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Cash flow sensitivity of investment: Evidence from the Polish listed companies

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Abstract

The paper focuses on assessment of the sensitivity of investment on cash flow (ICFS) made by listed companies in Poland. Achieving this goal will also involve analysing and drawing conclusions about the balance-sheet channel of monetary transmission. An empirical part uses data from financial statements for Poland derived from Emerging Markets Information Services (EMIS), related to companies listed on the Warsaw Stock Exchange and NewConnect. Estimations were made using the Ordinary Least Squares method with robust standard errors, and results made it clear that cash flow has a positive significant impact, indicating that most companies operate on the imperfect and incomplete market, and with constrained or costly access to external financing. Further, it is found that the impact is significantly strong in the slowdown, as financial constraints are more binding. These results seem to confirm that the balance-sheet channel of monetary transmission is operative in Poland.

1 Introduction

The balance-sheet channel of monetary transmission operates through fluctuations in financial level of agents' net income and wealth, as well as in the availability of external financing. Monetary policy can affect a company's balance sheet both directly and indirectly. In terms of direct impact, an increase in interest rates under a restrictive policy first raises the value of interest on existing loans and thus reduces net cash flow; and second lowers asset prices, thus reducing the collateral value of a borrower. But in terms of the indirect impact, it results in reduced households' consumption and the non-adjustment of fixed and quasi-fixed costs due to the short period of time, which will worsen a company's financial condition drastically. The balance-sheet channel of monetary transmission is thus a way in which monetary policy affects an enterprise's balance sheet, as well as possibilities for external financing, and ultimately investment and consumption (Bernanke & Gertler, 1995; Bondt, 2004).

The paper focuses on assessment of the sensitivity of investment on cash flow (ICFS) made by listed companies in Poland. Achieving this goal will also allow to analyse and draw conclusions about the balance-sheet channel of monetary transmission. According to the neoclassical investment theory, the economic fundamentals should be the sole determinants of business investment since no impact is exerted by financial variables such as cash flow. However, the financial crisis showed how monetary shocks actually impact the real variables, including investment spending, which are affected by financial distortions due to the asymmetry of information between borrowers and lenders.

In the empirical section of this work the data compiled from financial statements retrieved from the database of the Emerging Markets Information Services (EMIS) related to the companies listed on the Warsaw Stock Exchange and NewConnect were used. An advantage of this article is that the research is not confined to large public enterprises alone, but also includes smaller, developing enterprises from the NewConnect market. As the data period extended to include periods of severe banking crisis and slowdown, a complete examination of the effects of cash flow on

investments is possible as well as highlighting the problems with financing companies may face during the crisis and in unfavourable economic periods. When an econometric model was developed, the final sample used in it contained observations from 2008 (i.e. a period of high interest rates) and 2014 (of low interest rates). The model was estimated using Ordinary Least Squares (OLS) with robust standard errors.

As far as the investment is concerned, the Modigliani and Miller (1958) theorem states that there is substitution of external and internal sources of financing. In practice, however, this assumption may not be fulfilled, *inter alia* due to transaction costs, distortionary taxation and information asymmetries. Imperfections on the credit market will affect the difference between the cost of funds either obtained externally, or raised within an enterprise. This difference or wedge is the premium of external financing. Further it is assumed to increase where a company's condition (balance sheet) shows deterioration, the presence of financial frictions ensures investment decisions influenced by the availability of internal financing. But, it is clear from Fazzari, Hubbard and Petersen (1988) that the cost of internal sources of financing and debt capital is unequal, therefore companies face financial constraints.

Two **hypotheses** formulated here are that:

1: cash flow has a significant impact on investment engaged in by Polish listed companies;

2: the impact of cash flow on investment is particularly strong during a slowdown.

If there are no grounds for rejecting Hypotheses 1 and 2, then it denotes the likely existence of a balance-sheet channel of monetary transmission. The external finance premium should also be higher during periods of recession, which is in line with the concept of the financial accelerator (whereby economic shocks are strengthened and spread, due to imperfections on the financial markets). Negative shocks reduce the net value of fixed assets and the value of deposits, impairing individuals' capacity to borrow, reducing levels of investment, and ultimately ensuring that recession is deepened and prolonged (Bernanke & Gertler, 1989).

This paper contributes to the literature in the following manner. First, the paper provides insights

on the liquidity constraints of Polish listed companies and the determinants of their spending on tangible assets. It is shown that liquidity constraints seem to be more binding during economic slowdown and less binding during monetary loosening. The contribution is empirical but based on solid theoretical grounds.

Second, in the Polish literature, the analysis of listed companies, the problem of investment activities of private and partially owned by the state treasury was considered by Tyrowicz (2009). The study was conducted on the basis of data collected from 181 companies listed on the Warsaw Stock Exchange in the period 1995–2003. Apart from that, this article also covers the companies listed on NewConnect between 2008 and 2014. Alternative market – NewConnect provides the opportunity for inexperienced smaller companies whose capital ranges from a few hundred to several million polish zlotys operating in new technology industries to participate and compete in the market.

Third, in order to carry out the study, this article defines the key variables, such as investments and cash flow based on the financial statement – cash flow statement, in contrast to the existing analyses based on the literature review.

Section 1 of this article describes the theories and reviews of the literature on investment's dependence upon cash flow. Section 2 presents Tobin's Q investment model. Tobin's Q as a proxy for investment opportunities will be a key control variable in the econometric model, because in empirical research it is the main determinant of investments of listed companies. Section 3 describes the methodology, database, explained and explanatory variables, while further discussing outcomes for the estimated econometric model. The work ends with hypotheses verified by reference model.

