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Cash flow and investment decision: an application on the Romanian agriculture sector

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Abstract

This paper tests the relationship between cash flow and the investment decision of firms from the Romanian agriculture sector. Although the role of cash flow in influencing the investment decision is explained by the financial frictions theory, the investment – cash flow nexus is controversial in empirical investigations. However, only few studies address the bidirectional relationship between the investment decision and the cash flow level. Using a large data set of 739 firms and a panel VAR approach for the period 2006 to 2014, we report a bidirectional causality between investment and cash flow. We find that firm's cash flow positively influences the level of investment in the next period, and we show therefore that the access to liquidity is important for the investment decision. At the same time, investment in fixed assets enhances the cash flow level only for the subsequent period, but it does not generate a series of cash flows as expected. The results are less conclusive if we use investment dynamics instead of investment level in our empirical analysis.

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Keywords: Investment decision; cash flow; firm-level data; agriculture sector; panel VAR.

1. Introduction

The neo-classical theory of investment argues that firm's investment is determined by economic fundamentals, and not by financial variables such as cash flow (Melander et al., 2017). New developments of this theory show that,

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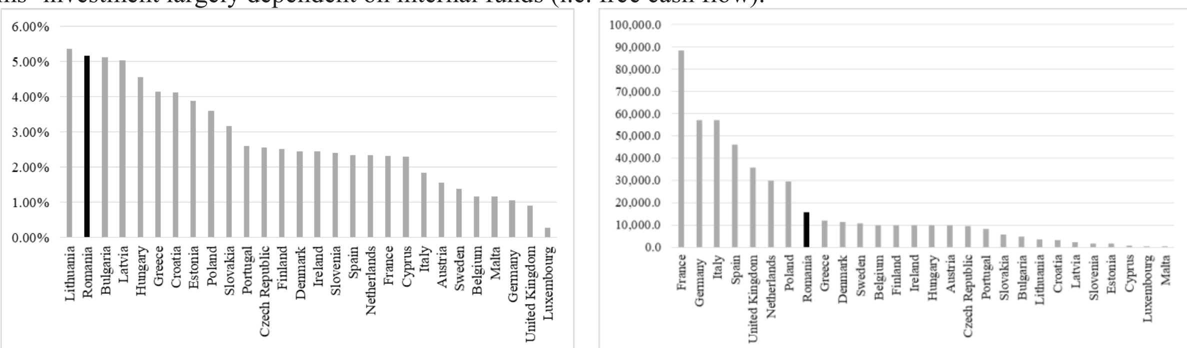
in the presence of financial frictions and asymmetry of information, investment is *inter-alia* a function of cash flow (see for example the Hayashi's (1982) neoclassical investment model). However, the interpretation of the investment – cash flow nexus is controversial (Carpenter and Guariglia, 2008). This relationship is influenced on the one hand by financial constraints and, on the other hand, by investment opportunities. A common solution for the second problem in the early literature was to include the Tobin's Q (the ratio between the market value and the replacement value of a physical asset) in the empirical regressions explaining the investment determinants.

From a theoretical point of view, it is expected that the cash flow have a positive influence on the investment decision, as it represents an internal funding source. However, noteworthy empirical findings report a negative relationship between investment and cash flow. Therefore, researchers try to explain the puzzling empirical findings on investment – cash flow sensitivities, underlining the role of firm's asset liquidity (Flor and Hirth, 2013), of firm's financial constraints (Kim, 2014), and of monetary transmission channels (Chatelain et al., 2003).

We contribute to the existing literature in several ways. First, using firm-level data, we test the bidirectional causality between investment and cash flow. Previous studies do not focus on the role of investment on cash flow, although the endogeneity issue is sometimes addressed in empirical papers (i.e. Bond and Meghir, 1994). It is well known that investment should be made if and only if the present value of future revenues equals the opportunity cost of capital. Accordingly, an investment should generates a stream of cash flows during the next periods. It is surprising that the empirical literature does not focus on the bidirectional causality between investment and cash flow, which might explain the divergent results reported so far. To show this, we use a panel data vector auto-regression method (pVAR) and we investigate the bidirectional Granger causality between investment (the ratio between fixed assets and total assets) and the cash flow level (as percentage of operational revenues) for 739 companies from the agriculture field in Romania (a similar empirical approach is used by Melander et al., 2017). We also search how shocks in cash flow/investment are transmitted to investment/cash flow, using impulse response functions.

