

COLLATERAL REQUIREMENTS FOR SME LOANS: EMPIRICAL EVIDENCE FROM THE VISEGRAD COUNTRIES

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Abstract. The purpose of this paper is to examine the determinants of collateral for small and medium enterprises (SMEs) in the context of Visegrad countries: Czech Republic, Slovak Republic, Hungary and Poland. The data set for this paper was obtained from the Business Environment and Enterprise Performance Survey (BEEPS), which was conducted by the World Bank and the European Bank for Reconstruction and Development (EBRD) from 2012–2014. A binary logistic regression model with different specifications was employed to examine the effect of independent variables on the incidence of collateral. The results show that risky borrowers need to pledge collateral and the reduction of asymmetric information can lower the incidence of collateral for SMEs. Moreover, we find that female borrowers are more likely to pledge collateral than male borrowers are. The results also suggest that loans with a longer maturity are more likely to be collateralized than short-term loans. We find evidence that bank-borrower proximity can alleviate the incidence of collateral whereas bank concentration may increase collateral requirements. Policy makers may consider these results to implement policies that can promote bank competition and can lower collateral requirements for female borrowers. The paper contributes to the ongoing debate on the determinants of collateral.

Keywords: SME finance, collateral, asymmetric information, bank competition, distance, Visegrad countries.

JEL classification: G21, G32, O16.

Introduction

Financial constraints on small and medium-sized enterprises (SMEs) are an open scientific research topic for academicians and practitioners due to the immense importance of SMEs to the economic development of a country. Lack of financing availability for SMEs not only hinders new business establishment but also hampers the economic

growth of countries because of fewer jobs. Ayyagari *et al.* (2007) found that SMEs contribute about 60% of jobs in the manufacturing sector in their analysis of 70 developing and developed countries. Beck *et al.* (2006) state that SMEs report higher financing difficulties than large firms do and the effects of financing obstacles are greater for SMEs. SMEs face stringent credit conditions from banks because it is contended that SMEs are information opaque and usually cannot produce audited financial statements when they are seeking bank financing (Berger, Udell 2002). Studies based on relationship lending suggest that small firms that engage in long-term relationships with their banks can overcome the asymmetric information problem (Carter *et al.* 2004; Berger, Udell 2006). However, information generation through relationship lending is costly and, consequently, banks are shy to lend to SMEs (Beck, De La Torre 2007). Due to this information mismatch between lenders and borrowers, commercial banks impose restrictive loan contract terms on SMEs to prevent defaults (Garcia-Teruel *et al.* 2014). Hence, this asymmetric hidden information may lead to credit rationing because it is difficult for the banks to evaluate the quality of the borrowers (Stiglitz, Weiss 1981). SME business conditions and financial environments are not competitive enough, and therefore SMEs may find it difficult to manage their credit risk properly and thus face strict terms when applying for bank loans (Belas *et al.* 2015; Lenka *et al.* 2014).

Imposing collateral requirements on a loan contract is a traditional bank practice to eliminate information opacity and to align the interest of borrowers with the interest of banks (Besanko, Thakor 1987; Boot *et al.* 1991). Beck *et al.* (2006), using the World Business Environment Survey (WBES), find that collateral requirements are the third of 12 most important financing obstacles for SMEs. Results from the EBRD and World Bank Business Environment and Enterprise Performance survey (BEEPS) in Eastern Europe and Central Asia indicate that collateral is the fourth most important financing obstacle for external loans. Prior literature suggests that collateral can alleviate adverse selection and moral hazard problems in a loan contract because collateral can act as a signalling device for banks to sort out quality borrowers from risky ones (Bester 1985; Chan, Kanatas 1985; Besanko, Thakor 1987; Boot *et al.* 1991). Bester (1985) shows that when borrower quality is unknown, banks can use collateral as a screening device to differentiate between good and bad borrowers. In the face of high asymmetric information, quality borrowers may pledge more collateral to show their credit quality by which they can avail loans with lower interest rates because their probability of default is lower (Bester 1985; Chan, Kanatas 1985; Besanko, Thakor 1987). On the contrary, when borrower quality is known and risky, banks will require higher collateral and charge higher interest rates (Jimenez, Saurina 2004; Brick, Palia 2007). This selection of borrowers based on their observable credit quality is known as the observed risk hypothesis. The observed risk hypothesis predicts that banks sort borrowers depending on their risk profile and results in risky borrowers having to pledge collateral and higher interest rates to compensate the risky investment by banks.

The role of collateral as a screening device is prominent in banking studies that find that if collateral minimizes adverse selection, pledging collateral can have a negative relationship with credit risk (Jimenez *et al.* 2006; Godlewski, Weill 2011). Collateral

requirements on loan contracts and the observed risk hypothesis have also received utmost attention from researchers. However, these studies are concentrated on a single country and dominated by the US market (Leeth, Scott 1989; Berger, Udell 1990, 2006; Brick, Palia 2007; Han *et al.* 2009; Berger *et al.* 2011), with a handful concentrated on the European market (Cowling 1999 – UK; Jimenez, Saurina 2004 – Spain; Hernandez-Canovas, Martinez-Solano 2006 – Spain; Duarte *et al.* 2016 – Portugal). There are studies based on cross-country analyses but they cover both developing and developed markets (Godlewski, Weill 2011; Duarte *et al.* 2017). Although, different authors examined the issue of collateral based lending in different markets, however, it is still an interesting topic for researchers because some loans are provided without any collateral security whereas others require pledging collateral (Steijvers *et al.* 2010).

In this paper, we focus on Visegrad countries (Czech Republic, Slovak Republic, Hungary, and Poland) to find the determinants of collateral for small business lending. We have purposefully selected Visegrad countries for our research. Because to the best of our knowledge, there is no empirical research that is investigated the issue of collateral based lending in the context of Visegrad countries or in a cross-country European setting. By doing so, we can extend the current state of the literature on collateral requirements for SME loans. Moreover, Visegrad countries are an integral part of European economic system and SMEs in the Visegrad countries contribute the largest portion of employment. Empirical research by Ayyagari *et al.* (2007) find that SMEs create about 65% of the jobs in the Czech Republic, 63% in Poland, 59% in the Slovak Republic and 46% in Hungary. Additionally, Daszkiewicz (2014) in his research finds that in 2012, SMEs counted for 99.8% of enterprises in the Czech Republic and in Poland, similarly, 99.9% enterprises are counted for SMEs in the context of Slovak Republic and in Hungary, respectively.

Likewise, we are interested in these countries because, during the worldwide financial crisis, business activities of SMEs in the Visegrad countries significantly suffered due to lack of finance from banks (Korab, Pomenkova 2014). Korab and Pomenkova examined pre and post financial crisis period and access to finance for SMEs in the Visegrad countries. They find that SMEs in the Czech Republic and the Slovak Republic show a greater reduction in loans than of the other two countries (Hungary and Poland) and they have a very limited access to finance during the period of financial crisis (2008–2009) in comparison to pre-crisis period (2006–2007). Hence, above studies suggest that in general, SMEs are financial constraints than the large firms and credit market contraction is making it even harder for SMEs to raise external finance for investment.