2 The importance of investment dependence on cash flow – a review of the literature

The theory of Modigliani and Miller (1958) assumes that the level of investment is independent of the financing structure, but empirical works show that financial changes caused by information asymmetry, agency problems and other market imperfections can affect investments in the period of recession. Based

upon a literature review, the researchers focus on the hypothetical relationship between a firm's investments and its cash flows (Investment-Cash Flow Sensitivity, ICFS). The above relation should be statistically significant if there is a significant difference in the cost of equity and debt. Most empirical work offers indications to the existence of a balance-sheet channel of monetary transmission of the impact of cash flow on investment. Selected literature examines the impact of monetary policy on the availability of external financing to enterprises, *inter alia* in the USA and UK, as well as Japan and Pakistan. The authors (Angelopoulou & Gibson, 2009; Shabbir, 2012) pay special attention to the way this monetary-policy transmission mechanism primarily affects enterprises that are small or weak financially.

Researchers needed to find a variable that could define firms' financial constraints fully because of the latent nature of financial restrictions. The literature review revealed that the sensitivity of investments to company cash flow (ICFS) presents financial constraints. Since markets are imperfect, the cost of borrowing capital relative to own capital will be significantly higher. As a result, companies facing financial constraints are forced to use internal funding to finance investments. Research findings offer frequent verification of an assumption regarding the greater sensitivity of investments to cash flow to enterprises which are constrained financially and lack access to external financing. It is for this reason that Investment-Cash Flow Sensitivity can be interpreted as a proxy for financial constraints. However, scientists continue to investigate this issue.

The first to carry out empirical work regarding the relationship between the sensitivity of investments and cash flow was Fazzari et al. (1988), using 1970–1984 data from US industrial companies. Those researchers stated that the diverse sensitivity of investments to the observed changes in cash flow was potentially ascribable to financial condition. Increased ICFS is characterised by enterprises paying high dividends, while sensitivity to cash-flow investments was higher in large, mature firms. Those companies having high debt burden face major financial constraints and as a result their investments only depend on internal financing. Bhaduri (2005) argues that firms are weakly dependent on external funding if tangible assets are at a high level.

According to Bond, Hoeffler, & Temple (2001), market-oriented economies have a high ICFS contrary to bank-oriented economies. Aggarwal and Zong (2006) showed that cash flow controlling investment opportunities has a significant positive relationship in the case of market-oriented countries (USA and UK) and bank-oriented countries (Japan and Germany). This confirms that many firms operate in an imperfect market and with constrained or costly access to debt capital. At the same time, ICFS increases along with financial constraints, which points to the theory regarding the balance-sheet channel of monetary transmission.

Scientists continue to hypothesise that a proxy variable showing the degree of financial constraints faced by the companies without any testing of investment opportunities, is sensitivity of investments to a firm's cash flow. Instead of pursuing an *a priori* division of firms by levels of financial constraint, Gomes (2001) acts in accordance with the calculated ICFS. Under these conditions, account is taken of companies of positive sensitivity (P-ICFS), or negative (N-ICFS); as well as of those in which sensitivity is lacking (L-ICFS).

While a high level of investment was noted initially for the N-ICFS, P-ICFS and L-ICFS groups of firms, positive-group firms were characterised by significant levels of cash flow. Over a period time, it is observed that the investments of these groups of firms continued to be at the same level on an average, while only the L-ICFS-group companies showing an increase in cash flow. Analysis of factors that determined different degrees of sensitivity of enterprises' investments revealed that firms of the N-ICFS group could be interpreted as in a pre-bankruptcy state, the P-ICFS-group as companies facing financial restrictions and the L-ICFS-group as not facing financial constraints.

Some authors believe that Investment-Cash Flow Sensitivity is not an appropriate proxy indicator of financial constraints. Kaplan and Zingales (1997) argue that enterprises that implement investment policies exhibit a non-monotonic relationship between the sensitivity of investments to a firm's cash flow and financial constraints. The authors explain this by saying that non-monotonic behaviour is associated with the shape of the cost function when borrowing capital. On the other hand, some consider this relationship an erroneous interpretation of the reasons for using external sources of financing. The authors dismissed as incorrect the verification of companies' financial constraints by reference to a pre-separation into financially constrained and financially unconstrained groups. Investment-Cash Flow Sensitivity cannot be higher, but only

lower, for those firms which are under most-severe financial constraints on the market. Hermet (2003) also emphasises how cash flow may only be a poor indicator of the existence of financial restrictions and the decision to use cash stock.

Scientists have drawn attention to firms facing bankruptcy, and to whether they should be included in analysis. Using a dividend-payout indicator, Fazzari et al. (1988) ranked firms, determining that those paying low dividends had higher Investment-Cash Flow Sensitivity. However, Kaplan and Zingales (1997) determined that companies with high ICFS are likely to be unconstrained financially. The obtained conclusions imply a questioning of the interpretation of most previous studies using this proposed methodology. High Investment-Cash Flow Sensitivity reflects a choice by managers to have the enterprise's cash flows meet their investment needs, even when relatively affordable external funding is available. Fazzari, Hubbard, & Petersen (2000) concluded that the firms that Kaplan and Zingales (1997) consider to be financially constrained are in fact bankrupt and should be ignored. Also Allayannis and Mozumdar (2004) found that the result from Kaplan and Zingales (1997) was dependent on influential observations.

