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Performance of family-owned firms: the impact of gender at the management level

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Abstract

Purpose – The purpose of this paper is to analyse the impact of gender (F/M), at the management level, on the family company's performance.

Design/methodology/approach – Company size, age, region and business sector were used as control variables in order to confirm the adjustment of the model to the theory. GMM dynamic panel models were used in order to control for: endogeneity; time-invariant characteristics; possible collinearity between independent variables; effects from possible omission of independent variables; elimination of non-observable individual effects; and the correct estimation of the relationship between the dependent variable in the previous and current periods. The study used data from 199 Portuguese family companies, from 2006 to 2014.

Findings – The results confirm the hypothesis from corporate governance literature, which argues that board diversity is potentially positively related to firm performance, showing that the presence of a female element in family firms' direction has positive impacts on their performance, compared to those with only male elements. Also, the results show that region and sector of activity are factors influencing family firm performance. Finally, the study confirms that company size and age are variables helping to explain these companies' life-cycle.

Originality/value – The study contributes to the literature on family firms regarding the effect of gender on family firm performance. The use of dynamic panel data models will make a strong contribution to this, as the problem of endogeneity is dealt with correctly here through using these models, and the possible collinearity between independent variables and correct estimation of the relationship between the dependent variable in previous and current periods.

Keywords Region, Gender, Performance, Age, Family firm, Business sector, Company size

Paper type Research paper

1. Introduction

Over the years, there has been noticeable progress towards gender equality in company management. This is observed worldwide and, for example, Eagly and Carli (2003) refer to this fact in the case of the USA, in both firms and politics. More recently, Rodríguez-Ariza *et al.* (2017) highlight the same in their study, considering a sample of quoted non-financial firms in Canada, Denmark, Finland, France, Germany, Italy, the Netherlands, Spain, Sweden, the UK and the USA. Interest in this subject in developing countries has also grown, and the limited number of studies on the issue in those countries is due to the differences in social structures between developed and developing countries, as well as the social roles associated with men and women (Khalife and Chalouhi, 2013).

Indeed, the introduction of compulsory quotas in several countries has led to a larger number of women in the boardroom (Xing and Gonzalez, 2015; Adams, 2016). Although the roles of women in business and in society in general have changed in recent years, real equality between men and women has yet to be achieved (Rodríguez-Ariza *et al.*, 2017).

Eagly and Carli (2003) state there is a double causality between the increased number of women in top management posts and changes in theories and practices of leadership. More recent theory of good leadership focusses on teamwork and collaboration and emphasises the ability to empower, support and engage workers (Hammer and Champy, 1994; Senge, 1994; Eagly and Carli, 2003).

Meroño-Cerdán and López-Nicolás (2017) argue that this improvement is more evident in middle management positions (Hoobler et al., 2011) than in top management (Dawley et al., 2004; Xing and Gonzalez, 2015).

According to Rodríguez-Ariza et al. (2017), there is particular evidence of improvement in the case of family firms, where gender diversity among board members is greater than in non-family firms (Barrett and Moores, 2011).

Researchers who focus on the role of women directors in family firms suggest they are more likely to be affiliated to management through family ties rather than their professional experience and knowledge, being seen as "family delegates" whose mission is to protect family interests via the control of corporate decisions (Ruigrok et al., 2007; Abdullah, 2013; Rodríguez-Ariza et al., 2017).

In addition, in non-family firms, Xing and Gonzalez (2015) argue that most board positions occupied by women are those of independent directors, suggesting a limited influence of women on the firm's day-to-day operations.

The presence of women on company boards may generate better firm performance if they bring an additional perspective to board decision making. Alternatively, women may have a negative impact if the decision to appoint female board members is motivated by societal pressure for greater gender equality (Campbell and Mínguez-Vera, 2008).

Family firms are considered the pillars of the economy, providing increased employment and GDP in countries, something which has led to increased interest in studying this type of company. Even today, we do not find a universal definition of family firm, with reference usually being made to management, ownership or succession-related issues. At the heart of most definitions of a family business is the significant power wielded by the family, due to its significant degree of ownership concentration and occupying fundamental positions that affect management and decision-making processes (Anderson and Reeb, 2003; Sharma, 2004; Villalonga and Amit, 2006; Rodríguez-Ariza et al., 2017).

So, in the case of family businesses, women have adopted important but subtle roles, in order to ensure their firms' continuity and growth (Jimenez, 2009; Meroño-Cerdán and López-Nicolás, 2017).

The impact of women in management positions in family firms continues to be an important topic in the family business literature, as Campopiano et al. (2017) and Meroño-Cerdán and López-Nicolás (2017) argue.

This study will bring additional knowledge to this area, by analysing the impact of gender (F/M), in management, on the family company's performance.

According to the literature on corporate governance, board diversity can be positively related to firm performance (Smith et al., 2006), so this study will analyse the impact of gender (F/M) on family companies' performance controlling for the effects of company size, age, region and sector of activity.

Family firms have special characteristics, and one differentiating aspect is that they are not homogeneous (Sharma et al., 1997; Chua et al., 2012). According to Chua et al. (2012, 2018), heterogeneity can arise from the existence of different objectives (Chrisman et al., 2012), governance structures (Carney, 2005) and types of resources (Habbershon et al., 2003).

Indeed, family firms present two types of objectives, financial and non-financial (Danes et al., 2007; Campopiano et al., 2017; Chua et al., 2018; Holt et al., 2017). However, as mentioned by Chua et al. (2018), both family and non-family firms pursue financial and

non-financial objectives. What distinguishes family firms from others (and also between each other) is the trade-off they make between the types of objectives pursued and the type of results they consider significant (Chua *et al.*, 2018; Holt *et al.*, 2017).

According to Danes *et al.* (2007) and Blanco-Mazagatos *et al.* (2010), the main goal of a family firm is to hold on to the company and make it sustainable. Therefore, from the set of theories supporting the study of family firms, particularly their performance, the sustainable family business theory will be used as the basis for the work done.

The sustainable family business theory results from the general systems theory and gives recognition to both family and business and to their interplay in achieving mutual sustainability (Stafford *et al.*, 1999; Danes *et al.*, 2007; Lee *et al.*, 2010). According to this theory, business sustainability is a function of the success of both the business and family functionality (Stafford *et al.*, 1999). The theory proposes that it is possible to analyse aspects related to the owning family and the business owner that are not within the firm, but which have impacts on its results and sustainability (Stafford *et al.*, 1999; Danes *et al.*, 2007). The overlapping of family and business varies from one firm to another, resulting in diverging objectives and results, which leads to the heterogeneity characterising these companies.

