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Financial ratios, credit risk and business strategy: Application to the PDO Parma ham sector in single production and non-single production firms

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ABSTRACT

Food geographical indications (GIs) protected by the European Union collective protection mark (CPM) have been the subject of a growing interest. Several research has analyzed the economic, social and environmental role of CPM, which require Production Specifications (PS), imposing constraints to food production, with side effects on performance and corporate strategy.

The research has the aim to analyze, through financial ratios (FRs), the performance of firms in the PDO Parma ham (PrH_PDO) sector; PrH_PDO is the third geographical indication (GI) in Italy among those protected by CPM of the European Union (PDO, PGI, TSG). The research considers, for firms associated with the PrH_PDO Consortium, a series of 10-year annual report, 739 observations, divided into two groups, first of 103 of 11 firms that sell only PrH_PDO and second of 636 of 78 firms that sell not only PrH_PDO. This categorization allows us to highlight and compare the effects of adopting PS in terms of FRs, credit scoring and firms' strategy.

Research highlights that PrH_PDO_Only firms perform slightly better, with less variable results. Research shows that the PS of Prosciutto di Parma PDO, determines reduction in turnover (T) and a longer duration of the INV_DAYS and, consequently, of the conversion cycle (CCC_DAYS). Research highlights that PrH_PDO_Only firms have a strategy based on higher margins (ROS) which compensates low T; research highlights that credit risk (EM-Score) is higher for PrH_PDO_Only firms.

The research can be replicated in other GI sectors, where there are few studies that have compared firms that produce only GIs and firms that produce not only GIs. The research can be useful to operators in the sector, to financial intermediaries and to policy makers. Lines of applied action may include development of financial instruments to assist maturation period and establishment to assess creditworthiness, tailored to PrH_PDO firms' characteristics.

1. Introduction

In Italy, the food geographical indications products (GIs) play an important role in the agri-food system and, more generally, in the entire socio-economic system of the European Union (EU) countries; in fact, "*Product names can be* granted *a 'geographical indication' (GI) if they have a specific link to the place where they are made. The GI recognition enables consumers to trust and distinguish quality products while also helping producers to market their products better. Products that are under consideration or have been* granted *GI recognition are listed in* geographical indications registers. *The registers also include information on the geographical and production specifications for each product. Recognized as intellectual property, geographical indications play an increasingly important role in* trade negotiations between the EU and other countries" [1]. GIs define an intellectual property rights for food products whose qualities are linked to the production area; GIs comprise: 1) PDO (protected designation of origin); 2) PGI (protected geographical indication); 3) Traditional speciality guaranteed (TSG).

Several research has shown that GI products today play an important role in national income, in the agricultural production and also in the processing and marketing phases [2,3]. In Italy (2021), GIs production value, expressed in euros (€), is 19.1 billion and the export value is 10.7 billion; are surveyed 845 GIs, of which 526 in wine and 319 in food; 291 protection consortia operate in the sector, 113,241 operators in the wine

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sector and 85,601 in the food sector. The weight of GIs is equal to 21% of the total Italian agri-food sector, with a greater concentration in the north-east of Italy, where 10.6 billion in production value of GIs are concentrated, which represent, out of the total agri-food production in regions, respectively 63% in regions Friuli Venezia Giulia, 48% in Veneto, 33% in Trentino Alto Adige and 31% in Emilia-Romagna.

GI products play also an important role on the environment, food safety, animal welfare, land protection and economic, environmental and social sustainability, as demonstrated by several research [4–8]. About this topic, some authors have analyzed the relationship that exists between GI products and tourist attraction potential, highlighting how food and wine tourism has taken on a growing role and has a positive role in the development of local economies [9–11]. Other studies have analyzed consumers' tastes and purchasing behavior regarding GI products [12], examining willingness to pay [13–16] and consumer awareness of sustainable supply chains for GI products [17]. Other authors have embraced the public intervention policies of the European Union, which have supported the multifunctional role of agriculture through interventions in support of GIs for rural development [18]. Statistical data and research confirm the economic, social, and environmental importance of GI products, which are widespread in the territories of the European Union. It is evident that certain GI products significantly impact production territories in terms of turnover, employment, and related activities.