Although several investigations are conducted on firm-level data (Bond and Meghir, 1994; Carpenter and Guariglia, 2008; Mulier et al., 2016; Melander et al., 2017), none of the existing works address the case of the agriculture sector. Agriculture is considered a sector where the value added is reduced as compared with industrial production or service domain, and where a considerable amount of time is needed so as the expected revenues to cover the initial investment cost. Further, cash flow might fluctuate more in this sector as compared to other sectors, one of the favouring element in this line being the climate conditions. Therefore, analysing the investment – cash flow nexus for agriculture firms is particularly interesting and represents another contribution of this paper to the existing literature. For this purpose, we use AMADEUS statistics from 2006 to 2014 for 739 firms located in Romania (NACE code: 01 – Crop and animal production, hunting and related service activities). Romanian agriculture is an interesting case study per se, as Romania is ranked as the second country of the European Union (EU) with the highest contribution of agriculture to the output, according to Eurostat data from 2014 (Fig. 1a). The same database shows that Romania is ranked as the eighth country of the EU in terms of agriculture output (Fig. 1b). Further, no specialized bank addresses the need of the agriculture sector in Romania, fact that makes the agriculture firms' investment largely dependent on internal funds (i.e. free cash flow).



(a) Agriculture as % of GDP (current prices) (b) Agriculture output (mil. Euro)

Source: Eurostat statistics

Fig. 1. Agriculture output in Romania and EU countries

Finally, we investigate not only the level of investment, but also its dynamics in relation with the cash flow. This way, we are able to underline two different aspects of the investment – cash flow relationship. On the one hand, when the level of investment is considered, we see how the cash flow influences firms assets' structure. In the case of financially constrained firms, there is a preference for more liquid capital, as current assets (Pérez-Orive, 2016). Therefore, the impact of cash flow on investment (measured in our research in terms of fixed assets) might be negative. However, if firms are not financially constrained, a long run strategy might be adopted, equivalent with investment in fixed assets. At the same time, if firms prefer external financing sources, they may obtain loans if the probability to have positive cash flows during the next periods is high. Consequently, it is expected that investment have a positive influence on cash flow. On the other hand, when the investment' dynamics is considered, we are able to see how an increase in the cash flow level contributes to the growth rate of fixed assets. A positive influence is associated with the existence of free cash flow, while a negative impact shows a cyclical behavior of the investment decision.

The rest of the paper presents the literature on investment – cash flow nexus (Section 2), the data and methodology (Section 3), and the empirical results (Section 4). The last section concludes.

2. Investment and cash flow: review of the literature

The investment – cash flow relationship is controversial because it can be analyzed from two different points of view, characterizing two concurrent theories. The "Modigliani-Miller's theorem" (Modigliani and Miller, 1958), shows that firm's capital structure has no relevance for its value. At the time, the "free cash flow" theory (Jensen, 1986) shows that cash flow in excess will lead to an increase in investment spending. Therefore, the impact of cash flow on investment may be either positive or negative. As Schiantarelli (1995) states, the investment – cash flow nexus is not only influenced by the asymmetry of information between lenders and borrows, but also by the non-value-maximizing behavior of firm's management.

Nevertheless, the investment – cash flow relationship is better explained by the financial frictions theory. The pioneering paper by Fazzari et al. (1988) shows that cash flow tends to have a powerful influence on investment in the case of financial constrained firms given the capital market imperfections and information asymmetry.

Over the past decades, a series of empirical papers extended the conventional investment models, to underline the role of financial constraints in influencing the investment (for a review of the literature, see Hubbard, 1998). In this line, Bond and Meghir (1994) investigate how investment responds to internal funds, and perform an empirical analysis for 626 manufacturing firms from the United Kingdom (UK), over the period 1974-1986. They discover that cash flow has a significant impact on investment, although the sign of its coefficient is not the expected one. With a focus on a similar set of UK firms over the period 1983 to 2000, Carpenter and Guariglia (2008) show that in the moment when the Tobin's Q is included in the investment regression, the explanatory power of cash flow remains unchanged for small firms, but falls for large companies. Therefore, the authors conclude that the significance of cash flow is related to its capacity to capture the effect of credit frictions. Melander et al. (2017) reach a similar conclusion. In their panel analysis for the period 1989-2005, the researchers use firm-level data and a reduced-form VAR methodology and show that cash flow has a positive impact on investment for all companies, but this effect is enhanced for financially constrained firms. For a set of UK listed firms, Pawlina and Renneboog (2005) advance a different conclusion and notice that investment is influenced by cash flow, and the agency costs and the level of free cash flow determine this effect.

