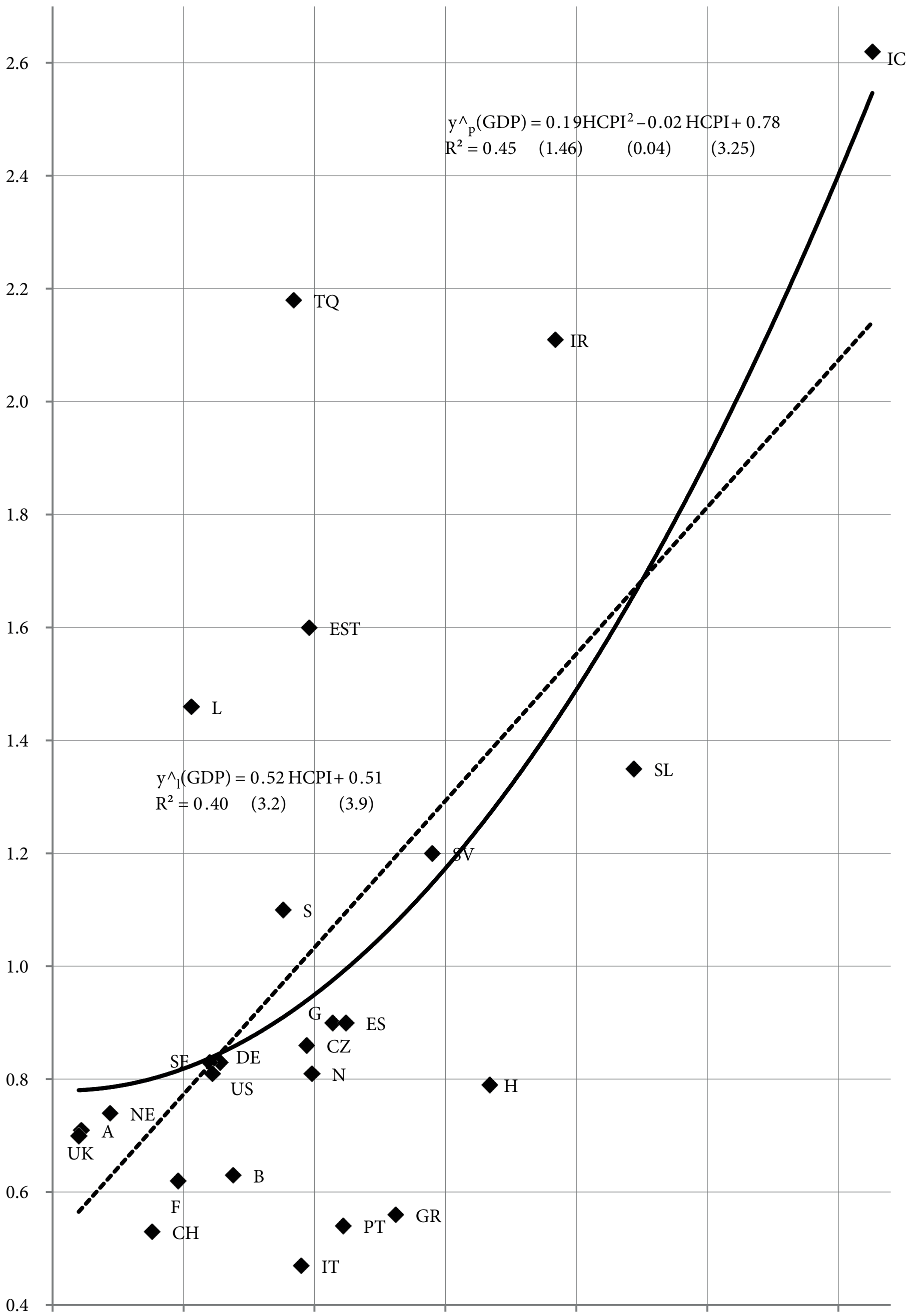
Depending on the position of the point A for the given country in relation to the respective points on the theoretical lines all the countries under analysis have been divided into countries with adverse, similar and favourable relationships of r*(GDP) to r^(GDP). Countries with adverse relationships are classified into three groups:

a) high (from –51.5% to –40.4%): Italy, Greece, Portugal and Hungary;
b) medium (from –29.9% to –21.4%): Switzerland, Belgium and France;
c) low (from –18.8% to –12.0%): Slovakia, Norway, Czech Republic and Germany.

On the other hand there are countries with favourable relationships: a) low: Iceland and Sweden (11.8% and 17.0%, respectively); b) medium: Ireland and Estonia (43.3% and 62.8%, respectively); c) high: Luxembourg (81.1%), and d) very high: Turkey (127.8%).

