What determines the capital structure of farms? Empirical evidence from Poland

Geoffroy Enjolras, Gilles Sanfilippo & Michał Soliwoda

Published online: 30 Aug 2021.

Submit your article to this journal ↗

Article views: 1430

View related articles ↗

View Crossmark data ↗

Routledge
Taylor & Francis Group

What determines the capital structure of farms? Empirical evidence from Poland

Geoffroy Enjolras ◉[a], Gilles Sanfilippo[a] and Michał Soliwoda[b]

[a]CERAG, Grenoble INP-IAE, Univ. Grenoble Alpes, Grenoble, France; [b]Faculty of Economics and Sociology, Corporate Finance Department, University of Lodz, Lodz, Poland

ABSTRACT
The purpose of this paper is to analyse capital structure and its dynamics for farms in Poland, a leading European Union producer. The theoretical framework is based on the trade-off and pecking order theories of capital structure. We use data from the Farm Accountancy Data Network (FADN), which is representative of Polish professional farms during the period 2009–2018. We adopt a dynamic partial adjustment model using the generalized method of moments in order to explain the financing of farms through debt. The results show that Polish farms exhibit low target levels of debt, which they adjust dynamically, thus partially validating the trade-off theory. While size and growth opportunities positively influence the indebtedness of farms, profitability and land have the opposite effect. Polish farmers therefore use available internal funds, especially retained earnings, as a substitute for debt, in line with the pecking order theory.

1. Introduction

The European agricultural sector, with more than 10 million full-time employees, creates an estimated €432 billion per year in total added value (Eurostat, 2019). As farm development requires innovation and investment, the financing of activities is a crucial issue for boosting growth, jobs and the overall development of rural areas (Turvey, 2017). Despite the subsidies provided by the Common Agricultural Policy (CAP), access to funding is one of the main obstacles to sustainable development of agricultural businesses in all European countries (Tropea & De Cavalho, 2016). The issue of limited access to credit has been considered in the literature as an important factor that can inhibit farm development, especially in Eastern European countries (Latruffe, 2005; Petrick, 2004a, 2004b; Petrick & Latruffe, 2006). A report published by fi-compass (2020) estimates the financing gap for agriculture in the EU to be between €19.8 billion and €46.6 billion.

The global macroeconomic situation during the last decade has made it even more necessary to strengthen and secure the financing capacities of agricultural businesses.

According to Petrick and Kloss (2013), the credit crunch following the 2007–2008 financial crisis and the instability of agricultural markets (in terms of prices and/or legislation) have led to a strong decline in average farm income. The planned reductions to the European public budget for agricultural and rural policies contained within the Common Agricultural Policy (CAP) 2021–2027 may also have a negative impact on farm revenue. Given the significant relationship between capital structure and firm competitiveness (Myers, 1984), an in-depth analysis of how financing decisions are (or should be) made appears to be more relevant than ever for European farms.

Compared with large corporate firms, which have direct access to capital markets and exhibit a sophisticated capital structure, most farms have a relatively limited number of accessible financial resources, which may be summarized as internal funds and short- and long-term debt. For farms, as for all businesses, the design and optimization of capital structure play a central role in their financial management. Most of the theoretical framework concerning the capital structure of firms is based on the seminal work of Modigliani and Miller (1958), which links the capital structure of a company to its market value. Following on from this article, many scholars have demonstrated that having a choice of available financial resources is essential for optimizing firm value, giving rise to different theories of optimal capital structure. Among these, the trade-off theory (Myers, 1984) and the pecking order theory (Myers & Majluf, 1984) are probably the most well-known.

Most empirical tests of these theories have been conducted on large companies, on mature markets and using secondary data (Kumar et al., 2017). By contrast, in the agricultural sector, few studies have investigated the financial structure and policy of farms. Most empirical studies in this area have concerned the US agricultural market (Barry et al., 2000; Katchova, 2005; Zhao et al., 2008), while some notable exceptions have examined Dutch, Irish and Swiss farms (Aderajew et al., 2019; Schorr & Lips, 2019; Tian, 2013; Wu et al., 2014). Although the issue of access to credit has been tackled in some studies (Petrick, 2004a, 2004b; Petrick & Latruffe, 2006), to the best of our knowledge, no study on capital structure has previously considered Eastern European countries.

This paper aims to fill the gap and provide further evidence of the validation of the theoretical framework of capital structure – trade-off and pecking order theories – by considering Poland, a former communist country in Eastern Europe. Petrick and Weingarten (2004) convincingly state that 'the group of countries summarised as "Central and Eastern European countries" is quite heterogeneous both in terms of national income levels and progress in the transition to a market economy'. Poland may simultaneously be considered as a typical and a unique example of Eastern European agricultural systems. On the one hand, the agricultural sector has benefitted enormously from steady growth based on substantial investments that have enabled it to provide food at affordable prices. On the other hand, while collective farming was historically the norm in all Eastern European communist countries, in Poland, private farming was officially recognized as a specific element of the 'Polish road to socialism' from the late 1950s (Turnock, 1996). Private ownership of land prevailed and a certain proportion of the land left by the socialized entities was transferred to family farms. Thus, quasi-peasant farms remain as a product of post-communist transformation, which is somewhat unusual among post-communist countries (Sadowski et al., 2015). As a legacy of this, Polish farms are among the least indebted in the EU (European Commission, 2018).

Poland is a relatively important European agricultural producer, accounting for 8% of EU farmland and 6% of EU agricultural output. Its agriculture is characterized by the predominance of small and medium (rarely large) farms. Production is diversified with an emphasis on field crops and livestock, such that the country's agriculture may be considered as representative of Eastern Europe (Eurostat, 2019). As Poland benefits from the CAP, the effects of subsidies on capital structure need to be considered explicitly in order to determine whether or not farms use them as a substitute for indebtedness. Our empirical findings may also bring added value from the perspective of policymakers given the growing interest in repayable financial instruments for boosting significant green investment in the agricultural sector (fi-compass, 2020).

Our empirical analysis is based on the database of the Farm Accountancy Data Network (FADN) for the period 2009–2018. FADN data are representative of Polish professional farms, especially in terms of productive orientation. Moreover, this database includes relevant accounting and financial statements (cash flows, balance sheets and income statements) as well as information on European subsidies. It allows us to perform a complete study on the different sources of farm financing, both internal and external. In order to estimate the influence of key factors on indebtedness, we use a dynamic partial adjustment model in line with the theoretical framework. Estimates are based on the generalized method of moments (GMM), which is suitable for samples with a small number of time periods and a large number of observations. Endogeneity issues are addressed through using lagged variables as instruments, while time- and farm-invariant parameters are removed. Finally, robustness tests are performed on subsamples.

The remainder of this article is organized as follows. The second section is devoted to an overview of the existing literature on the indebtedness of farms and other businesses. The third section focuses on the empirical framework, including descriptions of the Polish context, the database and the econometric modelling. The fourth section displays, analyses and discusses the results of the econometric model, while the fifth section concludes the study.

2. Theoretical background on the capital structure of farms

This section presents the main results of previous empirical studies testing these theories in the agricultural sector. The two most well-known theories of capital structure – trade-off theory (Miller, 1977; Myers, 1984) and pecking order theory (Myers & Majluf, 1984) – are summarized and a set of research hypotheses is presented.

2.1. Empirical studies on the capital structure of farms

The first economic analysis on the use of debt by farms dates back to the 1940s, following the Great Depression (Musser et al., 1977). Historically, farms have been using debt to finance capital investments and their working capital requirements for centuries (Bogue, 1976). Due to the leverage effect of debt, farms benefit from increased profitability, productivity and growth. By contrast, the literature has shown that restricted access to credit penalises the productivity and overall performance of farms, especially in Poland and other Eastern European countries (Ciaian et al., 2012; Latruffe, 2005; Petrick, 2004a, 2004b).

Empirical studies in agricultural finance have usually focused on macroeconomic factors that affect debt levels, such as the tax rate, GDP and inflation (Aderajew et al., 2019; Ahrendsen et al., 1994; Barry et al., 2000; Collins, 1985; Featherstone et al., 2005). Wu et al. (2014) propose a unified theoretical framework that explains farm capital structure choice, focusing on utility maximization models (Collins, 1985). Their general approach enables them to consider several hypotheses but they do not refer explicitly to those connected to the usual theoretical frameworks related to capital structure. However, their empirical test shows the same relationship between debt levels and other factors previously considered in the literature.

