ANNEXES

ANNEX 1. Factors that determine investment

Introduction

Investment is an important part of total expenditure. In Lithuania, investment comprises around 21 per cent of the country's GDP on average. It is also an important factor of the country's labour productivity, competitiveness and economic growth in the long term. Therefore, it is important to find out what determines investment changes. In this Annex, the linear regression method is used to analyse which variables have an impact on business investment in Lithuania and what share of investment fluctuations may be explained by the variables applied. Before that the annex discusses the most popular theoretical models of investment (accelerator, neoclassical, cash flow and Tobin's Q model), which are used as a foundation for applying the linear regression to research the factors explaining investment fluctuations. The Annex also reviews scientific articles, which mention variables explaining investment changes that are not related to the main investment theories.

Theories explaining investment changes

The accelerator theory model (Chenery 1952; Knox 1952) relates investment growth to the rise in production demand, i.e. when production demand grows, enterprises invest in order to increase production volumes. This model is simple and intuitive, however, it has shortcomings. Richard S. Brauman and Richard W. Kopcke (2001), who investigated various investment models, stated that the simple structure of the accelerator model works best when production changes smoothly and does not fluctuate much, however, the model's accuracy deteriorates in the presence of strong economic fluctuations. The view that investment mostly depends on demand factors is not contradicted by the private investment analysis performed by the IMF, which shows that the main reason for poor private investment in developed countries in recent years is low economic activity (IMF 2015). The IMF mentions public investment in important infrastructure objects, which increases demand in the short term, as one of the factors that may encourage private investment.

The model based on neoclassical theory (Jorgenson 1963, 1971) supplements the accelerator theory with the price of investment goods, interest rates and taxes. The model is based on the assumption that with the rise in production demand enterprises increase production supply in order to increase profit, taking into account other production factors. According to Richard S. Brauman and Richard W. Kopcke (2001), the neoclassical model is attractive, because it attempts to establish the optimum amount of capital on the basis of criteria that are important in the investment environment — return on equity and the cost of capital.

According to Tobin's Q theory (Tobin 1969), an enterprise's investment dynamics is explained by the ratio of the market value of the enterprise (which is most often calculated on the basis of stock exchange data, if the firm is quoted on the stock exchange) and the enterprise's balance sheet value. If the enterprise's value in financial markets is higher than the enterprise's balance sheet value, it may increase its value by acquiring more assets. If the enterprise's value in financial markets is lower than its balance sheet value, then the enterprise should invest less. Tobin's Q theory relates financial markets to the real sector: the rising stock value of enterprises encourages them to invest. Robert J. Barro (1990) suggested using stock price as an independent variable instead of Q. He states that stock price better reflects the expectations regarding future profitability of the enterprise's investment projects than the variable proposed by Tobin's Q theory. Still, informativeness of variables related to financial markets in explaining investment fluctuations in Lithuania is doubtful — the country's stock market is quite small and reflects the situation in a small part of enterprises only.

Contrary to the models discussed above, the cash flow model was created in order to evaluate the importance of various investment financing sources: cash flows, new loans and newly issued equity capital. John R. Meyer and Edwin Kuh (1957) paid attention to the fact that the enterprises that have large internal financial resources are more inclined to invest. Still, after Franco Modigliani and Merton H. Miller (1958) published the theory that the enterprise's financing structure does not determine its value when efficient capital markets are present, the research of the interaction between profit and investment was abandoned. According to F. Modigliani and M. H. Miller (1958), in efficient markets, enterprises can easily borrow, issue equity securities and finance their activities from their own internal resources (allocate profits to owners in the form of dividends or reinvest), whereas the manner of borrowing should not affect their value.

When the academic literature started to discuss market imperfections, attention wasonce again turned towards the importance of profit when taking investment decisions. Steven M. Fazzari et al. (1987) provided evidence that there are financial market imperfections, in the presence of which it is easier for a part of enterprises to finance their activities by using internal resources than to search for external resources, i.e. to borrow or to issue new stocks. This determines the fact that their investment decisions are limited by available internal resources. Economists analysing investment dynamics also indicate other factors that may explain investment growth significantly. For example, large financial leverage and the related financial risk and financial restrictions may subdue the inclination of enterprises to invest (Vermeulen 2002; Jaeger 2003; Diron and other 2005), whereas the link between investment and financial leverage may become stronger during financial tension periods. According to Philip Vermeulen (2002), the balance sheet quality of enterprises when taking investment decisions becomes more important during periods of recession. Marie Diron et al. (2005) stated that the link between business investment and balance sheet indicators of enterprises is significant only in certain periods, which are

related to recession, or when relative debt indicators increase substantially.