The European market is significantly different from the US or other market-based systems because in Europe, bank loans are the main source of business financing. According to the Survey on the Access to Finance in the Euro Area (SAFE 2015), 42% of the SMEs operating in 2012 faced a lack of access to financing and among these SMEs, approximately 74% reported bank loans as relevant to their capital structure. Furthermore, like other European countries, our examined countries are dominated by SMEs and they have momentous importance for the economic development of the country. Hence, considering the importance of SMEs in our examined countries, finding the determinants

of collateral can be valuable not only for researchers but also for practitioners to know more about the incidence of collateral during the loan acquisition process.

The rest of the paper is structured as follows. Section 1 provides theoretical and empirical evidence on the incidence of collateral and the factors that affect collateral. Section 2 describes our data set, variables and method. In section 3, we present our results and discussion. The paper concludes with main findings, recommendations and scope for future study.

1. Collateral-based lending and the determinants of collateral

Collateral requirements on a loan contract are particularly significant for SMEs compared to large firms because they lack physical assets to pledge as collateral to the banks, which may cause SMEs to be credit rationed (Menkhoff *et al.* 2006). Additionally, SMEs are owned and managed by individuals and, hence, personal characteristics and private wealth of the borrower can have a greater impact on the business performance of SMEs than large firms (Bolton Committee 1971; Tirole 2010). According to Ang *et al.* (1995), the influence of the personal wealth of SME borrowers can assist in obtaining bank financing because, at times, personal wealth is inseparable from business assets. In that case, an individual can pledge personal assets as collateral to the banks and obtain financing.

Jensen and Meckling (1976) show that collateral-based lending can generate benefits for the lenders, such as alleviation of the agency problem by which collateral can prevent asset substitution and hold back firms from borrowing excessively. Asset substitution may arise when the borrowing firms divert from their intended projects to other risky projects with anticipated higher returns. Furthermore, Myres (1977) shows that collateral might reduce the underinvestment problem. An underinvestment problem occurs when there is a tendency of managers to invest in risky projects with lower net present value, which reduces the value for shareholders and transfers the wealth to unsecured debt holders. Additionally, Stiglitz and Weiss (1981) report that collateral security can minimize banks' loss exposure and, as a result, it may facilitate easy access to financing by alleviating credit rationing.

Numerous studies show that bank-borrower relationships can lower the collateral requirements for firms. Relationship lending minimizes the information gap and helps banks to predict the quality of projects more accurately, which reduces collateral requirements from borrowers (Degryse, Van Cayseele 2000; Chakraborty, Hu 2006; Gama, Duarte 2015; Rahman *et al.* 2016). Nonetheless, relationship lending is a labour intensive process and can increase the loan process cost for lending institutions as a result of frequent visits to the firms to acquire soft information (Petersen, Rajan 2002). Furthermore, studies show that relationship lending may instead increase collateral with the duration and scope of a relationship due to a lock-in situation with banks caused by excessive information sharing (Lehmann, Neuberger 2001; Jimenez *et al.* 2006). Jimenez and Saurina (2004) show that relationship-lending loans are riskier than non-relationship based lending, as relationship lending involves a less restrictive loan screening process

and increases the default rates. It is argued that the importance of relationship lending in alleviating information asymmetry is decreasing with the use of credit rating models and availability of accounting-based hard information (Petersen, Rajan 2002; Jimenez *et al.* 2006). Jimenez *et al.* (2009) find that accounting-based hard information can be a substitute for collateral because it makes the loan screening process more accurate.

As discussed, collateral requirements on loan contracts are quite common in the credit market to align the interest of the borrowers with the interest of the banks. However, there are differences between firms that provide collateral and those that do not. Thus, depending on firm characteristics, collateral requirements can differ and are a main area of empirical study of this paper. Moreover, based on loan characteristics (loan size, maturity and interest rates) collateral requirements may vary, as different categories of loans might have idiosyncratic risk classifications. Additionally, credit market imperfections can have a significant impact on the incidence of collateral because not all markets are competitive or efficient enough to remove anomalies in the loan market. The situation is worsened by the distance between lenders and borrowers. Distance makes it more difficult for lenders to justify the viability of borrowers' projects (Petersen, Rajan 2002), which can impose collateral burdens for more distant borrowers (Jimenez *et al.* 2006). Thus, in this paper, we would like to evaluate the effect of firm characteristics, loan characteristics and market characteristics on the incidence of collateral.

1.1. Firm characteristics

Information asymmetry is one of the main problems faced by SMEs when seeking bank loans because they cannot show their credit quality. This limited information about the SMEs create barriers in accessing bank financing and, hence, banks impose different credit restrictions on SME loans to overcome this asymmetric information problem, for example, collateral, high interest rates, shorter maturity and covenants. Scholars frequently use firm size and age as inverse proxies for information asymmetry in SME lending and find that information transparency reduces collateral requirement. In this paper, we examine the impact of asymmetric information on the incidence of collateral with four inverse proxies for information asymmetry (firm size, age, audited financial statement and asset tangibility).

In terms of firm size it is argued that the large firms can demonstrate a consistent past business history, thus making it easier for banks to evaluate their credit quality (Knyazeva, A., Knyazeva, D. 2012). Hence, increased information transparency can lower the incidence of collateral. A study by Grunert and Norden (2012) shows that large firms pledge less collateral because they have more bargaining power and can borrow from different sources with better credit terms. Menkhoff *et al.* (2006) show that younger firms need to provide more collateral for bank loans, as they are considered unstable. Similarly, Chakraborty and Hu (2006) find that older firms are more transparent than smaller ones, resulting in older firms pledging lower collateral.

Berger and Udell (2002) report that SMEs suffer from information asymmetry due to lack of availability of audited financial statements, which may cause SMEs to be credit rationed. Ferri and Murro (2015) find that audited financial statements can minimize

information asymmetry and influence easy access to finance. Similarly, a research by Leon (2015) from 69 developing countries finds that firms having audited financial statements are more transparent and it is easier for them to access loans from external lenders. Considering the above studies from the point of view of access to finance, it may be possible to say that having audited financial statements may reduce information asymmetry and that may lessen collateral burden to SMEs. In contrary, audit reports may also increase collateral requirements for firms, as information transparency allows banks to evaluate the firm more accurately, which can result in higher collateral requirements depending on the credit quality of the firm. Therefore, we can expect both positive and negative effects of audited financial statements on collateral. Additionally, firms with tangible assets have more information transparency than those of the service, retail or innovation oriented business sectors, making it easier for lenders to assess their credit risk (Gompers 1995). A. Knyazeva and D. Knyazeva (2012) find that firms with asset tangibility receive loans with lower interest rates; they argue that asset tangibility signals easy loan recovery in the event of default. In this regard, we may argue that as manufacturing firms have more tangible assets than other business types, they may pledge lower collateral due to greater information transparency.