This study is based on the principles of the sustainable family business theory, in order to analyse the impact of gender (F/M) on family firm performance controlling for the effects of company size, age, region and sector of activity.

To achieve this goal, a sample was formed based on non-financial firms belonging to the Association of Portuguese Family Firms, in the period from 2006 to 2014, and dynamic panel data models were used.

In Europe, 70–80 per cent of firms are family businesses accounting for 40–50 per cent of employment (Astrachan and Shanker, 2003; Morck and Yeung, 2004; Mandl, 2008). The Portuguese case is no different: the Association of Portuguese Family Firms (2007) says that family businesses contribute to 60 per cent of employment and to 50 per cent of GDP. Given this, it is adjusted to resort to Portugal as a country for the study in question. On the other hand, there has been an effort from the government to develop, and adopt, policies and recommendations for gender equality. It is therefore interesting to use Portuguese family companies to validate the hypotheses in study.

This study makes a particular contribution to the literature on family firms, especially regarding the effect of gender on family firm performance, and also contributes to deepening knowledge about the impact of gender on firm performance in general. The use of dynamic panel data models will make a strong contribution to this area of the literature on family firms, as the problem of endogeneity, often referred to in the literature, is dealt with correctly here through using these models, as well as the possible collinearity between independent variables and the correct estimation of the relationship between the dependent variable in the previous and current periods. To the best of our knowledge, this is one of the first studies to do so using this set of variables.

Our results confirm the hypothesis that having a female element in family firm direction has positive impacts on performance, compared to firms with only male elements. The results also show that the region and business sector are factors influencing family firm performance. Finally, the study confirms that company size and age are variables that help to explain these companies' life-cycle, showing that the larger the family company, the better its performance, and as the family firm gets older, the lower its performance will be.

After this introduction, the paper is organised as follows: Section 2 presents the literature review and establishes hypotheses for investigation; Section 3 deals with the methodology, including the database, variables and empirical method used; Section 4 presents the results of both the descriptive statistics and the empirical models; and, finally, Section 5 presents the conclusions and possible implications of the study.

2. Literature review

2.1 Gender

The literature, particularly that related to gender theory, reveals the existence of a number of organisational conditions where differences associated with gender can be observed. Marlow and Patton (2005) revealed the existence of structural disadvantages (size, age, sector) resulting from lower resource endowment associated with female leadership (human, social and financial capital). Also, Eagly and Carli (2007) revealed that variables related to female management profile, such as age, experience and others, may lead to gender differences. Some studies also argue that women and men show different work styles in certain aspects (Huang and Kisgen, 2013; Francis *et al.*, 2015; Faccio *et al.*, 2016, among others).

The subject of gender and its impact on organisations has been widely studied, focussing on various aspects. The gender variable was introduced to the study of performance in 1991, examples of work in that year being Kalleberg and Leicht (1991) and Brush and Hisrich (1991). This paper intends to analyse the possible impact of gender at the managerial and administrative level on family firm performance, aiming to determine whether the presence of a woman in these posts could have a positive impact on that performance.

It is known that a higher percentage of women in managerial and administrative positions can be found in family firms, inasmuch as one of the non-financial objectives of these firms is to ensure their continuity and growth in family hands. Therefore, it is expected, as in Meroño-Cerdán and López-Nicolás (2017), that family involvement will end up eliminating the organisational differences mentioned above, as well as their impact, allowing more women to take on administrative posts in firms.

The general literature analysed did not show consistent results. Some authors find a negative relationship between female collaborators and firm performance, whereas others claim that success is identical whatever the gender. Yet others conclude on a positive relationship between females in direction and administration and firm performance.

Brush and Hisrich (1991), Loscocco (1991), Fasci and Valdez (1998), Du Rietz and Henrekson (2000), Bird *et al.* (2001) and Olson *et al.* (2003) find that firms with women in their administration present lower performance than those managed by men.

Kalleberg and Leicht (1991), Chaganti and Parasuraman (1997), Watson (2002), Khalife and Chalouhi (2013) and Meroño-Cerdán and López-Nicolás (2017) conclude that companies managed by men have the same chances of success and performance as those managed by women.

Finally, authors such as Fondas (1997), McDowell (1997), Duehr and Bono (2006), Smith *et al.* (2006), Carter *et al.* (2003), Campbell and Mínguez-Vera (2008), Krishnan and Parsons (2008), Adams and Ferreira (2009) and Xing and Gonzalez (2015) observe that diversity of gender in administrative posts gives firms better performance, with those firms presenting more effective management. Similarly, Danes *et al.* (2007) conclude on a significant effect of gender on management practices and profit in family firms.

Following the most recent work on the impact of gender regarding family firm administration, which concludes on female presence in administration improving these firms' performance, as found in Danes *et al.* (2007), Campbell and Mínguez-Vera (2008), Khalife and Chalouhi (2013) and Meroño-Cerdán and López-Nicolás (2017), the first hypothesis is formulated:

> *H1.* The female gender at the management level of the family firm influences its performance.

2.2 Company size

In studies about firm performance, the size effect should be considered. In 1991, Kalleberg and Leicht introduced firm size as a factor influencing performance. Studying micro-firms, Risseeuw (1997) identified a positive relationship between size and performance.

Serrasqueiro and Nunes (2008) concluded that firm size is a fundamental variable in explaining performance.

Some studies concluded that large companies can perform better than small ones, due to their ability to: hire highly skilled managers and workers; invest in innovation; take advantage of scale economies (Hardwick, 1997; Serrasqueiro and Nunes, 2008); implement better organisational learning and structural changes (Dobbs and Hamilton, 2007; Lampadarios *et al.*, 2017); and diversify their activities more, therefore being more able to respond to market changes or risky situations (Fiegenbaum and Karnani, 1991; Winter, 1994; Wyn, 1998; Goddard *et al.*, 2005; Serrasqueiro and Nunes, 2008). These situations make their work more efficient.

Indeed, Serrasqueiro and Nunes (2008) concluded that performance is positively related to size, suggesting the greater relevance of scale effects, diversification and larger companies' greater ability to cope with market changes. Nevertheless, performance increases associated with size become smaller above a certain size (Risseeuw, 1997; Yoon, 2004).

In the case of family firms, Danes *et al.* (2007) studied whether the gender of family business owners moderates the relationship between various business management practices and gross revenue, using the number of employees as a proxy for size, and found a positive and statistically significant impact.