Focusing on the Italian territory, which is the current area of our research, the top two GI products by turnover are cheeses, namely Parmigiano-Reggiano PDO and Grana Padano PDO, with consumer turnovers of 2.756 billion euros and 2.517 billion euros respectively (as of 2021). The third GI product by turnover is Parma PDO Ham (Prosciutto di Parma DOP in Italian), with a consumer turnover of 2.171 billion euros and a production turnover of 650 million euros (as of 2021). Parma PDO Ham (PrH_PDO) also ranks as the third GI product in Italy in terms of export turnover, which amounted to 291 million euros in 2021 [19,20].

The interest of our research focuses on PrH_PDO sector, because the firms that produce it present characteristics of production differentiation and capital intensity which, in our opinion, make this sector interesting in itself and for further developments of the research, also in other food sectors. To understand the attraction of capital from PrH_PDO sector, we can note that, during 2022, 7,845,283 pigs registered in the Italian protected supply chain register ("Registro della Filera Tutelata – RIFT") were slaughtered; of these, 8,487,474 fresh pork legs were proposed for the PDO marking and, of these, 7,705,402 were accepted for PrH_DOP production [21,22]. The certified quantity was 80,230 tons in 2022. PrH_PDO is regulated by the EC Reg. N. 1107 of 12.06.96, EC Reg. No. 102 of 02.04.08, EU Reg. No. 148 of 23.02.10, file number IT/PDO/0117/0067 [23,24]. Production is concentrated in a limited area of the province of Parma, particularly in the municipality of Langhirano and neighboring municipalities. In relation to ownership structures, PrH_DOP sector, historically characterized by the presence of a high number of small-sized, family-run firms, has seen the entry of numerous groups from the meat processing industry, operating at a national level, through the establishment of new firms, even with the construction of industrial plants from ground [25,26] determining a concentration of production in a small area, which takes on district characteristics [27] and this is due to mandatory provisions of Product Specification of PrH_PDO. About this topic, several researches have addressed the effects of the regulation of agri-food GIs, both on the demand side and on the supply side. In fact, GIs impose entry barriers: a) from a regulatory point of view [28–30], b) in terms of skills and competencies, which then form the human capital [31], c) financial capital to cover investment needs [32], d) with the aim of protecting GI productions, for the benefit of producers who follow traditional production patterns in local territories [33,34], e) to improve consumer information improved [35]. In the case of PrH_PDO, some changes to the Production Specification ("Disciplinare di Produzione" in Italian), briefly PS, have an effect on production and the capital necessary for production: a) the maturing period has been increased from 12 to 14 months; the terminology was also specified because *"the term used to refer to the stage of hanging the hams to dry has been changed from stagionatura ['seasoning' or 'ageing'] to maturazione ['maturing'] because stagionatura is actually the term for the entire curing period from when the ham-making process begins. Maturation instead refers to one of the stages of curing; the minimum curing time has been increased from 12 to 14 months"* [36] with the "Publication of an application for approval of an amendment, which is not minor, to a PS pursuant to Article 50 (2) of Regulation (EU) No 1151/2012 of the European Parliament and of the Council on quality schemes for agricultural products and foodstuffs (2022/C 429/08)"; b) PS now provides that the minimum weight of the product goes from 7 to 8.2 kg and the maximum weight to 12.5 kg, the breeding area is extended to Friuli Venezia Giulia, the reduction of salt content from 6.2% to 6% [36]. The PS therefore has the direct effect of imposing constraints on producers to protect consumer information [37–39]; however, there is also an effect on producers: the constraints of the specification can lead to an increase in invested capital or costs for producers and this effect has not been investigated frequently [40,41].

Some authors have examined the influence of GI marks on firms' capacity to penetrate the market at premium prices [42]. Other researchers have focused on managerial competencies and corporate strategies [43], while another group of scholars has analyzed the introduction of innovative financial instruments in fin-tech finance markets [44]. Nevertheless, there is a lack of research investigating the impacts of the constraints imposed by the PS of GI products on company performance and strategic behavior. Regarding this topic, indeed, ham is an interesting area of research. In fact, PrH_PDO imposes a constraint with the specifications: 1) the supply of the raw material, i.e. the fresh pork leg to be processed, which must derive from farms in a delimited territorial area of northern Italian regions; 2) certification by an independent third party of the compliance with the specifications of the pork legs sent for processing; 3) the localization of the transformation of the pork leg into the PrH_PDO finished product is limited to only one part of the province of Parma, where all production phases must be carried out, including maturing and possible slicing. PS determines that transformation process is concentrated in a limited territory; consequently, the capital investments necessary for the construction of the production plants, for the maturing of the fresh pork leg and for the investments in research and sustainability are concentrated in this territory.