To our knowledge, few studies have addressed the problem of farm indebtedness by considering capital structure theories. Barry et al. (2000), Katchova (2005) and Zhao et al. (2008) examine the impact of various individual, structural and financial variables on capital structure choice in the US, testing various theories (trade-off, pecking order and signalling) with mixed results. Howley and Dillon (2012) perform a similar analysis in Ireland, while Tian (2013) and Aderajew et al. (2019) investigate the capital structure of Dutch farms. Schorr and Lips (2019) consider Swiss farm capital structure with respect to performance indicators such as economic value added (EVA). These studies consider individual farm data and generally focus on only one country or one sector at a time. Generally speaking, they show that farms appear to have debt targets, which they partially adjust from time to time, in line with the dynamic version of trade-off theory. Some studies also emphasize that pecking order theory is relevant for farms that prefer internal over external funds.

2.2. The trade-off theory of capital structure

In trade-off theory, the objective of owners and managers is to optimize the indebtedness of the firm in order to maximize its value. This maximization is obtained by considering the trade-off between the costs and benefits of borrowing (Myers, 1984). The interest tax shield is balanced with the direct (repayment of the principal and interest) and indirect (monitoring and contracting, legal and administrative bankruptcy) costs of debt and with moral hazard. In a static framework, the optimal debt ratio mainly depends on the likelihood of bankruptcy, which is influenced by several accounting and economic variables described below.

Large firms, which have greater diversification of activities and less volatile profits, have a lower likelihood of bankruptcy (Smith & Stulz, 1985; Titman & Wessels, 1988). When bankruptcy does occur, tangible assets may be used as collateral, indicating a positive relationship between asset tangibility and indebtedness (Michaelas et al., 1999). This hypothesis could be very relevant for farms as their assets (e.g. land, equipment) are almost all tangible. In the same spirit, asset liquidity is of great importance, especially for small- and medium-sized companies. Asset liquidity may be positively associated with debt because a high liquidity ratio demonstrates the ability of firms to meet their short-term liabilities (Lipson & Mortal, 2009).

The most profitable firms have a greater capacity for indebtedness because recurrent cash flows indicate a smaller likelihood of bankruptcy. Subsidies, such as CAP payments, contribute to farm profitability and stability (Latruffe et al., 2010) and a reduction in risk aversion (Bhaskar & Beghin, 2009), thus favouring indebtedness (Ciaian & Pokrivcak, 2011).

Conversely, firms naturally face uncertain future cash flow and profitability. For instance, in agriculture, risk comes from various factors, such as the weather and volatile input and output prices. As a result, access to credit may be reduced for firms that are viewed by creditors as a greater risk and that would suffer from higher bankruptcy costs (Myers, 1984). In the same spirit, it may also be argued that a long-term activity might be associated with higher indebtedness, given that well-established firms have more advantageous loan terms than newer ones. The older the firm (and its reputation), the lower the cost of debt. By contrast, firms that are in a growth phase are perceived as higher risk and experience more unfavourable conditions when attempting to access finance.

In a dynamic setting, the trade-off theory accounts for the adjustment of the debt ratio as a balance between the costs of deviation from the target and the gains of adjustment towards that target. Empirically, firms make a partial adjustment of debt towards the optimal debt ratio (Lopéz-Gracia & Sogorb-Mira, 2008; Ray, 2012). For this to be achieved, the dynamic trade-off theory considers that for each period, the variation of the debt ratio is also explained by the deviation between the actual and the optimal ratio in the previous period.

2.3. The pecking order theory

The pecking order theory asserts that firms demonstrate a preference for using internal finance (such as retained earnings or excess liquid assets) over external finance due to information asymmetries. Information asymmetries imply that external stakeholders consider the firm to be higher risk, thus lowering its value (Myers & Majluf, 1984). If internal funds cannot fully finance investment opportunities, firms may look for and select from the various external finance sources, namely short- and long-term debt and equity, in order to minimize additional costs resulting from information asymmetries.

Under this theoretical framework, accounting variables may also explain a preference for each of the financing sources available to farmers. First, a profitable firm has the capacity to accumulate retained profits and has less need to turn to external finance (Fama & French, 2002; González & González, 2012). Second, firms with growth opportunities must undertake investment projects, which in turn increase their financial needs. As growth opportunities may produce moral-hazard effects and push firms into taking more risks, Myers (1984) argues that they should contain their indebtedness. Third, the variability in farm profitability is associated with a risk of default on debt repayment, which results in a negative relationship between risk and indebtedness (Barry et al., 2000).

In pecking order theory, asset structure is also an important determinant of the financing decision. Tangible assets (e.g. land, buildings, equipment) have a greater liquidation value (Harris & Raviv, 1991). So, the more assets are tangible, the more they may act as collateral for a loan. Moreover, there exists a negative relationship between liquidity and indebtedness of firms (Myers & Rajan, 1998). Firms benefitting from cash and liquid assets prefer to use this internal funding for their investments instead of external financing. Thus, subsidies, which naturally increase farm liquidity, may reduce indebtedness.

The size of the firm can also be an important factor in pecking order theory. Theoretically, size reduces the problems of information asymmetry between managers/owners and creditors, allowing firms to obtain debt on more favourable terms (Myers, 1984). Thus, a positive relationship between size and debt should be expected (Lopéz-Gracia & Sogorb-Mira, 2008; Psillaki & Daskalakis, 2009).

Table 1. Summary of hypotheses according to the trade-off and pecking order theories.

	Expected influence	
Factors	Trade-off theory	Pecking order theory
Land	+	+
Subsidies	+	−
Profitability	+	−
Liquidity	+	−
Tangibility	+	+
Size	+	+
Growth	−	−
Risk	−	−

We summarize the expected relationship between indebtedness and the different variables in Table 1.

3. Empirical framework

This section presents the empirical framework for our study. We start with a presentation of the structure and financing of Polish agriculture. We then focus on the database and the main variables used. Finally, we present our empirical model.

3.1. A presentation of Polish farms and the credit situation of the Polish agricultural sector

Poland is among the most important agricultural producers in the EU (Eurostat, 2019). Its agriculture is characterized by the predominance of small and medium (rarely large) farms with an average land area of 10 hectares. Production is diversified with an emphasis on field crops and livestock (Table 2). Agriculture also provides a significant contribution to national added value and accounts for 10.1% of employment in Poland. Since the communist period, the agricultural sector has undergone important structural changes, with increases in the average size of farms and the intensification of production. However, productivity remains low, which raises issues concerning levels of investment and access to credit for farms in this country (Bórawski et al., 2020; Dannenberg & Kuemmerle, 2010).

Before accession to the EU, Polish farms suffered from limited access to credit and other sources of external financing as well as few possibilities to accumulate internal funds. This had a significant impact on farm production, investment and consumption (Kata, 2011). Polish farmers preferred loans as a source of investment financing that was intended to enlarge, renew and diversify the production potential of their farms. To a lesser extent, loans are also used as a means of financing current agricultural production and maintaining financial liquidity (Kata, 2018). One might infer that other financing sources, such as European and national subsidies, contribute to the funding of structural investments (fi-compass, 2020).

According to the National Bank of Poland (NBP) data, at the end of 2018, the total amount loaned to farms amounted to over 34 billion zlotys (approx. 7.5 billion euros). It is worth noting that the total sum of loans (in nominal terms) grew by as much as 75.4% compared to 2009. Over the same period, average interest rates fell from 10.1% to 5.2%. However, there was still a barrier to accessing medium- and long-term loans

Table 2. Summary of Polish agricultural statistics.

