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Balance Sheet Theory During COVID-19: The Relationship Between Cash Flow and Investment in Polish Listed Companies*

Weryfikacja teorii kanału bilansowego podczas pandemii COVID-19: relacja pomiędzy przepływami pieniężnymi a inwestycjami polskich spółek giełdowych

Abstract

The aim of this paper is to verify the theory of the balance sheet channel among Polish listed companies, especially during the COVID-19 pandemic period. This objective was achieved by examining the relationship between cash flow and investment, based on an Emerging Markets Information Services (EMIS) database covering companies listed on the Warsaw Stock Exchange, including the bourse's alternative NewConnect market, and using panel econometric models (pooled OLS, Fixed Effect Model, Random Effect Model and Panel VAR). It has been established that there are no grounds to reject the hypotheses that investment is positively associated with the cash flow of Polish listed companies and that the relationship between investment and cash flow is particularly strong for financially constrained companies. This means that there is evidence in support of the balance sheet channel theories. The hypothesis that the relationship between cash flow and investment is especially strong for financially constrained companies during the COVID-19-induced recession has been rejected. The main novelty of the paper is that the balance sheet channel theory was verified for Polish listed companies, with a particular emphasis on the COVID-19 pandemic period.

Keywords:
COVID-19, cash flow, corporate investment, financial constraints, pVAR

JEL classification codes:
D90, E22, G31

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Streszczenie

Celem artykułu jest weryfikacja teorii kanału bilansowego wśród polskich spółek giełdowych – szczególnie w okresie pandemii COVID-19. Został on zrealizowany przez zbadanie relacji pomiędzy przepływami pieniężnymi a inwestycjami. Na podstawie sprawozdań finansowych pochodzących z bazy danych Emerging Markets Information Services (EMIS) dotyczących spółek notowanych na Giełdzie Papierów Wartościowych w Warszawie i NewConnect z wykorzystaniem panelowych modeli ekonometrycznych (pooled OLS, Fixed Effect Model, Random Effect Model oraz Panel VAR) stwierdzono, że nie ma podstaw do odrzucenia hipotezy,

Słowa kluczowe:
COVID-19, przepływy pieniężne, inwestycje korporacyjne, ograniczenia finansowe, pVAR

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że inwestycje są dodatnio skorelowane z przepływami pieniężnymi polskich spółek giełdowych, a związek między inwestycjami a przepływami pieniężnymi jest szczególnie silny w przypadku spółek z ograniczeniami finansowymi. Oznacza to, że istnieją elementy potwierdzające teorię kanału bilansowego. Hipoteza mówiąca o tym, że relacja występująca pomiędzy inwestycjami a przepływami pieniężnymi jest szczególnie wzmocniona w przypadku przedsiębiorstw o ograniczonych możliwościach finansowych podczas pandemii COVID-19, została odrzucona. Niniejszy artykuł stanowi wypełnienie luki w literaturze przedmiotu dotyczącej analizowanego zagadnienia.

Introduction

The balance sheet channel on the investment side is the way in which monetary policy influences a company's balance sheet, thereby affecting possibilities for external financing and further investment to be achieved (see, e.g., **Bernanke, Gertler** [**1989**, **1995**], **Bondt** [**2004**], **Masuda** [**2015**], **Mohd, Yunus** [**2015**], **Malinowska** [**2016**], **Peydró et al.** [**2020**]).

The COVID-19 pandemic has not only seen the suffering of many people, but also serious disruptions in the economy. These have led to a sharp drop in profits for most businesses [**OECD, 2021**]. While a slowdown in economic growth was already evident in global industry in 2019, the COVID-19 pandemic has exacerbated this crisis. During this period of forced decline in economic activity, the financing of investment projects with the help of bank lending decreased, while financing on the basis of enterprises' own funds increased. At that time, Poland's Ministry of Funds and Regional Policy (MFiPR) joined Bank Gospodarstwa Krajowego (BGK) in encouraging enterprises to invest, in the context of financing via a loan for technological innovation under the European Union's Smart Growth Operational Programme (POIR)[1]. Data from the Statistics Poland agency showed that gross fixed capital formation in the country decreased by 8.4%[2] in 2020. Investment is thus regarded as a "barometer of crisis" in the economy.

The aim of this study is to test the theory of the balance-sheet channel among Polish listed companies during the COVID-19 pandemic. These goals were addressed by exploring investment-cash flow sensitivity (ICFS), or the relationship between cash flow and investment in fixed assets. Investment is defined here as the purchase of property, plant, equipment and intangible assets divided by property, plant and equipment.