Starting from the early empirical findings reporting controversial results on investment – cash flow relationship, a new strand of literature emerged and analyses the sensitivity of this relationship to different elements, in particular financial constraints. For example, Aidogan (2003) investigates the sensitivity of firm's investment to its own cash flow, in the presence of financial frictions. The author states that the sensitivity of investment to cash flow is lower for higher dividend payout ratios, while it increases for growing firms. To explain the investment – cash flow sensitivity to financial constraints, Kim (2014) uses a traditional fixed effects model and a principal component analysis to measure the financial constraints. The author shows that investment – cash flow sensitivity puzzle is explained on the one hand by the substitutability between cash holdings and free cash flow, and on the other hand by the level of net external financing. Mulier et al. (2016) also develop an index of financial constraints for unquoted European SMEs, and show that the highest investment – cash flow sensitivities characterize financially constrained firms.

Alternatively, the sensitivity is explained by the firm's reliance on internal resources (Musloo and Parhoon, 2017). However, when the sensitivity of investment to cash flow increases, firms become more and more financially constrained (López-Gracia and Sogorb-Mira, 2014), showing the existence of a virtual cycle between the sensitivity of investment to cash flow, and the level of financial constraints. To explain the complexity of this relationship, D'Espallier et al. (2011) take into account the investment dynamics, and consider non-linear effects.

Nevertheless, the financial constraint is not the only element explaining the sensitivity of investment to cash flow. Flor and Hirth (2013) show that the investment – cash flow sensitivity can be negative and it is determined by the liquidity of firm's assets. In a different approach, D'Espallier and Guarigli (2015) consider several controls for investment opportunities in their panel regression for 5,999 Belgian unlisted SMEs, over the period 2000-2004. Musloo and Parhoon (2017) adopt a similar method in their study on companies listed in the Tehran Stock Exchange. In line with the results reported by Morck et al. (1988), they show that the relationship between investment, cash flow and insider ownership is S-shaped.

The above-mentioned sensitivity is further investigated from the point of view of behavioral finance, and from the perspective of monetary policy transmission channels. Malmendie and Tate (2005) provide a behavioral explanation for sub-optimal firm's investment decision. With a focus on 477 firms from Forbes 500 lists, for the period 1980 to 1994, the authors show how the personal characteristics of chief executive officers (i.e. their overconfidence) influence the sensitivity of investment to cash flow. Exploring the interest rate channel and the broad credit channel for an extended set of firms located in the largest countries of the euro area (Germany, France, Italy and Spain) from 1985 to 1999, Chatelain et al. (2003) find that investment is sensitive to user cost changes, and therefore to cash flow movements. At macro level, Christiano et al. (2011) also report that financial frictions determine the monetary policy to have an increased effect on investment in the case of the Swedish economy.

Finally, the controversial relationship between investment and cash flow conducted to a "ping pong" scientific game between Kaplan and Zingales on the one hand, and Fazzari, Hubbard and Petersen on the other hand. First, Kaplan and Zingales (1997) use a subset of firms and the same regression as Fazzari et al. (1988) and criticizes the usefulness of investment – cash flow sensitivities for identifying financial constraints. In their subsequent study, Fazzari et al. (2000) state that the Kaplan and Zingales's (1997) theoretical model does not provide an effective critique because it fails to capture the common approach employed in the literature on investment – cash flow nexus. Kaplan and Zingales (2000) in their turn comment on the practice of splitting the firms' sample according to a measure of financing constraints. They show that such practice can be used if, and only if, investment – cash flow sensitivities increase monotonically in the degree of financing constraints.

We notice that previous studies underline a series of elements that influence the investment – cash flow relationship. However, none of the previous works focuses on the bidirectional Granger causality between the level and the dynamics of investment on the one hand, and the cash flow level on the other hand. Further, as far as we know, no previous paper assesses how shocks in one element are transmitted to the other.