According to the agency theory, firms with more concentrated ownership and those owned and managed by the same person have minimum or, at times, zero agency costs (Jensen, Meckling 1976; Fama, Jensen 1983). Ang (1992) shows that firms with concentrated ownership tend to have long-term orientations and strive for survival and reputation, therefore, less agency related conflicts. Moreover, it is difficult to enforce loan recovery if several people own the firm (Hanedar *et al.* 2014). Hanedar *et al.* find that sole ownership firms pledge lower collateral than of the corporations. It is possible that firms with less concentration would make enforcement weaker, thus increasing collateral requirements. Therefore, we expect to find a negative relationship between ownership concentration and collateral pledges.

Borrower experience and gender is also considered as important determinants of collateral-based lending. Hsiao and Chou (2015) show that experienced borrowers can manage businesses more efficiently than inexperienced borrowers manage and minimize the credit risk of loans. Neuberger and Rathke-Doppner (2015) find that younger borrowers pledge higher collateral due to the lack of business experience compared to older, more experienced borrowers. Grunert and Norden (2012) argue that a skilled and experienced borrower has more bargaining power with banks and, therefore, it is possible to relax strict credit terms such as interest rate. At the same time, experienced managers of older firms can prepare better loan proposals and use their past business track records to lower collateral requirements (Berger, Udell 1995). Considering the above arguments, it is more likely that an experienced borrower may use his/her bargaining power and previous skills to minimize strict credit terms and collateral requirements on loan contracts. However, Duarte *et al.* (2017) did not find any statistically significant effects of borrower experience on collateral.

Studies show that because of sexual stereotyping and gender discrimination, female-owned firms face stricter credit conditions from banks compared to male-owned firms

(Carter, Rosa 1998). Boyer and Blazy (2014) find that default rates are higher for women-owned firms than those that are male owned. Moreover, Garwe and Fatoki (2012) find that female-owned firms have difficulty in accessing financing because they lack sufficient management skills. Alesina *et al.* (2013) find that women-owned firms in Italy pay higher interest rates than male-owned firms. Thus, it is possible that banks assume that women-owned firms are risky. Therefore, we expect to find a positive relationship between female ownership of firms and pledge of collateral. Belluchi *et al.* (2010) find that SMEs owned by female borrowers in Italy are required to provide higher collateral, which increases financial barriers on women-led SMEs.

A widespread collection of studies report that innovative firms encounter strict credit conditions in the form of credit rationing, lower maturity of loans and higher collateral requirements compared to non-innovative firms because innovative firms are more information opaque (Freel 2007; Lee *et al.* 2015). Additionally, it is difficult to demonstrate the quality of innovative projects due to intellectual properties concerning innovation activities (Hall 2010). Moreover, Moore and Garnsey (1993) contend that it is difficult to measure returns from innovation activities and estimate cash flows with any precision. Considering the above theories related to innovative firms and financing, we assume that innovative firms may pledge more collateral in compared to non-innovative firms because of uncertainties in their capital commitment as well as higher asymmetric information.

Prior studies on the observed risk hypothesis suggest that when the quality of the borrower is known and risky, more collateral is required due to the higher credit risk of the loan. Hanedar *et al.* (2014) used liquidity risk, overdue payments and crime as proxies for borrower risk and found that these factors have a positive correlation with the presence of collateral. Jimenez *et al.* (2006) used borrower loan defaults as observed risk proxies in the Spanish market and found that loan defaults have a positive correlation with collateral, thus supporting the observed risk hypothesis. Moreover, the quality of the firm is measured through the availability of international quality recognition, such as ISO certification. Availability of such certification indicates higher firm quality (Hanedar *et al.* 2014). In this paper, we used liquidity risk, crime and ISO certification as proxies for borrower observed credit quality and expect to find a positive relationship between liquidity risk and crime with collateral and a negative relationship with ISO certification.

1.2. Loan characteristics

Studies on collateral-based lending suggest that loan size and duration significantly affect the presence of collateral. Large loans are usually secured because of the high-risk perception (Godlewski, Weill 2011). Moreover, a large loan increases the leverage of a firm and may increase the likelihood of default (Leeth, Scott 1989; Avery *et al.* 1998). Hence, it is important for banks to secure loans by asking for collateral from borrowers (Degryse, Van Cayseele 2000). Voordeckers and Steijvers (2006) also find that large loans are collateralized, whereas Hernandez-Canovas and Martinez-Solano (2006) show that small loans are usually provided based on the relationship between the bank and the borrower.

With respect to loan maturity, long-term loans are riskier than short-term loans. Long-term loans may induce moral hazards and adverse selection problems due to the longer loan period and, hence, loan maturity is positively correlated to collateral (Harhoff, Korting 1998; Voordeckers, Steijvers 2006; Hainz *et al.* 2013; Duarte *et al.* 2017). Additionally, longer periods may induce borrowers to shift from less risky to high-risk projects (Jensen, Meckling 1976). Shorter loan maturity can control borrowers' risk shifting behaviour by minimizing the moral hazard problem (Knyazeva, A., Knyazeva, D. 2012).

Researchers frequently measure the observed risk hypothesis and validate the adverse selection theory using the relationship between loan spread and collateral. When borrower quality is observable as risky, borrowers need to provide more collateral and need to incur higher interest rates (Bester 1985; Besanko, Thankor 1987). Brick and Palia (2007) find that loans secured with collateral need to afford 200–400 basis points higher interest rates than the non-secured loans. Berger and Udell (1990) suggest that risky borrowers need to provide collateral and are charged higher interest rates. Therefore, according to the observed risk hypothesis, we expect to find a positive relationship between collateral and interest rates. Regarding the adverse selection hypothesis, quality borrowers may provide more collateral to obtain loans with lower interest rates through signalling their superior credit quality; hence, collateral acts as a substitute for lower interest rates (Bester 1985; Besanko, Thakor 1987). Degryse and Van Cayseele (2000) find a negative relationship between interest rates and collateral, supporting the adverse selection theory. Godlewski and Weill (2011) argue that both the adverse selection and observed-risk hypotheses can be validated depending on the degree of information asymmetry in the loan market. However, they also find strong support for the observed-risk hypothesis and borrower quality.