In the empirical section of this article, use was made of data compiled from financial statements retrieved from the database of the Emerging Markets Information Services (EMIS), and focusing on companies listed on the Warsaw Stock Exchange, including its NewConnect alternative trading market. The inclusion of the NewConnect market is a major contribution of this article as the research was not confined to large public enterprises, but also included smaller, developing businesses.

Three research hypotheses are formulated here:

H1: The investment rate is *associated positively* with the cash flow (as a proxy for the net worth or balance-sheet strength) of Polish listed companies;

H2: The positive relationship between the investment rate and cash flow is more pronounced when firms face financial constraints.

In line with the balance-sheet theory, it should be expected that investment by companies with financial constraints is more sensitive to cash flows than investment by companies that do not have such constraints. The research results confirm previous findings in the literature review, but are based on a dataset that includes relatively smaller companies.

1 https://www.bgk.pl/male-i-srednie-przedsiebiorstwa/inwestycje/finansowanie-ze-srodkow-unijnych/kredyt-na-innowacje-technologiczne/ (accessed on 12.04.2022).

2 https://stat.gov.pl/wyszukiwarka/?query=tag:nakłady+brutto+na+środki+trwałe (accessed on 12.04.2022).

H3: The investment-cash flow sensitivity (ICFS) level has been significantly greater during the recession triggered by COVID-19.

More specifically, the relationship between investment and cash flow in constrained companies should be much stronger in a period of recession than in a non-recessionary period. This implies that financial constraints are of greater importance in periods characterised by unfavourable economic conditions.

This paper makes various contributions to the subject literature. Following an analysis of the literature on financial constraints and investment decisions (where the relationship between investment and cash flow for listed companies was considered by **Tyrowicz [2009]** and **Nehrebecki [2020]**), the study considers the relationship between investment and cash flow during the pandemic. In order to verify the research hypotheses, a dynamic approach was also taken into account, using the Panel Vector Autoregression (pVAR) in RStudio. W celu weryfikacji hipotez badawczych uwzględniono również podejście dynamiczne wykorzystując Panel Vector Autoregression (pVAR) w RStudio.

Section 1 of this article describes the literature review on the economic effects of COVID-19. Sections 2 and 3 present the empirical approach, dealing with matters such as the methodology, database and variables. Section 4 discusses the outcomes for the empirical approach, and the paper ends with suggestions on policy implications.

Literature review

For a number of years now, many researchers have focused in their articles on the relationship between enterprises' investment decisions and financial constraints. Examples of such work include: **Fazzari, Hubbard, Peterson [1988]**, **Hoshi, Kashyap, Scharfstein [1991]**, **Agca, Mozumdar [2008]**, and **Nehrebecki [2020]**. These researchers come to the conclusion that companies facing financial constraints are forced to use internal funding to finance investment.

Furthermore, various research findings disprove the assumption that financially constrained enterprises exhibit greater investment-cash flow sensitivity because they lack access to external financing. Such results offer further empirical evidence for the balance-sheet channel, although scientists continue to investigate the issue.

If a company lacks funds of its own and needs a bank loan, subjecting the company to bankruptcy enters into risky investment projects [**Zicchino, 2001**]. The relationship between investment decisions and the cost of external capital is an important component of economic growth. For the successful development of economic growth, it is necessary to comply with legal regulations, have an active stock market and developed financial intermediaries.

Many scientists have drawn attention to the problem of "information asymmetry" between enterprises and lenders in financial markets, finding that external financing is more expensive than the internal variety. This ensures that the relationship between investment and cash flow will be stronger for enterprises that are constrained financially [**Gul, Tastan, 2018**; **Mulier, Schoors, Merlevede, 2016**; **Silva, Carreira, 2012**]. Moreover, the effect that confirms the balance-sheet channel theory should be stronger in units for which the premium on external financing is higher. In order to divide into financially constrained companies, the literature refers to the use of dividends, the size of an enterprise, and affiliation to business groups.

A review of the literature on the sensitivity of investment to cash flows shows that little attention has been paid to the macroeconomic factor. However, it is macroeconomic conditions during a recession that make it difficult to access capital markets [**Gul, Tastan, 2018**; **Gupta, Mahakoud, 2019**]. At such times, politicians become persuaded that production resources are not being used in full. Researchers [**Campello, Graham, Harvey, 2010**; **Drobetz et al., 2017**] have established that access to capital markets will prove difficult during liquidity crises.

In 2007, a financial crisis began that brought the economy into recession. As a result, the supply of external financing was reduced [**Campello, Graham, Harvey, 2010**]. The borrowing premium should be higher

in periods of recession, in line with the financial accelerator concept, which holds that economic shocks are amplified and spread thanks to the imperfections of the financial market. Negative shocks reduce the net asset value and the value of the borrower's collateral, thereby worsening the borrower's borrowing capacity, which in turn reduces the level of investment and consequently deepens and prolongs the recession.