3. Data and methodology

3.1. Data

Our data are extracted from the AMADEUS database and include firms implicated in agriculture production and related services (code 01) from Romania, for the period 2006 to 2014 (data were extracted in December 2016). From 1968 firms unregistered in Romania under this code, 739 are retained into analysis. We have excluded from our sample firms for which data are unavailable for a specific year to avoid the broken panel problem. This means that firms which have interrupted their activity, as well as new entries and firms that have made default during the analyzed period, are excluded from the sample. Consequently, our empirical results do not characterize the entire agriculture set of firms from Romania, but only those firms that have a continuity in their activity. The sample choice that we have made is justified by empirical reasons on the one hand, and by the fact that investment – cash flow nexus can be assessed if a sufficient amount of time elapses, in order for the investment to generate cash flows.

3.2. Methodology

To assess the bidirectional relationship between investment and cash flow, we use an unrestricted pVAR model. While a simple VAR model is characterized by a set of L endogenous variables $y_t = (y_{1t}, \dots, y_{lt}, \dots, y_{Lt})$, with $l = 1, \dots, L$, a general VAR(p)-process is defined as:

$$y_t = c + A_1 y_{t-1} + \cdots + A_p y_{t-p} + \varepsilon_t \quad (1)$$

where: A_k are $(L \times L)$ coefficient matrices with $k = 1, \dots, p$; ε_t is a white noise L-dimensional process with $E(\varepsilon_t) = 0$.

In the case of a pVAR, y_{it} represents for each firm i $(i = 1, \dots, N)$ a vector of L endogenous variables at time t $(t = 1, \dots, T)$, and thus $Y_t = (y'_{1t}, \dots, y'_{Nt})'$. Consequently, a VAR for each firm i from our sample can be written as:

$$y_{it} = c + A_{1,i} Y_{t-1} + \cdots + A_{P,i} Y_{t-P} + \varepsilon_{it} \quad (2)$$

where: $A_{p,i}$ are $(L \times NL)$ matrices for each lag $p = 1, \dots, P$; ε_{it} are uncorrelated and normally distributed errors $N(0, \Sigma_{ii})$; $cov(\varepsilon_{it}, \varepsilon_{jt}) = E(\varepsilon_{it}, \varepsilon_{jt}) = \Sigma_{ij}$ is the covariance matrix between the errors in the vector of firm i and firm j.

Compared with a cross-sectional analysis, the pVAR adresses all static and dynamic dependencies between firms (Albulescu and Miclea, 2016). Further, the pVAR allows to see the causality between variables, and also the response of one variable to shocks in the other variable. Nevertheless, a noteworthy drawback for an unrestricted pVAR with P lags is that we must estimate $G = (NK)^2 P$ autoregressive coefficients, operation which becomes problematic if the number of firms is large. However, this is not an issue for our sample.

4. Empirical findings

4.1. Panel unit root investigations

A primary condition for using a pVAR is the stationary of our series. The panel unit root tests show that the level of investment measured as the fixed to total assets ratio (FTA), the investment dynamics measured as the growth rate of fixed assets (FAD), as well as the cash flow to operating revenues ratio (CF) are stationary (Table 1).

Table 1. Panel unit root tests.

	Levin–Lin–Chu *t**	Im–Pesaran–Shin *W-stat*	ADF–Fisher *Chi-square*	PP–Fisher *Chi-square*
FTA	-41.04***	-8.243***	2125.5***	2831.7***
FAD	-381.8***	-36.12***	2829.0***	5323.7***
CF	-44.95***	-8.935***	2127.9***	3457.8***

*Notes: (i) *, **, ***, mean stationarity significant at 10 %, 5 % and 1 %; (ii) For all the tests, the null hypothesis is that the panel contains a unit root; (iii) Probabilities for the Fisher tests are computed using an asymptotic Chi-square distribution, while the other tests assume asymptotic normality.*

4.2. The relationship between the level of investment and cash flow

In this section, we focus on the level of investment (FTA) and we start the pVAR analysis by selecting the lag order (Table 2). We see that three out of five criteria indicate seven lags to be used in our pVAR estimation, while the other two criteria recommend three and four lags, respectively. Consequently, we perform the estimation with seven lags.

Table 2. pVAR lag order selection (FTA – CF).