The analysis of the sector is also interesting from the point of view of crisis prevention and financial sustainability. Financial market crisis resulting from the speculative bubble of subprime mortgages which, starting from 2008, also in Italy led to a contraction of bank credit [45–47]. Firms in the PrH_PDO sector frequently apply for lines of credit to finance maturing of food product [26,27]; these credit lines were largely reduced by the banks, often requested the return of credit lines or not according further credit expansions, due to the entry into force of the Basel II and subsequently Basel III regulations [48–50]. PrH_PDO sector has been characterized, particularly in the past, by artisan firms in which ownership and control coincide; these firms, often small in size, have higher default rates, worst credit access and, in several cases, present financial and operational difficulties which can lead to a bankruptcy [51–54]. The firms in the sector were the subject of a crisis which led to the closure, also due to liquidation or insolvency procedures, of a large number of firms. In fact, from 2009 to 2022 the firms registered with the Consortium for the Protection of Prosciutto di Parma PDO (PrH_PDO Consortium) decreased from 166 to 140 and there were 13 insolvency proceedings (bankruptcies or preventive agreements) due to business crises. The sector has in fact been affected by fluctuations in the price of the raw material [55–57] and in the market price of the PrH_PDO at retailer stage given that producers are in the majority of the cases price taker, suffering from the bargaining power of the large retailer that is the main distribution channels applied by producers [58–61].

The changes to PS increase the capital needs of firms in the sector for

several reasons: 1) the increase in the duration of maturing determines a greater investment of working capital (WC), to finance the product which is maturing for a longer period, and in fixed asset (FA), to have larger production facilities available for greater volumes of maturing product; 2) the increase in the initial investment due to the purchase of heavier fresh pork legs, at the same purchase cost per kg; 3) the increase in costs relating to production services, including energy, personnel costs, insurance, transport, etc. Which are related to production volumes. The topic of investment in WC is of wide interest to agri-food firms. Several studies have investigated, also for agri-food firms, the relationship between working capital and performance. Some studies have focused on the management of working capital and the effects that this management has on performance [62–66]; several studies have focused on the relationship that exists between the duration of the cash conversion cycle (CCC) and the performance of firms, again in the agri-food sector [67–70].

PrH_PDO remains a product strongly characterized also by the presence of firms brands, in addition to the GI collective mark, with the presence, consequently, of a loyalty strategy to the manufacturer's brand; on this, various studies have investigated the issue of the premium price that consumers are willing to pay [71–74]. About this topic, to understand the strategy of the firms in the PrH_PDO sector, and to introduce the research questions, we have to remember that firms are members of the PrH_PDO Consortium on a voluntary basis and do not have exclusive production constraints; the firms can therefore produce other products in addition to PrH_PDO. In the sector there are therefore two types of firms: 1) firms associated with the PrH_PDO Consortium that produce exclusively PrH_PDO (PrH_PDO_Only firms) and implement a single production strategy; 2) firms associated with the PrH_PDO Consortium that do not produce exclusively PrH_PDO (PrH_PDO_NotOnly firms) and implement a multi-production strategy.

The research aims to verify whether the PrH_PDO's Product Specification has effects on the performance of firms; to achieve this objective, the analysis is carried out by comparing the performance of firms that produce only PrH_PDO, and therefore completely subject to the PrH_PDO Product Specification, with other firms that, even if associated with the PrH_PDO Consortium, have made the choice to operate with a multi-production strategy, therefore producing other products also different from PrH_PDO. Our study aims to examine the impact of the Product Specification of GI products on company performance and credit scoring. To do so, we intend to categorize firms into two groups: those exclusively producing GI marks products and those producing both GI brand products and other items in the PrH_PDO sector. Notably, there is a lack of prior research utilizing this approach for firms engaged in GI products production. Given all this topic, the work aims, specifically, to verify three research questions (RQs).