Different theories have been put forward to explain investment actions. Most researchers associate cash flow with verification of the liquidity theory, according to which a firm's long-term investments depend directly on the amount of cash flow. When all internal sources of financing are exhausted, companies turn to the external sources existing on the capital market. In contrast, a high volume of cash flow will help solve underinvestment problems. However, some scholars have criticised the liquidity theory referred in. relevant literatures (Whited & Wu, 2006 vs. Kaplan & Zingales, 1997; Cleary, Povel, & Raith, 2007), which show that investments increase steadily with cash flows when these are at a high level, and decrease if these are low enough, producing a U-shaped curve. D'Espallier and Guargilia (2011) are among those who suggested that, if potential liquidity problems are to be anticipated and prevented, account should be taken of a cash-flow volatility indicator, as volatility exerts a negative impact on ICFS. The tendency of a company to underinvest where cash flow is limited is significantly more marked than of the likelihood of over-financing among companies with high liquidity ratios.

Scholars such as Kaplan and Zingales (1997) and Wei and Xing (2004) believe that ICFS is totally dependent on increasing investment opportunities, hence their advocacy of the augmentation (with an extra variable) of the underlying investment equation determining such opportunities. In addition, Martinez-Carrascal and Ferrando (2008) analysed several countries i.e. Belgium, Germany, France, Italy, The Netherlands and Spain and concluded additional variables representing financial pressure (debt burden and indebtedness) should be introduced.

As stated before (see e.g. Aggarwal & Zong, 2006), scientists look at company cash flow, a change in which is a direct result of the monetary policy pursued by central banks. Gertler and Gilchrist (1994) stated that, while firms enjoying relatively poor credit-market access must respond to declining cash flow by reducing production and employment and for those companies whose credit access is good have no such need. It was also emphasised how typical it was for larger companies, often using the securities market and other forms of credit, to react to an unexpected drop in cash flow by increasing short-term lending/borrowing. Stocks of large enterprises rise after monetary tightening, suggesting at least a temporary capacity to maintain levels of production and employment in the face of higher interest costs and falling revenues. But small enterprises with constrained access to short-term loans must react to a drop in cash flow by reducing inventory, working hours and production.

Hermet (2003) analysing Korean manufacturing companies from 1994-2001 including the Asian financial crisis of 1997, confirmed the theory regarding the balance-sheet channel of the monetary transmission. The researcher concluded that for large companies (unconstrained financially) investments can be translated using traditional variables, while for small companies (constrained financially) the explanations for their investments needed to be related to the additional level of internal funds.

Shabbir (2012) arrived the conclusions similar to those of Gertler and Gilchrist (1994), confirming the existence of a balance-sheet channel in Pakistan. A restrictive monetary policy has a negative impact on the balance sheet, cash flow and profit-and-loss account of enterprises, so their borrowing costs will increase. Again, however, this conclusion applies more to small and medium-sized enterprises than to large enterprises. SMEs suffer more and are more susceptible to monetary-policy shocks. A 1% increase in the overnight interest rate is shown to reduce the net worth of the company to assets for SMEs by 4.3%, with the corresponding figure

for large enterprises being 3.8%. It is worth considering such problems of SMEs with liquidity. The results show that a 1% increase in the ratio of financial expenditure to sales is linked with a 1% decrease in the cash-flow ratio for large enterprises; while the figure for SMEs is as high as 8.4%.

Both Angelopoulou and Gibson (2009), and Shabbir (2012) similarly focussed on cash flow and found a positive effect on enterprises' investments. A 10% increase in cash flow increases the level of investment by 1%, while in periods of restrictive monetary policy a 10% increase in cash flow increases investment by 2.4%. To examine whether this result was due to financial constraints, the author broke down the reference sample to size of enterprise, policy related to dividends and leverage ratio. It emerged that enterprises with financial problems experience most of the sensitivity of cash flows to investments (in that, while a 10% increase in cash flows leads to investments increased by 0.7% on average in enterprises not experiencing financial problems, firms forced into financial curbs increase their investment from 2.8% to 3.8%). In total, the authors demonstrated the existence of a balance channel in the UK showing increased sensitivity of cash flows to investments during periods of monetary tightening reflecting enterprises' financial constraints. British monetary policy proved effective, not only through its interaction with traditional channels (such as those involving interest or exchange rates), but also in the way it influenced company equity and hence spending decisions.

Masuda (2015) found that the enterprises lacking liquid assets have little access to external financing and company response to monetary policy is balance-sheet dependent. That study – also seen to confirm the presence of a balance channel in Japan – examined the monetary-policy balance channel as well as the quantitative easing transmission mechanism, coming to two main conclusions. First, a restrictive monetary policy is seen to impair both corporate cash flow and access to credit (and, as expected, the smaller the enterprise, the greater the effects of monetary-policy tightening). Second, examination of the quantitative-easing transmission mechanism showed how the reduction in liquidity of enterprises tails off significantly where each industry has an increasing supply of money in circulation. Quantitative loosening mainly leads to an increase in the level of investment in firms, thereby improving their net value and alleviating liquidity restrictions.

It was demonstrated that the central bank contributes to an increased availability of loans to enterprises via the balance channel by increasing the supply of money in circulation. However, it is worth mentioning that, in this case, no statistically significant differences were found on the effects of quantitative easing in small or large enterprises. Further, though the sign of the coefficient of interaction between the variable reflecting increased money supply and liquidity of companies is in line with expectations, the same is not with the coefficient for the quantitative easing variable. The author suggests that the operation of a balance channel via an increased money supply requires further research.