1.3. Lender market characteristics

Bank competition and concentration is widely used in banking studies to determine their impact on collateral requirements. Berlin and Butler (2002) argue that as competition in the market intensifies, lenders need to relax lending terms, for example, lower expected collateral ratios due to less market power. Voordeckers and Steijvers (2006) find that bank competition reduces collateral requirements because borrowers can switch to other banks to obtain loans with better lending terms. Conversely, Jimenez *et al.* (2009) find that in a competitive market, banks can increase collateral ratios in an attempt to increase their superiority over competitors in a loan contract. Hainz *et al.* (2013) report that requiring collateral in a loan contract is more likely when the market is less competitive, the assumption is that competition and concentration is negatively associated. Jimenez *et al.* (2006) find that bank concentration is negatively correlated with collateral. In a concentrated market, a bank can use its market power to attract quality borrowers more efficiently than in a competitive market.

Bank-borrower distance is also a significant determinant of collateral requirements in a loan contract. Berger and Udell (2002) in their theoretical model showed that soft information collection is critical in SME lending and is obtained by continuous interaction with borrowers. However, the cost of collecting site-specific soft information about the borrower increases with the distance between bank and borrower (Petersen,

Rajan 2002). Therefore, banks choose between their most cost-efficient options, such as screening the borrower or asking for collateral to alleviate organizational diseconomies (Manove *et al.* 2001). Jimenez *et al.* (2009) find that lenders ask for more collateral from local borrowers, whereas distant borrowers pledge lower collateral. They argue that banks conduct strict credit screening processes while lending to a distant borrower, which reduces the incidence of collateral. A later study by Hainz *et al.* (2013) shows that loans granted to distant borrowers are more likely to be collateralized than loans granted to local borrowers. It is argued that local lenders have superior information about firms closer to the bank and, as a result, it is easier for local lenders to evaluate the credit risk of the firms. Regardless of these studies, the effect of distance on collateral requirements is still inconclusive and in this paper, we show new evidence from the Visegrad countries.

A summary of collateral based studies concentrated on the firm characteristics, loan characteristics and lender market characteristics in different countries are presented in the following table.

Table 1. A summary of studies based on firm characteristics, loan characteristics, and lender market characteristics and their impact on collateral requirements on SMEs

Study	Country	Variable	Results
Knyazeva A. and Knyazeva D. (2012)	USA	Firm size	Large firms pledge less collateral due to better information quality.
Grunert and Norden (2012)	USA & Germany	Firm size	Large firms pledge less collateral because of more bargaining power.
Chakraborty and Hu (2006)	USA	Firm age	Firm age has a negative impact on collateral.
Menkhoff <i>et al.</i> (2012)	Thailand	Firm age	Younger firms need to pledge higher amounts of collateral than of the older firms.
Gompers (1995)	USA	Asset tangibility	Asset tangibility has a negative effect on collateral.
Hanedar <i>et al.</i> (2014)	27 transition countries	Ownership structure as a measure of agency costs	Ownership concentration has a negative effect on collateral.
Steijvers <i>et al.</i> (2010)	USA	Family and non-family firms as proxies for agency costs	Family firms pledge more collateral due to agency issues.
Neuberger and Rathke-Doppner (2015)	Germany	Borrower experience	Experienced borrowers pledge less collateral.

End of Table 1

Study	Country	Variable	Results
Berger and Udell (1995)	USA	Borrower experience	Negative effect on collateral.
Duarte <i>et al.</i> (2017)	29 developed and emerging countries	Borrower experience	Borrowers experience has no effect on collateral.
Belluchi <i>et al.</i> (2010)	Italy	Borrower gender (female)	Female borrowers provide more collateral than the male borrowers do.
Hanedar <i>et al.</i> (2014)	27 transition countries	Borrower observed risk	Risky borrowers need to pledge collateral on their loan application.
Godlewski and Weill (2011)	31 developing and developed countries	Borrower observed risk	Borrower observed risk profile has a positive effect on collateral.
Leeth and Scott (1989)	USA	Loan size	Large loans are secured due to high-risk perception by the banks.
Voordeckers and Steijvers (2006)	Belgium	Loan size	Positive effect on collateral.
Hernandez–Canovas and Martinez–Solano (2006)	Spain	Loan size	Small loans are based on relationship lending.
Harhoff and Korting (1998)	Germany	Loan maturity	Long-terms loans are provided with collateral security.
Voordeckers and Steijvers (2006)	Belgium	Loan maturity	Longer maturity has a positive relationship with collateral.
Duarte <i>et al.</i> (2016)	Portugal	Loan maturity	Long-term loans are collateralized due to moral hazard issue.
Besanko and Thakor (1987)	USA	Loan interest rate	Positive impact on collateral.
Brick and Palia (2007)	USA	Loan interest rate	Positive results on collateral due to borrower observed-risk profile.
Voordeckers and Steijvers (2006)	Belgium	Bank competition	Negative effect on collateral because of other competitors and less holding power.
Jimenez <i>et al.</i> (2009)	Spain	Bank competition	Banks would like to create their superiority over other lenders by taking collateral. Hence, positive effect on collateral.
Hainz <i>et al.</i> (2013)	70 developed and developing countries	Bank concentration	Positive results on collateral.
Jimenez <i>et al.</i> (2009)	Spain	Bank-Borrower distance	Local borrowers pledge more collateral than the distant ones.
Hainz <i>et al.</i> (2013)	70 developed and developing countries	Bank-Borrower distance	Distance borrowers pledge higher collateral.

2. Data, method and variables

2.1. Data

The data set we used for our analysis was obtained from the latest version of the BEEPS V survey, which was a joint project of the European Bank for Reconstruction and Development (EBRD) and the World Bank (WB) conducted from 2012–2014. The BEEPS survey was first conducted in 1999 in 26 countries by covering about 4000 firms. The latest version of the BEEPS survey was completed in 30 transition economies, including Russia, to examine the business environment conditions of the enterprises. The data set covers 15,883 enterprises that include micro, small, medium and large firms. All firms' related variables are obtained from the BEEPS survey and to examine the effect of bank market structure on collateral we included data from the Beck *et al.* (2000), Global Financial Database.

The BEEPS data set covers 254 firms in the Czech Republic, 268 firms in the Slovak Republic, 542 firms in Poland and 310 firms in Hungary. However, as the aim of this paper is to examine collateral requirements in the segment of SMEs only, we eliminated non-SME firms. We have defined SMEs according to the conventions of both OECD and BEEPS as firms with less than 250 employees. By doing so, we obtained 239 firms in the Czech Republic, 260 in the Slovak Republic, 518 in Poland and 294 firms in Hungary, totalling 1,311 SMEs for our descriptive analysis. Among these 1,311 SMEs, 492 firms had loan information with collateral requirements.

2.2. Method and variables

The aim of this paper is to find the determinants of collateral. Collateral is a binary dependent variable, which indicates its presence in a loan contract. Considering the nature of our dependent variable, we employed logit regressions for our analysis following Hainz *et al.* (2013), Jimenez *et al.* (2006) and Berger *et al.* (2011). Our full empirical model is as follows:

$$\Pr(\text{Collateral} = 1) = \beta_1 \text{ firm characteristics} + \beta_2 \text{ loan characteristics} + \beta_3 \text{ lender market characteristics} + \varepsilon_i, \quad (1)$$

where *Collateral* is a binary dependent variable that takes a value of one if the loan is collateralized, and zero otherwise. ε_i is the usual error term. Moreover, β_1 firm characteristics, β_2 loan characteristics, and β_3 lender market characteristics are set of independent variables to determine their impact on our dependent variable (*Collateral* = 1).