The study of the empirical material was followed by an analysis of investment-cash flow sensitivity (ICFS), or the relationship between cash flow and investment in fixed assets, among Polish listed companies, especially during the COVID-19 pandemic.

Empirical methodology

Following the standard neoclassical approach, investment is presented with the following equation [**Cummins et al., 2006**]:

$$\left[\frac{I}{K}\right]_{it} = a + \frac{1}{b}\left[\frac{V_{it}}{p_t^k\left(1-\delta\right)K_{it-1}} - 1\right]\frac{p_t^k}{p_t} + \varepsilon_{it} = a + \frac{1}{b}Q_{it} + \varepsilon_{it} \qquad [1]$$

where I_{it} stands for gross investment, p_t^k – is the capital stock, V_{it} – the futures dividends, p_t^k – the price of capital goods, p_t – the price of output, and Q_{it} is average q, or the total value of an enterprise scaled by the replacement cost of capital.

Equation [1] provides that investment decisions are made on the basis of the average q. However, in reality they are made on the basis of the marginal q (the shadow value of capital, which is non-observable quantity). Based on the neoclassical model, the average q and the marginal q are actually equal (see **Erickson, Whited** [**2000**]).

In this study, the marginal productivity of capital has been approximated by the sales-to-capital ratio *i.e.* $\left[\frac{Sales}{K}\right]_{it}$ (see **Gilchrist, Himmelberg** [**1998**]).

Under neoclassical investment theory, the sole determinant of a firm's investment should be the basic economic fundamentals, with no role for financial variables such as cash flow. Based on the literature on the subject, Eq. [1] is used by researchers to test the neoclassical theory in terms of whether financial factors in empirical investment equations add any explanatory value.

However, when allowance is made for credit market imperfections, for example those reflecting information asymmetry, a difference will be generated between the cost of external and internal funds. This difference, or wedge, is known as the borrowing bonus, and it is further assumed to increase as the condition of a company, i.e. its balance sheet, deteriorates. So in the presence of financial frictions, a company's access to internal financing affects its investment decisions.

However, the subject literature shows that, in the face of the global financial crisis, monetary shocks have a clear impact on real variables. Data also reveals that financial changes caused by an asymmetry of information between borrowers and lenders, or by other financial variables, are capable of affecting investment. However, if there are *financial frictions*, then Eq. [1] is augmented by cash flow $\left(CF_{it}\right)$, so that the liquidity of enterprises can be presented as follows:

$$\left[\frac{I}{K}\right]_{it} = a + \frac{1}{b}\left[\frac{Sales}{K}\right]_{it} + \gamma\left[\frac{CF}{K}\right]_{it} + \varepsilon_{it} \qquad [2]$$

Where capital markets are perfect, coefficient γ is expected to be non-significant from a statistical point of view. Meanwhile, if there are financial frictions, parameter γ will be statistically significant and positive.

Eq. [2] is defined as the fundamental one as far as the verification of this paper's hypotheses is concerned. The work uses econometric models based on panel data: pooled OLS, the Fixed Effects Model, and the Random Effects Model. An attempt was also made to assess the dynamic approach by reference to pVAR. This model is in essence similar to the VAR model, the only difference being the panel nature of the data encompassed. In the case of three endogenous variables (as in our study), the model takes the following form:

$$\begin{bmatrix} \left[\frac{I}{K}\right]_{it} \\ \left[\frac{Sales}{K}\right]_{it} \\ \left[\frac{CF}{K}\right]_{it} \end{bmatrix} = \boldsymbol{B}_0 + \boldsymbol{B}_1 \begin{bmatrix} \left[\frac{I}{K}\right]_{it-1} \\ \left[\frac{Sales}{K}\right]_{it-1} \\ \left[\frac{CF}{K}\right]_{it-1} \end{bmatrix} + u_i + d_t + \boldsymbol{\varepsilon}_{it} \quad [3]$$

A detailed description of the assessment process can be found in an article by **Sigmund and Ferstl [2017]**.