Mohd and Yunus (2015) analysed investment behaviour for constrained and unconstrained financially firms in Malaysia using the threshold variable based on the work of Hansen (1999). It turned out that the firms with low debt were not constrained financially, while those with high levels of debt are indeed constrained.

Malinowska (2016) examined the operation of the balance channel in the United States over the 2005–2014 periods. The transmission of monetary-policy impulses in this way proved particularly important, given the inactive interest-rates channel. The first hypothesis presented here is related to the restriction generated by the restrictive monetary policy on access to liquidity. However, unlike previous analyses, Malinowska's study did not confirm the impact of restrictive monetary policy on investments in physical assets through an effect on the ratio of liquid assets. A restrictive monetary policy was not found to be linked up with restricted access to credit. Nevertheless, both the level of financial leverage and enterprise size emerged as factors important in determining company access to external financing.

The second research hypothesis of Malinowska is related to the impact of quantitative easing on the level of investment in tangible assets in the period 2008–2014. However, her results offered no explicit confirmation of the importance of the transmission balance channel in the context of increased money supply in circulation. But still a positive relationship between liquidity ratio and the level of investment in non-current assets was demonstrated.

In summary, the balance channel can prove to be an effective mechanism in monetary policy. However, its operation is often confined to small enterprises and the impact on larger companies is kept in check

by high financial liquidity. Most empirical work confirms the existence of a balance channel in the context of manipulation of interest-rate levels by central banks. However, the operation of this channel through unconventional monetary policy has neither gained full confirmation nor been precluded.

3 The Tobin's Q investment model – a literature review

The capital market-based concept of investment presented by James Tobin (1969) entails the Tobin indicator, which is the ratio of the market value of a company to the cost of capital replacement. In the neoclassical investment model investments in listed enterprises can be described by the regression (Melander, 2009; Melander, Sandström, & Schedvin, 2017):

$$\left(\frac{I}{K}\right)_{it} = a + \frac{1}{b}Q_{it} + \varepsilon_{it} \qquad (1)$$

where: I denotes investments, K fixed assets and Q average q, which is the total value of an enterprise as scaled by the replacement cost of capital.

The presented equation (1) shows that investment decisions are made on the basis of the average q. However, in reality, investment decisions are made rather on the basis of the marginal q (the shadow value of capital, which is to say a non-observable quantity). Based on the above neoclassical model, the mean q and the marginal q are actually equal. Operating on this equality, scientists use the average q in their studies, which is approximated using Tobin's Q.

Credit-market imperfections give rise to a difference between the costs of funds obtained externally as opposed to inside the enterprise. The wedge between them is the premium of external financing, which is further assumed to increase as a firm's financial condition deteriorates. So when there are financial frictions, the availability of internal financing influences a company's investment activity. Therefore, the cash flow variable (*CF*) is added to regression (1), with the result being the model:

$$\left(\frac{I}{K}\right)_{it} = a + \frac{1}{b}Q_{it} + \gamma\left(\frac{CF}{K}\right)_{it} + \varepsilon_{it} \qquad (2)$$

Gilchrist and Himmelberg (1995, 1999) addressed two controversies related to the explanatory power of cash flow in the investment function (Fazzari et al., 1988; Kaplan & Zingales, 1997). The first one revolves around the way that financial factors may contain information on future returns to capital; while the second one is concerned to the difference between *marginal return to capital* and *average return to capital.*

Gilchrist and Himmelberg (1995) conducted research based on US manufacturing firms in the period 1979–1989 and revealed that cash flow determines an additional explanation in the investment regressions, even after investment opportunities has been controlled for. Further, the cash-flow effect on investments seems to be stronger in companies subject to more-severe financial constraints. Moreover, Tobin's proxy variable Q is the corresponding measure of investment opportunity for financially unrestricted businesses.

The second controversy referred to above, i.e. the distinction between average and marginal returns to capital, was considered by Gilchrist and Himmelberg (1999). Empirical literature on investments that lacks a good measure of marginal return on capital is often based on the average figure (i.e. the ratio of profits to capital) as an approximation. However, apart from providing information on future investments, this also represents an indicator of a firm's financial condition. The authors obtained that investments respond to changes relating to both Fundamental Q (expected present value of the future marginal product of capital) and Financial Q (expected present value of the company's future financial condition). In addition, according to the theory of the balance channel, small companies and enterprises without bond rating (i.e. those constrained financially) show the strongest responses to financial variables, while bond-rated firms show almost none responses.

Kaplan and Zingales (1997), Erickson and Whited (2000) argue that Tobin's Q is not accurate enough for a proxy due to incorrect measurement. The authors noted this phenomenon was due to the fact that the real marginal Q is explained by 40% of the volatility in the observed values of Tobin's Q. According to Maksimovich and Phillips (2002) for a company included in the conglomerate the median q value for the industry is an erroneous indicator of investment opportunity because the efficiency of its capital depends on the total assets. Analysing the empirical material more broadly, Carpenter and Guarilla (2008) add a new variable – contracted capital expenditure,

which has information on investment opportunities only available to insiders. Due to the fact that Tobin's Q index, in the presence of information asymmetry, determines an imperfect measure of a firm's investment opportunities.

Researchers *inter alia* by Benito and Young (2002), Lorenzoni and Walentin (2007), Abel and Eberly (2011) and Shabbir (2012) have shown the advantage of the Q measure. This indicator can be used to assess incentives for potential investments.