2.2.1. Independent variables

To examine our model on the incidence of collateral, we group our independent variables into three categories: firm-specific, loan-specific and lender market characteristics. In Table 2, we present a definition and source for each variable.

With respect to the first group of firm-specific factors, we examine four inverse proxies for information asymmetry: *Size* (number of full-time employees), *Age* (number of years the firm has been operating), *Audit* (1 if external auditors check the firm financial

statement, and 0 otherwise) (Berger, Udell 2002; Chakraborty, Hu 2006; Ortiz-Molina, Penas 2008; Menkhoff *et al.* 2012; Duarte *et al.* 2017). By following the related studies, we also consider firm size, age, audit report as inverse proxies for information opacity, and expect to find a negative association with collateral. To examine the effect of asset tangibility in minimizing information asymmetry, we include *Manufacturing* firms (1 if the firm is a manufacturing firm and 0 otherwise) (Gompers 1995). To examine the impact of agency costs in collateral requirements (Hanedar *et al.* 2014), our model includes *Ownership* concentration (percentage ownership of the firm held by the largest shareholder). As discussed elsewhere, ownership concentration may have a negative effect on collateral requirements due to less agency related issues, since the owner is most likely the manager of the firm's. To examine the effect of borrower experience in collateral based lending, we include *Experience* (years of experience of the top manager) (Duarte *et al.* 2017). To measure gender-based discrimination in collateral based lending, we include *Female* (1 if one of the firm owners is female, and 0 otherwise). Empirical research finds that female owners face greater restrictions from banks (Belluchi *et al.* 2010). To examine financial constraints on innovative firms in the form of higher collateral, we include *Innovation* (1 if the firm introduced new products or services during last three years, and 0 otherwise). Finally, to measure the borrower observed-risk hypothesis, we examine three proxies for borrower risk: *Quality*, *Crime* and *Liquidity*. *Quality* is 1 if the firm has an internationally recognized quality certificate, and 0 otherwise. *Crime* is 1 if the firm has experienced any losses because of theft, robbery, vandalism or arson, and 0 otherwise (Hanedar *et al.* 2014; Duarte *et al.* 2017). *Liquidity* measures the percentage of credit sales over total sales, as more credit sales can increase the possibility of liquidity crisis (Hanedar *et al.* 2014). These above studies argue that firms observed risk profile could have a positive impact on collateral.

To examine the impact of loan characteristics and the presence of collateral, we estimate three loan-specific variables: *LoanSize*, *LoanMaturity* and *InterestRate*. *LoanSize* is loan amount in dollars (Godlewski, Weill 2011), *LoanMaturity* is loan duration in months (Jimenez *et al.* 2006) and *InterestRate* is the annual cost of the loan in percentage (Hanedar *et al.* 2014). According to the moral hazard theory, we expect to find a positive relationship between loan size and loan maturity with the presence of collateral. However, as discussed earlier with interest rates, we can validate both the adverse selection and observed-risk hypotheses.

This paper examines three lender market characteristics and their impact on the presence of collateral. *City* is 1 if the firm is located in the capital city, and 0 otherwise (Hanedar *et al.* 2014). *City* is included in the analysis because it is expected that firms located in the capital city may experience lower collateral requirements from banks, as the capital city is usually the financial hub of the country and, hence, distance will be lower between the banks and borrowers. *BRC* (number of bank branches per 100,000 adults) (Duarte *et al.* 2017) is also included as a proxy for bank-borrower proximity (inverse to distance). We expect to find a negative relationship between number of bank branches and collateral. As increased number of bank branches may reduce bank-borrower distance and that may increase information collection efficiency, it may lead

to a reduction of dependency on collateral. Finally, yet importantly, as an inverse proxy to bank competition, we included *C R* (asset share of the largest three banks in total banking system assets) (Hanedar et al. 2014). If the market is highly concentrated, we may find a positive relationship between concentration and the incidence of collateral. Detailed selection of variables can also be seen in Table 1.

Table 2. Definition and sources of variables

Variable	Definition	Source
Collateral	Equals 1 if the firm has pledged collateral to obtain an external loan (0,1)	BEEPS
<i>Firm characteristics</i>		
Age	Age of firm, measured as the number of years that the firm has been operating	BEEPS
Size	Size of the firm, measured as the number of full-time employees	BEEPS
Audit	Equals 1 if the firm financial statement is checked by external auditors (0,1)	BEEPS
Manufacturing	Equals 1 if the firm is a manufacturing firm (0,1)	BEEPS
Ownership	Percentage ownership of the firm held by the largest shareholder	BEEPS
Experience	Experience of top manager measured in years	BEEPS
Female	Equals 1 if one of the firm owners is female (0,1)	BEEPS
Quality	Equals 1 if the firm has an internationally recognized quality certification (0,1)	BEEPS
Innovation	Equals 1 if the firm has introduced any new products within the last three years	BEEPS
Crime	Equals 1 if the firm has experienced any losses as a result of theft, robbery, vandalism or arson (0,1)	BEEPS
Liquidity	Credit sales over total sales (%)	BEEPS
<i>Loan characteristics</i>		
LoanSize	Loan amount measured in US dollars	BEEPS
LoanMaturity	Loan duration in months	BEEPS
InterestRate	Loan annual cost (%)	BEEPS
<i>Lender market characteristics</i>		
City	Equals 1 if the firm is located in the capital city (0,1)	BEEPS
CR	The asset share of the three largest banks in total banking system assets	Beck et al. (2000)
BRc	Number of bank branches per 100,000 adults	Beck et al. (2000)

Note: This table presents variable definitions and sources of the data set. BEEPS = Business Environment and Enterprise Performance Survey.

3. Results

3.1. Descriptive statistics

Table 3 presents the results of descriptive statistics for our full sample of firm and also shows country-level segmentation. With respect to all firms, 432 had collateral information and about 70% of the SMEs pledged *Collateral* for their most recent loans. Thus, the preliminary data suggests that pledging collateral is quite common for SMEs in the Visegrad countries. It is not surprising that only 34% have financial statements verified by external auditors (*Audit*). This result also supports the existing literature that SMEs usually cannot produce audited financial statements, which we have already discussed. Descriptive statistics also suggest that firm structure in our sample possesses a high concentrated ownership pattern (mean of *Ownership* is 77%). We can also see that about 40% of the firms have at least one owner who is female (*Female*) and 19% reported that they incurred losses due to theft, robbery or vandalism. Moreover, it is noticeable from table 2 that only 31% of the SMEs conduct innovation activities, which suggests SMEs are reluctant to develop new products or make any changes in their existing product lines.

