Fiscal deficit, size of the public sector and investment rate – a panel study*

Piotr Krajewski **

Michał Mackiewicz ***

Abstract

Objective of the analysis presented in the article is to examine empirically the long-run impact of fiscal policy on investment. Econometric analysis based on the panel of 27 countries in years 1960-2003 shows that an increase in deficit by 1% of GDP results in a decrease of investment by 0.3% of GDP on average, while an increase of revenue of the public sector by 1% of GDP brings an investment decrease by ca. 0.2% of GDP. This suggests that expansionary fiscal policy and the large public sector are typically coupled with lower long-term capital accumulation and can exert a negative influence on the long-run economic growth.

Keywords: long-run impact of fiscal policy, panel analysis, capital accumulation; JEL classification: E60, E62

---

* This paper was prepared within the research project 1 H02C 020 28 „The attempts to reform public finance in Poland – causes and consequences of failures", financed from the budgetary funds in years 2005-2007.

** Ph.D., Institute of Economics, University of Lodz, piotr_krajewski@uni.lodz.pl

*** Ph.D., Institute of Economics, University of Lodz, mackiewicz@uni.lodz.pl

Introduction

According to the standard macroeconomic analysis, fiscal policy affects economy in two fundamental ways. Firstly, through its short-term impact within the business cycle and, secondly, through its influence on the long-run economic growth. The first channel can contribute to reduced fluctuations within the business cycle through its influence on the aggregate demand. In the longer run, the expansiveness of fiscal policy and the size of the public sector can have an effect on the rate of long-run economic growth, among others through their influence on investment.

The aim of this article is an empirical assessment of the direction and size of the long-term impact of fiscal policy on the investment rate. In the first part (sections 1-3) the theoretical foundations of the following empirical analysis are presented. Section 1 briefly describes channels through which fiscal policy may affect investment in the long run. The influence of fiscal policy on the investment rate is exerted mainly through the size of the budget deficit and through the size of the tax burden. Section 2 presents a simple theoretical model that illustrates an influence of the budget deficit and tax rates on the accumulation of fixed assets in the economy. Theoretical analysis allows to specify an econometric model presented in section 3. Further sections show the results of the empirical analysis based on the panel of 27 countries. The last section concludes.

1. Impact of budget deficit and tax rates on investment

1.1 The role of budget deficit

First of the analysed instruments of the long-term impact of fiscal policy on real economy is the budget deficit. The supply of bonds issued to finance the deficit decreases propensity to invest, as it increases the real interest rates (crowding-out effect). The typical sovereign bonds

are characterised by the low risk, low transaction costs and small nominal values, which can additionally imply that given the same rate of return they are more attractive to investors than investment in real assets.

The influence of the budget deficit on investment depends on the validity of the Ricardian equivalence phenomenon (Barro [1974]). According to this well-known concept, a reduction of taxes, which is accompanied by an increase in budget deficit, does not trigger growth of consumption, and hence does not have any expansionary effect. This stems from the fact that households tend to increase savings in anticipation of higher taxes in the future, which are necessary to redeem the debt. In this case higher budget deficit does not cause growth of interest rates (because private savings increase to the same amount, hence the aggregate effect is zero), thus not having any negative impact on investment. However, if the Ricardian equivalence does not hold perfectly, there is a room for crowding-out effect, which may have negative influence on the long-run growth.

The views on the validity of the Ricardian equivalence are ambiguous and to a large extent dependent on the underlying model. According to theories that base on the permanent income concept, consumers take the future taxes into consideration when making their saving-spending decisions, which gives support to the Ricardian view. At the same time, the standard economic literature points out a number of reasons which make the budget deficit likely to affect the interest rates, and thereby the accumulation of capital. The typical argument is that consumers are not infinitely-lived, so sovereign borrowing is an opportunity for them to increase consumption at the cost of future generations, which will have to retire the debt (Bernheim [1987]). In addition, the usual difference between interests on public and private can imply that the fiscal deficit increases the disposable resources of a typical household, thus also increasing its consumption. Moreover, borrowing by the state can constitute an opportunity to increase temporary consumption by some consumers who could not afford it

due to the existing liquidity constraints (see Tobin [1980], Hubbard and Judd [1986]). Among other reasons, for which Ricardian equivalence may not hold is the possibility of not perfectly rational behaviour of consumers who may act according to some rules-of thumb (see Loewenstein and Thaler [1989]). Romer [2000] in his brief review of the discussion concludes that although the concept of equivalence is an attractive theoretical idea, the empirical studies confirm the presence of influence of fiscal policy on consumption and aggregate demand. The empirical analysis presented in the following part of this article confirms this view.