To sum up, Tobin's Q is the proxy variable recommended most commonly to verify the hypothesis that a company's investments are affected by growth opportunities as an independent indicator.

4 Verification of Investment-Cash Flow Sensitivity (ICFS) among Polish listed companies

Sections 1 and 2 addressed economic models of investment, as well as presented recent relevant empirical studies confirming the validity of researching the issue further. Section 3 now presents a verification of cash-flow sensitivity of investment among Polish listed companies, being divided in such a way that the selected research methodology is first accounted for, before the database as well as explained and explanatories variables are described. The diagnostics models are also presented and the results of the estimation of the econometric model are discussed, and concluded with a verification of hypotheses stated previously.

4.1 Research methodology

To study the verification of cash-flow sensitivity of investment for enterprises in terms of the existence of a balance-sheet channel of monetary transmission, the authors used the model with fixed or random effects for panel data and in some cases the model of vector autoregression (VAR). The importance of the balance channel using the random effects model was investigated by Shabbir (2012) and Malinowska (2016). It is worth noting that Malinowska (2016), Angelopoulou and Gibson (2009) introduced lagged variables into the model for two reasons. First, monetary policy shocks take time to have a real impact on the economy. Second, delays can help avoid the endogeneity problem. The fixed effects model was initially used by Angelopoulou and Gibson (2009) and Masuda (2015)., The vector autoregression model and the impulse response function are used by Gertler and Gilchrist (1994).

This article represents the first stage to the author's research, which is verifying cash-flow sensitivity of investment among Polish listed companies. The results obtained in the work underpinning this study will prove useful for further research. The Ordinary Least Squares Method for cross-sectional data is applied, with methodology as described by Wooldridge (2002).

4.2 Specification of the database and variables

4.2.1 Presentation of the database

This section of the article presents the dataset selected to verify cash-flow sensitivity of investment among Polish listed companies, as well as the rationale behind the choice of a target subset appropriate for assessment of the econometric model. These data in fact are derived from the EMIS dataset, with information on over 147 emerging markets. Formerly known as ISI Emerging Markets,[1] this firm was established in 1994, so it should be noted that its data for listed companies in Poland dated back to 1996. In spite of that, the sample used ultimately in the model was between the period 2008 and 2014 and initial part of the period was characterised by financial crisis and special restrictions on access to finance, while the latter period may be regarded as a 'normal' post-financial crisis and debt crisis year.

The selected sample excludes all firms related to finance (section K of the Polish Classification of Activities 2007) as these inter alia feature different kinds of balance-sheet item, e.g. where assets and liabilities are concerned. In addition, observations were not taken into account, where firms have below-zero shareholder equity. This reflects the high probability of bankruptcy among the companies listed above (e. g. Fazzari et al., 2000). It should be noted that the winsorization method is applied to variables used in the econometric model. This procedure reduces any negative impact due to outliers.

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1 https://www.emis.com/about

4.2.2 Description of the explained and explanatory variables used

This section presents definitions and descriptive statistics related to the explained and explanatory variables selected for the econometric model and used in the verification of working hypotheses. It has already been noted how the neoclassical investment model may described the investments of listed firms using Tobin's Q (Melander et al., 2009). However, the financial crisis showed that monetary shocks have a clear impact on real variables and so the investment was affected by financial changes reflecting asymmetry of information between borrowers and lenders, or other financial variables.

The choice of appropriate definitions for the variables used in the following part relating to the econometric model is crucial. Table 1 defines the explained and explanatory variables and Table 2 presents basic summary statistics relating to them.

The literature review suggests that the definition of the dependent variable represented by investments in fixed assets is unambiguous – being the ratio of investments from the current year to the value of fixed assets at the end of the previous year. Analysis of investment variability in Poland suggested 2008 and 2014 are the years to be selected for the model. There was an economic slowdown in 2008, while 2014 was characterised by low interest rates. But, the histogram and box graph indicate a very large number of outliers.

Explanatory variables were used to explain variability of the explained variable – Investment. Fazzari et al. (1988) introduced a factor for investment analysis namely the cash-flow indicator – as the key explained variable –significantly effective in testing the theory of Modigliani and Miller (1958), regarding the substitution of debt and equity. Further, change in a company's cash flow is a direct result of monetary policy pursued by central banks. At times when such policy is restrictive, production by enterprises decreases, while their quasi-fixed costs do not change immediately; the effect being to reduce cash flow and leave the given firm's financial position looking very weak (Shabbir, 2012). The cash-flow histogram offered the basis for the finding that the variable has no normal distribution. Moreover, the Spearman correlation coefficient in analysing the relationship between cash flow and the investments in fixed assets indicates the rejection of a hypothesis concerned to the independence of the analysed variables for both of the years considered (Table 3).

Tab. 1. Definitions of the explained and explanatory variables used in the econometric model

Variable	Definition
Investment	$\dfrac{\text{Purchase of property, plant, equipment and intangible assets}_t}{\text{Property, plant and equipment}_{t-1}}$
Tobin's Q	$\dfrac{\text{Firm's market value}_t}{\text{Total Assets}_t}$
Cash Flow	$\dfrac{\text{Cash flow from operating activities}_t}{\text{Total Assets}_{t-1}}$
Business sector	$\begin{cases} 1 - \text{Construction} \\ 2 - \text{Trade} \\ 3 - \text{Other services} \\ 4 - \text{Manufacturing} \end{cases}$
Size	$\begin{cases} 0 - \text{Small firms} \\ 1 - \text{Medium} - \text{sized firms} \\ 2 - \text{Large firms} \end{cases}$

Source: Author's own work based on literature review.