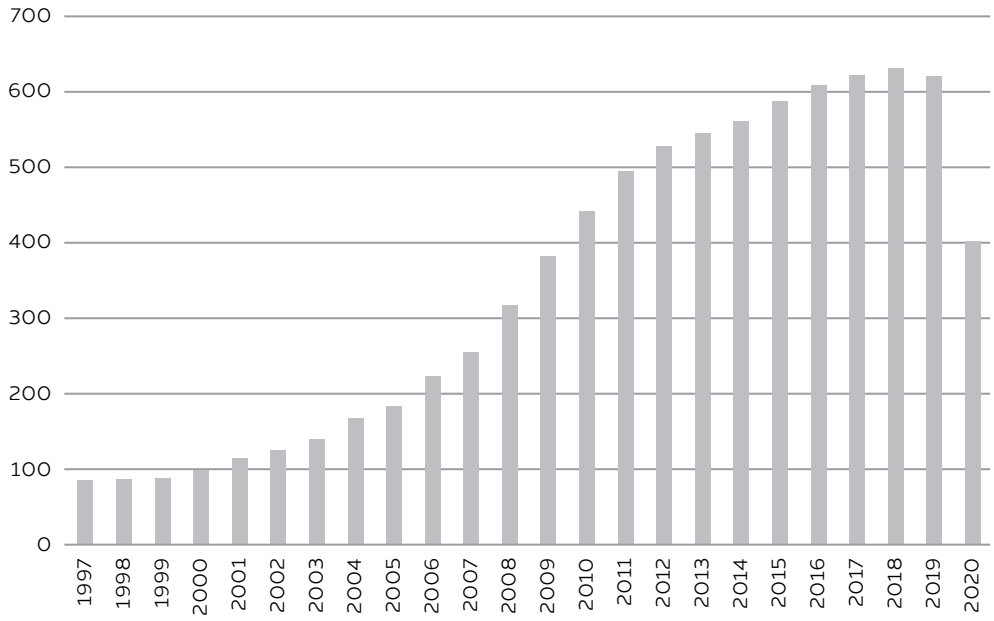
Data description

This section of the article presents the dataset selected to verify relations between cash flow and investment among listed Polish companies. These data in fact derive from the EMIS dataset, with information on over 147 emerging markets. Under its former name of ISI Emerging Markets, this firm was established in 1994, ensuring that its data for listed companies in Poland date back to 1996.

The selected sample excludes all firms related to finance (section K of the Polish Classification of Activities 2007) as these feature different kinds of balance-sheet items, for example as far as assets and liabilities are concerned.

The empirical part (see Table 3) used the aforementioned data for the period from 1997 to 2020. Chart 1 shows the number of enterprises analysed in this study for 1997–2020. In addition, companies were considered in terms of economic sector (construction, industry, services), market (GPW, NewConnect) and size (large, medium-sized, small) – see Chart 2. This, however, is confined to the structure of data for the last two years as well as the most recent two full years, i.e. before the COVID-19 pandemic (2019) and during the pandemic (2020).

Chart 1. The number of companies used in the research



Source: Author's own calculation based on EMIS.

Chart 2. The structure of the dataset in 2019 (before COVID-19) and 2020 (during COVID-19)

Source: Author's own calculation based on EMIS.

Chart 2 suggests no change in the structure of enterprises before and during the COVID-19 pandemic, except the change in the structure of enterprises related to the presence of companies on the WSE and its alternative NewConnect market.

Table 1 presents descriptive statistics for the main variables considered in the study, which are winsorised. Additionally, the research has been concerned with the sizes of enterprises, company business sectors and the market. Table 2 presents summary statistics for key variables on the activities companies engage in.

Table 1 and Chart 3 reveal how on average the surveyed companies have greater investment during the pandemic than prior to it. The listed companies feature a trend entirely different from the general one in the economy as presented by Statistics Poland (GUS). Moreover, a median cash flow of 2.4% during COVID-19 compares with 2% previously.

On average, the services sector features greater investment than other sectors (see Table 2). Moreover, companies operating in the manufacturing sector have the highest median cash flow. Enterprises in that sector also seem less profitable when set against the other sectors.

Table 1. Summary statistics

Stats	2020			2019		
	I/K[3]	*Sales/K*[4]	*CF/K*[5]	*I/K*	*Sales/K*	*CF/K*
mean	0.71	26.25	0.07	0.42	24.2	0.06
p25	0.07	2.06	0	0.03	2.21	0.00
p50	0.23	8.51	0.024	0.13	7.21	0.02
p75	0.81	45.83	0.13	0.34	34.24	0.11
sd	1.2	32	0.08	0.74	30.74	0.08
N	329			526		

"N" is the number of observations, "mean" is the average of the variables, "p25" is the first quartile of the variables, p50 is the median of the variables, and p75 is the third quartile for the variables.

Source: Author's own calculation based on EMIS.