Agricultural characteristic	Year	EU-28	Poland
Farmland (1000 hectares)	2016	172,967	14,406 *(8.3%)*
Farms	2016	10,467,760	1,410,700 *(13.5%)*
Farmland/holding (hectares)	2016	16.523	10.211
Employment (% of national employment)	2016	4.2%	10.1%
Total agricultural output (M€)	2017	432,600	24,938 *(5.7%)*
> Crops (M€)	2017	218,918	11,244 *(5.1%)*
> Livestock (M€)	2017	176,883	13,071 *(7.3%)*
Value added (M€)	2017	188,460	10,273 *(5.4%)*
Export value (M€)	2017	137,900	25,867
Import value (M€)	2017	117,400	17,537

Source: Eurostat (2019) and Statistical Factsheets from the European Commission (2020). The share of Poland's contribution within the EU (28 countries) is italicized in brackets, where available.

as only 12.4% of Polish farmers applied for such loans in 2017–2018, while the EU average was 29.6% (fi-compass, 2020). The dominant component of farmers' debt (70%) is the long-term investment loan with a maturity period of more than 5 years (Polish Ministry of Agriculture and Rural Development, 2019). According to the Polish Financial Supervision Authority (UKNF, 2018), the quality of loans to individual farmers is relatively good and stable due to the high share of preferential loans. It should be noted that cooperative banks account for less than 60% of loans to agriculture and this figure has gradually decreased over the last decade. A fairly broad offer from commercial banks is being well-promoted and is gaining ground on the cooperatives.

3.2. Database

In order to study the capital structure of farms, we use individual and annual data from FADN for the period 2009–2018. These data are the most accurate available at the individual level. It is worth noting that the FADN sample includes only commercial farms, which, by definition, attain a minimum economic size (standard output of at least €4000 in Poland). Furthermore, the sample is based on a defined stratification (geographical location, economic and technical orientation and physical size) and extrapolation factors (weights) are computed.[1] Our sample is thus representative of Polish professional farms, including those specializing in crops and livestock.[2] From the database, we extract all the relevant variables previously used in other studies (Aderajew et al., 2019; Barry et al., 2000; Zhao et al., 2008) in order to test the relevance of the trade-off and pecking order theories when applied to the financing of Polish farms.

Given that our study covers the period following the economic crisis in Europe, we also combine this database with several macroeconomic indicators (Aderajew et al., 2019). We assume that macroeconomic factors play an important role in the timeline of financing and the choice of capital structure. We choose to measure the effect of GDP growth and inflation on indebtedness. These variables are from the World Bank database. Table 3 specifies the variables used to test the hypotheses defined in Table 1 of this paper.

3.3. Econometric modelling

According to the literature (Aderajew et al., 2019; Barry et al., 2000; Katchova, 2005; Tian, 2013; Zhao et al., 2008), the most appropriate models for testing our research hypotheses

Table 3. List of variables used in the analysis.

Variable	Unit	Definition
Year	–	Year of the observation
Leverage	%	Debt-to-asset ratio (financial debts/total assets)
Standard output	€	Standard output
Decoupled subsidies	€	Decoupled subsidies from the 1st pillar of the Common Agricultural Policy
Rural development subsidies	€	Rural development subsidies from the 2nd pillar of the Common Agricultural Policy
Farmland	ha	Agricultural land area
Land	%	Share of land value in total assets
Tangibility	%	Fixed/current assets
Profitability (ROA)	%	Earnings before interest and taxes/total assets
Liquidity	%	Stock-to-sales ratio
Assets	€	Total assets (agricultural land, buildings, machinery, equipment, breeding livestock)
Growth	%	Total investments/assets
Risk	%	Standard deviation/average ROA
Age	Years	Age of farmer
Orientation	Classes	Economic and technical orientation of the farm (field crops, horticulture, livestock, granivores, mixed crop-livestock)
GDP	%	Annual growth of GDP in Poland
Inflation	%	Annual inflation rate in Poland

are panel data regressions, with the debt ratio or leverage (defined here as the debt-to-asset ratio) being the dependent variable. This estimation method allows us to test the two main theories (trade-off and pecking order) simultaneously.

$$
\begin{aligned}
\text{Leverage}_{it} =\ & \alpha + (1 - \lambda)\text{Leverage}_{it-1} + \beta_1\text{Land} + \beta_2\text{Subsidies} + \beta_3\text{Tangibility} \\
& + \beta_4\text{Profitability} + \beta_5\text{Liquidity} + \beta_6\text{Size} \\
& + \beta_7\text{Growth} + \beta_8\text{Risk} + \beta_9\text{Age} + \beta_{10}\text{Orientation} \\
& + \gamma_1\text{GDP} + \gamma_2\text{Inflation} + T_t + \varepsilon_{it}
\end{aligned}
\tag{1}
$$

where: α is the constant, other variables are farm-specific, macroeconomic factors with β and γ are the respective associated coefficients to be estimated and ε is the error term, which considers individual effects associated with adjustment costs on the basis of the empirical estimation (Heshmati, 2001). In line with the trade-off theory, λ is the adjustment speed to the target leverage. Following Aderajew et al. (2019) and Flannery and Rangan (2006), we assume that λ is constant over time and that $|\lambda|<1$. This implies that farms make a progressive adjustment to their leverage each year, which is consistent with the theoretical framework of this study, namely the trade-off theory.

Estimating equation (1) requires us to account for potential issues that may cause the use of standard ordinary least squares (OLS) or panel regression methods to lead to biased results. First, it is acknowledged that estimators for short-time panel series are inconsistent due to the correlation of the lagged dependent variable with the error term (Nickell, 1981). In particular, this may bias $(1-\lambda)$ towards zero (Aderajew et al., 2019). Second, some endogeneity may exist between the dependent variable (leverage) and other variables, e.g. profitability. Indeed, pecking order theory states that internal funding is preferred to external financing, which is in line with the fact that profitable farms may self-finance using retained earnings. However, such farms may benefit from favourable credit conditions, which may motivate them to borrow money.

This issue may be addressed by using the generalized method of moments (GMM), developed by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and

Bond (1998). The GMM provides dynamic panel estimators that are suitable for a small number of time periods and a large number of observations (Baltagi, 2013; Bampasidou et al., 2017). The one left-hand-side variable of the equation is dynamic and depends upon its own past realisations. As right-hand-side variables may not be strictly exogenous, they are lagged in order to constitute valid instruments (Roodman, 2009). More precisely, testing several model specifications has shown that at least 2 lags are needed as instruments in order to ensure correct specification of the method. Consequently, time- and farm-invariant parameters are removed. As our sample covers a 10-year period, we use a system GMM, which is more appropriate when applied to samples with a short-time series dimension and also presents better asymptotic and finite sample properties than a difference GMM (Baltagi, 2013). In order to validate the use of additional instruments, the Hansen (1982) test checks for overidentifying restrictions while the Arellano and Bond (1991) test ensures there is no second-order residual serial correlation.

4. Results

In this section, we start by presenting some descriptive statistics. We then develop the results of the econometric modelling and the robustness tests.

4.1. Descriptive statistics

The first striking result is that Polish farms have a very low debt level (Table 4). By the end of 2018, their level of indebtedness was only 10.6% on average, which is common to field crops and livestock production (Figure 1). While indebtedness increases from 2009 to 2018 (except for livestock), it remains at a rather low level overall. Kołoszko-Chomentowska (2014) stresses that farms from the EU-10 (i.e. countries that joined the EU in 2004) are characterized by low indebtedness. Felczak (2015) and Zawojska (2008) explain that this is due to the use of informal sources of capital outside the formal credit market, especially in rural areas. Research carried out at the request of the Polish Office of Competition and Consumer Protection (UOKIK, 2008) shows that popular informal lending channels in Poland include loans from friends and family. Kata and Walenia's

Table 4. Summary statistics for Polish farms.