3.3. Recommendations for policymakers

The position of the given country on the "strategic groups" map discussed allows for the formulation of the following recommendations for economic policymakers of countries with a negative relationship of the maximum GDP growth rate to the respective theoretical one.



Symbols of countries are explained in column 1 of Appendix

Figure 6. Coordinates of A points for 25 OECD countries in 1990Q1–2015Q4

As a rule economic policymakers of the countries with similar and the more unfavourable relationships should analyse carefully the economic policy measures applied in countries with similar optimal inflation rates but much higher GDP growth rates and possibly use at least some of them. In particular politicians of six countries (Switzerland, France, Finland, the United States, Denmark and Belgium) with optimal inflation in the range of 0.4%-0.6% and a maximum GDP growth rate equal to 0.5–0.8% should study thoroughly the economic policy solutions applied in Luxembourg (r*(p) = 0.53; r*(GDP) = 1.46). For politicians of the following seven countries (Sweden, Italy, the Czech Republic, Norway, Germany, Portugal and Spain) with optimal inflation in the range of 0.9–1.1% and a GDP growth rate from 0.5% to 1.1%, the points of reference should be the measures applied in Estonia (1.0% and 1.6%, respectively) and even in Turkey (0.9% and 2.2%, respectively). In addition the economic politicians of Hungary (1.7% and 0.8%, respectively) and Slovakia (2.2% and 1.35%, respectively) should consider carefully the economic policy solutions applied in Ireland (1.9% and 2.1%, respectively). Finally the economic policymakers of Greece (1.3% and 0.6%, respectively) should be interested in the economic policy solutions in Spain (1.1% and 0.9%, respectively) and Slovenia (1.4% and 1.2%, respectively).

Conclusions

The results of research confirm, in general, that in the last decade of the 20th century and at the beginning of the 21st century (including 2015), the relationships between inflation rates and GDP growth rates in OECD countries for which data on HCPI were available in early 2016 were, approximately, parabolic, or generally speaking, non-monotonic and concave. However the shapes and locations of the parabola in a rectangular Cartesian coordinate system for the different countries were different, sometimes very different. As a result the coordinates of the point A are different (sometimes very different). Thus a hypothesis on the need to research every country separately turned out to be true.

From the economic point of view the results obtained differ only slightly from the results obtained in the previous study. First, in the previous investigation results for six countries were vague: for Poland, Denmark, Iceland and Sweden the B curve was convex and for the Netherlands and the United Kingdom the coordinates of r*(p) were outside the volatility range of HCPI. Secondly, the coordinates of the corresponding A points for other countries differ, on the whole, to only a small extent.

The results of the current study are more reliable. Firstly, numbers of observations in the previous study were usually significantly smaller. As one knows from the theory of statistics an increase in the number of observations when it is low, increases the reliability of the results. On the other hand, if it is large it may impair their credibility due to the increase of the range of variation of the analysed variables (eg. the case of Turkey). The first case strongly prevailed in the present study.

Secondly, the formal results indicate the superiority of the current study. Currently the values of the determination coefficients range within 0.5–0.8 by, generally, 70–80 degrees of freedom. They are relatively high considering that the models have (formally) only two explanatory variables (the inflation rate and its square). In addition the estimates of structural parameters are statistically significant. Such good results were obtained thanks to the use of the simple four-step procedure. Its essence is to eliminate the impact of outlying observations. This procedure can be used to determine the relationship between any variables.

In addition we have divided the countries analysed into different (sometimes very different) "strategic groups" depending on the optimal rates of inflation and the maximum GDP growth rates. Then we discovered the stochastic relationship for these countries the maximum levels of the GDP growth rate and the corresponding levels of optimal inflation. Next we have classified the countries analysed into a number of groups according to the relationship between the maximum GDP growth rate and the theoretical one. Finally we have formulated recommendations for economic policymakers of countries for which these relationships are less than or close to 1.

Appendix

Numbers of observations, values of R^2 for the linear SAS functions and the parabolic B curves and the values of the optimal inflation and the corresponding values of the maximum GDP growth rate for analysed OECD countries in 1990Q1–2015Q4