Lag	LR	FPE	AIC	SC	HQ
0	na	17166	17.729	17.741	17.733
1	1789.0	15264	15.309	15.346	15.323
2	131.22	12904	15.141	15.203	15.165
3	39.862	12353	15.097	15.184*	15.131
4	19.625	12156	15.081	15.193	15.124*
5	6.7819	12175	15.082	15.220	15.135
6	12.155	12103	15.077	15.239	15.139
7	14.074*	11999*	15.068*	15.255	15.140
8	4.3744	12057	15.073	15.285	15.154

Notes: LR – sequential modified LR test statistic; FPE – Final prediction error; AIC – Akaike information criterion; SC – Schwarz information criterion; HQ – Hannan-Quinn information criterion.

Table 3 presents the results of the pVAR analysis and shows that the level of investment (FTA) has a positive influence on the cash flow (CF) of the next period, but does not generate a series of cash flows. At the same time, the first lag of CF positively influences the level of investment, while the second lag has a negative impact. Therefore, the cash flow enhances the level of investment for the next period only, while for the second period it has a negative influence. This result partially sustains the affirmation of Bond and Meghir (1994) stating that cash flow has a wrong sign in the investment regression. At the same time, these findings explain the results reported by Morck et al. (1988), who show that investment – cash flow relationship is S-shaped.

Table 3. pVAR results (FTA – CF).

	FTA	CF
FTA_{t-1}	0.795*** (0.02)	0.071** (0.03)
FTA_{t-2}	0.029 (0.03)	0.007 (0.03)
FTA_{t-2}	0.024 (0.02)	-0.039 (0.03)
FTA_{t-4}	0.022 (0.02)	-0.015 (0.03)
FTA_{t-5}	-0.018 (0.02)	-0.022 (0.03)
FTA_{t-6}	-0.019 (0.02)	-0.031 (0.02)
FTA_{t-7}	0.069*** (0.02)	0.009 (0.02)
CF_{t-1}	0.053*** (0.02)	0.471*** (0.02)
CF_{t-2}	-0.034* (0.02)	0.302*** (0.03)
CF_{t-3}	0.004 (0.02)	0.191*** (0.03)
CF_{t-4}	-0.028 (0.02)	0.106*** (0.02)
CF_{t-5}	0.023 (0.02)	0.070*** (0.02)
CF_{t-6}	-0.009 (0.02)	-0.069*** (0.02)
CF_{t-7}	0.036** (0.01)	-0.061*** (0.02)
intercept	4.753*** (0.86)	0.805 (1.07)
R-squared	0.753	0.655
Adj. R-squared	0.751	0.651

*Notes: (i) *, **, ***, mean stationarity significant at 10 %, 5 % and 1 %. (ii) Standard errors in brackets.*

In the next step, we perform a Granger causality analysis, which shows the existence of a bidirectional causality between the selected elements (Table 4). However, CF Granger causes FTA with a degree of confidence of 90% only.

Table 4. Granger causality results (FTA – CF).

	FTA	CF
CF	12.24*	-
FTA	-	16.17**

*Notes: (i) *, **, ***, mean significance at 10 %, 5 % and 1 %. (ii) H0: y_{1t} does not Granger cause y_{2t} and the opposite. (iii) Chi-squared is reported.*

Because these findings are not very conclusive for the investment – cash flow nexus, we further test how shocks in one variable are transmitted to the other variable, using impulse response functions (Figure 2). First, we see that the response of CF to FTA is non-significantly different from zero, as the upper confidence band is over zero, while the lower limit is below zero (red dash lines). Second, it appears that a shock in CF has a positive impact on FTA one period ahead, and a negative impact two periods ahead, result in line with that reported by the pVAR analysis.