Even accepting the heterogeneity of family firms, and thereby their difference from non-family ones, it seems possible to state that larger size could contribute positively to their performance. For example, this could mean diminishing information asymmetry between owners, managers and creditors, less likelihood of bankruptcy and, finally, with large companies being less able to change their asset composition, a certain level of guarantee is implied.

Based on those arguments, the following hypothesis is formulated:

H2. The size of the family firm positively influences its performance.

2.3 Company age

Hannan and Freeman (1984) and Hannan (1998) concluded that age is an important factor for a firm's strategic options. With the passing of time, the firm acquires knowledge of its operating market and improves its performance. Besides, the oldest firms generally have a greater reputation in the eyes of creditors and clients.

Shane and Venkataraman (2000) and de Carvalho *et al.* (2013), concluded that younger firms have a greater perception of risk than older ones, being able to select highly profitable investment projects and therefore presenting better growth rates.

Lampadarios *et al.* (2017), quoting Orser *et al.* (2000), stated that age presents the same relationship with performance as that mentioned for firm size. Some studies analyse the relationship between age and growth and performance, considering firms' stage in the life-cycle.

In a study aiming to test whether the age and size of family firms had implications for their financing decisions, Serrasqueiro *et al.* (2016) concluded that the applicability of the trade-off and pecking order theories to family firms' financing decisions depended on their age and size.

For example, studying the effect of age on SME growth, Nunes *et al.* (2013) obtained a negative, statistically significant relationship between age and growth in young SMEs, and a negative, but not statistically significant, relationship between age and growth in older ones.

In the same connection, La Rocca *et al.* (2011) argued that firms in the early stages of the life-cycle present higher levels of information asymmetry, greater opportunities for growth and smaller size.

Previously, Anderson and Reeb (2003) observed a negative relationship between founding-family ownership and firm performance in family firms in the S&P500 index.

Based on those arguments, the following hypothesis is formulated:

H3. The age of the family firm negatively influences its performance.

2.4 Company region

Few studies explain how family firms affect regional development (Block and Spiegel, 2013; Bird and Wennberg, 2014; Berlemann and Jahn, 2016), with similarly few being found to study the impact of the region variable on family firm performance (Stough *et al.*, 2015).

The existing literature reveals there is a double causality effect between the region's impact on family firm performance and the impact of family firm performance on regional development (Bird and Wennberg, 2014; Stough *et al.*, 2015; Baù *et al.*, 2017).

Block and Spiegel (2013) concluded that family firms have a positive effect on the level of innovation existing in the region. This positive effect is due to these firms being more oriented to the long term (through their local roots), and being more integrated in the region than non-family firms.

Using three longitudinal, multi-level databases covering all regions, companies and individuals for Sweden between 1991 and 2007, Bird and Wennberg (2014) try to see if the family context and the regional environment shape the objectives, visions and practices that family firms pursue. They conclude that, since family start-ups try to establish durable relationships with their regional communities, they will better overcome the resource scarcity characterizing rural and more economically deprived regions than non-family start-ups. In this way, they also show the family effect of that type of firm.

Using a database of Swedish family and non-family firms, Backman and Palmberg (2015) studied whether the urban or rural location of family and non-family firms would affect their growth. They found that family firms located in rural areas had a higher rate of growth than non-family ones (Stough *et al.*, 2015), thereby obtaining conclusions similar to those of Bird and Wennberg (2014).

Cucculelli and Storai (2015) analysed the relevance of family firms in the Italian economy and discuss how and to what extent family ownership and regional organisation interact to support firm performance. They concluded that family and district effects operate as a substitute in smaller firms, but both effects complement each other in medium-sized firms. They also concluded that medium-sized firms are the only ones to benefit from location (in a district) but only in the case of family ownership.

From the above, there is seen to be a relationship between the region in which the family firm is located and its performance, and so the intention is to control for this effect here, following the indications of Stough *et al.* (2015), among others. This leads to the following hypothesis:

H4. The family firm's region influences its performance.

2.5 Company business sector

Pena-Sanchez (2013) made a study seeking to relate the growth rate of the 500 largest firms in the USA, in 2012, with their sectors of activity. The author described the most competitive business sectors among those firms[1], dividing the economic sectors into: primary: mining, fishing, etc.; secondary: manufacturing; and tertiary: service sector. The majority of firms belonged to the service sector (tertiary sector). The use of the Kruskal test led to the conclusion there was no statistical significance between growth rate and the various sectors of activity.

Khalife and Chalouhi (2013) studied how the firm owner's gender influenced the performance of Lebanese family firms, also considering the owner's human capital and the firm's business characteristics' impacts. Having divided the sample into female-owned and male-owned firms and using the χ^2 test to observe the differences, no statistically significant results were found between performance and family firms' sector of activity.

Nunes *et al.* (2013) studied the influence of age on growth in Portuguese SMEs. In particular, they intended to analyse that effect by dividing firms into high-tech and non-high-tech[2]. Concerning the impact of these two sector sub-groups, the authors obtained a positive and statistically significant relationship between the dummy sector variable and the growth of young and old SMEs in general. Showing that, whatever the firm age, the fact that firms belong to a high-tech sub-sector means higher levels of growth.

From the above, we do not find consistency regarding the impact of this variable, which leads us to the fifth hypothesis aiming to determine what impacts could occur in our sample of family firms:

H5. The family firm business sector influences its performance.

3. Methodology

3.1 Sample

The study data were selected from the Association of Portuguese Family Firms. This association defines family firms as those where there is overlapping of family, firm and ownership, giving them specific characteristics which distinguish them from non-family firms (Villax, 2016). A list of 275 family firm members was obtained from the association, in June 2016.

The database is formed of accounting/financial and governance information about family firms belonging to the Association of Portuguese Family Firms, for the period 2006–2014. The information about each firm was gathered from the AMADEUS database, as supplied by Bureau van Dijk, since it contains economic and financial information on European firms.

The following sample procedure was used: from the initial list of 275 family firms, this was reduced to the 238 with information available on the database. Subsequent sorting led to the exclusion of: firms with only one or two years of observations; firms with missing values in most years of study; and holding companies (SGPS), in order to diminish result bias.

So, the final sample is formed of 199 companies, for the period 2006–2014. However, the database is not balanced because data were not available for all companies for the complete study period.