1. The firms associated with the PrH_PDO Consortium that produce exclusively PrH_PDO (PrH_PDO_Only), observations in n1, have different financial ratios compared with the firms associated with the PrH_PDO Consortium that produce not exclusively PrH_PDO (PrH_PDO_NotOnly), observations in n2; this is research question 1 (RQ1)
2. The risk of granting credit to firms, as perceived by financial intermediaries, and thus access to credit, is different for PrH_PDO_Only (n1) and PrH_PDO_NotOnly firms (n2); this is research question 2 (RQ2)
3. The financial ratios highlight different business strategies between PrH_PDO_Only (n1) and PrH_PDO_NotOnly firms (n2); this is research question 3 (RQ3)

2. Material and methods

To answer the RQ1, in the research financial ratios (FRs) are calculated. FRs have been applied in many research for the analysis of performance in agri-food firms to analyze profitability, capital solidity and financial liquidity [75–80]. Several studies have focused on the application of FRs in the different phases of the company's life cycle [81–83] and the importance of FRs is demonstrated by the existing literature in which FRs are widely applied for insolvency prediction [84–88]. For application purposes, the application of the FRs is used by banks in assessing creditworthiness [89–93] also with reference to the Basel interbank stability agreements [94–97]. The application of FRs has the advantage of allowing comparison between different firms, as several researches have shown for the agro-food system within the same sector [98,99] or between firms that belong to different sectors [100–102]. In our research, we apply specifically FRs to analyze: 1) The financial performance of equity investment is measured by the return on equity (ROE), which calculates the relationship between net income (Π) and equity capital (E) using the formula: ROE = Π: E; 2) The effectiveness of invested capital is gauged through the return on assets (ROA), which is determined by the ratio of EBIT to Total Assets (TA): ROA = EBIT: TA; 3) The computation involves analyzing investments in the net working capital cycle, encompassing receivables from customers, investments in warehouse goods, and debts to suppliers (NWC). When analyzing firms' financial performance and strategy, it's useful to note that the return on equity (ROE) can be broken down as follows:

$$ROE = \left[ROA + (ROA - ROD)\frac{NFP}{E}\right](1 - T_m) \quad (1)$$

In equation (1), ROD is the cost of debt, calculated as the ratio between the interest paid by the firm to the banks (I) and the net financial position (NFP); the ratio NFP and E is called debt equity ratio (DER), while T_m is the income tax rate. The formula of (1) has its origins in the seminal works of Modigliani and Miller [103,104] and has been applied over time by a growing literature, including the agri-food system [105–109]. formula (1) is called the additive formula of ROE or the financial leverage formula [110] and allows us to highlight that: a) a necessary and sufficient condition for having ROE >0 is that ROA > ROD; b) if ROA > ROD then an increase in DER determines an increase in ROE, although this conclusion is true under restrictive conditions, as several authors have highlighted [111–120].

For the analysis of business strategy, the decomposition of ROA is also useful, and it could be expressed as multiplicative formula [121], as follows:

$$ROA = \frac{EBIT}{S} \cdot \frac{S}{TA} = ROS \cdot T \quad (2)$$

In equation (2), the return on sales (ROS) is calculated as the ratio between EBIT and the company's annual sales (S); ROS expresses unit profitability as a percentage of sales. The Turnover ratio (T) is calculated as the ratio between annual sales (S) and the total invested capital (TA). T expresses the turnover of the capital invested in the firm on an annual basis as a result of sales. Equation (2) is applied in the research, because it allows us to isolate the strategy based on high margins on sales (ROS) from the capital turnover strategy (Turnover). About this topic, many researches have highlighted how the business strategy can be analyzed through the multiplicative decomposition of the ROA set out with formula (2) [122,123] even with reference to agri-food firms [124], but there is little research relating to GIs producing firms [26] and it seems that no research has so far been carried out on firms that operate the mono production of GI products, as in the case of our research.