Variable	Obs.	Mean	Std. Dev.	Min	Max
Leverage	58,476	8.531	9.706	0.000	151.027
Standard output	58,476	106,601	163,624	−830,765	9,161,251
Decoupled subsidies	58,476	16,806	21,717	0.000	641,111
Rural development subsidies	58,476	5,246	12,991	0.000	424,991
Farmland	58,476	27.416	33.066	0.000	772.800
Land	58,476	49.474	17.104	0.000	0.997
Tangibility	58,476	89.205	6.191	0.000	104.182
Profitability	58,476	6.795	7.043	−85.055	317.678
Liquidity	58,388	39.065	21.457	−10.933	100.000
Assets	58,476	1,052,479	1,089,000	27,244	3,280,000
Growth	58,476	0.017	0.080	−159,850	89,790
Risk	33,251	59.029	11.222	−843.222	1,866.307
Age	57,693	43.983	9.501	19.000	84.000

Note: Euro amounts are current euros.
Source: Own calculations based on the weighted Farm Accountancy Data Network (FADN) database 2009–2018.
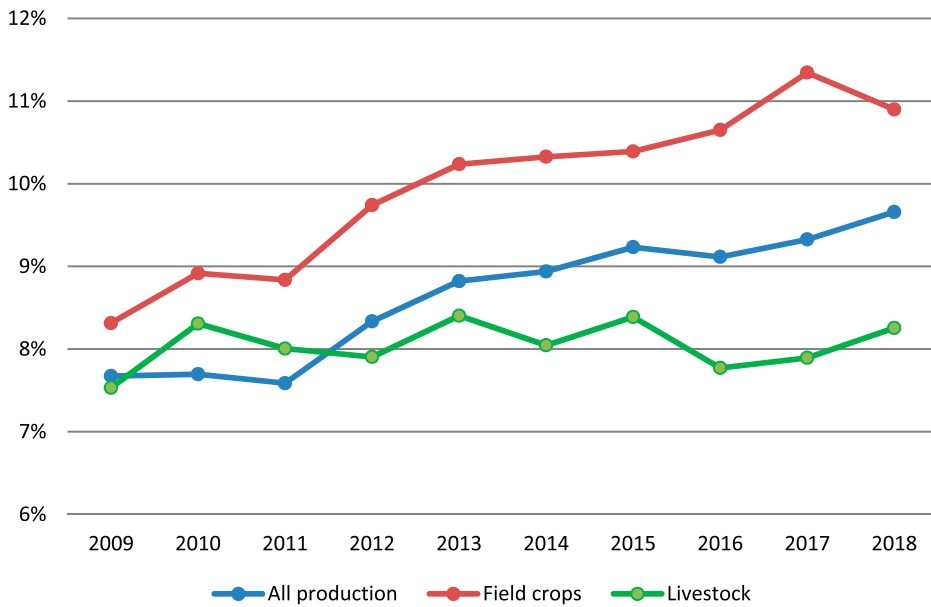
Figure 1. Evolution of farm leverage in Poland between 2009 and 2018. Source: Own calculations based on the weighted Farm Accountancy Data Network (FADN) database 2009–2018.

(2015) in-depth empirical study highlights that financial exclusion, particularly credit exclusion, specifically affects farmers and rural entrepreneurs: nearly 60% of surveyed farmers did not have access to credit, while 64% did not use credit for financing current farm activity and development. This exclusion results from endogenous and institutional credit restrictions and rationing as well as an individual conservative mentality towards credit and an aversion to financial risk (Kata & Walenia, 2015; Soliwoda, 2015).

Polish farms demonstrate relatively high liquidity levels (39%) on average, which denotes control of the volume of stocks and, therefore, capital requirement. Liquidity is also a result of European payments (decoupled and rural development subsidies). Similarly, tangibility is at a high level (89%), which denotes the existence of strong collateral. This is compatible with the average size (measured through total assets) of farms (k€730). By contrast, profitability (measured through the return on assets) is 6.8%. As shown in Figure 2, the decade 2009–2018 was characterized by high volatility in the price of agricultural commodities, including a sudden and persistent drop between 2013 and 2018. This resulted in increased risk and reduced profitability (Hill & Bradley, 2015). As farms adjusted their (capital) structure according to changes in their environment and exposure to risk, a direct consequence was the slow growth of investments in Poland (Kulawik, 2018).

4.2. Econometric results

The results of the econometric models based on equation (1) are presented in Table 5. All statistical tests confirm that the underlying assumptions required for the estimation of the GMM model are satisfied. More precisely, the Wald test is significant at the 1% level for all models, ensuring the whole significance of the model. The assumptions of the Arellano-
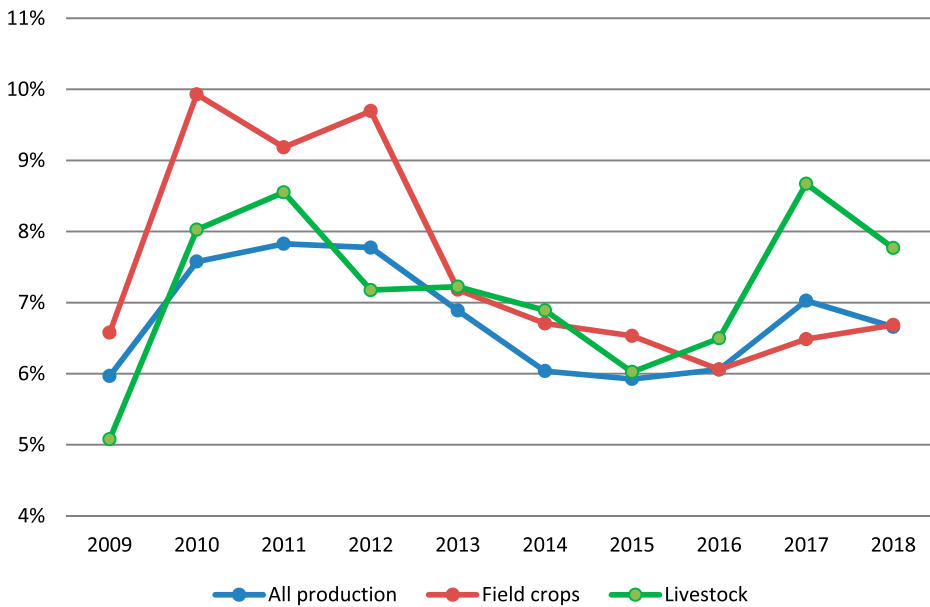
Figure 2. Evolution of farm profitability in Poland between 2009 and 2018. Source: Own calculations based on the weighted Farm Accountancy Data Network (FADN) database 2009–2018.

Bond model regarding the first-order autoregressive correlation and the absence of second-order autoregressive correlation are respected. The Hansen test gauges the validity of the instruments at the 10% level.

All models show a positive and strongly significant effect (at the 1% level) of the lagged leverage (between 0.637*** and 0.737*** depending on the sector). This result may be interpreted as the adjustment speed of leverage. As the value of the coefficient $(1 - \lambda)$ lies between 0 and 1, the leverage converges towards a target level over time. Consequently, each year, farmers adjust their indebtedness. The adjustment rate λ is relatively high in Poland (between 26.3% and 36.3%), which is in line with the moderate indebtedness of farms. It is generally higher for field-crop and livestock production since the risk of these specializations (with a more volatile return on assets – ROA) – translates into a higher adjustment rate.

Farm profitability (ROA) has a strong and negative influence on indebtedness regardless of the type of production (−0.136*** for all farms; all coefficients are significant at a 5% level). In other words, profitability reduces the need for external financing (debt, in our case) by increasing the accumulation of retained profits. This result validates the pecking order theory. Previous studies on farms have noted such effects (Aderajew et al., 2019; Barry et al., 2000; Zawadzka et al., 2015; Zhao et al., 2008). The negative effect of profitability is more important for livestock than for field crops.

Liquidity has no significant effect on indebtedness, even if available cash may sometimes be used as a substitute for debt. We thus find similar results to previous studies of industrial firms (Baker & Wurgler, 2002). In the same vein, European subsidies have no specific influence on indebtedness. This does not prevent Polish farms from increasing their assets using subsidies, but the debt-to-equity ratio remains broadly stable. In

Table 5. Panel regression results.