The sample can be considered viable for the study in question. First, because the Portuguese business sector is mostly made up of family businesses (distributed according to various dimensions); according to Pordata's data, in 2016, the Portuguese business sector was made up of 99.9 per cent of SMEs and 0.1 per cent of large companies, the sample of family firms in the present study is composed of 94.6 per cent of SMEs and 5.3 per cent of large companies, not meeting outside the reality of where they come from. Second, because there is no consensus in the literature about how a family firm should be defined, criteria related to firm management, ownership and/or control have been used; selecting the companies that are members of the Association of Portuguese Family Firms eliminates possible mistakes in the classification of companies as family firms; and, finally, it can be seen that the definition of a family firm used by the Association is identical to that used in the literature, that is, family firms are those where there is overlapping of family, firm and ownership.

3.2 Variables

There is no consensus in the literature regarding what is considered by performance. This variable is taken to be both a measure of success and a measure of profitability.

Aiming to analyse the impact of gender (F/M), in the management position, on the family company's performance, this study uses three variables as the dependent variable: variation in sales, turnover over total assets and variation of turnover.

Used as independent variables are: gender in top management, company size, company age, company's region and company business sector.

The gender variable was constructed as a dummy variable, with the value of 1 when one or more elements of the firm's board of directors are women and 0 when this is only formed of men.

To determine whether there is any relationship between the size of family firms and their performance, the company size variable was elaborated. To define the company size, the European Union's definition was used, according to guideline 2013/34/EU, of 26 June. The size variable was calculated through three variables: the logarithm of total assets, the logarithm of turnover and the number of employees.

Aiming to analyse the sample according to the size of family firms, it was necessary to divide it into micro, small, medium-sized and large firms. Here, dummy variables were constructed to classify firms as micro, small and medium-sized[3], using the value of total assets, turnover and number of employees of the respective firms. The work of Danes *et al.* (2007) and Serrasqueiro and Nunes (2008) were closely followed.

The age variable is used to determine its impact on firm performance. In the literature, some authors use as a proxy for this variable the logarithm of the number of years the firm has been in existence (Khalife and Chalouhi, 2013; Serrasqueiro *et al.*, 2011, 2016), while others use only the number of years of existence (as is the case here).

As for the region variable, the Territorial Nomenclature for statistical purposes (NUTS) was used. NUTS II was selected for this study since it divides Portugal in seven regions (North, Centre, Lisbon Metropolitan Area, Alentejo, Algarve, Autonomous Region of the Azores and Autonomous Region of Madeira). Dummy variables were formed for each of the regions except the Autonomous Region of Madeira, this being the variable presenting always the value of 0. The procedure was very similar to that of authors such as Bird and Wennberg (2014), Backman and Palmberg (2015) and Cucculelli and Storai (2015), among others.

Finally, concerning the company business sector variable, initially, this was divided according to the Portuguese Classification of Economic Activities-Revision 3 (CAE-Rev 3), to subsequently join the codes in six large groups, as in Nunes *et al.* (2013), in order to reduce the number of dummy variables and improve the degrees of freedom. The CAE codes were divided in six dummies: agriculture, forestry and mining (codes A and B of CAE-Rev 3); construction (code F of CAE-Rev 3); Manufacturing (code C of CAE-Rev 3); commerce (code G of CAE-Rev 3); services (codes D, E, H, J, M, N, O, P, Q, R, S and T of CAE-Rev 3); and tourism (code I of CAE-Rev 3). Tourism was the dummy variable excluded from the regression. The procedure followed was similar to that of Nunes *et al.* (2013), Pena-Sanchez (2013) and Khalife and Chalouhi (2013).

Table I summarises the variables to be analysed.

3.3 Method

The literature on company performance reveals there can be relationships between performance in the current and previous years, as well as problems of endogeneity between variables and even effects resulting from the omission of independent variables. Therefore, the use of static panel data models would not be appropriate for this study.

In fact, analysing the literature on the impact of directors' gender on family firm performance, models with instrumental variables have been used, for example, panel data using two-stage least squares (Campbell and Mínguez-Vera, 2008; Anderson and Reeb, 2003; Smith *et al.*, 2006). More recently, Xing and Gonzalez (2015) and Sila *et al.* (2016) used dynamic GMM estimation, due to the possible problem of reverse causality in studying the impact of gender on firm performance.

Variables	Measures	Expected sign
Dependent		
Performance (perf)	Variation of sales (varsales); business volume over total assets (volbusass); and variation of business volume (varvolbus)	
Independents		
Gender (gender)	Dummy variable with the value of 1 if there is at least one female member of the board of directors, and 0 otherwise	+/−
Company size		
Dimen1	Log (turnover)	+
Dimen2	Logarithm of total assets	+
Dimen3	Number of employees	+
Company age (age)	Number of years of firm existence	+/−
Company region		+/−
Dum_{Nort}	Dummy variable with the value of 1 if situated in the North region; and 0 otherwise	
Dum_{Center}	Dummy variable with the value of 1 if situated in the Centre region; and 0 otherwise	
Dum_{Lisbon}	Dummy variable with the value of 1 if situated in the Metropolitan Area of Lisbon; and 0 otherwise	
Dum_{Alent}	Dummy variable with the value of 1 if situated in the Alentejo region; and 0 otherwise	
Dum_{Algar}	Dummy variable with the value of 1 if situated in the Algarve region; and 0 otherwise	
$Dum_{Açores}$	Dummy variable with the value of 1 if situated in the Autonomous Region of the Azores; and 0 otherwise	
$Dum_{Madeira}$	Dummy variable with the value of 0 if situated in the Autonomous Region of Madeira	
Company business sector		
Dum_{Agric}	Dummy variable with the value of 1 if the firm belongs to agriculture; and 0 otherwise	
Dum_{Const}	Dummy variable with the value of 1 if the firm belongs to construction; and 0 otherwise	
$Dum_{Manufat}$	Dummy variable with the value of 1 if the firm belongs to manufacturing; and 0 otherwise	
Dum_{Com}	Dummy variable with the value of 1 if the firm belongs to commerce; and 0 otherwise	
Dum_{Serv}	Dummy variable with the value of 1 if the firm belongs to services; and 0 otherwise	
Dum_{Turis}	Dummy variable with the value of 0 if the firm belongs to tourism	

Table I.
Variable definition

Therefore, this study will use dynamic panel data models, as these are most suitable, given the need to control for: endogeneity, time-invariant characteristics, possible collinearity between independent variables, effects of possible omission of independent variables, elimination of non-observable individual effects, and the correct estimation of the relationship between the dependent variable in the previous and current periods. In particular, we will use the dynamic panel system GMM estimator proposed by Arellano and Bover (1995) and Blundell and Bond (1998). As a system GMM estimator, the model is estimated simultaneously in both levels and first differences. This improves the efficiency of the estimator and the power of hypothesis tests by allowing more instrumental variables to be included in the estimation (Roodman, 2006).