The literature defines Tobin's Q as the ratio of a company's market value to the replacement value of its assets. This indicator measures the incentives for a firm to invest or to be taken over. When fixed assets are worth more than the cost of replacing them, enterprises will be inclined to invest. When the ratio is less than 1, enterprises will limit investment, they may also try to merge to acquire new assets or be taken over themselves. The fact that Tobin's Q has a positive impact on investments is confirmed by the research carried out by Fazzari et al. (1988), Benito and Young (2002) and Shabbir (2012).

Researchers (such as Butzen, Fuss, & Vermeulen, 2001) also introduced a variable that reflected a given enterprise's sector of activity (Graph 1) into the investment for fixed assets model. This is due to characteristics of company activity differing from one business sector to another. The Kruskal-Wallis test was carried out as the part of the initial data analysis. Rejection of the null hypothesis in the above-mentioned test regarding the similarity of distribution in groups emphasises the validity of this variable being introduced into the study.

The next variable is the size of enterprises, which may be responsible for a company's financial problems as monetary policy becomes tighter. In their work, authors (Oliner & Rudebusch, 1996) assumed that small enterprises have constrained access to external financing, given that they have to bear the cost of borrowing by large firms as large firms offer greater security. The risk of default is therefore smaller

Tab. 2. Summary statistics of the variables considered in the econometric model

Variable	Mean	Lower quantile	Median	Upper quantile	Mean	Lower quantile	Median	Upper quantile
	2008				**2014**			
Investment	0.408	0.017	0.203	0.650	0.347	0.019	0.145	0.465
Tobin's Q	0.812	0.422	0.677	1.033	0.729	0.406	0.608	0.882
Cash Flow	0.075	0	0.050	0.128	0.066	0	0.036	0.112
Investment by business sector								
Construction	0.405	0.089	0.259	0.579	0.242	0.019	0.095	0.228
Trade	0.420	0	0.331	0.743	0.316	0.018	0.122	0.393
Other services	0.499	0	0.214	1.159	0.439	0.006	0.183	0.767
Manufacturing	0.320	0.068	0.170	0.419	0.285	0.045	0.139	0.276
Investment by size								
Small firms	0.438	0	0.110	1.041	0.421	0	0.151	0.826
Medium firms	0.400	0.064	0.210	0.627	0.269	0.061	0.159	0.276
Large firms	0.395	0.153	0.283	0.552	0.247	0.063	0.131	0.264

Source: Author's own work based on the EMIS database.

Tab. 3. Spearman correlations for all continuous variables considered in the econometric model

Variable	Investment	Tobin's Q	Cash flow	Investment	Tobin's Q	Cash flow
	2008			**2014**		
Investment	1			1		
Tobin's Q	0.1065	1		0.0448	1	
Cash Flow	0.1243	-0.0289	1	0.1445	-0.0258	1

Source: Author's own work based on the EMIS database.

than in the case of smaller businesses. Second, large companies are more reliable in the eyes of potential investors and creditors. The introduction of the variable of enterprise size[2] (Graph 2) is thus justified. The non-parametric Kruskal-Wallis test offered

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2 According to the European Commission Recommendation of 6 May 2003 (2003/361/EC), the classification of enterprises by size class is based on the three variables of turnover, total assets and number of employees. This study for the article used only one variable to determine the size class of enterprises – turnover, which is to say that the variable number of employees was not included, and neither was information on groups of corporations.

The three classes of enterprise size made use of were:
- Large – turnover higher than EUR 50M,
- Medium – turnover between EUR 10M and 50M,
- Small – turnover lower than EUR 10M.

a basis for rejecting the null hypothesis as regards distribution similarity in groups.

5 Results for the econometric model applied

5.1 Outcomes of the assessment of the econometric model with diagnostic tests

Given the relationship between cash flow and level of investment (Investment-Cash Flow Sensitivity, ICFS) at two different times (the years 2008 and 2014), two different econometric models (1 and 2) were estimated using the Ordinary Least Squares method with robust
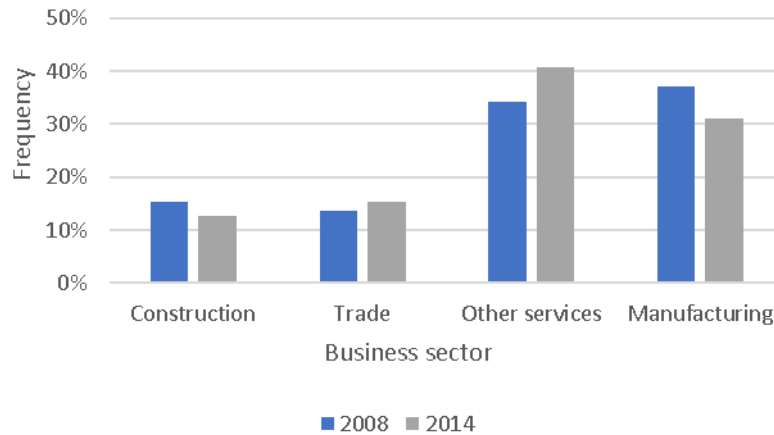
Graph 1. Structure of the analysed sample by business sector. *Source*: author's own work based on the EMIS database.
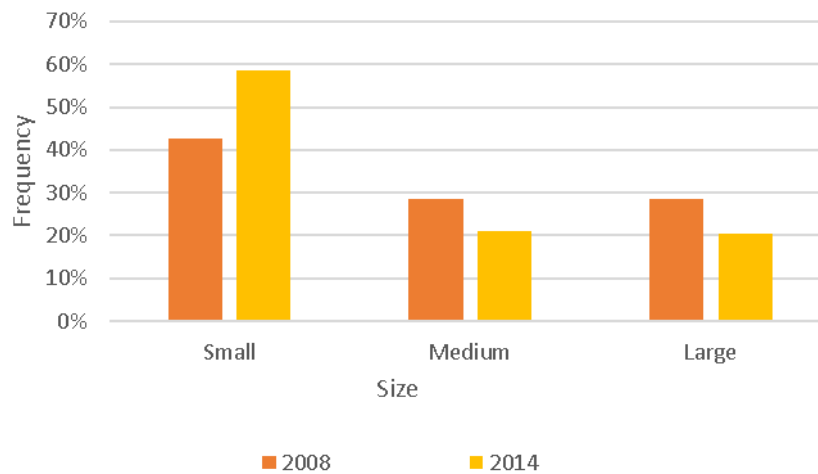
Graph 2. Structure of the analysed sample by the sizes of enterprises. *Source*: author's own work based on the EMIS database.