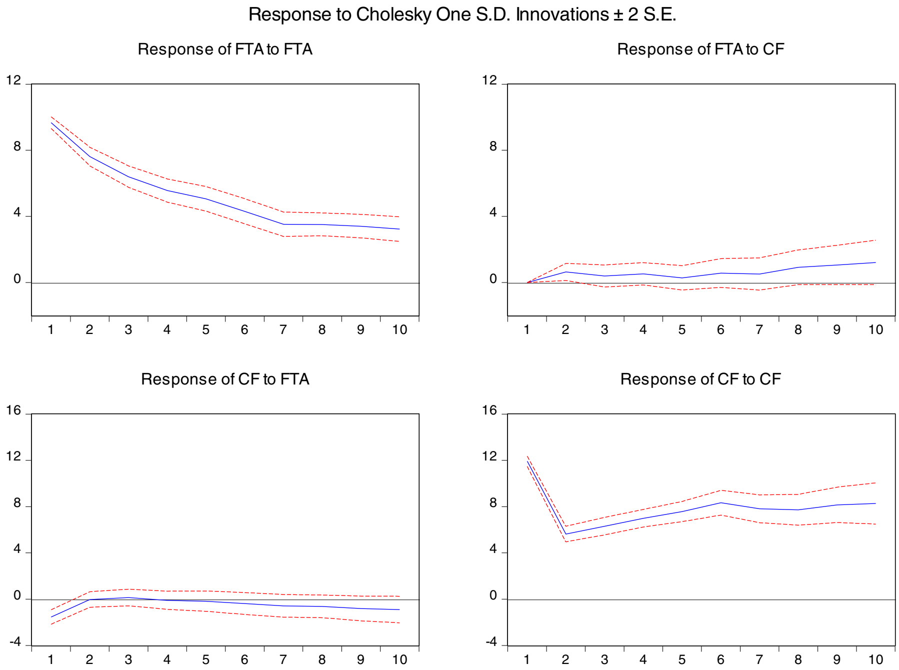


Fig. 2. Impulse response functions (FTA – CF)

Overall, we report a bidirectional causality and influence in the short run between investment level and cash flow. However, it appears that the influence of cash flow on investment is not linear. In this context, the analysis of the relationship between the investment dynamics and the cash flow level might provide additional insights to our empirical investigation.

4.3. The relationship between investment dynamics and cash flow

As in the previous case, we start with the lag order selection. We notice that for investment dynamics – cash flow relationship, three out of five criteria indicate six lags for the pVAR (Table 5).

Table 5. pVAR lag order selection (FAD – CF).

Lag	LR	FPE	AIC	SC	HQ
0	na	1048	19.538	19.551	19.543
1	739.24	3882	18.545	18.582	18.559
2	131.19	3281	18.377	18.439	18.401
3	32.891	3171	18.343	18.430*	18.376*
4	14.652	3142	18.333	18.445	18.377
5	8.1154	3141	18.333	18.470	18.386
6	14.706*	3112*	18.324*	18.486	18.386
7	7.1668	3115	18.324	18.511	18.397
8	na	1048	19.538	19.551	19.543

Notes: LR – sequential modified LR test statistic; FPE – Final prediction error; AIC – Akaike information criterion; SC – Schwarz information criterion; HQ – Hannan-Quinn information criterion.

Table 6 reports results that are even more inconclusive. Nevertheless, similar to the previous case, the cash flow positively influences the investment dynamics for the next period. That is, the first lag of cash flow level positively influences the investment dynamics (FAD). In addition, we notice that an increase in the cash flow level generates subsequent increases.

Table 6. pVAR results (FAD – CF).

	FAD	CF
FAD_{t-1}	-0.002 (0.00)	0.000 (0.00)
FAD_{t-2}	-0.002 (0.00)	0.000 (0.00)
FAD_{t-2}	0.004* (0.00)	0.000 (0.00)
FAD_{t-4}	0.007* (0.00)	-0.000 (0.00)
FAD_{t-5}	0.001 (0.00)	-0.001* (0.00)
FAD_{t-6}	-0.000 (0.00)	0.000 (0.00)
CF_{t-1}	0.174* (0.13)	0.474*** (0.02)
CF_{t-2}	-0.055 (0.15)	0.298*** (0.03)
CF_{t-3}	0.054 (0.15)	0.190*** (0.03)
CF_{t-4}	-0.139 (0.14)	0.093*** (0.02)
CF_{t-5}	-0.101 (0.14)	0.058** (0.03)
CF_{t-6}	0.282** (0.14)	-0.080*** (0.02)
intercept	15.91*** (2.53)	-0.365 (0.51)
R-squared	0.008	0.650
Adj. R-squared	0.000	0.647

*Notes: (i) *, **, ***, mean stationarity significant at 10 %, 5 % and 1 %. (ii) Standard errors in brackets.*

Different from the previous set of results, the Granger causality is not significant when the investment dynamics is used in the analysis (Table 7).

Table 7. Granger causality results (FAD – CF).