Variable	Models without macro-economic variables			Models with macro-economic variables		
	All farms	Field crops	Livestock	All farms	Field crops	Livestock
Leverage (−1)	0.720***	0.637***	0.648***	0.737***	0.650***	0.642***
Decoupled subsidies (ln)	−0.005	−0.003	−0.009*	−0.006*	−0.003	−0.008*
Rural development subsidies (ln)	−0.002	−0.001	−0.002	−0.001	−0.001	−0.002
Land	−0.198***	−0.088*	−0.205***	−0.195***	−0.086*	−0.225***
Tangibility	−0.024	0.130	−0.118	0.047	0.127	0.009
Profitability	−0.136***	−0.101**	−0.186***	−0.134***	−0.102**	−0.215***
Liquidity	−0.001	0.001	−0.002	−0.000	0.002	−0.001
Assets (ln)	0.043*	0.075	0.051*	0.050**	0.073	0.054*
Growth	0.328***	0.308***	0.295***	0.309***	0.313***	0.303***
Risk	−0.000	0.000	−0.000	−0.000	0.000	−0.000
Age (ln)	−0.092	−0.170	−0.166*	−0.076	−0.163	−0.164*
Horticulture	−0.215*			−0.140		
Livestock	−0.040			−0.036		
Granivores	0.035			0.052		
Mixed crop-livestock	−0.035			−0.011		
GDP				−0.000	−0.000	0.001*
Inflation				0.000	0.000	0.001
Constant	−0.045	−0.383	0.142	−0.227	−0.387	0.098
Observations	32,787	10,310	8951	32,787	10,310	8,951
Groups	5670	1655	1977	5670	1655	1,977
Instruments	53	53	53	55	55	55
Wald χ^2	1687.79***	552.78***	1468.85***	1658.65***	569.24***	1466.96***
Arellano-Bond test for AR(1)	−6.43***	−3.03***	−6.04***	−6.47***	−3.09***	−6.06***
Arellano-Bond test for AR(2)	0.05	1.10	1.45	−0.07	−1.06	1.46
Hansen test *(p-value)*	36.95 *(0.471)*	43.40 *(0.370)*	46.87 *(0.244)*	43.43 *(0.216)*	43.42 *(0.357)*	38.76 *(0.571)*

Notes: *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively. (−1) and (ln) denote a lagged variable and a natural logarithm, respectively. Arellano and Bond (1991) is the test for second-order serial correlation in the first-differenced residuals. Hansen (1982) is the test for overidentifying restrictions. AR(1) and AR(2) respectively stand for first- and second- order autoregressive correlations. A system generalized method of moments (GMM) was used and the following variables were considered as potentially endogenous with the dependent variable: decoupled subsidies, rural development subsidies, land, tangibility, profitability, liquidity, assets, growth, risk, GDP and inflation. These variables were used in difference and level equations. At least 2 lags were selected for the estimations.

Source: Own calculations based on the weighted Farm Accountancy Data Network (FADN) database 2009–2018.

contrast to the results of Latruffe et al. (2010), we find that subsidies do not have ex-post coupled effects through an income multiplier effect on credit-constrained farmers. Polish farmers do not seem to use subsidies as a way to significantly increase their indebtedness and thus their capacity to finance their fixed assets. This situation is probably indicative of the credit constraints that affect Polish farmers.

For most models, the share of land value in total assets has a significant negative influence on indebtedness. At first glance, this result may seem surprising insofar as land ownership may be considered as potential collateral. This may indicate that farmers who own a high share of productive land are less likely to seek additional indebtedness. Thus, the effect of tangibility on indebtedness is not significant for all farms and types of productions. Given that most Polish farms do not borrow large amounts of money, tangibility is not necessarily seen as collateral.

As, on average, Polish farms are not much indebted, an increase in size results in a relatively greater need for funding, especially through debt. Growth opportunities also play a very significant positive role in indebtedness for all sectors. This result contradicts both the trade-off and pecking order theories but may be explained by the fact that farmers seem to use investments as a positive signal for lenders. Farm investments (e.g. tractors, milking stations) are usually new fixed assets that basically improve a farm's efficiency and productivity (Barry et al., 2000). Thus, these investments are often considered as a source of future cash flow that will secure payback of the debt and the associated interest (Aderajew et al., 2019). Taken together, these results point to the fact that the farms that are most concerned with self-development, such as production intensification, are the most interested in access to credit.

Finally, risk (volatility of ROA) seems to have no significant influence on indebtedness. This result may denote information asymmetries: in an adverse selection context, the highest risk farms (e.g. those facing unfavourable weather conditions or volatile input and output market prices) may also apply for loans as long as they have sufficient tangible assets to offer as collateral. Considered as control variables, neither the age of the farmer nor the farm's specialization appear to negatively influence indebtedness. One important result is that the relative influence of all the considered factors on indebtedness is almost the same across all sectors and types of farms. This point illustrates the weight of the historical system of agricultural production on the financial policies of Polish farms today, even though agricultural collectivization has been increasingly abandoned in Poland since the 1960s.

The use of macroeconomic variables as determinants of leverage does not affect previous results. Inflation has a significant positive effect on indebtedness for field-crop farms only. This result may stem from inflation levels observed in the EU following the financial crisis, which, on average, were moderate in Poland (2.38%) between 2009 and 2018. Low inflation causes nominal and real prices to be similar, which does not provide a significant incentive to become indebted, even though interest rates are also low. The low GDP growth rate (3.45% on average in Poland between 2009 and 2018) is correlated with reduced investments and lower financing needs. Our results are in line with those of Aderajew et al. (2019), who found mixed results for these factors. Although we cannot precisely measure this with the data at our disposal, it is likely that the indebtedness of Polish farms is mainly influenced and

constrained by major external events such as the 2008 financial crisis and the 2013 global food price crisis.

4.3. Robustness tests

We perform some robustness tests in order to check for differences in estimates according to standard output (economic size), physical size, workforce, growth and the time period (Table 6). To do this, for each test, the overall sample of farms was split into two sub-samples.[3] The results for both subsamples generally keep the sign and significance of previously estimated coefficients.

Overall, the significance of the results does not change according to the size (economic, physical and workforce) and growth opportunities of farms. The adjustment levels are lower for the largest and most dynamic farms because they clearly benefit from easier access to credit. Consequently, the pecking order theory is only partially validated for Polish farms: while land, profitability, size and growth appear to be important determinants of their capital structure, European subsidies, liquidity and risk are not significant. At the same time, farms seem to target and adjust debt levels, thus validating the trade-off theory. These results contrast with Weill (2005), who studied the determinants of capital structure in Eastern and Western Europe and observed the lack of significance of tested factors in the former compared to the latter. They also differ from Hernádi and Ormos (2012), who found no strong trade-off considerations in financing decisions in their sample of Central and Eastern European firms. It is likely that the gradual increase in the indebtedness of Polish farms leads to the identification of trends that were not previously detectable in earlier studies.

In addition to these robustness tests, Figure 3 presents the results of a quantile regression with panel data, together with 95% confidence interval for the total sample of Polish farms. It can be seen that indebtedness consistently increases with tangibility and growth across the quantiles. Land and profitability have an inverse effect on debt. For these key variables, the results confirm and strengthen those of panel regressions (Table 5). The shape and slope of the graphs indicate the non-significance of rural development subsidies and risk, which aligns with the findings in the main models. Moreover, the magnitude of change is small regarding decoupled subsidies, liquidity and the farmer's age. Thus, these three parameters are also not significant.

5. Conclusion

In this article, we study the indebtedness of Polish farms by focusing on this specific and crucial source of financing. This work is based on corporate finance literature and tests the validity of the trade-off and pecking order theories when applied to the capital structure of farms. Using the FADN database 2009–2018 for Polish farms, a dynamic partial adjustment model estimates the influence of key factors on indebtedness according to the theoretical framework. Estimates are based on the generalized method of moments (GMM), which is suitable for a small number of time periods and a large number of observations.

Polish farms are among the least indebted in Europe but their indebtedness increases constantly over time, with the exception of livestock production. The results show that

Table 6. Robustness tests.