With respect to loan characteristics, *LoanMaturity* ranges from 1 month to 300 months, which suggests a huge dispersion between loan maturities. Considering the *InterestRate*, on average, firms pay about 8.5% on their borrowings. However, the maximum loan cost is about 70%, indicating that, at times, SMEs pay an extremely high cost for loans.

Variables regarding lender market characteristics suggest that about 19% of firms are located in the capital city (*City*), implying that firms in our sample countries are geographically distributed rather than concentrated in the capital. The average number of bank branches (*BRC*) per 100,000 adults is 26 and ranges from 15 to 32 branches in our sample countries. A higher number of bank branches indicate less distance between the banks and borrowers, which reduces bank organizational diseconomies in the loan screening process. Finally, the mean value of *CR* is about 73%, suggesting that the banking industry in our sample countries is highly concentrated.

In our country level segmentation, the survey result suggests that 75% of firms in the Czech Republic and 76% in the Slovak Republic and Hungary pledged collateral (*Collateral*) on their loan. However, only 56% of firms in Poland pledged collateral on their loans. Regarding audit reports, 47% of firms in the Czech Republic and Slovak Republic have audit reports (*Audit*) and 46% of firms in Hungary have their statements audited. However, only 15% of firms in Poland have audited their financial statements. The survey result also suggests that ownership structure of firms in the Czech Republic are highly concentrated (*Ownership* about 84%), which is highest among the countries. Descriptive statistics also highlight that firm-level innovation is lowest in Slovak firms (18%), whereas about 50% of the SMEs in the Czech Republic reported that they have introduced new products during the last three years excluding the year when the survey was conducted. Surprisingly, 36% of firms in the Czech Republic (highest) reported that they had experienced losses due to theft, vandalism or arson (*Crime*), whereas only 12% of firms in Hungary (lowest) reported they had losses due to criminal activities.

Table 3. Descriptive statistics

Statist.	Coll.	Age	Size	Audit	Manu.	Own.	Exp.	Female	Inno.	Quality	Crime	Liq.	Loan Size	Loan Maturity	Interest Rate	City	CR	BRc	
<i>All firms</i>																			
Mean	0.70	18.39	33.11	0.34	0.31	76.46	20.32	0.39	0.31	0.40	0.19	46.53	1.14E+06	41.20	8.21	0.19	72.09	26.04	
St.Dev.	0.46	9.12	46.02	0.47	0.46	26.16	9.83	0.49	0.46	0.49	0.39	39.88	9.37E+06	40.23	7.24	0.39	16.14	6.56	
Min	0	1	1	0	0	0	1	0	0	0	0	0	220	1	0	0	54.74	15.35	
Max	1	97	249	1	1	100	57	1	1	1	1	100	1.54E+08	300	70	1	94.67	32.53	
Obs.	492	1307	1306	1299	1311	1280	1242	1310	1310	1304	1311	1206	283	352	233	1311	1311	1311	
<i>Czech Republic</i>																			
Mean	0.752	17.33	31.40	0.47	0.38	83.24	21.32	0.31	0.50	0.38	0.36	75.48	4.80E+05	38.03	5.79	0.17	69.00	24.25	
St.Dev.	0.434	5.35	42.41	0.50	0.49	24.39	10.12	0.47	0.50	0.49	0.48	31.20	8.89E+05	31.82	3.43	0.38			
Min	0	1	4	0	0	14	1	0	0	0	0	0	7504.5	1	2	0			
Max	1	25	235	1	1	100	51	1	1	1	1	100	5.00E+06	200	19	1			
Obs.	125	239	239	239	239	239	239	239	239	239	239	231	90	108	85	239	239	239	
<i>Slovak Republic</i>																			
Mean	0.76	17.04	34.43	0.47	0.30	77.68	19.33	0.32	0.18	0.45	0.13	36.71	5.85E+04	55.30	7.06	0.23	94.67	26.86	
St.Dev.	0.43	6.54	46.70	0.50	0.46	26.01	9.34	0.47	0.39	0.50	0.34	38.48	3.46E+06	55.30	8.44	0.42			
Min	0	2	1	0	0	9	1	0	0	0	0	0	1.92E+03	3	0	0			
Max	1	60	245	1	1	100	50	1	1	1	1	100	2.69E+07	300	56	1			
Obs.	103	260	260	260	260	260	260	260	260	260	260	258	60	74	48	260	260	260	
<i>Hungary</i>																			
Mean	0.761	16.734	32.817	0.463	0.279	70.649	22.111	0.329	0.212	0.536	0.116	37.214	2.99E+06	42.538	10.811	0.337	85.220	15.350	
St.Dev.	0.429	8.491	48.051	0.500	0.449	24.480	10.237	0.500	0.409	0.500	0.320	39.685	1.85E+07	43.786	6.924	0.473			
Min	0	2	2	0	0	35	1	0	0	0	0	0	220	2	3	0			
Max	1	69	249	1	1	100	55	1	1	1	1	100	1.54E+08	240	35	1			
Obs.	117	290	289	283	294	279	289	293	293	289	294	252	69	80	37	294	294	294	
<i>Poland</i>																			
Mean	0.565	20.473	33.396	0.151	0.292	75.558	19.200	0.388	0.330	0.306	0.176	42.632	5.97E+05	32.244	10.841	0.104	54.740	32.530	
St.Dev.	0.498	11.304	46.214	0.358	0.455	27.726	9.767	0.488	0.471	0.461	0.381	37.968	2.05E+06	26.553	8.861	0.306			
Min	0	3	1	0	0	30	1	0	0	0	0	0	1504.7	1	2	0			
Max	1	97	240	1	1	100	57	1	1	1	1	100	1.50E+07	120	70	1			
Obs.	147	518	518	517	518	502	454	518	516	518	518	465	64	90	63	518	518	518	

Source: Authors' calculation based on the BEEPS survey. The table reports descriptive statistics for dependent and independent variables for the full sample of firms and country level.

Considering *InterestRate*, firms in the Czech Republic pay the lowest interest rates (mean interest rate is 5.79%), whereas interest rates are highest in Poland (mean interest rate is 10.84%). Results regarding bank concentration (*CR*) suggest that the banking industry is extremely concentrated in the Slovak Republic (94.67%) and Hungary (85.22%). It signals that banks in these countries may use their market power to increase financial constraints to SMEs.

3.2. Empirical results and discussion

In Table 4, we present logit regressions results on the incidence of collateral. We estimate three regressions by using different sets of independent and control variables for our analysis. The first regression reports all firm characteristics and their impact on the presence of collateral. The second regression includes all loan characteristics with firm characteristics. The third regression reports all lender market characteristics along with firm characteristics excluding loan characteristics.