	FAD	CF
CF	8.153	-
FAD	-	2.868

*Notes: (i) *, **, ***, mean significance at 10 %, 5 % and 1 %. (ii) H0: y_{1t} does not Granger cause y_{2t} and the opposite. (iii) Chi-squared is reported.*

Figure 3 clearly shows that shocks in one variable are not transmitted to the other variable. The impulse response functions state that the response of CF (FAD) to FAD (CF) is non-significantly different from zero.

5. Conclusions

We empirically investigate the investment – cash flow relationship for a set of 739 Romanian firms acting in the agriculture industry. For this purpose, we use a pVAR analysis for the period 2006 to 2014, and we conclude, in line with several previous studies, that the investment – cash flow nexus is controversial.

More precisely, when the level of investment is considered, we obtain a bidirectional causal relationship between investment and cash flow. Our pVAR shows that only the first lag of each variable positively influence the level of the other variable. The impulse response functions show that a shock in CF level is positively transmitted to FTA one period ahead, and has negative impact two periods ahead, pointing in the favor of a non-linear relationship. However, when the investment dynamics is used in our pVAR, we report no significant Granger causality and non-significant response to shocks between variables.

From the perspective of financial management of agriculture companies, our results underline the importance of cash flow in sustaining investment in the short run. However, the cash flow (and the associated free cash flow) does not represents a reliable source of investment for multiple periods. Curiously, the investment has a positive impact on cash flow in the next period, but not a significant impact during the subsequent periods.

Our paper has, however, several limitations. On the one hand, the nexus between the investment and cash flow is assessed in a linear specification, while this relationship might be non-linear and characterized by structural breaks, as for example the outburst of the food crisis in 2008. On the other hand, our pVAR estimation does not represent a classic VAR regression. Instead, it represents an ordinary least square (OLS) estimation on stacked data, which has the advantage that lags do not go across cross-sections.

This paper might be extended in the following ways. First, to better characterize the investment behavior of agriculture firms from Romania, we may extend our sample, considering both new entries and firms that stopped their activity over the analyzed time horizon. Second, to cope with the financial friction theory of investment, both the Tobin's Q and the firms' debt ratio should be included in the analysis. Nevertheless, the computation of Q Tobin implies the existence of information about stock price and book value per share, information available for listed firms only. Unfortunately, only few firms from our sample are listed on stock exchange.

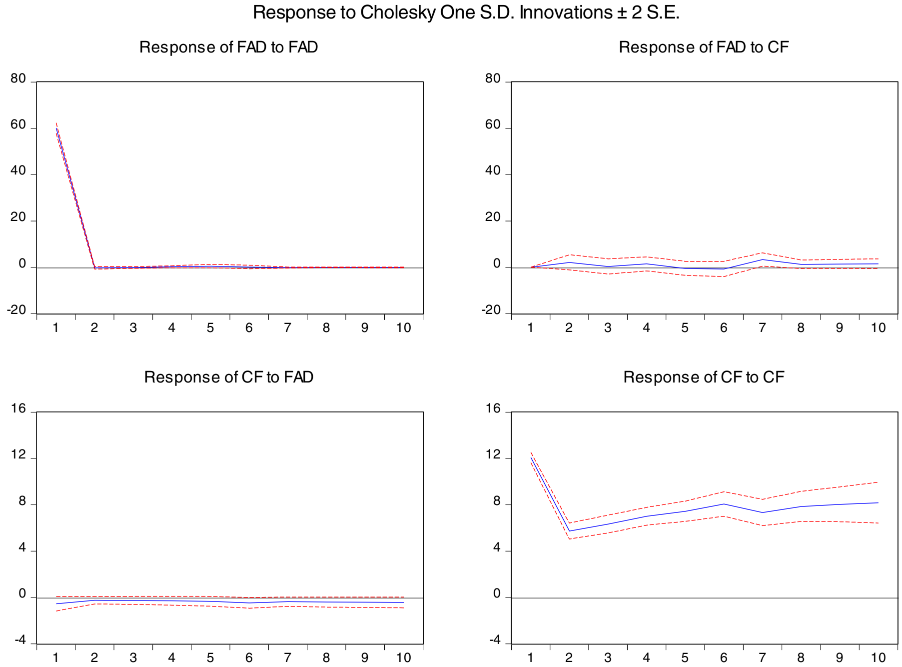


Fig. 3. Impulse response functions (FAD – CF)

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