Another methodological issue, useful for answering the research questions, concerns the duration of the working capital cycle; the duration of the working capital cycle could be calculated as follows:

$$NWC(€) = AR(€) + INV(€) - AP(€) \quad (3)$$

$$AR\_DAYS = \frac{AR(€) \cdot 365}{S} \quad (4)$$

$$\text{INV\_DAYS} = \frac{\text{INV}(€)\cdot 365}{\text{S}} \tag{5}$$

$$\text{AP\_DAYS} = \frac{\text{AP}(€)\cdot 365}{\text{S}} \tag{6}$$

$$\text{CCC\_DAYS} = \text{AR\_DAYS} + \text{INV\_DAYS} - \text{AP\_DAYS} \tag{7}$$

Equations (3)–(7) allow us to analyze the working capital cycle. In particular, (3) expresses the value of the investment in net working capital (NWC), as the sum of receivables from customers (AR) and the investment in inventory (INV) minus debts towards suppliers (AP). If NWC >0 the firm has a conservative working capital policy [125]; this expresses that the NWC absorbs capital that must be financed with equity capital (E) or with financial debt (NFP). If NWC <0 the firm uses NWC as a source of financing and applies an aggressive working capital management strategy [126,127]. Both cases have been extensively studied in the agri-food sector [128–132] and there are also some studies for the PrH_PDO sector [26,58]. The duration of the working capital expressed in days is calculated using formulas (4), (5) and (6) which allow us to calculate, respectively, the duration in days of the extension granted to customers (AR_DAYS), the duration in days of the cycle of the warehouse (INV_DAYS) and the duration in days of the extension granted by the suppliers (AP_DAYS). In particular, (5) has relevance in research; in fact, the PrH_PDO Production Specification imposes a minimum maturation of the product today of 14 months and this has a direct effect on the increase in the duration in days of the working capital cycle.

The analysis of FRs is also used to calculate the default risk of firms, which is a fundamental parameter in estimating corporate rating (CR). CRs are methodologies aimed at determining, on the basis of probabilistic methods, the creditworthiness of firms [133–136]. The application of credit scoring has become extensive with interbank agreements called Basel 2 and Basel 3, imposing the need to use rating systems [137–142] also to quantify the price of the money lent, so-called loan pricing [143].

The rating systems are thus aimed not only at estimating the risk of failure (default) of the debtor company, but also at quantifying the loan risk premium, which is reflected in the pricing of the financing operation. To calculate the rating, banks and rating agencies use an information base which is made up of: a) firm balance sheet data, b) information relating to the regularity of financing relationships (so-called performance information), c) sector information, such as sector growth rates, failure rates of firms in the sector, average sector balance sheet data etc., d) qualitative information on management effectiveness [144,145]. In this context, Altman's seminal work [146] originated the application of corporate scoring through the development of the Z-Score model. The Z-Score has undergone various adaptations by Altman himself [147–150] and others [151–155] for application to unlisted firms and for application to firms belonging not to a single sector but different sectors. The revision of the model gave rise to the EM-Score [156] which has the following formulation:

$$\text{EM} - \text{Score} = 6.56(\text{X}_1) + 3.26(\text{X}_2) + 6.72(\text{X}_3) + 1.04(\text{X}_4) + 3.25 \tag{8}$$

In equation (8), X_1 is the ratio between NWC and TA, X_2 is the ratio between E and TA, X_3 is the ratio between EBIT and TA, X_4 is the ratio between E and total liabilities (TL); for the analysis of the EM-Score and its application in the evaluations, a scale of equivalence between EM-Score values and debt quality is used; EM-Score values above 3.75 indicate investment grade ratings (B- and higher rating classes) while values equal to or lower than 3.75 indicate non-investment grade ratings (CCC+ and lower rating classes); EM-Score values less than or equal to 1.75 indicate a firm with a high risk of default (class D of the equivalence scale). EM-Score has some advantages: 1) EM-Score is a widely known test, used for many years by scholars and in practice; 2) EM-Score has been widely tested and considered reliable, in particular for risk analysis in small and medium-sized enterprises (SMEs), not listed on the financial markets. For these reasons, we apply EM-Score to answer RQ2.

Given these premises on the method, we now expose the research plan that we set up and followed to carry out the research to answer the RQs.