Country	Number of observations			R^2 for linear functions				R^2 for parabolas				HCPI*			r*(GDP)		
	I	II, III	IV	I	II	III	IV	I	II	III	IV	I	II, III	IV	I	II, III	IV
A Austria	104	96	71	0.01	0.00	0.02	0.00	0.02	0.07	0.29	0.71	0.78	0.27	0.11	0.58	0.67	0.71
B Belgium	104	99	89	0.00	0.03	0.07	0.19	0.05	0.17	0.48	0.75	0.63	0.70	0.69	0.54	0.63	0.63
CZ Czech Republic	86	73	59	0.00	0.01	0.02	0.12	0.01	0.08	0.19	0.49	1.47	1.34	0.97	0.71	0.70	0.86
DE Denmark	103	88	63	0.02	0.01	0.02	0.19	0.02	0.04	0.16	0.63	6.77	0.61	0.64	1.37	0.55	0.83
EST Estonia	71	67	62	0.01	0.01	0.01	0.01	0.14	0.39	0.49	0.55	1.20	0.98	0.98	1.39	1.76	1.60
SF Finland	103	92	89	0.00	0.00	0.01	(0.03)	0.06	0.26	0.46	0.68	0.69	0.64	0.60	0.64	0.96	0.83
F France	104	94	93	0.01	0.04	0.07	0.07	0.19	0.34	0.65	0.69	0.46	0.47	0.48	0.55	0.61	0.62
G Germany	104	95	90	0.01	0.04	0.11	0.13	0.06	0.15	0.38	0.46	0.90	1.07	1.07	0.59	0.89	0.90
GR Greece	104	98	76	0.00	(0.04)	(0.08)	(0.06)	(0.00)	0.11	0.23	0.42	−768.75	0.84	1.31	23.53	0.53	0.56
H Hungary	83	78	54	(0.00)	(0.02)	(0.04)	(0.26)	0.01	0.06	0.12	0.51	2.38	2.07	1.67	0.59	0.77	0.79
IC Iceland	103	89	77	(0.00)	0.02	0.05	0.20	(0.00)	0.05	0.13	0.54	4.61	2.90	3.13	0.31	1.49	2.62
IR Ireland	103	92	88	0.03	0.17	0.38	0.55	0.04	0.19	0.43	0.63	1.52	1.89	1.92	1.41	1.92	2.11
IT Italy	104	95	90	0.05	0.08	0.20	0.23	0.09	0.22	0.59	0.75	1.15	1.05	0.95	0.34	0.47	0.47
L Luxembourg	103	100	90	(0.01)	(0.02)	(0.07)	(0.00)	0.04	0.12	0.35	0.69	0.35	0.37	0.53	1.17	1.46	1.46
NE Netherlands	104	94	93	(0.00)	(0.03)	(0.18)	(0.16)	0.01	0.09	0.53	0.59	0.24	0.16	0.22	0.55	0.75	0.74
N Norway	104	104	81	0.00	0.00	0.02	0.14	0.01	0.01	0.06	0.35	0.91	0.91	0.99	0.65	0.65	0.81
PL Poland	82	79	66	0.06	0.12	0.22	0.50	(0.09)	(0.13)	(0.24)	(0.53)	0.90	−0.98	−1.56	0.87	0.89	0.89
PT Portugal	103	87	77	0.01	(0.00)	(0.00)	(0.02)	0.02	0.34	0.58	0.71	2.06	1.10	1.11	0.49	0.61	0.54
SL Slovak Republic	91	83	68	(0.00)	(0.00)	(0.00)	(0.01)	0.01	0.06	0.15	0.52	2.49	2.27	2.22	1.23	1.33	1.35
SV Slovenia	82	70	62	0.04	0.15	0.23	0.24	0.10	0.30	0.46	0.60	1.77	1.66	1.45	0.93	1.23	1.20
ES Spain	104	92	84	(0.02)	0.11	0.18	0.22	0.03	0.23	0.40	0.60	1.35	1.18	1.12	0.61	0.83	0.90
S Sweden	103	88	79	(0.01)	(0.00)	(0.00)	0.01	0.05	0.22	0.36	0.70	0.96	1.35	0.88	0.63	1.04	1.10
CH Switzerland	103	94	87	0.00	(0.00)	(0.01)	0.00	0.03	0.15	0.37	0.57	0.46	0.30	0.38	0.47	0.53	0.53
TQ Turkey	(103) 54	51	29	(0.00)	0.02	0.03	0.24	(0.00)	0.02	0.04	0.29	4.18	−2.05	0.92	1.06	1.77	2.18
UK United Kingdom	104	97	88	(0.06)	(0.22)	(0.48)	(0.55)	(0.06)	0.26	0.55	0.77	2535.00	−0.25	0.10	−256.43	0.77	0.70
US United States	104	100	75	0.03	(0.02)	(0.07)	(0.01)	0.22	0.03	0.12	0.45	0.49	0.07	0.61	0.71	0.72	0.81

Figures in parentheses in columns 5–12 correspond to the untypical slopes/shapes of the respective functions; figures in bold in columns 13–18 correspond to the unreliable values of the respective variables.

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