In line with the literature concerning the so-called non-Keynesian impact of fiscal policy, a considerable budget deficit may also worsen expectations concerning the stability of public finance, which also usually implies higher risk premiums. A negative influence of increased supply of bonds on investment is particularly strong when the growth of interest rates contributes to a substantial decrease of investment demand. In such a situation investment becomes less profitable both due to higher interest rates and worse perspective concerning the future growth.

The permanent budget deficit causes accumulation of the public debt, and as a result increased interest payments, which in turn leads to crowding out of public spending of other types. For social and political reasons it is often difficult to reduce the social spending or the wages in the government sector. It is at the same time relatively the easiest to make reductions in the public investment expenditure, which can to a large extent affect the supply side of economy and contribute negatively to the long-run economic growth.

1.2 Influence of taxes

Tax rates affect investment mainly through the difference between the costs of capital borne by enterprises and income of the owners of capital (the tax wedge). The wedge can be divided into the part that influences savings and the tax one that directly influences investment.

Higher taxes may decrease savings mainly through:

- lower income on savings – especially as the tax base is typically the nominal income, which even under moderate inflation often means high taxation in real terms,
- lower disposable income at the times of high revenues (in the working age), i.e. in the period when savings are typically generated,[1]
- additional consumption smoothing provided by pension systems, which creates disincentives for private savings,
- insurance against loss of income – social benefits financed from taxes reduce the uncertainty about the future income (cf. Leibfritz, Thornton, Bibbee [1997], van den Noord, Heady [2002]),
- progressive taxation[2], which reduces income of the "rich" more severely than the income of the "poor", while the latter have typically lower marginal propensity to save.[3]

---

[1] According to the life-cycle theory of F. Modigliani (see, among others, in Brumberg, Modigliani [1954], Ando, Modigliani [1957]), working age is the period when income is generated, and which is used by rational consumers to accumulate savings to finance consumption at the retirement age.

[2] Beside their impact on income redistribution, progressive taxes can also exert a negative influence on labor supply, as they are typically combined with relatively high marginal tax rates. In addition, progressive tax system lowers the rate of return on human capital (taxes on lost income during the education period are lower than taxes on income in the working age). However, the elimination of tax progression can simultaneously imply that effective tax rates (which include social security benefits) will be highest for the persons who earn little (when a job is taken up, a social benefit is lost). Moreover, Leibfritz, Thornton and Bibbee [1997] point to the fact that a lower tax progression can put pressure on a wage increase, and consequently reduce the labour demand.

[3] On the other hand, income redistribution can also affect the long-run economic growth in a positive way. Due to the imperfections of the credit market, the "poor" have no access to credits to make investment in human

Research by Tanzi and Zee [1998] provide empirical support for the hypothesis of negative influence of taxation on savings. According to their results, in the OECD countries a high average tax rate (share of tax revenue in GDP) affects in a statistically significant and negative way the saving rate of households. Tanzi and Zee found that this effect is particularly strong in case of the income taxation.

Apart from its influence on savings, the rate of taxation also directly affects investment, through the higher break-even point of new investment. Under high taxes, the rate of return before taxation on marginal unit of investment must also be high, so that the predetermined rate of return after taxation can be reached. Quantitatively, according to the OECD [2000] report, an increase in tax revenue to GDP ratio by 1 percentage point entails in the long run a decrease in GDP per capita by 0.3-0.4%, through its negative influence on investment.