The validity of the estimated parameters obtained using system GMM from 1998, depends on: the restrictions being valid, a result of using the instruments; and the absence of second-order autocorrelation. We run the Sargan–Hansen test to test for identifying

restrictions, so under the null hypothesis, the instruments are valid. The Arellano–Bond test for AR(1) and for AR(2) allows us to test the second condition.

According to Roodman (2006), the system GMM from 1998 general model consists of:

$$y_{it} = \alpha y_{i,t-1} + x_{it}' \beta + \varepsilon_{it}, \tag{1}$$

$$\varepsilon_{it} = \mu_i + v_{it},$$

$$E[\mu_i] = E[v_{it}] = E[\mu_i v_{it}] = 0.$$

Equation (1) can be written as follows:

$$\Delta y_{it} = (\alpha-1)y_{i,t-1} + x_{it}' \beta + \varepsilon_{it}. \tag{2}$$

The general model to study will be as follows:

$$perf_{it} = \beta_1 gender_{it} + \beta_2 size_{it} + \beta_3 age_{it} + \beta_4 region_{it} + \beta_5 sector_{it} + \varepsilon_{it}. \tag{3}$$

4. Results

4.1 Descriptive statistics

The descriptive statistics of the variables used in this study are presented in Table II.

Characterising the sample companies, the Net Result is seen to present an average of €234,690, assets €10,948,630, ROA 25 per cent, sales in the order of €6,825,660, turnover €6,964,120 and number of employees being, on average, 59 per family firm.

	n	Mean	SD
Net Income	1,683	23.469	323.547
Assets	1,683	1,094.863	3,432.803
ROA	1,683	0.250	4.551
Sales	1,683	682.566	1,651.229
VolBuss	1,683	696.412	1,682.826
NumWorkers	1,683	59.436	185.927
Age	1,683	24.733	19.162
Dum_{Gender}	1,683	0.585	0.493
Dum_{Micro}	1,683	0.268	0.443
Dum_{Small}	1,683	0.465	0.498
Dum_{Medium}	1,683	0.213	0.410
Dum_{Large}	1,683	0.053	0.225
Dum_{Nort}	1,683	0.144	0.351
Dum_{Center}	1,683	0.143	0.350
Dum_{Lisbon}	1,683	0.589	0.492
Dum_{Alent}	1,683	0.077	0.267
Dum_{Algar}	1,683	0.021	0.145
$Dum_{Açores}$	1,683	0.011	0.103
$Dum_{Madeira}$	1,683	0.013	0.113
Dum_{Agric}	1,683	0.061	0.239
Dum_{Const}	1,683	0.043	0.202
$Dum_{Manufat}$	1,683	0.223	0.416
Dum_{Com}	1,683	0.257	0.437
Dum_{Serv}	1,683	0.329	0.470
Dum_{Turis}	1,683	0.066	0.248

Table II.
General descriptive statistics

In terms of size, the family firms with greatest weight are small firms, with 46.5 per cent, micro-firms with 26.8 per cent, while medium-sized firms account for 21.3 per cent and large firms only 5.3 per cent. The average age of the companies analysed is 25 years. As for the location of family firms, the sample shows there is an equal number (14.4 per cent) of family firms in the North and Centre regions; 58.9 per cent are located in the metropolitan area of Lisbon; 7.7 per cent in the Alentejo; 2.1 per cent in the Algarve; 1.1 per cent in the autonomous region of the Azores; and 1.3 per cent in the autonomous region of Madeira.

The sectors of activity with the highest percentages in the sample are: manufacturing (22.3 per cent), commerce (25.7 per cent) and services (32.9 per cent). Agriculture and tourism are somewhat distant from the other sectors of activity, with 6.1 and 6.6 per cent, respectively. In 58 per cent of family firms, there is at least one female on the board of directors.

Although the focus of the analysis is the impact of gender, it was interesting to observe the differences between the Portuguese regions with respect to the set of remaining independent variables under analysis, so let us analyse Table III.

Regarding the number of workers, it is observed that family businesses in the regions of Alentejo, Algarve and Madeira have the lower number of employees, followed by the Centre region and metropolitan area of Lisbon, Autonomous Region of the Azores (72 workers) and, finally, the North region (116 employees) having, on average, a greater number of workers.

The youngest companies are located in the autonomous region of Madeira and Alentejo, with an average of 15 years, while the oldest companies are located in the autonomous region of the Azores at the age of 79.

Observing the distribution of the gender variable along the regions of Portugal in the sample, it is verified that the female gender in the direction is not present in any family firm in Azores; in the Algarve region, 25 per cent of family businesses have at least one female member in the company's management; in Lisbon, the gender in the direction of the companies is very similar; in the Alentejo region, 61.5 per cent of the companies have the female gender in the direction of family businesses; the North presents 69.1 per cent; and, in the Centre Region, only 16.5 per cent of family-owned enterprises do not have at least one member of the female company.

Considering the distribution of companies, according to their size and to the regions, in the sample, it can be seen that in the North, there is a very similar distribution of the three dimensions of companies (micro, small and medium), larger companies have an expression of only 18.5 per cent in the North; in the Centre, Lisbon and Alentejo, it is verified that half of the companies are Small companies and there are no Large companies in the Centre and

	North	Centre	Lisbon	Alentejo	Algarve	Azores	Madeira
NumWorkers	116	44	55	23	26	72	31
Age	34	24	22	22	27	79	15
Dummy$_{Gender}$ (%)	69.1	83.5	51.1	61.5	25	0	81.8
Dummy$_{Micro}$ (%)	23.5	9.5	34.4	23.1	0	0	0
Dummy$_{Small}$ (%)	29.6	50.5	46.2	56.2	100	0	100
Dummy$_{Medium}$ (%)	28.4	40	14.9	20.7	0	100	0
Dummy$_{Large}$ (%)	18.5	0	4.5	0	0	0	0
Dummy$_{Agric}$ (%)	0	0	4.6	43.8	25	0	0
Dummy$_{Const}$ (%)	8.8	2.1	5.6	0	0	0	18.2
Dummy$_{Manufat}$ (%)	37.8	47.9	13.5	30	0	0	40.9
Dummy$_{Com}$ (%)	16.8	18.6	24.2	26.2	75	50	40.9
Dummy$_{Serv}$ (%)	36.6	16.9	44.3	0	0	0	0
Dummy$_{Turis}$ (%)	0	14.5	7.8	0	0	50	0

Table III.
Descriptive statistics
by region

Alentejo; and in the Algarve, and in the autonomous region of Madeira, 100 per cent are small companies, and in the autonomous region of the Azores, there are only medium-sized companies.