1. The database on the website of the PrH_PDO Consortium was made available free of charge for research purpose, which lists all the associated firms updated as of 31 December 2022 [157]. The firm name and VAT number were extracted for these firms. Firms which, during the 2013/2021 observation period, were no longer affiliated with the PrH_PDO Consortium, including 13 insolvency proceedings, are not considered. 140 firms were extracted, of which 31 were individual firms or partnerships and, therefore, the balance sheet is not available.
2. The database was therefore reduced to 109 firms; of these firms, 8 firms appear to have not submitted their annual report to the business register or, in any case, the data for these firms is not available, not even for one financial year. As a result, the database was reduced to 101 firms.
3. A database of 101 firms was therefore extracted, over an annual report historical series of 10 years (from 2013 to 2021 inclusive) for a total of 840 observations (each annual report is an observation).
4. The database has been further reduced to only firms classified SMEs according to Commission Recommendation 2003/361. The database was then reduced to 89 firms with 739 observations, because 12 firms with 101 observations were excluded.
5. Through research conducted in the field, we attempted to divide the firms in the sample into two groups, the first made up of firms that produce and sell Parma PDO PrH_PDO_Only ham and the second made up of firms that sell other products in addition to ham of Parma PDO PrH_PDO_NotOnly. To partition the observations between the two groups, we followed these steps: a) during the setting up the research plan, we conducted 5 interviews with producers to ask which operators in the sector produce only Parma PDO Ham; b) we subsequently conducted two rounds of interviews with three opinion leaders: one entrepreneur from the sector, one trader within the sector, and one university professor, totaling six meetings; c) we analyzed explanatory notes and management reports to shareholders, both of which are included in the firms' annual reports. This analysis was conducted for all firms included in the research. The examined documents provide valuable insights into whether the company exclusively produces Parma PDO Ham or also manufactures other products. After carrying out these analyses, we composed the two groups of observations, formed as follows: 1) PrH_PDO_Only group made up of 11 firms for 103 observations, that we call n1 group; 2) PrH_PDO_NotOnly group made up of 78 firms for 636 observations, that we call n2 group.
6. All data were extracted from AIDA from database, available for research purposes free of charge by University of Parma. All data used for research are therefore public and research is replicable. Data analysis was performed with: a) MS Excel™; b) IBM™ SPSS Statistics, release 29.

The research plan must take into account that: a) the classification of firms is unable to divide the belonging of firms to business group of firms; b) the classification of firms is unable to divide firms into managerial firms or family firms, for example according to the definition given by Daspit et al. [158].

3. Results

The first research question (RQ1) of the research is to establish whether the firms associated with the PrH_PDO Consortium that produce exclusively PrH_PDO (PrH_PDO_Only) have different financial ratios compared with the firms associated with the PrH_PDO Consortium that produce not exclusively PrH_PDO (PrH_PDO_NotOnly). To answer

RQ1, FRs discussed in the material and methods section, Formulas (1)to (7), were calculated for each observation. The observations were divided into two clusters, i.e. observations related to PrH_PDO_Only firms (n1) and PrH_PDO_NotOnly firms (n2).

To address the research questions (RQs), it is essential to first determine whether the distribution shape of financial ratios (FRs) deviates from normality. To assess this, the Shapiro-Wilk W-test was conducted to evaluate the null hypothesis of a normal distribution of observations. The results (Table 1) indicate that only INV_DAYS and CCC_DAYS, among the FRs, exhibit a normal distribution in the n1 sample (consisting of 103 observations for PrH_PDO_Only firms). For the other FRs, the W-test rejects the null hypothesis of normality, including all FRs calculated for the n2 sample (comprising 636 observations for PrH_PDO_NotOnly firms), as shown in Table 2. Consequently, answering the RQs requires employing a non-parametric approach that does not assume the FRs' distribution to follow normal distribution.