Finally, it should be noted that the corporate income tax rate is not the most important factor that affects the marginal profitability of investment. The latter is determined by effective taxation on investment, which usually depends on the form of financing. Debt financing is usually lower taxed than financing from accrued profit, whereas financing by means of issue of shares is usually higher taxed than the accrued income financing (cf. Leibfritz, Thornton, Bibbee [1997]).

2. A simple theoretical model

A simple theoretical model that allows to analyze an influence of budget deficit and tax rate on a capital increase is presented below. It is based on the model described by Chalk and

---

capital, even if the corresponding rate of return is high. Income redistribution increases the possibility to make investment in human capital for the less wealthy members of the society.

Tanzi [2002].[4] It assumes that the economy consists of L identical households, which maximize the utility function:

(1) $$U(c_t, c_{t+1}) = \ln c_t + \gamma \ln c_{t+1} \ ,$$

given the following constraints:

(2) $$c_t + s_t = w_t(1-\tau),$$

(3) $$c_{t+1} = R_t s_t(1-\tau),$$

where: c_t - consumption of household, w_t - real wage, R_t - return on investment, τ – tax rate (for simplicity it was assumed that the same rate is applicable to work income and savings income). The solution to the maximisation problem are the household savings:

(4) $$s_t = \frac{\gamma}{1+\gamma} w_t(1-\tau).$$[5]

The aggregate savings in the analysed economy (S_t) amount to:

(5) $$S_t = \frac{\gamma}{1+\gamma} w_t(1-\tau)L_t \ .$$

Savings can be spent on investment in real assets or on the budget deficit financing (sovereign bonds):

---

[4] Unlike in the model presented by Chalk and Tanzi [2002], it was assumed that the amount of public spending has no influence on technological progress.

[5] The adoption of the utility function as specified in equation (1) and the assumption that households generate future income only from investment implies that the amount of savings is dependent merely on a wage rate and the tax rate. The amount of savings can depend on the interest rate, given that the more general CES utility function is adopted or under an assumption that household can also have other than savings source of income in the future period. The adoption of those generalizations does not change the conclusions about the direction of influence of fiscal policy on investment.

(6) $$S_t = B_{t+1} - B_t + K_{t+1} - K_t \ ,$$

where K_t represents the real assets[6], while B_t is the amount of bonds available on the market (difference $B_{t+1} - B_t$ equals the budget deficit). Hence, it holds:

(7) $$\frac{\gamma}{1+\gamma} w_t (1-\tau) L_t = B_{t+1} - B_t + K_{t+1} - K_t \ .$$

With the standard Cobb-Douglas production function, the amount of capital and labour can be determined through the maximization of the following expression:

(8) $$\pi(K_t L_t) = K_t^{\alpha} L_t^{\beta} - w_t L_t - r_t K_t \ .$$

Thus, it holds:

(9) $$R_t = 1 + \alpha \frac{Y_t}{K_t} \ ,$$

(10) $$w_t = \beta \frac{Y_t}{L_t} \ .$$

The substitution of appropriate expression in equation (7) with (10) gives the formula:

(11) $$\frac{\gamma}{1+\gamma} (1-\tau) \beta Y_t = B_{t+1} - B_t + K_{t+1} - K_t \ ,$$

or, finally:

(12) $$K_{t+1} - K_t = \frac{\gamma}{1+\gamma} (1-\tau) \beta Y_t - (B_{t+1} - B_t) \ .$$

Hence, an increase of budget deficit or the tax rate leads to a slower capital accumulation. Hence, the fiscal policy that encompasses growth of public revenue to GDP ratio or permanent budget deficit can result in a slowdown of economic growth (lower long-run steady state growth path).

---

[6] For simplicity it was assumed that there is no capital depreciation in the model.