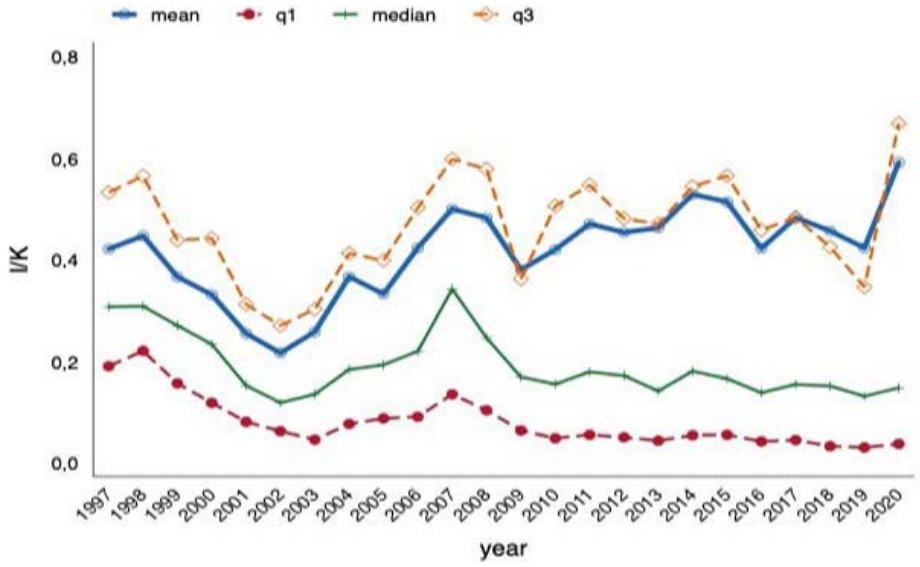
Table 2. Summary statistics – by economic sectors

Variables		2020			2019		
		Industry	Construction	Services	Industry	Construction	Services
I/K	Mean	0.267	0.293	0.807	0.199	0.214	0.616
	Median	0.095	0.115	0.439	0.109	0.121	0.245
	Std.dev.	0.569	.501	1.037	0.374	0.281	0.071
Sales/K	Mean	11.738	25.040	33.378	10.192	22.124	33.275
	Median	2.400	7.995	17.989	2.609	11.918	19.208
	Std.dev.	22.920	30.685	33.678	21.891	25.314	33.253
CF/K	Mean	0.071	0.063	0.067	0.062	0.040	0.071
	Median	0.056	0.008	0.015	0.047	0.005	0.030
	Std.dev.	0.073	0.076	0.084	0.065	0.0611	0.0832

"Std.dev." is standard deviation.

Source: Author's own calculation based on EMIS.

Chart 3. The investment rate of Polish listed companies



Source: Author's own calculation based on EMIS.

3 I/K is defined in terms of the purchase of property, plant, equipment and intangible assets divided by property, plant and equipment.

4 Sales/K is defined as sales divided by property, plant and equipment.

5 CF/K is defined as cash flow from operating activities divided by property, plant and equipment.

Results

The validation of the research hypotheses entailed estimating models with pooled OLS, FE and RE as well as an attempt to estimate pVAR in reference to the sample of all enterprises, and then separately on the basis of the large *vs* small and medium-sized enterprise (SME) sample, while taking into account the COVID-19 pandemic (see Table 3). To examine whether the results reflected financial constraints, the sample of enterprises was broken down by size into large (financially unconstrained) companies vs. SMEs (financially constrained). The difference between these groups denotes that, in the case of financially unconstrained companies, investment can be determined by traditional variables (economic fundamentals), while in the case of financially constrained companies, explanations regarding investment need to apply to the additional level of internal funds, in line with the assumed theory (see e.g. [**Shabbir, 2012**]). SMEs are more susceptible to monetary policy shocks. Explanatory variables were introduced into the model with a lag in order to account for the endogeneity problem.

The formula representing the econometric model, the estimation results of which are given in Tables 3 and 4, is as follows:

$$\left[\frac{I}{K}\right]_{it} = \beta_1 + \beta_2\left[\frac{Sales}{K}\right]_{it-1} + \beta_3\left[\frac{CF}{K}\right]_{it-1} + \beta_4 sector_{it} + \beta_5 market_{it} + \beta_6 size_{it} + u_i + d_t + \varepsilon_{it} \quad [4]$$

where: $\left[\frac{I}{K}\right]_{it}$ – investment rate, $\left[\frac{Sales}{K}\right]_{it-1}$ – the sales – to – capital ratio, $\left[\frac{CF}{K}\right]_{it-1}$ – the cash flow-to-capital ratio, $sector_{it}$ – economic sector (construction, industry, services), $market_{it}$ – market (GPW, NewConnect), $size_{it}$ – size of enterprises (large, small and medium-sized enterprises (SME)), $\beta_1, \ldots, \beta_5$ – unknown parameters, u_i – specific individual effects, d_t – specific time effects, ε_{it} – random errors, i – observation index, t – time index.