standard errors. The parameters estimated for each are presented in Table 4. The Fisher-Snedecor test is used for confirming the rejection of the null hypothesis that all variables are jointly insignificant (p-value=0.0000). R^2= 20% for Model 1, meaning that that model explains 20% of the overall variation where investment in 2008 was concerned. For Model 2, R^2=7% related to year 2014 – a year characterised by low interest rates. Table 4 also presents the diagnostic tests. Results of the Jarque-Bera test allowed for rejection of the null hypothesis that the random component has a normal distribution (for Models 1 and 2: p-value = 0.000). For the analysed issue, the obtained results are not complicated as the observation numbers are 236 for Model 1 and 524 for Model 2. While the random components do not assume a normal distribution, in line with the Gauss-Markov

theorem, the OLS estimator is still BLUE (Best Linear Unbiased Estimator). Nonetheless, it is worth to note that a more effective estimator can be found among nonlinear estimators. For both Models 1 and 2, the RESET test offers no grounds for the null hypothesis at the 1% significance level to be rejected. In Model 1, the null hypothesis that model parameters are stable based on the Chow test is not rejected, while for Model 2 it is. So for Model 2 it was worth running separate models for different sizes of companies. Having run the Breusch-Pagan test and White test for Models 1 and 2, the null hypothesis that residuals show homoscedasticity is rejected (p-value = 0.000 < a = 0.05). Both econometric models for investment (Models 1 and 2) were thus estimated using the Ordinary Least Squares method with White's robust standard errors. Additionally,

Tab. 4. Model for investment estimation results usingthe Ordinary Least Squares method with robust standard errors

Variable	Model 1 (for 2008)	Model 2 (for 2014)
Tobin's Q	0.1474*** (0.0519)	0.01488 (0.0411)
Cash Flow	1.1029*** (0.3592)	0.7517*** (0.2697)
Business sector (Manufacturing – base level)		
Construction	0.1559** (0.0767)	−0.0438 (0.0631)
Trade	0.2669*** (0.0784)	0.0291 (0.0596)
Other services	0.2441*** (0.0746)	0.1099** (0.0493)
Size (Small firms - baselevel)		
Medium-sized firms	−0.1617** (0.0823)	−0.1393*** (0.0508)
Large firms	−0.1817*** (0.0746)	−0.1646*** (0.0519)
Constant term	0.2701*** (0.0936)	0.3315*** (0.0550)
Number of observations	236	524
R^2	0.2042	0.0771
Adj R^2	0.1980	0.0645
F test for business sector	6.39 [0.0004]	2.54 [0.0554]
F test for size	3.00 [0.0519]	6.46 [0.0017]
F test for joint insignificance	9.29 [0.0000]	5.90 [0.0000]
Diagnostic tests	**p-value**	
	Model 1	Model 2
RESET test	0.7948	0.0411
Jarque-Bera test	0.0000	0.0000
Chow test for size	0.6191	0.0000
Breusch-Pagan test	0.0005	0.0000
White test	0.0009	0.0001

The symbols *, **, *** indicate statistical significance of parameters in accordance with significance levels of 1%, 5% and 10%.
In () standard errors for the OLS estimator.
In [] p-values.
Source: Author's own work based on the EMIS database.

observations with large standardised residuals (greater in absolute value than 2) and leverage (greater than $\frac{2K}{N}$, where K is the number of explanatory variables and N the number of observations in the sample) as well as Cook's distance are also considered. Moreover, Leverage vs. squared residual plot was also analysed, the chart corroborating the non-existence of observations along with simultaneously high leverage values and squared residual. Values of VIF statistics (close to one) also fail to signal a collinearity problem in this regression.

To sum up this section, we state that model diagnostics prove the correctness of the econometric models developed. The obtained estimates using the Ordinary Least Squares method with robust standard errors for investment in tangible assets will be considered in the next subsection, where the first and second hypotheses stated previously will be tested.