Regarding the sectors that stand out most in each region, on average, it is observed that in the North, there is a higher concentration in manufacturing (37.8 per cent) and services (36.6 per cent), with 16.8 and 8.8 per cent, we have trade and construction, respectively; in the Centre, as in the North, the manufacturing sector has the highest percentage (47.9 per cent), followed by commerce (14.8 per cent), services (16.9 per cent), tourism (14.5 per cent) and the construction sector (2 per cent); in Lisbon, with 44.3 per cent, we have the services sector, followed by commerce (24.2 per cent) and manufacturing (13.5 per cent), with smaller and similar percentage tourism (7.8 per cent), construction (5.6 per cent) and, finally, agriculture with 4.6 per cent; in Alentejo, as expected, agriculture is dominant (43.8 per cent) followed by manufacturing (30 per cent) and the remaining 26.2 per cent are dedicated to trade; in the Algarve, the sectors are divided equally by trade and tourism; and in Madeira, we have the same percentage (40.9 per cent) in the manufacturing and trade sectors, while construction holds the remaining 18.2 per cent.

Concerning the gender variable, we began by examining how gender diversity in the board of directors has evolved over the time period under analysis and it was observed that the percentage levels remained more or less close to the mean value of the sample, with a maximum of 59 per cent (in 2011) and a minimum of 57.5 per cent (in 2013) of women in management positions.

It was also possible to analyse some other aspects in this descriptive analysis; let us see Tables IV–VI. Table IV shows that males are more predominant in micro-firms and small firms.

Dividing the country into regions, Table V shows that only in family firms in Lisbon and the Algarve do males predominate in company direction. In the other regions, there is a greater percentage of companies with women on the board of directors.

The sample studied shows the gender division, in company direction, in the various sectors of activity. Table VI reveals that in the sectors of agriculture, construction and tourism, although not pronounced, there is a higher percentage of males in the direction of family firms in the sample. The results support the conclusions of Meroño-Cerdán and López-Nicolás (2017), as it is in the services sector where there is the highest percentage of

	Female gender (%)	Male gender (%)
Dum_{Micro}	22.3	33.2
Dum_{Small}	43.9	50.2
Dum_{Medium}	26.5	14.0
Dum_{Large}	7.3	2.5

Table IV.
Distribution of gender by company size

	Female gender (%)	Male gender (%)
Dum_{Nort}	17.1	10.7
Dum_{Center}	20.5	5.7
Dum_{Lisbon}	51.5	69.4
$Dum_{Alentejo}$	8.1	7.1
Dum_{Algar}	0.9	3.8
$Dum_{Açores}$	0.0	2.5
$Dum_{Madeira}$	1.8	0.5

Table V.
Gender distribution by region

women, thus demonstrating the so-called sectoral "gender effect" referred to by Gisbert López *et al.* (2009), Watson *et al.* (2002) and Smith *et al.* (2006).

Table AI shows the correlation matrix. This shows the values presented are under 50 per cent, which indicates that the problem of collinearity of variables will not be relevant[4] (Gujarati and Porter, 2010).

4.2 Analysis and discussion of results

Table AII shows the results of the regressions for the dynamic panel system GMM models, with the *z*-statistics in brackets, the results of the Wald test, the Arellano–Bond test for AR(1) and for AR(2), and the Sargan–Hansen test.

We ran three models for each of the dependent variables (*varsales*, *volbusass*, *varvolbus*), observing that whatever the model the results of the Sargan–Hansen test show that we cannot reject the null hypothesis of the lack of validity of the instruments used. Also, the results of the second-order autocorrelation test indicate that we cannot reject the null hypothesis of absence of second-order autocorrelation. Based on these results, the results can be considered valid and open to interpretation.

The results presented in Table AI show that performance can be measured through the three variables, namely, *varsales*, *volbusass* and *varvolbus*. Of the three, *volbusass* presents the lowest values for the Wald test and therefore fewer variables with statistical significance.

Each variable and its impact are now analysed.

The main variable studied, gender at management level, has a positive impact on family firm performance and is statistically significant at a 1 per cent level of significance. So, *H1* is validated. This result agrees with the findings of Danes *et al.* (2007), Campbell and Mínguez-Vera (2008), Khalife and Chalouhi (2013) and Meroño-Cerdán and López-Nicolás (2017). We can conclude that the presence of women in administration has positive impacts on performance in Portuguese family firms, compared to entirely male presence. The specific characteristics of family firms, particularly the fact of the family being concerned about ensuring its presence over several generations, seems first to create a favourable environment for women rising to administrative posts, and, second, will eliminate possible organisational differences referred to in the literature as being one of the causes of gender differences reported in some studies.

The analysis of gender's impact on family firm performance controlling for the effects of the size, age, region and business sector is in accordance with sustainable family business theory, in that family and business systems are affected by environmental and structural changes.

Using the system GMM estimator as the dynamic panel data model was a convenient way of dealing with the possible problem of reverse causality in studying the impact of gender on firms' performance, which lets us conclude that the results presented in relation to this variable are robust and therefore make a contribution to the specific literature.

To control for the impact of size on family firm performance, three variables (*dim1*, *dim2* and *dim3*) were used. The results reveal a positive sign for all the variables and statistically

	Female gender (%)	Male gender (%)
Dum$_{Agric}$	4.8	7.7
Dum$_{Const}$	3.6	5.1
Dum$_{Manufat}$	26.7	16.0
Dum$_{Com}$	24.6	23.5
Dum$_{Serv}$	35.4	29.5
Dum$_{Turis}$	3.9	10.3

Table VI.
Distribution of gender by business sector

significant at a 1 per cent level of significance (except for model 1 with the dependent variable of *volbusass*, which presents significance at 10 per cent). So, *H2* is validated. The results agree with those of Fiegenbaum and Karnani (1991), Goddard *et al.* (2005), Dobbs and Hamilton (2007), Serrasqueiro and Nunes (2008) and Lampadarios *et al.* (2017) in terms of the literature on firms in general, and with those presented by Danes *et al.* (2007) and Meroño-Cerdán and López-Nicolás (2017) for family firms.