3. Specification of the econometric model

It should be noted that fiscal policy can exert its long-run influence on investment in two main ways. The direct impact is the acquisition of the real assets by the government (direct public investment), while the indirect channel works through its impact on private savings through the real interest rate. As the aggregate investment is determined on the capital market, the main equation is the condition of the partial equilibrium on this market in period *t*, country *i*:

$$S_{G,it} + S_{H,it} + S_{W,it} = I_{P,it} + I_{G,it}, \tag{13}$$

where S_G, S_H and S_W are, respectively, public sector savings[7], domestic private sector savings and net savings from abroad (equal to the balance on the capital account), while I_P and I_G represent investment made by the private and public sector. It should be noted that the above identity is a generalized form of equation (12), extended by the inclusion of the foreign savings, where the capital accumulation was additionally disaggregated into private and public capital.

Due to the crucial advantages of an analysis based on the stationary series, it was decided to bring the data to stationarity through dividing them by the real gross domestic product Y_{it}. For simplicity, in further transformations the subscripts *t* and *i* were omitted. The capital market equilibrium condition takes than the following form:

$$s_G + s_H + s_W = i_P + i_G. \tag{14}$$

It is assumed that all the analysed relationships can be presented in a linearized form around equilibrium. Since s_G and i_G are the economic policy variables, they can be treated as exogenous. The remaining components of savings and investment are described by the

[7] It should be noted that savings of the public sector are equal to the current surplus of the sector, i.e. the difference between current income and spending (excluding capital revenue and expenditure).

behavioural equations. According to the presented theoretical model, private savings depend on the tax rate. In addition, the generalization of the utility function (e.g. to the CRRA function) implies that savings may also depend on the interest rate. The equation of the private saving rate takes thus the form:

$$s_H = \alpha_0 + \alpha_1 r - \alpha_2 \tau + \varepsilon_\alpha , \tag{15}$$

where r represents the real interest rate, τ is the ratio of public revenue to GDP[8], while ε_α is i. i. d. random variable with zero expected value and a constant variance ($\varepsilon_\alpha : \text{I.I.D.}(0, \sigma_\alpha^2)$). The savings inflow from abroad depends on the difference between the level of domestic and world interest rate, which means that it is also a function of the interest rate. Moreover, according to the convergence hypothesis, an inflow of foreign savings should negatively depend on the level of economic development. The inflow of foreign savings can also depend on the stability of economy, as well as on its openness. Hence, the foreign savings are described by the following equation:

$$s_W = \beta_0 + \beta_1 r - \beta_2 v - \beta_3 y + \beta_4 q + \varepsilon_\beta , \tag{16}$$

where y represents the labour productivity as a ratio to the average level for the group of the developed countries, variation (standard deviation) of the price growth index was adopted as a measure of uncertainty v, while q is the measure of openness of economy equal to the sum of imports and exports in relation to GDP. Like in the previous case, ε_β is a random variable $\varepsilon_\beta : \text{I.I.D.}(0, \sigma_\beta^2)$.

The last equation necessary to determine the equilibrium of the capital market is the equation of private investment. It depends on the real interest rate, as well as on the degree of uncertainty. The equation of private investment takes thus the following form:

---

[8] The detailed information on the construction of used variables is presented in section 4.

(17) $$i_P = \gamma_0 - \gamma_1 r - \gamma_2 v + \varepsilon_\gamma ,$$

where $\varepsilon_\gamma : \text{I.I.D.}(0, \sigma_\gamma^2)$. On the basis of behavioural equations (15), (16), (17) and equilibrium condition (14) it is possible to determine the real interest rate that corresponds to the equality of savings and investment on the domestic capital market:

(18) $$r = (\alpha_1 + \beta_1 + \gamma_1)^{-1}((\alpha_0 + \beta_0 + \gamma_0) + (i_G - s_G) + (\beta_2 - \gamma_2)v + $$

$$+ \alpha_2 \tau + \beta_3 y - \beta_4 q + (-\varepsilon_\alpha - \varepsilon_\beta + \varepsilon_\gamma)).$$

If the capital market remains in equilibrium, the aggregate investment rate in a given economy $i = i_P + i_G$, corresponding to the real interest rate (18), equals to:

(19) $$i = \delta_1 \delta_2 + i_G + \delta_1 (s_G - i_G) - ((1 - \delta_1) + \delta_1 \gamma_2) v - \delta_1 \alpha_2 \tau - \delta_1 \beta_3 y + \delta_1 \beta_4 q + \varepsilon ,$$

where $\delta_1 = \gamma_1 / (\alpha_1 + \beta_1 + \gamma_1)$ and $\delta_2 = \alpha_0 + \beta_0 + \gamma_0 (1 - 1/\delta_1)$. Private investment rate is then given by:

(20) $$i_P = \delta_1 \delta_2 + \delta_1 (s_G - i_G) - ((1 - \delta_1) + \delta_1 \gamma_2) v - \delta_1 \alpha_2 \tau - \delta_1 \beta_3 y + \delta_1 \beta_4 q + \varepsilon ,$$

It is worth to note that the expected value of the random variable $\varepsilon = \delta_1 \varepsilon_\alpha + \delta_1 \varepsilon_\beta + (1 - \delta_1) \varepsilon_\gamma$ equals 0.

4. Data and estimation methods

The estimation of parameters of the reduced form (20) was performed basing on the panel data of 27 countries – European Union member states (with exception of Hungary and Cyprus[9]) and Norway, the USA, Canada, Australia, New Zealand and Japan. The sample covers the years 1960-2003, while the time series are usually shorter due to the problems with

[9] The reason for the exclusion of these countries from the sample was in both cases the unavailability of long enough time series of data about the level of income and the balance of the public finance sector.

availability of comparable data, especially for earlier periods. All information is taken from the Ameco database provided by the European Commission.

Typically for the panel data the variation in time provides mainly the information concerning short-term relationships, while the variation over the cross-sections is more useful for analyzing the information about the long-run relationships (see Kennedy [2003]). However such an approach is justified primarily for the typical panels with a considerable number of cross-sections and relatively short time dimension. In the considered case, the time series that cover in some cases over 40 years can also provide valuable information about the existing long-run relationships. Because of this, it seems appropriate to use estimators that make use of both cross-sectional and time variation, such as least squares or random effects .

The direct use of such estimators to estimate the parameters of equation (20) using the annual data could be justified only when the capital markets remain in equilibrium also in the short run, or when the deviations from equilibrium are white noise. As is it unlikely to be the case, a method is required that allows for separating the long-run developments from short-run (cyclical) fluctuations. In this article, it was decided to use a relatively simple method, which is to use multi-annual averages. It bases on the assumption that short-run deviations from equilibrium have an expected value of 0, hence means calculated for sufficiently long periods are (almost) free from cyclical effects.

The key problem here is to determine the length of periods to calculate means. In the ideal case, the length of the period should correspond to the length of the business cycle, since the influence of the cyclical fluctuations is then equal to 0. A difficulty lies in the fact that the length of the cycle is at best stochastic, while in some extreme cases (like in the real business cycle theory), any regularity cycles is questionable. At the same time, however, it seems that there is some consensus in empirical research concerning the fact that cyclical fluctuations can be observed, with the length of the full cycle ranging from two to ten years. From the

statistical point of view, the strongest filtering effect can be achieved by using possibly long periods. However, when doing so, an effective number of observations that can be subject to an econometric analysis, is severely decreased. In addition, the willingness to include in the analysis the post-transition countries reduces automatically the length of the period, as the number of comparable annual data for these countries rarely exceeds 10. As there is a need for compromise between both requirements, it was decided to base the analysis on averages calculated for eight-year periods. It totals to 60 panel observations, while the length of time series ranges from 1 (one eight-year period) in case of Central and Eastern European countries to 4-5 (32-40 years) for the majority of developed countries.

The investment rates of the private sector (i_P) and the public sector (i_G) used for estimation are mean investment rate calculated as the ratio of investment in nominal values to nominal GDP. A surplus of the public finance sector (s_G-i_G) was calculated as a mean of the ratio of the total surplus of the public sector calculated according to the ESA'95 methodology, to GDP. The variability of the price growth index (v) was calculated as a standard deviation (within the eight-year period) of the growth rate of GDP deflator. The average ratio of public revenue (according to ESA'95) to GDP was used as a measure of average tax rate (τ). An index of the relative level of economic development (y) was calculated as the relationship of GDP per worker expressed in ECU/Euro to the average level of this measure in the group of five developed countries that consists of the United States, Japan, Great Britain, France and Germany. The variable representing the degree of the openness of economy is equal to eight-year average of the half of the sum of exports and imports in relation to GDP.