Table 3. Model of relationship between investment and cash flow; results of estimation

Panel A: whole sample (1997–2020)

Variables	POLS	RE	FE	FE–robust	FE (time effect, LSDM)	FE (time effect, within estimator)	FE–robust (time effect, within estimator)
$Sales/K_{t-1}$	0.009*** (0.0003)	0.006*** (0.0004)	0.005*** (0.0004)	0.005*** (0.001)	0.005*** (0.0004)	0.005*** (0.0004)	0.005*** (0.001)
CF/K_{t-1}	0.835*** (0.101)	0.530*** (0.096)	0.481*** (0.097)	0.481*** (0.098)	0.413*** (0.098)	0.413*** (0.098)	0.413*** (0.098)
Sector: industry	0.082*** (0.024)	0.075 (0.054)					
Sector: services	0.249*** (0.023)	0.331*** (0.052)					
Market: NC	–0.018 (0.018)	0.009 (0.036)					
Size: SME	0.205*** (0.019)	0.132*** (0.026)	0.081*** (0.029)	0.081*** (0.022)	0.069** (0.029)	0.069** (0.029)	0.069*** (0.022)
Year: 2000				–0.088 (0.071)			
Year: 2001					–0.110 (0.071)		
Year: 2002					–0.174** (0.069)		
Year: 2003					–0.194*** (0.067)		

Variables	POLS	RE	FE	FE–robust	FE (time effect, LSDM)	FE (time effect, within estimator)	FE–robust (time effect, within estimator)
Year: 2004					–0.110* (0.066)		
Year: 2005					–0.077 (0.065)		
Year: 2006					0.014 (0.063)		
Year: 2007					0.051 (0.062)		
Year: 2008					0.004 (0.061)		
Year: 2009					–0.076 (0.060)		
Year: 2010					–0.121** (0.059)		
Year: 2011					–0.084 (0.058)		
Year: 2012					–0.112* (0.057)		
Year: 2013					–0.136** (0.057)		
Year: 2014					–0.060 (0.057)		
Year: 2015					–0.065 (0.057)		
Year: 2016					–0.198*** (0.057)		
Year: 2017					–0.155*** (0.057)		
Year: 2018					–0.186*** (0.057)		
Year: 2019					–0.208*** (0.057)		
Year: 2020					–0.138** (0.060)		
Constant	–0.120*** (0.025)	–0.010 (0.051)					
Observations	6,250	6,250	6,250	6,250	6,250	6,250	
R^2	0.195	0.098	0.028		0.047	0.028	
Adjusted R^2	0.194	0.097	–0.077		–0.060	–0.081	
F Statistic	252.032***	496.420***	54.474***		11.598***	54.319***	
Testing for individual effects		1720.8***	7.9702***				
Hausman test			538.06***				
Testing for serial correlation			179.57***				
Testing for heteroskedasticity			638.76***				
Test for time effects					4.1205***		

Panel B: sample of large companies (1997–2020)

	POLS	RE	FE	FE–robust	FE (time effect, LSDM)	FE (time effect, within estimator)	FE – robust (time effect, within estimator)
$Sales/K_{t-1}$	0.004*** (0.0003)	0.005*** (0.0004)	0.005*** (0.001)	0.005*** (0.001)	0.005*** (0.001)	0.005*** (0.001)	0.005*** (0.001)
CF/K_{t-1}	0.239** (0.094)	0.141 (0.094)	0.071 (0.099)	0.071 (0.086)	0.012 (0.100)	0.012 (0.100)	0.012 (0.086)
Sector: industry	0.034* (0.020)	0.054 (0.039)					
Sector: services	0.076*** (0.021)	0.086** (0.040)					
Market: NC	–0.178*** (0.047)	–0.193*** (0.069)					
Year: 2000					0.044 (0.065)		
Year: 2001					–0.078 (0.063)		
Year: 2002					–0.063 (0.062)		
Year: 2003					–0.089 (0.060)		
Year: 2004					–0.077 (0.059)		
Year: 2005					–0.082 (0.057)		
Year: 2006					0.010 (0.057)		
Year: 2007					0.035 (0.055)		
Year: 2008					–0.022 (0.054)		
Year: 2009					–0.133** (0.055)		
Year: 2010					–0.079 (0.054)		
Year: 2011					–0.100* (0.054)		
Year: 2012					–0.112** (0.053)		
Year: 2013					–0.108** (0.053)		
Year: 2014					–0.085 (0.053)		
Year: 2015					–0.080 (0.053)		
Year: 2016					–0.108** (0.053)		
Year: 2017					–0.100* (0.052)		
Year: 2018					–0.124** (0.052)		
Year: 2019					0.143*** (0.053)		
Year: 2020					0.157*** (0.057)		