Regarding the firm-level determinants of collateral, we find that firm size (*Size*) has a positive effect on collateral. However, we find a negative relationship between firm age (*Age*) and collateral. The positive coefficients of firm size with collateral did not meet our expectation. We hypothesized that large firms are more information transparent than the smaller ones, which may help the large firms to avail loans with lower collateral requirements. Nevertheless, our result suggests that large firms pledge more collateral compared to smaller firms. This result is similar to those of Hanedar *et al.* (2014) and Steijvers *et al.* (2010). It can be that larger firms prefer to demonstrate credit quality by providing more collateral. Hence, collateral can act as a signalling device for the large firms by which it could be possible that they can lower the loan interest rates. On the other hand, it is also possible that number of employees, as a measure of firm size may not be appropriate to determine the incidence of collateral. A firm can have many employees but may still lack audited financial statements or unable to show satisfactory business information to the bank to minimize information asymmetry that can reduce the incidence of collateral. The negative coefficients of firm age (*Age*) and collateral suggest that mature firms pledge less collateral than the younger firms do. This result is in line with our expectation and corroborates with the findings of Chakraborty and Hu (2006); Hanedar *et al.* (2014) and Duarte *et al.* (2017). As prior studies suggest, it is easier for the older firms to show past business information, thus reducing collateral requirements. Furthermore, according to relationship lending theory, older firms can engage in long-term relationships with their banks that can reduce collateral for small businesses (Berger, Udell 1995).

With respect to audit report (*Audit*), we did not find that audited financial statements had any significant effect on collateral requirements. It could be that audit reports may not reflect the overall business condition of firms, and therefore banks do not consider audit reports as sufficient information asymmetry tools for collateral-free loans. The negative coefficient of manufacturing (*Manufacturing*) firms and collateral suggests that firms with more tangible assets pledge lower collateral than other types of firms. Hence, our result supports the idea that manufacturing firms can show greater information trans-

parency than firms with fewer tangible assets. It could be the fact that asset tangibility can increase bank efficiency in evaluating the credit risk of firms, making it easier for banks to recover loans by liquidating tangible assets (Gompers 1995; Knyazeva, A., Knyazeva, D. 2012). Thus, banks ask for lower collateral from the firms those possess a significant amount of tangible assets.

Considering the ownership (*Ownership*) structure of firms and the incidence of collateral, we find a positive significant result, which is opposite to our expectation. The result suggests that banks are taking restrictive measures in terms of holding collateral from concentrated firms. It could be possible that concentrated firm ownership increases the possibility of agency costs, as argued by Jensen and Meckling (1976). Additionally, risk-shifting behaviour may be more likely in concentrated firms due to individual holding power in the management of the firms. Steijvers *et al.* (2010) find that family firms pledge more collateral in comparison to non-family firms due to the free riding problem of family members in the business. Hence, this reasoning may also apply to our sample of firms, as SMEs are more likely to be managed and operated by individual or family members.

Our estimation result for female ownership (*Female*) of firms is positively associated with collateral in all regression specifications. This suggests that female-owned firms are more likely to provide collateral compared to male-owned firms in our sample countries. There can be a few explanations for this result. First, banks perceive female-owned firms as riskier because they often have less experience in business management and more attachment with the family than the business (Garwe, Fatoki 2012; Boyer, Blazy 2014). Second, female-owned firms usually lack a past business record and, hence, receive strict credit conditions from banks (Irwin, Scott 2010). Third, Alesina *et al.* (2013) report that female borrowers have less bargaining power than male borrowers, which may cause women borrowers to accept loans with higher collateral requirements. Finally, it could also be the fact that female owners in our sample of firms manage firms that require higher collateral. However, we did not examine this possibility in this paper, which could be an interesting topic for future research.

We did not find any effect of borrower experience (*Experience*) on the incidence of collateral. Therefore, we may say that borrower experience in Visegrad countries is not a determinant factor for banks while deciding for granting loans to a particular borrowers and asking for collateral. Our result is also aligned with the result of Duarte *et al.* (2017), where they did not find any significant effect of borrower experience in collateral requirements for SMEs.

According to our expectation, we find a positive effect of firm innovativeness (*Innovation*) on collateral requirements but the result is not statistically significant. We hypothesized that innovative firms are more information opaque in comparison to non-innovative firms and need to pledge more collateral to reduce information asymmetry. However, the insignificant results suggest that collateral constraints on innovative SMEs are no more than on non-innovative ones. Thus, innovation activities do not create borrowing constraints for SMEs at least in the form of higher collateral requirements.

Table 4. Logistic regression on the presence of collateral

Variable	Model 1	Model 2	Model 3
	Collateral (1/0); logit	Collateral (1/0); logit	Collateral (1/0); logit
<i>Firm characteristics</i>			
Size	0.007(0.003)*	0.002(0.007)*	0.007(0.004)**
Age	-0.001(0.016)**	-0.013(0.034)	-0.009(0.017)
Audit	0.307(0.251)	0.348(0.481)	0.085(0.262)
Manufacturing	-0.0368(0.382)*	-0.504(0.452)*	-0.230(0.259)*
Ownership	0.004(0.005)**	0.002(0.009)*	0.004(0.005)*
Experience	0.018(0.013)	0.052(0.026)	0.018(0.013)
Female	0.540(0.245)**	0.568(0.474)**	0.436(0.246)**
Innovation	0.057(0.246)	0.455(0.447)	0.186(0.252)
Quality	0.482(0.252)	0.572(0.482)	0.491(0.262)
Crime	0.025(0.262)**	0.040(0.473)**	0.065(0.265)**
Liquidity	0.008(0.003)	0.006(0.005)	0.011(0.003)
<i>Loan characteristics</i>			
Ln (LoanSize)		0.031(0.007)	
LoanMaturity		0.008(0.006)*	
InterestRate		0.071(0.031)**	
<i>Lender market characteristics</i>			
City			-0.486(0.306)*
CR			0.022(0.010)**
BRc			-0.002(0.025)
Constant	-1.464(0.686)***	-0.404(1.024)	-2.587(1.364)*
Observations	430	126	430
Log-Likelihood	-474.083	-141.17	-468.908
Pseudo-R Square	0.135	0.217	0.15

Source: Authors' own estimation. Statistical significance at the 10%, 5% and 1% level indicated by *, ** and ***, respectively. Standard errors are in parentheses.

With respect to the borrower observed-risk hypothesis variables *Quality*, *Crime* and *Liquidity*, we find a significant result only in the case of crime, whereas quality and liquidity have an insignificant effect on collateral. The positive coefficients of crime and collateral suggest that firms with a track-record of losses due to theft, robbery, vandalism or arson must pledge more collateral due to their high-risk perception. Hence, in accordance with past literature, we provide evidence that when borrower quality is observable as risky, banks require more collateral (Berger, Udell 1990; Jimenez *et al.* 2006; Godlewski, Weill 2011; Hanedar *et al.* 2014; Duarte *et al.* 2017) to protect their loan portfolio (Blazy, Weill 2013). Thus, borrower observed-risk has a positive effect on collateral in the Visegrad countries.