Among other factors that may affect investment, political uncertainty and uncertainty about the economic growth should be mentioned — they are associated by enterprises with risk and deter them from investment. Alan Carruth (2000) reviewed the research studies evaluating investment uncertainty and concluded that in most cases its negative effect on investment is statistically significant. Nicholas Bloom (2009) used the model that allows researching the effect of uncertainty and proved that even small uncertainty shocks may force enterprises to temporarily suspend hiring of new employees and new investment.

Engelbert Stockhammer and Lucas Grafl (2010) researched business investment changes and financial uncertainty (changes of stock indices, exchange rates and gold prices) and concluded that it significantly affects investment in the countries, where financial markets are more integrated. Ryan Banerjee et al. (2015) researched poor investment growth in major advanced economies in recent years and concluded that profit expectations are an important factor defining investment. According to these researchers, higher uncertainty about the future reduces profit expectations; therefore, enterprises invest less, whereas poor investment growth in Europe in recent years could be a consequence of economic uncertainty. The above-mentioned IMF article indicates uncertainty of political decisions, restrictions of political decisions and financial restrictions of enterprises, especially those that are dependent on external financing, as factors that may subdue investment.

Research of factors determining investment fluctuations in Lithuania

When researching what determines investment in Lithuania, the data for the period from the first quarter of 1997 to the second quarter of 2014 are used. Investment is modelled by applying linear regression. Models include differentials of natural logarithms. All models comply with the assumptions raised for linear regressions: normal distribution of investment data[10], compliance of residuals of regressions with homoscedasticity requirements[11] and stationary data series.[12] Seasonally and working day adjusted data at constant prices are used for the analysis.

Investment is modelled as gross fixed capital formation in the sectors of non-residential buildings and infrastructure as well as transport equipment and other machinery and equipment. It is expected that these data series are related to investment by business enterprises to the largest extent. Lagged GDP data (which are likely to reflect production demand), investment (which are likely to reflect the changes in capital resources), interest rates (which are likely to reflect capital costs), the share of profitable enterprises and overall profitability of enterprises (which are likely to reflect cash flows of enterprises) are used as independent variables. The data used are indicated in Table A.

Table A. Data used in the analysis

Variable	Explanation
Investment	Gross fixed capital formation, excluding residential buildings and cultivated resources (includes other buildings and infrastructure, transport equipment, other machinery and equipment), at constant prices, seasonally and working day adjusted
GDP	GDP at constant prices, seasonally and working day adjusted
Interest	3-month interbank interest rate VILIBOR, CPI-deflated*
Share of profitable enterprises	Share of profitable enterprises, compared to the total number of enterprises, seasonally adjusted**
Profitability	Overall profitability of enterprises (gross profit to income ratio), seasonally adjusted**
CPI	Consumer Price Index

Source: compiled by authors.

* *Real interest rate* $= \frac{(1 + Nominal\ interest\ rates)}{(1 + Inflation\ over\ the\ last\ 12\ months)} - 1;$

** *Adjusted by applying Census X13 procedure.*

In order to establish factors determining investment, six models were selected. Model 1 was created on the basis of the accelerator theory, according to which investment depends on production demand and available capital resources. Models 2 and 3 are based on the neoclassical theory, according to which investment is affected by capital costs, whereas Models 4–6 were created taking into account the variables that reflect cash flows. The results of the application of regressions (see Table B) do not contradict either the accelerator theory or the cash flow theory; however, they are not favourable to the neoclassical theory. Variables that describe production demand growth (ΔBVP) are statistically significant and positive. Accordingly, a part of variables describing cash flows (share of profitable enterprises and profitability) are statistically significant and positive. Interest rates are among the statistically significant variables that explain investment; however, statistical significance of this variable varies and decreases when other variables are introduced in the models. Lagged investment is not a statistically significant variable in most regression equations.