5.2 Verification of the research hypothesis

Estimations for the econometric models indicate that the key determinant of investment is cash flow. The first hypothesis of this article states that cash flow has a significant impact on investment among Polish listed companies, while the second holds that the impact of cash flow on investments is particularly strong during a slowdown. Results presented in Table 4 confirm verification of these hypotheses. However, while the results for both years (in Model 1 and 2) are prove the first hypothesis, only those for Model 1 relating to 2008 prove the second hypothesis.

For each model (1 and 2), the estimates of ICFS are positive, and achieve statistical significance (Model 1: b » 1.1029; *p*-value = 0.0000; Model 2: b » 0.7517; *p*-value = 0.0000). On average every 1 p. p. of *cash flow* in the $t-1$ period translates into approx. 1.103 p.p. invested in the t period in 2008, as opposed to 0.751 p. p. in 2014 (assuming that all other variables are fixed). This analysis shows that, as investments made by Polish companies are positively and statistically significantly dependent on internal sources of financing, namely cash flows and there are no grounds for rejecting the first hypothesis.

These results indicate that a higher ICFS during the slowdown (Model 1) means the firms are very constrained to access to credit financing. The above strong dependence means that investment is financed

internally, rather than externally. The method tests the balance-sheet channel of monetary transmission indirectly, and there are no grounds for rejecting the second hypothesis. It is worth adding that the reservation to the verification of the above hypothesis in the results obtained (in Models 1 and 2) do not cover the same companies in the two different years (45% of the samples from 2008 and 2014 overlap). In addition, the Fisher-Snedecor test was carried out to analyse the equality of parameters with the variable cash flow in the two Models 1 and 2. The finding was that the null hypothesis should be rejected.

It can be concluded that the empirical research conducted offers no basis for rejection of this study's hypotheses (Hypotheses 1 and 2). It also points to the untenable nature of the presented theory by Modigliani and Miller (1958) on the independence of the level of investment from financing structure. On the other hand, the empirical findings of researchers such as Fazzari et al. (1988) are confirmed.

Tobin's Q index (a control variable for investment opportunities) emerged as a factor of impact on the level of investment in fixed assets, which is positive in Model 1 (relating to 2008 and the economic slowdown) ($\beta \approx 0.14$; p-value = 0.0000). The model corrected using Tobin's Q confirms that the investment project is profitable (Malinowska, 2016).

It is further emerged that the sector in which a given company operates is a significant indicator for investment. The estimates obtained suggest rejection of a hypothesis regarding joint insignificance of the business sector, at a significance level of 10%, suggesting that sector has a significant impact in explaining investment volatility. Referring to the literature review, the work of authors like Martinez-Carrascal and Ferrando (2008) indicate that there is a lack of clear evidence of sectoral differences when it comes to the impact of the respective financial conditions of enterprises on investments between countries (Belgium, Germany, France, Italy, The Netherlands and Spain). In both econometric models (Models 1 and 2), the highest values of coefficients correspond to trade or other services; the lowest values for parameters to industry. The 2009 NBP Report indicates how the previous year had experienced a relative increase in investments in trade (of 14.9%), construction (8.1%) and manufacturing (4.8%). However, from 2012, acceleration in the rate of growth of investments in manufacturing sector has been observed (The 2015 NBP Report).

Some authors (like Oliner & Rudebusch, 1996) have concluded that enterprise size is an important parameter or representative for the asymmetric information often viewed by the literature as implying financial constraints. In addition, enterprise size is a determinant of growth opportunities, because small companies are characterised by great development potential. The results (for Models 1 and 2) reveal grounds for rejection of the hypothesis regarding joint insignificance of size, at a significance level of 10%. This is to say that company size has a statistically significant impact in explaining investment volatility.

In sum, empirical study does not offer any grounds to reject first and second hypotheses stated in this article. Rather, the results obtained seem to confirm theories regarding the balance-sheet channel of monetary transmission.

6 Conclusion

The aim of this article is to verify the impact of cash flows on investments made by listed companies in Poland. It has described the important economic theories by presenting the issue of sensitivity of investments to cash flow (ICFS) as well as by describing research work done in recent years. This allowed the two research hypotheses to be sustained. With the EMIS database in the case of Polish nonfinancial companies listed on the Warsaw Stock Exchange and *NewConnect* in 2008 and 2014, the hypotheses are verified using the Ordinary Least Squares method with robust standard errors.

Obtained parameter estimates offered no grounds for rejecting the research hypotheses as follows:

> **Hypothesis 1:** Cash flow has a significant impact on investment in the Polish listed companies

The postulated hypothesis involved verifying the dependence of companies' investment policy on their internal funding sources (such as cash flow). In empirical work, this relationship is presented, analysed and tested with reference to the theory of liquidity. Companies operating in an imperfect market face difficulties in obtaining debt capital for the pursuit of investment. In this case, the financing of investment activity will be achieved using cash flow. This attests to the consistency of the theory of liquidity.

Hypothesis 2: The impact of cash flow on investments is particularly strong during a slowdown

It is known that cash flow is shown to have a positive impact, and to be characterised by statistical significance, most companies would appear to operate on an imperfect and incomplete market, and with constrained or costly access to external financing. Furthermore, the impact referred here is significantly stronger during a slowdown, when financial constraints are more binding. These results would seem to confirm the operation in Poland of a balance-sheet channel of monetary transmission.

In the future, it would be worth considering research into the differences between companies in terms of employment and inventory dynamics related to financial-flow shocks. According to Gilchrist and Himmelberg (1999), enterprises use external financing not only for investment purposes, but also to pay for labour and inventory factors. This should ensure that financial-flow shocks affect the cyclicity of changes in these variables.

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