Table 3 (Model 2) reports the loan characteristic variables and their impact on the likelihood of pledging collateral. We find a positive result for all three loan characteristic variables – *LoanSize*, *LoanMaturity* and *InterestRate* – on the incidence of collateral. However, we find significant results for loan maturity and interest rates but insignificant results for loan size. The result suggests that loans with longer maturity are more likely to pledge collateral than short-term loans. It can be that long-term loans may induce risk-shifting behaviour in managers (Jensen, Meckling 1976). Long-term loans may also create moral hazard problems, provoking banks to ask for collateral (Duarte *et al.* 2016). Voordeckers and Steijvers (2006) find that long-term loans are collateralized with fixed assets in the Belgian market. Thus, longer maturity signals higher risk for banks and requires collateral safety to assure that the borrowers will not engage in any activities that is contradictory with the interest of the banks. The positive coefficients of interest rate with collateral are evidence that risky borrowers are required to provide more collateral and pay higher interest rates; hence, we show further evidence of the borrower observed-risk hypothesis (Bester 1985; Chan, Kanatas 1985; Brick, Palia 2007; Godlewski, Weill 2011). Hence, we can propose that there is an inter-relationship between observed credit quality, interest rates and collateral. It might be the case that when information asymmetry is low, a bank may screen its borrowers more thoroughly and any evidence of risky nature can induce banks to ask for more collateral and charge higher interest rates to compensate their investments. Therefore, the evidence from the Visegrad countries suggests that interest rates and collateral act as complementary rather than substitute of each other.

With respect to lender market characteristics, we find significant negative results for *City* and positive coefficients for *CR*. However, coefficients for *BRc* are negative but not statistically significant. The negative coefficients for *City* suggest that firms located in the city are closer to the banks, which may reduce the probability of pledging collateral. It could be that a shorter distance may help in mitigating the information gap between the banks and borrowers. As a result, banks may require less collateral from borrowers that are closer to their branch. Therefore, our results also corroborate with the prior findings of Hainz *et al.* (2013) that firms located closer to banks are financed via screening and distant borrowers need to pledge collateral because of information opacity. It can be that a shorter distance increases bank efficiency in the loan screening process because the credit officer can travel to the firm more frequently and acquire firm-specific soft information, as asserted by Agarwal and Hauswald (2010). The positive coefficients of *CR* suggest that firms in a concentrated market need to provide more collateral than in a competitive market. Therefore, we can say that in a concentrated market, banks may use their market power to increase collateral requirements for small businesses. Our results are in line with those of Duarte *et al.* (2017), who also find a positive effect of bank concentration on collateral. It might be that by asking for collateral, banks in a concentrated market could reduce their screening efforts and associated costs. Thus, as argued by Manove *et al.* (2001), concentration may increase the “lazy” behaviour of banks, as they rely more on collateral to provide small business loans.

Conclusions

Collateral requirements on a loan contract are particularly significant for SMEs rather than the large firms because SMEs are information opaque and collateral can act as a signalling device for borrowers to show their credit quality, which can ease access to financing and strict loan conditions. Similarly, by asking for collateral, a bank can minimize its loss exposure in the event of loan default and provide protection from borrower moral hazards. Hence, collateral has important implications for both borrowers and lenders on a loan agreement. However, SMEs possess fewer assets that can be pledged as collateral and, hence, SMEs face credit rationing from banks. In this paper, we examine the determinants of collateral on SME financing in the context of four central European countries, or Visegrad countries (Czech Republic, Slovak Republic, Poland and Hungary). The data set was obtained from the European Bank for Reconstruction and Development (EBRD) and the World Bank (WB) Business Environment and Enterprise Performance Survey (BEEPS), wave V, which was conducted from 2012–2014. We also complemented the BEEPS survey data with indicators from the Beck *et al.* (2000), Global Financial Database. This paper investigates the incidence of collateral by focusing on three main areas: firm characteristics, loan specific variables and lender market characteristics.

Our results suggest that large firms, ownership concentration, firms owned by females and firms with a past business record of losses due to theft, robbery, vandalism or arson are more likely to pledge collateral on their borrowings. However, the probability of requiring collateral is lower for older and manufacturing firms, which may be due to lower information asymmetry. Therefore, we provide evidence that reduction of information asymmetry can play a significant role in alleviating collateral requirements for SMEs. The negative association between firm age, manufacturing firms and the incidence of collateral supports our claims. We show that firms affected by criminal activities are more likely to pledge collateral because of their high-risk perception. Hence, borrower observed-risk characteristics could induce collateral on a loan contract. Our results also support that the ownership concentration increases the likelihood of pledging collateral. Thus, banks perceive firms managed by the owner or owned by a few people as riskier due to risk-shifting behaviours of individuals and, hence, banks ask for more collateral to align the interest of the borrower with the interest of the banks. We also find evidence that firms owned by female borrowers are more likely to pledge collateral in comparison to male-owned firms. Therefore, we can infer that banks in our sample countries treat female-owned firms as riskier than those owned by their male counterparts.

We also find that loans granted for a longer period are more likely to be secured with collateral. Therefore, it may suggest that long-term loans are riskier than the short-term loans. Similarly, collateral requirements are higher for loans with higher interest costs. These results provide evidence that borrower observed credit quality is a main factor inducing collateral requirements on a loan contract.

It is also noticeable that firms located in the capital city are less likely to provide collateral on their loan contract. Therefore, it seems that shorter distance alleviates the

information gap between the banks and borrowers. Finally, we find empirical evidence that banking concentration increases collateral requirements for SMEs. Thus, we can say that concentration is not ideal for SMEs to obtain loans with lower collateral, as in a concentrated market, a bank can exploit its market power to impose stringent collateral requirements.

By considering the significance of our results, it is worth to mention that the current research brings several new insights in collateral based lending in the segment of SMEs. Such as, this paper examines the determinants of collateral by using a unique dataset that has not been used in any earlier research. Furthermore, unlike previous research, this paper not only shows empirical results considering the firm characteristics but also from the perspective of financial market structure and lending terms in a loan contract. We also show disadvantage for distant and female borrowers in collateral based lending which is quite scant in the past literature.

The results of the current paper provide a few implications for policy makers. First, taking effective measures to increase bank competition can create a level playing field for other banks and may reduce strict collateral requirements for SMEs. Second, banks can lower collateral requirements for female-owned firms, which can encourage more female entrepreneurs to access bank loans. Finally, regulators may take initiatives to reduce the interest rate for SMEs that can foster SME growth and therefore contribute to the economy. Further studies are required to understand the ratio of collateral to loan and the impact of market structures that induce a high ratio of collateral for SMEs. Similarly, this study has not analysed which type of collateral is preferable for SME loans – personal or business – hence, we leave that for future studies.

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