According to model 1, the GDP growth is, with a statistically significant positive link, related to investment of the nearest four quarters. 1 p.p. faster GDP growth is linked to 1.24 per cent higher investment in the nearest quarter. In the

[10] Shapiro-Wilk test was used.
[11] Breusch-Pagan and non-constant variance score tests were used.
[12] Extended Dickey and Fuller as well as Phillips-Perron criteria were used.

long term, 1 p.p. GDP growth change is linked to 9.45 per cent higher investment at a 1 per cent significance level. The accelerator based model explains only slightly more than one third of investment fluctuations. The adjusted coefficient of determination amounts to 0.35.

Table B. Results of the application of regressions

Variable	Investment					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient
ΔBVP $_{t1}$	1.24***		1.16***			
	(0.00)		(0.01)			
ΔBVP $_{t2}$	1.70***		1.52***			
	(0.00)		(0.01)			
ΔBVP $_{t3}$	1.86***		1.55***			
	(0.00)		(0.01)			
ΔBVP $_{t4}$	1.82***		1.47***			
	(0.00)		(0.00)			
Interest $_{t1}$		–0.13***	–0.07			–0.05
		(0.01)	(0.17)			(0.28)
Interest $_{t2}$		–0.08*	–0.05			–0.04
		(0.09)	(0.27)			(0.32)
Interest $_{t3}$		–0.01	–0.02			0.01
		(0.77)	(0.71)			(0.75)
Interest $_{t4}$		0.01	0.02			0.08*
		(0.81)	(0.69)			(0.09)
Profitable enterprises $_{t1}$				0.92***	0.85**	0.94**
				(0.01)	(0.02)	(0.02)
Profitable enterprises $_{t2}$				0.72**	0.75**	0.59*
				(0.02)	(0.02)	(0.09)
Profitable enterprises $_{t3}$				0.57*	0.53	0.54
				(0.07)	(0.11)	(0.12)
Profitable enterprises $_{t4}$				0.11	0.27	0.30
				(0.76)	(0.47)	(0.44)
Profitability $_{t1}$					0.07	0.13
					(0.77)	(0.60)
Profitability $_{t2}$					0.36	0.38
					(0.16)	(0.13)
Profitability $_{t3}$					0.25	0.19
					(0.29)	(0.42)
Profitability $_{t4}$					0.44*	0.40*
					(0.07)	(0.08)
Investment $_{t1}$	0.17	0.19	0.10	–0.04	–0.10	–0.12
	(0.16)	(0.17)	(0.44)	(0.76)	(0.51)	(0.39)
Investment $_{t2}$	–0.04	0.06	–0.01	–0.13	–0.14	-0.08
	(0.76)	(0.68)	(0.91)	(0.34)	(0.31)	(0.56)
Investment $_{t3}$	0.04	0.15	0.09	–0.01	–0.03	0.03
	(0.72)	(0.28)	(0.47)	(0.97)	(0.84)	(0.79)
Investment $_{t4}$	0.13	0.14	0.20	0.19	0.16	0.23*
	(0.28)	(0.30)	(0.12)	(0.14)	(0.21)	(0.10)
Constant	0.01	–0.01	0.00	0.00	0.01	0.00
	(0.40)	(0.51)	(0.99)	(0.63)	(0.59)	(0.78)
Number of observations	62	62	62	62	62	62
Adjusted R^2	0.35	0.20	0.34	0.38	0.41	0.44

Source: Bank of Lithuania calculations.
Note: p — value in brackets; *t* — the number of laggs in respective quarter.
*p < 0,1;
**p < 0,05;
***p < 0,01;

Model 2, based on neoclassical theory, explains only one fifth of investment fluctuations. The adjusted coefficient of determination amounts to 0.20. According to this model, interest rates are, with a statistically significant (1% significance level) negative link, related to higher investment in the nearest quarter and with a statistically significant (10% significance level) negative link to investment after two quarters. 1 per cent higher interest rates are linked to 0.13 per cent lower investment in the nearest quarter. In the long term, the respective increase is linked to 0.48 per cent lower investment at a 10 per cent significance level.