In order to estimate parameters of the static models based on the panel data, the following three types of estimators are typically used: least squares, random effects and fixed effects estimator. The use of the first one usually bases on the relatively strong assumptions – it requires assuming that equation parameters in the sample are the same, and additionally that

the error term in the entire panel comes from the same distribution, which in the discussed case seems to be questionable.

The use of fixed effects estimator allows for constant varying across countries, while an assumption that the error term comes from the same distribution for each observation is maintained. Kennedy [2003] points to a serious drawback of this estimator – the information that comes from the cross-sectional variance is ignored, which can lead to underestimating the effects that are long-run by nature. As the analysis presented in this paper concentrates mainly on such effects, the use of random effects estimator seems to be a better solution. Using this estimator means estimating with the generalized least squares method, allowing for different variance of the error term between the countries. Consequently, the panel-corrected standard errors to calculate the t-Student statistic were also used (cf. Beck and Katz [1995]).

5. Empirical results

The results of estimation of parameters of equation (20) are shown in column (I) of Table 1. Below the equation parameters, the t-Student statistics are presented (in italics).

In estimation (I) the parameter beside surplus of the public finance (estimate of δ_1) takes the value of 0.27, and is statistically significant. It shows that growth of the current surplus of the sector by 1% of GDP results in an increase of aggregate investment by 0.27% of GDP on average. This also means that the growth of public sector investment by 1% of GDP entails an increase in aggregate investment by 0.73% of GDP, if it is financed by growth of deficit. The fact that the aggregate growth of investment is lower than the growth of public investment results from the partial crowding out of the private sector investment. In the case when growth of public investment is accompanied by an equal increase in the current surplus of the public

sector, this results in similar growth of aggregate investment, which implicitly results from equation (19)).[10]

Table 1 The results of parameter estimation of the equation of investment rate

Estimation	(I)	(II)	(III)	(IV)
Dependent variable	i_P	i_P	i_P	i_P+i_G
Constant	0.277*** *10.194*	0.292*** *10.938*	0.304*** *9.989*	0.307*** *9.921*
Surplus of p.f.s.+ (s_G-i_G)	0.270*** *3.666*	0.240*** *3.403*	0.249*** *3.412*	0.215*** *2.934*
Public investment (i_G)	x	x	x	0.839*** *5.764*
Public revenue (τ)	-0.177*** *-3.290*	-0.198*** *-3.662*	-0.204*** *-3.660*	-0.212*** *-3.685*
Price variability (v)	0.097 *1.496*	0.063 *1.160*	0.072 *1.360*	0.077 *1.467*
Level of development (y)	-0.027* *-1.988*	-0.022 *-1.610*	-0.034** *-2.309*	-0.028* *-1.789*
Openness of economy (q)	0.034 *1.601*	0.026 *1.339*	0.036** *2.017*	0.034* *1.839*
USA, UK, Ireland dummy variable	x	-0.049*** *-5.003*	-0.052*** *-5.248*	-0.053*** *-5.063*
Developing countries dummy variable	x	x	-0.017 *-0.836*	-0.012 *-0.568*
R^2	0.736	0.804	0.807	0.854
Adj. R^2	0.712	0.782	0.781	0.831
Std err. of residuals	0.011	0.012	0.012	0.012
F-statistic	30.122	36.242	31.004	37.282
d-w statistic	1.889	1.808	1.826	1.595

Source: calculations based on the data of the European Commission;
+ p.f.s. - public finance sector;
//*** - parameter different from 0 on the significance level of 10%, 5% and 1%, respectively.*

The results of estimation also show that the size of the public sector (measured by the ratio of public revenue to GDP) has a statistically significant impact on the investment rate. An increase revenue of the public sector by 1% of GDP causes an investment decrease by 0.18%

[10] In the described case, the total deficit of public finance does not increase. In such situation, the interest rate remains unchanged, which gives no place for the crowding-out of private investment by the public investment.

of GDP, which supports the hypothesis of the negative influence of high average tax rate on ability to accumulate capital.