	POLS	RE	FE	FE–robust	FE (time effect, LSDM)	FE (time effect, within estimator)	FE – robust (time effect, within estimator)
Constant	0.094*** (0.020)	0.087** (0.036)					
Observations	1,615	1,615	1,615		1,615	1,615	
R^2	0.143	0.102	0.050		0.088	0.055	
Adjusted R^2	0.141	0.099	–0.056		–0.029	–0.067	
F Statistic	53.874***	150.789***	555***		6.003***	41.565***	
Testing for individual effects		300.64***	4.7766***				
Hausman test			10.865***				
Testing for serial correlation			83.882***				
Testing for heteroskedasticity			63.903***				
Test for time effects					2.6402***		

Panel C: sample of SMEs (1997–2020)

	POLS	RE	FE	FE–robust	FE (time effect, LSDM)	FE (time effect, within estimator)	FE–robust (time effect, within estimator)
$Sales/K_{t-1}$	0.010*** (0.0004)	0.006*** (0.0004)	0.004*** (0.001)	0.004*** (0.001)	0.004*** (0.001)	0.004*** (0.001)	0.004*** (0.001)
CF/K_{t-1}	0.870*** (0.129)	0.657*** (0.123)	0.633*** (0.127)	0.633*** (0.128)	0.560*** (0.128)	0.560*** (0.128)	0.560*** (0.128)
Sector: industry	0.075** (0.031)	0.070 (0.066)					
Sector: services	0.289*** (0.030)	0.365*** (0.062)					
Market: NC	–0.030 (0.021)	–0.020 (0.041)					
Year: 2000					–0.147 (0.095)		
Year: 2001					–0.131 (0.095)		
Year: 2002					–0.236** (0.094)		
Year: 2003					–0.239*** (0.091)		
Year: 2004					–0.124 (0.090)		
Year: 2005					–0.085 (0.090)		
Year: 2006					0.007 (0.086)		
Year: 2007					0.045 (0.086)		
Year: 2008					0.001 (0.083)		
Year: 2009					–0.064 (0.081)		
Year: 2010					–0.148* (0.079)		
Year: 2011					–0.090 (0.078)		

	POLS	RE	FE	FE–robust	FE (time effect, LSDM)	FE (time effect, within estimator)	FE–robust (time effect, within estimator)
Year: 2012					–0.116 (0.078)		
Year: 2013					–0.152** (0.077)		
Year: 2014					–0.057 (0.077)		
Year: 2015					–0.066 (0.077)		
Year: 2016					–0.230*** (0.077)		
Year: 2017					–0.179** (0.077)		
Year: 2018					–0.211*** (0.077)		
Year: 2019					–0.233*** (0.077)		
Year: 2020					–0.136* (0.081)		
Constant	0.042 (0.028)	0.112** (0.057)					
Observations	4,635	4,635	4,635		4,635	4,635	
R^2	0.196	0.095	0.024		0.044	0.024	
Adjusted R^2	0.195	0.094	–0.107		–0.091	–0.113	
F Statistic	226.112***	364.843***	50.753***		0.142***	50.177***	
Testing for individual effects		1222.3***	6.3053***				
Hausman test			95.483***				
Testing for serial correlation			95.947***				
Testing for heteroskedasticity			63.903***				
Test for time effects					2.9569***		

Panel D: sample of SMEs including the COVID-19 pandemic period (1997–2020)

	POLS	RE	FE	FE-robust
$Sales/K_{t-1}$	0.010*** (0.0004)	0.006*** (0.0004)	0.004*** (0.001)	0.004*** (0.001)
CF/K_{t-1}	–0.837 (0.536)	–0.551 (0.473)	–0.402 (0.488)	–0.402 (0.510)
Non-COVID period	–0.211*** (0.058)	–0.140*** (0.050)	–0.095* (0.050)	–0.095 (0.059)
Sector: industry	0.074** (0.031)	0.069 (0.065)		
Sector: services	0.289*** (0.030)	0.366*** (0.061)		
Market: NC	–0.036* (0.021)	–0.024 (0.041)		
CF/K_{t-1} X Non-COVID period	1.807*** (0.552)	1.276*** (0.483)	1.087** (0.496)	1.087** (0.515)
Constant	0.245*** (0.063)	0.245*** (0.074)		
Observations	4,635	4,635	4,635	4,635
R^2	0.199	0.098	0.025	
Adjusted R^2	0.198	0.096	–0.107	

	POLS	RE	FE	FE-robust
F Statistic	164.032***	378.642***	26.681***	
Testing for individual effects		1222.9***	6.2884***	
Hausman test		53.841***		
Testing for serial correlation		95.032***		
Testing for heteroskedasticity		426.82***		

Note: *p<0.1; **p<0.05; ***p<0.01

Source: Own calculation based on EMIS.