It is therefore possible to conclude that greater size allows family firms to make more efficient use of the resources employed in activities, have greater negotiating power with suppliers, enhance their reputation and therefore have easier access to key resources. These effects are also the result of the lower information asymmetry between owners, managers and creditors generally presented by larger firms, which means less likelihood of bankruptcy and a certain level of guarantee.

The independent variable of age (*age*) presents a negative sign (except in model 2 with the dependent variable of *volbusass*) and is statistically significant at a 1 per cent level of significance. It is possible to validate *H3* and argue that the older the family firm the lower its performance will be. This result is in line with those of Shane and Venkataraman (2000), La Rocca *et al.* (2011) and de Carvalho *et al.* (2013) for firms in general, and those of Anderson and Reeb (2003) for family firms in particular.

Since, in the sample used, the average age of family firms is 25 years, these firms are already at a more advanced stage of their life-cycle. So, the result obtained is in line with the firms' stage in the life-cycle theory, with the immediate aim of these firms not being to achieve high growth rates and performance. Loderer and Waelchli (2010) demonstrate that this negative relationship between age and performance is due to organisational rigidity and assets that have become obsolete. This result leads us to conclude on the importance of family firms making investments to maintain their level of innovation, and also to prevent their assets from becoming obsolete.

Concerning the impact of the region on family firm performance, most of the dummies used are seen to present statistical significance (between 1 and 10 per cent), except for the case of the three models with the dependent variable of *volbusass,* where only the Dum_{Nort} variable presents statistical significance at 10 per cent. The interpretation of these results is not direct in that we are analysing dummy variables, but there seems to be evidence that the region where a family firm is located will affect its performance, with the North and Lisbon emerging with the highest estimated values. This result seems to indicate that family firms located in these two regions will present higher levels of performance (compared to those located in Madeira and the other regions considered). So, there is evidence to validate *H4*.

These results agree with those of Bird and Wennberg (2014), Cucculelli and Storai (2015) and Stough *et al.* (2015), who concluded on family firms' performance being affected by their location.

Finally, regarding the variables that capture the effect of the family firm's business sector, most of the dummy variables are found to present statistical significance, but there is no consistency of the sign for the five types of business sector analysed. We can point to evidence that the family firm's business sector influences its performance, but we cannot say a specific sector has a greater impact on that performance. This type of result agrees with the literature, where no studies were found to present clear results about the impacts of this variable.

5. Conclusions

This study aimed to analyse the impact of gender (F/M), at the management level, on family companies' performance controlling for the effects of company size, age, region and activity sector.

A sample of non-financial family firms belonging to the Association of Portuguese Family Firms in the period 2006–2014 and dynamic panel data models were used.

The empirical results allow the conclusion that gender at the management level, firm size, firm age, firm region and firm business sector are important factors for family firm performance. Therefore, having a female element in family firm management produces positive impacts on performance, compared to firms with only male elements; the greater the size of the family company, the better its performance; as the family firm gets older, its performance will be lower; and the firm's region and sector of activity are factors which influence family firm performance.

The study presents contributions at several levels: literature, practice and policy. At the level of literature, it can be mentioned that there are implications in two dimensions: for family firm research, and for corporate governance research. It makes contributions to the literature on family firms, especially on the effect of gender on family firm performance, and on the effects of family firm size, age, region and business sector on their performance. The results lead us to conclude that the presence of women in the administration has a positive impact on the performance of Portuguese family firms, compared to the single presence of men. In fact, the specific characteristics of family businesses, in particular, the concern to keep the company in the family's possession, provides a favourable environment for more women to reach positions at the level of business administration. As Meroño-Cerdán and López-Nicolás (2017) mentioned, the prevalence of family values, the preservation of socio-emotional wealth and the succession planning make it possible for women to exercise their managerial positions, especially when they are obliged to retire for a while and later they can return to their positions. By using the system GMM as the dynamic panel data model, and given the results obtained for the tests, we can conclude on the greater suitability of this type of model to study the impact of gender at management level on family firm performance. The use of these models allows the appropriate treatment of two of the problems mentioned in the literature on the subject, namely, endogeneity and reverse causality in studying the impact of gender on firm performance. These models also let us capture the effects of dependence in relation to past values of the dependent variable studied – performance – how a family firm's performance evolved in the past will affect the value of its performance today.

Concerning the contributions to the corporate governance research, it was confirmed that board diversity positively influences the performance of companies, and the results demonstrated that the presence of women in administration potentiates the performance of companies. In this way, it also contributes to deepening knowledge about the gender impact on firm's performance in general.

Regarding the practical implications, demonstrating that the presence of women in management has a positive impact on the performance of family businesses confirms the role that family businesses have in minimising the losses related to the "female talent" in the economies (as Meroño-Cerdán and López-Nicolás, 2017 referred). Thus, family businesses should formally recognise the important contribution of women in the management of these firms, and, on the other hand, this result should contribute as a motivation for women to make more efforts to eliminate existing barriers and try to achieve success levels identical to those achieved by men. We can say that family firms should serve as a model for non-family firms leverage the female talent and so the number of women at management levels.

Finally, about policy implications, insofar as this type of firm has a great expression in the global business sector, and Portugal is no exception, with a strong impact on GDP and job creation, it is suggested that governments pay special attention to this type of firm, particularly because it can be seen that family businesses can be vehicles for reducing gender inequality in the management of enterprises. So, the creation of policies directed to family businesses with the adjustment of forms of financing, or even the creation of specific funding sources for family businesses, will enable the expansion of these companies and

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thus the reduction of gender inequality. Also, as stated by Xing and Gonzalez (2015), governments should promote policies oriented to balance female directorship together with female leadership.

This study is not without limitations, which opens up possibilities for future research. The fact of the database being formed of only Portuguese family firms could be pointed out as a limitation, and so it would be interesting to repeat this study with data from other countries. Because we are talking about family businesses, in which the characteristics associated with the family are important, whenever data collection is possible, mixed methods should also be used. Regarding the region variable, it would be interesting to test the impact of a different regional aggregation, for example, considering aspects of an inland or coastal location in the country. This could capture better the different characteristics of regions. Finally, a different aggregation could be considered in relation to the sector of activity to be able to capture specific sector characteristics.