Model 4, based on cash flows, explains investment better than the above-mentioned models; however, more than half of investment fluctuations still remain unexplained. The adjusted coefficient of determination amounts to 0.38. According to model 4, the number of profitable enterprises, compared to the total number of enterprises is statistically significantly (5% significance level) positively linked to investment in the nearest two quarters and statistically significantly (10% significance level) positively linked to investment after three quarters. 1 per cent higher share of profitable enterprises is linked to 0.92 per cent higher investment in the nearest quarter and 2.35 per cent higher investment in the long term at a 5 per cent significance level.

Conclusions

Summarising the results obtained, we cannot reject the assumption that demand factors, which are underlined by the accelerator and cash flow models, have an effect on investment in Lithuania, i.e. economic activity and cash flows of enterprises affect investment by enterprises. We cannot reject the possibility that investment is affected by capital costs as well, i.e. enterprises invest relatively more when interest rates are lower. However, the model based on capital costs gave the poorest explanation of investment fluctuations, whereas interest rates were not a statistically significant variable in other models. The analysis also did not show a link between investment in the current period and in the nearest period. Moreover, the selected models fail to explain a large part of investment fluctuations, most likely because the models do not include certain additional factors that may explain investment, for example, variables reflecting financial restrictions of enterprises or uncertainty of the economic environment.

References

Banerjee, R., Kearns, J. & Lombardi, M. J. (2015). "(Why) is Investment Weak?", BIS Quarterly Review, March 2015.

Barro, R. J. (1990). "The Stock Market and Investment", *Review of Financial Studies* 3(1), p. 115–131.

Bloom, N. (2009). "The Impact of Uncertainty Shocks", *Econometrica* 77(3), p. 623–685.

Brauman, R. S. & Kopcke R. W. (2001). "The Performance of Traditional Macroeconomic Models of Businesses' Investment Spending", *New England Economic Review* 2, p. 3–39.

Carruth, A., Dickerson, A., & Henley, A. (2000). "What Do We Know About Investment Under Uncertainty?", *Journal of Economic Surveys* 14(2), p. 119.

Chenery, H. B. (1952). "Overcapacity and the Acceleration Principle", *Econometrica* 20(1), p. 1–28.

Diron, M., Manzano, M. C. & Westermann, T. (2005). "Forecasting Aggregate Investment in the Euro Area: Do Indicators of Financial Conditions Help?", Bank for International Settlements, Working Paper.

Fazzari, S., Hubbard, R. G. & Petersen, B. C. (1987). "Financing Constraints and Corporate Investment", National Bureau of Economic Research, Working Paper.

IMF 2015. "Private Investment: What's the Holdup? World Economic Outlook: Uneven Growth — Short- and Long-Term Factors", April, p. 111–143.

Jaeger, M. A. (2003). "Corporate Balance Sheet Restructuring and Investment in the Euro Area", International Monetary Fund, Working Paper.

Jorgenson, D. W. (1963). "Capital Theory and Investment Behavior", *The American Economic Review* 53(2), p. 247–259.

Jorgenson, D. W. (1971). "Econometric Studies of Investment Behavior: A Survey", *Journal of Economic Literature* 9(4), p. 1111–1147.

Knox, A. (1952). "The Acceleration Principle and the Theory of Investment: A Survey," *Economica* 19, p. 269–297.

Meyer, J. R. & Kuh, E. (1957). "The Investment Decision: An Empirical Study", Reviewed Work.

Modigliani, F. & Miller, M. H. (1958). "The Cost of Capital, Corporation Finance and the Theory of Investment", *The American Economic Review* 48, p. 261–297.

Stockhammer, E. & Grafl, L. (2010). "Financial Uncertainty and Business Investment", *Review of Political Economy* 22(4), p. 551–568.

Tobin, J. (1969). "A General Equilibrium Approach to Monetary Theory", *Journal of Money, Credit and Banking* 1(1), p. 15–29.

Vermeulen, P. (2002). “Business Fixed Investment: Evidence of a Financial Accelerator in Europe”, *Oxford Bulletin of Economics and Statistics* 64(3), p. 213–231.