In each case, a reference to the Hausman test made it possible to reject the null hypothesis to the effect that the estimator of random effects is consistent. The model considered was thus one with Fixed Effects. In this model, the significance of the individual effect was tested using the F test. The null hypothesis of the individual effect being statistically non-significant needed rejecting. The homoscedasticity of the random error component (studentised Breusch-Pagan test) and testing for serial correlation (Breusch-Godfrey/Wooldridge test for serial correlation in panel models) were then checked under the FE model. As the null hypothesis was rejected in the case of these two tests, use was made of robust estimation, thereby controlling for heteroskedasticity and autocorrelation (**FE – robust, time effect, within estimator**).

The results obtained allowed for further procedures to verify the hypotheses in the paper, with reference to the literature.

The results (as in Table 3, Panel A) further showed that the coefficient estimate of the variable CF/K is positive (0.410) and significant statistically, meaning that a 1-unit increase in the cash-flow index is associated with a 0.41-unit increase in investment in fixed assets, holding all the other variables fixed.

To verify the correctness of the results obtained, an assessment was also carried out for pVAR (see Table 4; the coefficient estimate of CF/K is 0.3652 and statistically significant).

Table 4. Model of relationship between investment and cash flow using pVAR; results of estimation

Variables	I/K	$Sales/K$	CF/K
I/K_{t-1}	0.3082*** (0.0497)	−0.0008 (0.9044)	0.0149 (0.0112)
$Sales/K_{t-1}$	0.0033* (0.0016)	0.3955*** (0.0529)	−0.0002 (0.0003)
CF/K_{t-1}	0.3652* (0.1790)	−5.8524 (3.9769)	−0.0489 (0.1044)
Hansen test of overid. restrictions	chi2(2268) = 352.28		
BIC	−19002.59		
AIC	−4195.723		
HQIC	−9873.783		

Note: *p<0.1; **p<0.05; ***p<0.01

Source: Author's own calculation based on EMIS.

The implication, in sum, is that there are no grounds to reject the first research hypothesis (**H1**) [**Fazzari, Hubbard, Peterson, 1988**; **Agca, Mozumdar, 2008**]. This provides an argument in support of theories on the balance-sheet channel of monetary policy.

The results obtained (see Table 3, Panels B and C) showed that the coefficient estimate of the variable CF/K is positive but insignificant for large companies (0.012), while being statistically significant for SMEs (0.56). This means that an increase of 1 unit in the cash flow rate increases investment in fixed assets by 0.56 units, holding all the other variables fixed. This implies that there are no grounds for the second research hypothesis (**H2**) to be rejected. The problem of asymmetry of information between enterprises and creditors in financial markets is revealed, as exemplified by the way in which external financing is more expensive than

internal. Consequently, the relationship between investment and cash flow will be stronger for enterprises that are constrained financially [**Gul, Tastan, 2018**; **Mulier, Schoors, Merlevede, 2016**; **Silva, Carreira, 2012**]. Moreover, the effect confirming the balance-sheet channel theories should be stronger in units for which the premium of external financing is higher.

The results obtained (see Table 3, Panel D) included non-significance of the coefficient estimate of the *CF* / *K* variable, denoting non-application of the cash-flow index to investment in fixed assets during the pandemic. That, in turn, invalidates this paper's third research hypothesis (**H3**). The result is the opposite of that noted in the literature for relationships between investment and cash flow during a recession. However, the recession triggered by the COVID-19 pandemic is a completely different and new phenomenon, representing an exogenous shock to the economy. It has been associated with monetary policy easing, with the reference rate brought down from 1.5% to 0.1%. In addition, enterprises gained the support of government aid programmes.

Conclusions

Investment management is a key factor in company financial management, especially during a crisis. Problems with liquidity management can lead to various financial problems.

The aim of the study described in this paper was to verify the theory of the balance-sheet channel among Polish listed companies, with a particular emphasis on the COVID-19 pandemic period. These objectives were attained as a result of examining the relationship between cash flow and investments. A database of the Emerging Markets Information Services (EMIS) covering companies listed on the Warsaw Stock Exchange and its alternative NewConnect market showed that there were no grounds to reject hypotheses **H1** and **H2**, under which investment is positively associated with the cash flow of Polish listed companies. Meanwhile, the relationship between investment and cash flow was shown to be particularly strong for companies experiencing financial constraints. This conclusion shows that Poland does have a balance-sheet channel of monetary policy. Hypothesis **H3** has been rejected, however, meaning that the cash-flow-investment relationship is especially strong in the case of financially constrained companies operating during the recession induced by COVID-19.

This paper's suggestions about fiscal policy may be regarded as a contribution to the assessment of the effectiveness and form of government action as part of the so-called anti-crisis shield.

Analyses carried out for this article focus on listed companies in Poland. In the future, it would be worth carrying out similar studies for other companies, especially micro-enterprises, in terms of how they have been affected by the COVID-19 pandemic crisis

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