Variable	Standard output		Growth		Workforce		Size	
	Small	Large	Low	High	Small	Large	Small	Large
Leverage (−1)	0.672***	0.859***	0.639***	0.791***	0.668***	0.754***	0.681***	0.754***
Decoupled subsidies (ln)	−0.005	−0.005	−0.006	−0.004	−0.004	−0.002	−0.005	−0.002
Rural development subsidies (ln)	−0.001	−0.000	0.001	−0.004	−0.001	−0.001	0.004	−0.001
Land	−0.051*	−0.212***	−0.321***	−0.016	−0.130***	−0.314***	−0.251**	−0.314***
Tangibility	−0.044	0.015	0.038	−0.224*	−0.061	0.153	−0.016	0.153
Profitability	0.125***	−0.202***	−0.124***	−0.206***	−0.139***	−0.159***	−0.119**	−0.159***
Liquidity	0.003	−0.005	0.009	−0.022	−0.008	0.017	0.012	0.017
Assets (ln)	0.042	0.028	−0.018	0.013	0.036*	0.066*	0.031	0.066*
Growth	0.295**	0.415***	0.257***	0.476***	0.354***	0.299***	0.187***	0.299***
Risk	−0.000	−0.000*	0.000	−0.000*	−0.000	−0.000*	0.000	−0.000*
Age (ln)	−0.128*	0.051	−0.169*	−0.131	−0.153*	0.004	−0.104	0.004
Horticulture	−0.177	−0.177	−0.509	−0.191	−0.168	−0.162	0.002	−0.162
Livestock	−0.035	−0.122	−0.129*	−0.033	−0.039	−0.003	−0.011	−0.003
Granivores	0.061	−0.070	0.027	0.031	−0.017	0.119	0.081	0.119
Mixed crop-livestock	−0.002	−0.045	−0.050	0.007	−0.054	−0.018	0.045	−0.018
Constant	0.139	−0.370	1.158	0.636	0.336	−0.867*	−0.094	−0.867*
Observations	14294	18493	22181	10606	19551	13236	8402	24385
Groups	2982	3240	5124	3325	3987	2694	1681	4245
Instruments	53	53	53	53	53	53	53	53
Wald χ^2	861.33***	1681.46***	995.61***	979.66***	1309.23***	701.32***	548.74***	2014.09***
Arellano-Bond test for AR(1)	−4.65***	−3.61***	−4.44***	−5.50***	−4.80***	−2.95***	−3.94***	−6.68***
Arellano-Bond test for AR(2)	−1.00	1.38	−0.43	0.92	−0.45	1.62	−0.91	0.99
Hansen test (p-value)	31.81 (0.711)	21.40 (0.844)	40.57 (3.316)	48.03 (0.106)	22.28 (0.973)	34.52 (0.221)	38.76 (0.390)	23.14 (0.770)

Notes: *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively. (−1) and (ln) denote a lagged variable and a natural logarithm, respectively. Arellano and Bond (1991) is the test for second-order serial correlation in the first-differenced residuals. Hansen (1982) is the test for the overidentifying restrictions. AR(1) and AR(2) respectively stand for first- and second-order autoregressive correlations. A system generalized method of moments (GMM) was used and the following variables were considered as potentially endogenous with the dependent variable: decoupled subsidies, rural development subsidies, land, tangibility, profitability, liquidity, assets, growth and risk. These variables were used in difference and level equations. At least 2 lags were selected for the estimations.

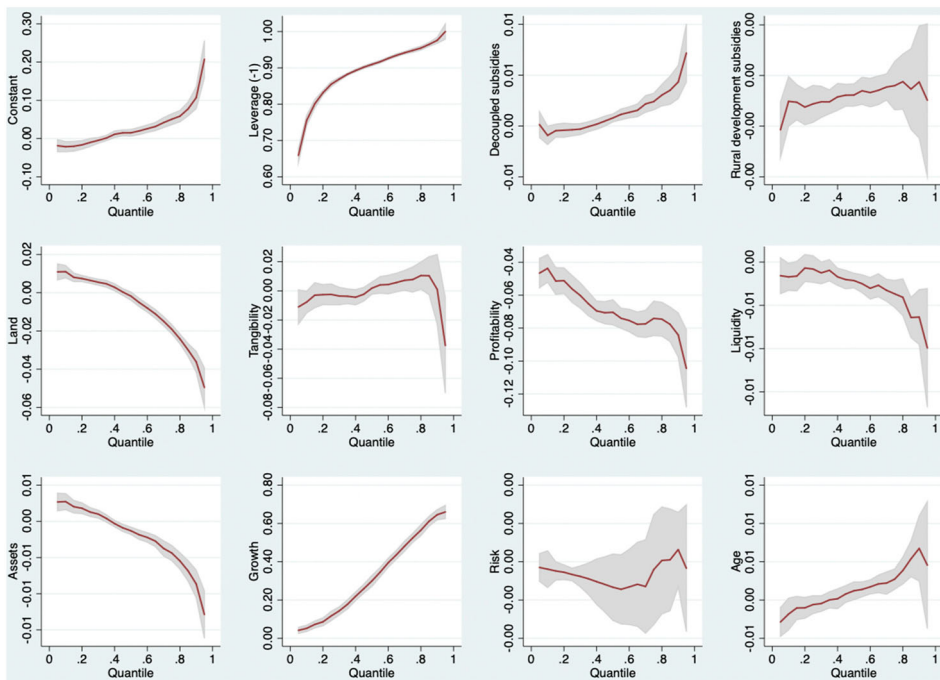Source: Own calculations based on the weighted Farm Accountancy Data Network (FADN) database 2009–2018.

Figure 3. Quantile regressions for indebtedness. Source: Own calculations based on the weighted Farm Accountancy Data Network (FADN) database 2009–2018.

profitable farms are less indebted. Indeed, profitability encourages retained earnings and reduces the need for external financing, in line with the pecking order theory. Growth opportunities play a significant positive role in indebtedness for all specializations. Investments thus send a positive signal to lenders, indicating future cash flow. This result may be explained by the specificity of farm investments, which are considered as a means of securing debt repayment. Some parameters, such as subsidies, tangibility, liquidity and risk, have little or no influence on indebtedness. The age of the farmer and macroeconomic variables (GDP and inflation) do not significantly affect indebtedness either.

Lagged leverage has a strong influence on current leverage in all sectors. This result may be interpreted as an annual adjustment of debt towards a target level. The adjustment rate is quite high in Poland, especially for field-crop production. As, on average, Polish farms have low levels of indebtedness, they can adjust their leverage more dynamically. These results emphasize the validity of the trade-off theory and some of the pecking order theory when applied to farms. They also have implications for public policies.

In Poland, barriers to the modernization of farms could be resolved if farms were able to obtain better access to credit in order to finance their projects and benefit from a leverage effect. Banks need to propose loans tailored to the needs of farmers and also prioritize the development of long-term relationships. At the same time, public authorities could create a regulatory and supervisory framework that would encourage banks to become more involved in providing financial services in rural areas. The Polish 'Strategy for sustainable rural development of agriculture and fisheries 2030', adopted by Resolution

No. 123 of the Council of Ministers on 15 October 2019, promotes a wider use of financial instruments, including preferential loans and loan repayment guarantees.

Finally, European subsidies could also play a key role in helping the financing of farms. Indeed, unconventional monetary policies (including ongoing quantitative easing by the European and Polish central banks) have led to low interest rates in the EU. Under a constrained CAP budget, these low rates may encourage the financing of farm investments and activities at a limited cost through the credit channel (Mamatzakis & Staikouras, 2020). Future research could consider these changes through a long-term analysis of the dynamics of indebted farms.

Notes

1. More information on the organization of the Polish FADN can be found on its website: http://fadn.pl/en/organisation/polish-fadn/organizacja-polskiego-fadn/.
2. A farm is considered to be specialized when a particular activity provides at least two-thirds of the production or business size of the agricultural holding.
3. Criteria are considered as large/high when the standard output is higher than €55,000 (median value in Poland), growth is positive, the number of workers is higher than 2 full-time equivalent (median values), and the land area is larger than 23 hectares (median values).

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

Notes on contributors

Geoffroy Enjolras is full professor of finance and head of the department in audit-accounting-control-finance at the School of Management (IAE) of the University of Grenoble, France. His research is focused on risk management issues, especially regarding natural disasters, agricultural and environmental economics. He is involved in many national and international research projects which address the issues of natural risks hedging, the reform of the Common Agricultural Policy and environmentally-friendly farming.

Gilles Sanfilippo is associate professor of finance at the School of Management (IAE) of the University of Grenoble, France. He is the head of the Master degree in Finance and he leads a chair on the financing of SMEs. He teaches corporate finance, financial analysis and portfolio management. His research is focused on corporate finance and financial markets.

Michał Soliwoda is assistant professor at University of Lodz, Poland. His main research areas relate to household and agricultural finance (inter alia, capital structure of family farms and risk management in agriculture, concept of financial resilience). He is active in international cooperation and project

initiatives (including International Visegrad Fund, H2020, Polish National Centre for Research and Development – NCBR).