Notes

1. Classifying them according to 25 sectors.

2. They began by dividing the sample in six major groups of activity: agriculture, forestry and mining; construction; manufacturing; commerce; services and tourism; and subsequently created the sub-groups of high-tech and non-high-tech firms.

3. Considered a large firm whenever all the others present a value of 0.

4. The exception lies in the sales and turnover variables, as would be expected, but these two variables are never used simultaneously in the models.

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Appendix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) Net Income	1							
(2) Assets	0.057*	1						
(3) ROA	0.122**	−0.016	1					
(4) Sales	0.291**	0.442**	−0.011	1				
(5) VolBuss	0.294**	0.448**	−0.011	0.999**	1			
(6) NumWorkers	0.082**	0.197**	−0.011	0.403**	0.402**	1		
(7) Age	0.047	0.172**	0.005	0.214**	0.214**	0.121**	1	
(8) Dummy$_{Genero}$	−0.005	0.053*	0.047	0.119**	0.116**	0.003	−0.021	1

Notes: *,**Significant at 1 and 5 per cent, respectively

Table AI.
Correlation matrix

Performance of family-owned firms

	Model 1	Model 2	Model 3	Model 1	Model 2 GMM	Model 3	Model 1	Model 2	Model 3
Dependent variable	Varsales			Volbusass			Varvolbus		
Independent variables									
Gender	151.185***	−37.813	420.981***	0.335	0.986***	0.679***	272.827***	114.183***	445.983***
	(4.74)	(−1.47)	(21.26)	(1.62)	(6.17)	(3.72)	(7.27)	(3.95)	(19.54)
Company size									
Dimen1	2,089.175***			1.172*			2,649.145***		
	(22.58)			(1.76)			(26.12)		
Dimen2		3,519.445***			4.502***			4,307.859***	
		(25.91)			(7.45)			(33.63)	
Dimen3			18.015***			0.015			21.848***
			(27.09)			(1.24)			(37.59)
Age	−11.650***	−34.895***	−6.069***	−0.025***	0.054***	−0.027*	−17.984***	−45.360***	−9.833***
	(−9.21)	(−18.08)	(−7.05)	(−2.68)	(5.69)	(−1.94)	(−12.55)	(−24.29)	(−11.58)
Company region									
Dum$_{Nort}$	1,256.991***	571.032***	159.053*	0.325	1.124*	−0.600	1,306.594***	464.483***	−28.730
	(11.92)	(5.89)	(1.76)	(0.48)	(1.75)	(−0.61)	(10.1)	(4.10)	(−0.28)
Dum$_{Center}$	438.771***	254.212***	129.391	0.384	0.048	0.220	529.096***	288.095***	134.626
	(4.15)	(2.72)	(1.59)	(0.57)	(0.08)	(0.33)	(4.08)	(2.61)	(1.42)
Dum$_{Lisbon}$	1,119.302***	926.761***	248.341***	1.007	0.523	0.390	1,250.705***	995.868***	170.029*
	(10.76)	(10.14)	(3.06)	(1.51)	(0.85)	(0.54)	(9.83)	(9.22)	(1.81)
Dum$_{Alent}$	496.982***	−359.523***	226.028***	0.379	0.931	0.264	591.665***	−472.545***	242.885**
	(4.44)	(−3.58)	(2.62)	(0.53)	(1.39)	(0.37)	(4.32)	(−4.01)	(2.42)
Dum$_{Algar}$	262.150**	−242.990**	79.216	0.021	0.993	−0.157	241.244	−372.216***	24.966
	(2.03)	(−2.08)	(0.79)	(0.03)	(1.27)	(−0.18)	(1.53)	(−2.71)	(0.21)
Dum$_{Açore}$	371.023**	358.532***	113.311	0.902	0.620	0.672	384.4647**	365.921**	65.800
	(2.38)	(2.59)	(0.93)	(0.90)	(0.66)	(0.67)	(2.01)	(2.23)	(0.47)

(*continued*)

Table AII.
Results of the regression models

Table AII.

Dependent variable	Varsales			Volbusass GMM			Varvolbus		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Company business sector									
Dum_{Agric}	389.183***	1,166.458***	154.670***	−0.110	−1.119***	−0.286	410.976***	1,361.995***	126.393**
	(6.04)	(17.98)	(3.04)	(−0.27)	(−2.71)	(−0.64)	(5.20)	(18.49)	(2.15)
Dum_{Const}	231.447***	415.345***	−65.788	1.169**	2.111***	0.813	54.17	305.385***	−273.433***
	(3.3)	(6.93)	(−1.09)	(2.44)	(5.3)	(1.08)	(0.64)	(4.36)	(−4.17)
$Dum_{Manufat}$	−92.542	1,448.624***	−10.109	−0.442	0.491*	−0.783	−492.867***	1,462.232***	−306.551***
	(−1.13)	(37.51)	(−0.16)	(−0.76)	(1.87)	(−0.75)	(−5.32)	(31.98)	(−4.96)
Dum_{Com}	−434.961***	2,184.636***	348.470***	0.789* (1.94)	−0.946**	1.224***	−683.331***	2,561.858***	315.671***
	(−7.49)	(28.27)	(10.36)		(−2.37)	(4.27)	(−10.06)	(32.91)	(8.07)
Dum_{Serv}	211.536***	2,755.082***	−750.965***	0.424	−3.064***	−0.348	233.714***	3,341.626***	−939.964***
	(5.06)	(25.19)	(−16.81)	(1.58)	(−5.84)	(−0.54)	(4.56)	(31.39)	(−20.31)
cons	−4,420.410***	−9,164.144***	−521.588***	−1.835	10.383***	0.416 (0.56)	−5,354.011***	−11,007.28***	−433.975***
	(−23.48)	(−27.63)	(−6.11)	(−1.44)	(6.79)		(−24.93)	(−34.38)	(−4.39)
Wald test	4,576.34***	5,815.95***	7,456.92***	86.82***	150.32***	84.88***	3,483.40***	4,937.38***	6,546.61***
A-B AR(1)	−7.42***	−3.04***	3.06***	−3.43***	−3.24***	−3.16***	−7.52***	−3.12***	3.98***
A-B AR(2)	−1.60	1.100	1.100	0.29	0.32	0.36	−1.45	0.93	1.04
Sargan test	1,038.59***	1,208.74***	1,631.94***	200.04***	167.04***	139.48***	921.47***	993.20***	1,389.24***

Notes: *, **, ***Significant at 10, 5 and 1 per cent, respectively

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