The index of price variability turned out to be statistically insignificant and the estimated coefficient has a different sign than expected. The level of development measured by the relationship of labour productivity in a given country to average labour productivity in the group of five large developed countries turned out to be significant factor at the significance level of 0.1 is. The respective point estimate suggests that an increase in relative labour productivity by 10 percentage points leads to a decrease in the investment rate by 0.27 percentage points. Such observation is consistent with one of the convergence hypotheses, according to which along with an increase of capital-to-worker ratio, which is usually accompanied by the growth of labour productivity, both the marginal product of capital and the investment rate decrease.

A variable whose influence cannot be statistically confirmed based on the results of estimation, is the openness of economy. However, if the results of point estimation are correct, the higher openness, measured by simultaneous increase in imports and exports by 1% of GDP, leads to increase of investment by ca. 0.03% of GDP.

The analysis of residuals obtained from the estimation (I) showed that a group of countries, including the United States, Great Britain and Ireland, is characterised by substantial, remarkably higher than in the remaining countries, negative residuals of the similar size, relatively invariant within the analysed period. Hence, a dummy variable was incorporated into the model that takes value of 1 for these countries and 0 in the remaining cases,. The results of estimation performed with this variable included among the regressors are presented in column (II) in Table 1. This change brought about a considerable increase in R^2 (both standard and adjusted), as well as some minor changes in the estimates of the parameters. The most important ones are the weaker impact of the fiscal surplus (change of parameter from

0.27 to 0.24) and a small increase of estimates of the impact of the size of the public sector (increase from 0.18 to almost 0.20). The introduced dummy variable turned out to be different from 0 in a statistically significant way, and its value shows that in the mentioned group of countries the investment rate is, *ceteris paribus*, by 4.9 percentage points lower than in the remaining countries.

As an additional step, an attempt to verify the hypothesis concerning a different level of investment rates in developing countries was undertaken. For this purpose, a dummy variable that takes the value of 1 for the new European Union member countries, as well as for Bulgaria, Romania, Turkey, Korea and Mexico, and the value of 0 in the remaining cases, was introduced into the equation as a regressor. The results are presented in Table 1, column (III). The estimate of the respective parameter shows that in these countries investment rates are by 1.7% of GDP lower an average than in the developed countries. At the same time, the considerable standard error of estimation does not allow to reject the null hypothesis that there is no difference between the two groups of countries. However, it should be noted that the effect can reveal in the values of another variable – a relative labour productivity. The lack of statistical significance of both variables can result from the multicollinearity problem . For the purpose of verification of the respective hypothesis , the Wald statistic for testing the null hypothesis of no influence of both variables was calculated. The value of statistic is ca. 2.8, which allows rejecting the null hypothesis at the 10% significance level.

Finally, it is worth noting that estimation of the model (20) means imposing restrictions on the parameter measuring the impact of the investment rate of the public sector (in form (19) it has to be equal $(1-\delta_1)$, while in form (20) it has to be equal $(-\delta_1)$). Hence, there is a need to verify the validity of this restriction. In order to run an appropriate test, the parameters of equation (19) were estimated. It should be stressed that the parameter measuring the influence of the investment rate of the public sector on the aggregate investment rate was also subject to

estimation. The results are presented in Table 1, column (IV). If the imposed restriction is consistent with the data, the parameters measuring impact of the fiscal balance and the public investment should sum up to 1. In order to verify this hypothesis, the Wald statistic was used again. Its calculated value was 0.095, which means there is no reason to reject the restriction at any of the commonly used significance levels.