ORCID

Geoffroy Enjolras ⓘ http://orcid.org/0000-0003-3034-7745

References

Aderajew, T. S., Trujillo-Barrera, A., & Pennings, J. M. E. (2019). Dynamic target capital structure and speed of adjustment in farm business. *European Review of Agricultural Economics*, *46*(4), 637–661. https://doi.org/10.1093/erae/jby035

Ahrendsen, B. L., Collender, R. N., & Dixon, B. L. (1994). An empirical analysis of optimal farm capital structure decisions. *Agricultural Finance Review*, *54*(2), 108–119.

Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte carlo evidence and an application to employment equations. *The Review of Economic Studies*, *58*(2), 277–298. https://doi.org/10.2307/2297968

Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics*, *68*(1), 29–51. https://doi.org/10.1016/0304-4076(94)01642-D

Baker, M., & Wurgler, J. (2002). Market timing and capital structure. *The Journal of Finance*, *57*(1), 1–32. https://doi.org/10.1111/1540-6261.00414

Baltagi, B. H. (2013). *Econometric analysis of panel data* (5th ed). John Wiley and Sons.

Bampasidou, M., Mishra, A. K., & Moss, C. B. (2017). Modeling debt choice in agriculture: The effect of endogenous asset values. *Agricultural Finance Review*, *77*(1), 95–110. https://doi.org/10.1108/AFR-06-2016-0054

Barry, P. J., Bierlen, R. W., & Sotomayor, N. L. (2000). Financial structure of farm businesses under imperfect capital markets. *American Journal of Agricultural Economics*, *82*(4), 920–933. https://doi.org/10.1111/0002-9092.00091

Bhaskar, A., & Beghin, J. C. (2009). How coupled are decoupled farm payments? A review of the evidence. *Journal of Agricultural and Resource Economics*, *34*(1), 130–153. https://doi.org/10.22004/ag.econ.50077

Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, *87*(1), 115–143. https://doi.org/10.1016/S0304-4076(98)00009-8

Bogue, A. G. (1976). Land credit for northern farmers 1789-1940. *Agricultural History*, *50*(1), 68–100. https://www.jstor.org/stable/3741907

Bórawski, P., Guth, M., Bełdycka-Bórawska, A., Jankowski, K. J., Parzonko, A., & Dunn, J. W. (2020). Investments in Polish agriculture: How production factors shape conditions for environmental protection? *Sustainability*, *12*(19), 8160. https://doi.org/10.3390/su12198160

Ciaian, P., Fałkowski, J., & Kancs, D. (2012). Access to credit, factor allocation and farm productivity: Evidence from the CEE transition economies. *Agricultural Finance Review*, *72*(1), 22–47. https://doi.org/10.1108/00021461211222114

Ciaian, P., & Pokrivcak, J. (2011). *Do agricultural subsidies crowd out or stimulate rural credit institutions? The case of CAP payments. Working papers 117485, factor markets*. Centre for European Policy Studies.

Collins, R. A. (1985). Expected utility, debt-equity structure, and risk balancing. *American Journal of Agricultural Economics*, *67*(3), 627–629. https://doi.org/10.2307/1241085

Dannenberg, P., & Kuemmerle, T. (2010). Farm size and land Use pattern changes in postsocialist Poland. *The Professional Geographer*, *62*(2), 197–210. https://doi.org/10.1080/00330120903546312

European Commission. (2018). EU farm economics overview based on 2015 (and 2016) FADN data. Brussels.

European Commission. (2020). Statistical factsheet. Poland. https://ec.europa.eu/info/sites/default/files/food-farming-fisheries/farming/documents/agri-statistical-factsheet-pl_en.pdf

Eurostat. (2019). *Agriculture, forestry and fishery statistics: 2018 edition*. Publications Office of the European Union.

Fama, E., & French, K. (2002). Testing trade-off and pecking order predictions about dividends and debt. *Review of Financial Studies*, *15*(1), 1–33. https://doi.org/10.1093/rfs/15.1.1

Featherstone, A., Allen, M. F., Gregory, A. I., Winter, J. R., & Aslihan, S. (2005). Farm financial structure. *Agricultural Finance Review*, *65*(2), 97–117. https://doi.org/10.1108/00214660580001163

Felczak, T. (2015). Źródła finansowania działalności indywidualnych gospodarstw rolniczych w opinii zarządzających (sources of financing the activities of individual farms in the opinion of managers). *Zeszyty Naukowe Uniwersytetu Szczecińskiego*, *74*(2), 83–91. https://doi.org/10.18276/FRFU.2015.74/2-07

fi-compass. (2020). Study on financial needs in the agriculture and agri-food sectors in 24 EU Member States.

Flannery, M. J., & Rangan, K. P. (2006). Partial adjustment toward target capital structures. *Journal of Financial Economics*, *79*(3), 469–506. https://doi.org/10.1016/j.jfineco.2005.03.004

González, V., & González, F. (2012). Firm size and capital structure: Evidence using dynamic panel data. *Applied Economics*, *44*(36), 4745–4754. https://doi.org/10.1080/00036846.2011.595690

Hansen, L. P. (1982). Large sample properties of generalized method of moments estimators. *Econometrica*, *50*(4), 1029–1054. https://doi.org/10.2307/1912775

Harris, M., & Raviv, A. (1991). The theory of capital structure. *The Journal of Finance*, *46*(1), 297–355. https://doi.org/10.1111/j.1540-6261.1991.tb03753.x

Hernádi, P., & Ormos, M. (2012). What managers think of capital structure and how they act: Evidence from Central and Eastern Europe. *Baltic Journal of Economics*, *12*(2), 47–71. https://doi.org/10.1080/1406099X.2012.10840517

Heshmati, A. (2001). The dynamics of capital structure: Evidence from Swedish micro and small firms. Stockholm School of Economics, No. 0440.

Hill, B., & Bradley, D. (2015). *Comparison of farmers' incomes in the EU member states*. Report prepared for European Parliament's Committee on Agriculture and Rural Development.

Howley, P., & Dillon, E. (2012). Modelling the effect of farming attitudes on farm credit use: A case study from Ireland. *Agricultural Finance Review*, *72*(3), 456–470. https://doi.org/10.1108/00021461211277286

Kata, R. (2011). Asymetria informacji jako przyczyna ograniczeń kredytowych w rolnictwie [Asymmetry of information as a cause of credit restrictions in agriculture]. Zeszyty Naukowe SGGW w Warszawie. *Ekonomika i Organizacja Gospodarki Żywnościowej*, *88*, 127–139.

Kata, R. (2018). Dynamika i struktura zadłużenia kredytowego gospodarstw rolniczych w Polsce [Dynamics and structure of credit commitments of agricultural farms in Poland]. *Annals of the Polish Association of Agricultural Economists and Agribusiness - Stowarzyszenie Ekonomistow Rolnictwa e Agrobiznesu (SERiA)*, *2018*(5), 74–80.

Kata, R., & Walenia, A. (2015). Financial exclusion of farmers and rural entrepreneurs. *Journal of Agribusiness and Rural Development*, *36*, 225–235. https://doi.org/10.17306/JARD.2015.24

Katchova, A. L. (2005). Factors affecting farm credit use. *Agricultural Finance Review*, *65*(2), 17–29. https://doi.org/10.1108/00214660580001164

Kołoszko-Chomentowska, Z. (2014). Selected effects of financing of agricultural holdings in new member states of the European Union. *Financial Internet Quarterly "E-Finanse"*, *10*(3), 65–72.

Kulawik, J. (2018). Subsidies and finance and economics of farms managed by natural persons. In M. Soliwoda (Ed.), *Subsidies versus economics, finances and income of farms* (Multiannual Program Reports 2015-2019, No. 77.1). IAFE-NRI Press.

Kumar, S., Colombage, S., & Rao, P. (2017). Research on capital structure determinants: A review and future directions. *International Journal of Managerial Finance*, *13*(2), 106–132. https://doi.org/10.1108/IJMF-09-2014-0135

Latruffe, L. (2005). The impact of credit market imperfections on farm investment in Poland. *Post-Communist Economies*, *17*(3), 349–362. https://doi.org/10.1080/14631370500204370

Latruffe, L., Davidova, S., Douarin, E., & Gorton, M. (2010). Farm expansion in Lithuania after accession to the EU: The role of CAP payments in alleviating potential credit constraints. *Europe-Asia Studies*, *62*(2), 351–365. https://doi.org/10.1080/09668130903506862

Lipson, M. L., & Mortal, S. (2009). Liquidity and capital structure. *Journal of Financial Markets*, *12*(4), 611–644. https://doi.org/10.1016/j.finmar.2009.04.002

Lopéz-Gracia, J., & Sogorb-Mira, F. (2008). Testing trade-off and pecking order theories financing SMEs. *Small Business Economics*, *31*(2), 117–136. https://doi.org/10.1007/s11187-007-9088-4

Mamatzakis, E., & Staikouras, C. (2020). Common agriculture police in the EU, direct payments, solvency and income. *Agricultural Finance Review*, *80*(4), 529–547. https://doi.org/10.1108/AFR-04-2019-0047

Michaelas, N., Chittenden, F., & Poutziouris, P. (1999). Financial policy and capital structure choice in U.K. SMEs: Empirical evidence from company panel data. *Small Business Economics*, *12*(2), 113–130. https://doi.org/10.1023/A:1008010724051

Miller, M. H. (1977). Debt and taxes. *The Journal of Finance*, *32*(2), 261–275. https://doi.org/10.1111/j.1540-6261.1977.tb03267.x

Modigliani, F., & Miller, M. H. (1958). The cost of capital, corporation finance, and the theory of investment. *The American Economic Review*, *48*(3), 261–297. https://www.jstor.org/stable/1809766

Musser, W. N., White, F. C., & McKissick, J. C. (1977). An analysis of optimal farm capital structure. *Southern Journal of Agricultural Economics*, *9*(1), 163–168. https://doi.org/10.22004/ag.econ.29295

Myers, S. C. (1984). The capital structure puzzle. *The Journal of Finance*, *39*(3), 575–592. https://doi.org/10.2307/2327916

Myers, S. C., & Majluf, N. S. (1984). Corporate financing and investment decisions when firms have information that investors do not have. *Journal of Financial Economics*, *13*(2), 187–221. https://doi.org/10.1016/0304-405X(84)90023-0

Myers, S. C., & Rajan, R. C. (1998). The paradox of liquidity. *The Quarterly Journal of Economics*, *113*(3), 733–771. https://doi.org/10.1162/003355398555739

Nickell, S. (1981). Biases in dynamic models with fixed effects. *Econometrica*, *49*(6), 1417–1426. https://doi.org/10.2307/1911408

Petrick, M. (2004a). A microeconometric analysis of credit rationing in the Polish farm sector. *European Review of Agriculture Economics*, *31*(1), 77–101. https://doi.org/10.1093/erae/31.1.77

Petrick, M. (2004b). Farm investment, credit rationing, and governmentally promoted credit access in Poland: A cross-sectional analysis. *Food Policy*, *29*(3), 275–294. https://doi.org/10.1016/j.foodpol.2004.05.002

Petrick, M., & Kloss, M. (2013). Exposure of EU farmers to the financial crisis. *Choices*, *28*(2), 1–6. https://doi.org/10.22004/ag.econ.151496

Petrick, M., & Latruffe, L. (2006). Contractual relations in agricultural credit markets: A hedonic pricing approach with application to Poland. *Journal of Agricultural Economics*, *57*(1), 49–63. https://doi.org/10.1111/j.1477-9552.2006.00031.x

Petrick, M., & Weingarten, M. (2004). The role of agriculture in Central and Eastern European Rural development: Engine of change or social buffer? In M. Petrick, & P. Weingarten (Eds.), *Studies on the agricultural and food sector in Central and Eastern Europe, Vol. 25* (pp. 1–20). IAMO.

Polish Ministry of Agriculture and Rural Development. (2019). Diagnoza Sytuacji Społeczno-Gospodarczej Rolnictwa, Obszarów Wiejskich i Rybactwa W Polsce (Diagnosis of the Social and Economic Situation of Agriculture, Rural Areas and Fisheries in Poland). https://www.gov.pl/attachment/3a8239b5-1776-4e7e-9ca5-5db953184d7d

Psillaki, M., & Daskalakis, N. (2009). Are the determinants of capital structure country or firm specific? *Small Business Economics*, *33*(3), 319–333. https://doi.org/10.1007/s11187-008-9103-4

Ray, S. (2012). Determinants of capital structure of aluminum industry in India: A post liberalisation period analysis. *International Journal of Accounting, Auditing and Performance Evaluation*, *8*(4), 355–372. https://doi.org/10.1504/IJAAPE.2012.050011

Roodman, D. (2009). How to Use Xtabond2: An introduction to difference and system GMM in stata. *The Stata Journal*, *9*(1), 86–136. https://doi.org/10.1177/1536867X0900900106

Sadowski, A., Poczta, W., Szuba-Barańska, E., & Beba, P. (2015). Modele gospodarstw rolnych w państwach Unii Europejskiej [Models of farms in the European Union]. *Wieś i Rolnictwo [Village and Agriculture]*, *3*(168), 43–62. https://doi.org/10.22004/ag.econ.232012

Schorr, A., & Lips, M. (2019). The optimal capital structure of Swiss dairy farms. *Agricultural Finance Review*, *79*(3), 323–337. https://doi.org/10.1108/AFR-05-2018-0034

Smith, C. W., & Stulz, R. M. (1985). The determinants of firms' hedging policies. *The Journal of Financial and Quantitative Analysis*, *20*(4), 391–405. https://doi.org/10.2307/2330757

Soliwoda, M. (2015). Zwyczaje płatnicze ludności wiejskiej w Polsce: bariery i wyzwania dla systemu usług finansowych [Payment habits of rural population in Poland: Barriers and challenges for the financial services system]. *Problemy Zarządzania*, *13*(3(1)), 85–101. https://doi.org/10.7172/1644-9584.54.6

Tian, L. (2013). Financial structure and strategies of Dutch pig farming businesses. M.Sc. Thesis, Wageningen University.

Titman, S., & Wessels, R. (1988). The determinants of capital structure choice. *The Journal of Finance*, *43*(1), 1–19. https://doi.org/10.1111/j.1540-6261.1988.tb02585.x

Tropea, F., & De Cavalho, L. (2016). Access to credit and financial instruments in agriculture, Briefing September 2016. European Parliamentary Research Service, Research Service PE 586.677.

Turnock, D. (1996). Agriculture in Eastern Europe: Communism, the transition and the future. *GeoJournal*, *38*(2), 137–149. https://doi.org/10.1007/BF00186661

Turvey, C. G. (2017). Historical developments in agricultural finance and the genesis of America's farm credit system. *Agricultural Finance Review*, *77*(1), 4–21. https://doi.org/10.1108/AFR-09-2016-0076

UKNF. (2018). Informacja o sytuacji banków spółdzielczych i zrzeszających w 2017 r [Information on the situation of cooperative and affiliating banks in 2017]. Warsaw. https://www.knf.gov.pl/knf/pl/komponenty/img/Informacja_o_sytuacji_BS_2017_61882.pdf

UOKIK. (2008). Zarządzanie domowymi finansami a korzystanie z kredytów i pożyczek – Raport z badań (Management of home finances and use of credits and loans – Research report). https://www.uokik.gov.pl/download.php?id=209

Weill, L. (2005). Estimating the Gap in banking efficiency between Eastern and Western European countries. In K. Liebcher, J. Christl, P. Mooslechner, & D. Ritzberger-Grünwald (Eds.), *South Eastern European challenges and prospects* (pp. 335–349). Edwards Elgar.

Wu, F., Guan, Z., & Myers, R. (2014). Farm capital structure choice: Theory and an empirical test. *Agricultural Finance Review*, *74*(1), 115–132. https://doi.org/10.1108/AFR-08-2012-0041

Zawadzka, D., Szafraniec-Siluta, E., & Ardan, R. (2015). Czynniki wpływające na wykorzystanie kapitału obcego przez gospodarstwa rolne (factors influencing the use of debt capital on farms). *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu*, *412*, 356–366.

Zawojska, A. (2008). Uwarunkowania i kanały finansowania rolnictwa w Polsce [Conditions and channels of agriculture financing in Poland]. *Ekonomika i Organizacja Gospodarki Żywnościowej*, *65*, 98–108.

Zhao, J., Barry, P. J., & Katchova, A. L. (2008). Signaling credit risk in agriculture: Implications for capital structure analysis. *Journal of Agricultural and Applied Economics*, *40*(3), 805–820. https://doi.org/10.1017/S1074070800002340