6. Conclusions

The analysis presented in this article investigates the impact of fiscal policy on the investment rate. The described theoretical model suggests that there are potential mechanisms implying that both the budget deficit and the size of the public sector may exert impact on investment and thereby affect the long-run economic growth. In order to verify the existence of such a relationship, an econometric analysis based on an unbalanced panel of 27 countries in years 1960-2003 was used. In order to focus analysis on the long-run developments and remove the cyclical effects, the estimates base on the eight-year averages. The analysis shows a statistically significant negative impact of fiscal deficit on the investment rate – increasing the deficit by 1% of GDP results in decrease of investment by 0.3% of GDP. The average tax rate (ratio of public revenue to GDP) also shows a statistically significant negative correlation with investment. An increase of this variable by 1 percentage point results in investment decrease by 0.2% of GDP. These results turn out to be relatively stable and are robust to changes of specification. The presented analysis suggests that permanently expansionary fiscal policy, as well as large public sector, tend to limit the ability to accumulate capital and can lead to slower economic growth in the long run.

References:

Ando, Alberto, Franco Modigliani, 1957, *Tests of the Life Cycle Hypothesis of Savings*, „Bulletin" vol. 19, May 1957, Oxford University, Institute of Economics and Statistics

Brunila, Anne, 2002, *Gauging Ricardian Equivalence*, in: "The Behaviour of Fiscal Authorities. Stabilization, Growth and Institution", edited by M. Buti, J. von Hagen, C. Martines-Mongay, Palgrave, New York.

Barro, Robert, 1974, *Are Government Bonds Net Wealth?*, Journal of Political Economy 82, p. 1095-1117

Beck Nathaniel, Jonathan N. Katz, 1995, *What to Do (and Not to Do) With Time-series Cross-section Data*, American Political Science Review, 89(3), 634-647

Bernheim B. D., 1987, *Ricardian Equivalence: An Evaluation of Theory and Evidence*, NBER Macroeconomics Annual, Vol. 2

Brumberg Robert, Franco Modigliani, 1954, *Utility Analysis and the Consumption Function*, in: Kurihara K., *Post Keynesian Economics*, Rutgers University Press, Brunswick, N. J.

Chalk, Nigel, Vito Tanzi, 2002, *Impact of Large Public Debt on Growth In the EU: A Discussion of Potential Channels*, in: "The Behaviour of Fiscal Authorities. Stabilization, Growth and Institution", edited by M. Buti, J. von Hagen, C. Martines-Mongay, Palgrave, New York.

Deveri, Francesco, Guido Tabellini, 1997, *Unemployment, Growth and Taxation in Industrial Countries*, typescript

Hiebert, Paul, Ana Lamo, Diego Romero de Avila, Jean-Pierre Vidal, 2002, *Fiscal Policies and Economic Growth in Europe: An Empirical Analysis*, in: "The Impact of Fiscal Policy", Banca d'Italia, Rome

Kennedy P., 2003, *A Guide To Econometrics*, Blackwell Publishing, Oxford

Hubbard R. G., Judd K. L., 1986, *Liquidity Constraints, Fiscal Deficit and Consumption*, Brookings Papers on Economic Activity, No 1: 1-50

Lamo, Ana, Rolf Strauch, 2002, *The Contribution of Public Finances to the European Growth Strategy*, in: "The Impact of Fiscal Policy", Banca d'Italia, Rome

Leibfritz, Willi, John Thornton, Alexandra Bibbee, 1997, *Taxation and Economic Performance*, OECD Economics Department Working Papers No. 176

Loewenstein G., Thaler R. H., 1989, *Anomalies: Intertemporal Choice*, Journal of Economic Perspectives, Vol. 3: 181-193

OECD, 2000, *Links Between Economy and Growth – Cross Country Evidence,* OECD Economic Outlook 68

Romer David, 2000, *Makroekonomia dla zaawansowanych* [Macroeconomics for advanced learners], PWN, Warszawa

Tanzi, Vito, Howell H. Zee, 1998, *Taxation and the Household Saving Rate: Evidence from OECD Countries*, IMF Working Paper WP/98/36

Tobin J., 1980, *Asset Accumulation and Economic Activity*, University of Chicago Press, Chicago

van den Noord, Paul, Christopher Heady, 2002, *Tax Design, Economic Efficiency and Growth*, in: "The Impact of Fiscal Policy", Banca d'Italia, Rome