To answer RQ1, we first develop the data analysis for the FRs that measure the economic performance of firms, which are indicated in equation (1). The FRs which expresses the return on equity capital (ROE), which expresses the annual return on the shareholders' equity capital, has a higher average value in PrH_PDO_Only firms (3.40% versus −1.82%) while the median value is similar in the two groups (2.79% versus 2.66%). The standard deviation in the sample is much higher in PrH_PDO_NotOnly observations as well as g1 and g2. For the frequency distribution see appendix I, figure A (frequency) and figure B (cumulative frequency). As regards the operating return on capital, ROA has a slightly higher average value in PrH_PDO_Only firms (2.92% versus 2.67%) confirmed for the median values (2.82% versus 2.37%); standard deviation is much higher in PrH_PDO_NotOnly as well as g1 and. For the frequency distribution see appendix I, figure C and figure D. To evaluate the convenience of financial borrowing and, therefore, the use of financial leverage, data highlights that ROD has a higher average value in PrH_PDO_Only firms (2.59% versus 1.09%) while the median has the opposite case (1.30% versus 1.93%). Also for ROD, as for ROE and ROA, a more concentrated frequency distribution is confirmed in the case of firms, which highlight negative g1. The Debt-to-Equity Ratio (DER) is a FR that reflects the proportion of financial debt in relation to equity, serving as an indicator of the utilization of financial leverage, as shown in equation (1). DER has a higher average value in PrH_PDO_NotOnly firms (161.90% versus 99.42%) while the median highlights the opposite case (96.16% versus 84.65%). The standard deviation in the sample is much higher in PrH_PDO_NotOnly observations as well as g1 and g2. The combined analysis of ROS and T enables us to glean insights into firms' strategies. Specifically, firms with high ROS typically adopt a strategy focused on generating high operating margins on sales, whereas those with high T tend to emphasize efficient capital turnover. The two strategies can be interpreted using the formula presented in equation (2). Data highlights that ROS is higher in the observations relating to PrH_PDO_Only firms (average 4.78% and median 4.89%) compared to PrH_PDO_NotOnly firms (average 1.95% and median 3.43%). The variability is lower in the observations of PrH_PDO_Only. T also has different results between the groups of observations, in fact T is lower in the observations relating to the PrH_PDO_Only firms compared to the PrH_PDO_NotOnly firms. Also for T, the variability is lower in the observations of PrH_PDO_Only firms; for the frequency distribution for ROS and T, respectively see appendix I, figures G and I (frequency) and figures H and J (cumulative frequency). This finding appears to validate the research hypothesis suggesting that n1 firms exhibit higher capital intensity, resulting in lower turnover of T. Additionally, these firms exhibit similarity in their management cycle duration strategy, contributing to reduced variability of T.

The analysis of the FRs AR_DAYS, INV_DAYS and AP_DAYS is carried out jointly; in fact, these ratios are related on the basis of the 4, 5 and 6 formulas. These FRs express the duration of NWC and are therefore central to the research. In fact, the minimum maturing duration of Parma PDO Ham, as mandated by the PS, has direct impact on FRs. Data highlights that the duration of payments from customers and suppliers is similar in the groups of firms, even if the average values of PrH_PDO_NotOnly are much higher. The average length of the inventory cycle is longer in observations relating to PrH_PDO_Only firms compared to PrH_PDO_NotOnly firms (average value of INV_DAYS 380.13 versus 250.95 and median value INV_DAYS 373.06 versus 229.99). Consequently, calculating on the basis of formula (7) we have that the average duration of the working capital cycle (CCC_DAYS) is greater in the observations relating to PrH_PDO_Only firms compared to PrH_PDO_NotOnly firms.

The research also analyzed the values of different FRs, dividing the observations of the two groups (n1 and 2) into two further sub-groups, discriminating membership of one or the other group according to whether FRs takes on a value strictly greater than zero (>0) or less than zero (≤0); for Turnover (T), we discriminate values strictly greater than 1 (>1) and values less than 1 (≤1); in fact, by convention, firms with turnover "<1" are judged to be capital intensive; for INV_DAYS we strictly discriminate values greater than 360 (>360) and values less than 360 (≤360). The value is aligned with the minimum duration of maturation, which is mandatory require by the PrH_DOP's PS (12 months), conventionally expressed as 360 days for the future, the minimum duration has increased to 14 months.

The observations highlight (Table 3 and Table 4) that ROE values for PrH_PDO_Only firms are higher than those observed for PrH_PDO_NotOnly firms (84.47% observations >0 compared to 77.83% observations >0).

In terms of ROA, PrH_PDO_Only firms exhibit higher results compared to PrH_PDO_NotOnly firms, with 88.35% of observations >0 for the former versus 83.33% for the latter. Similarly, for the difference between ROA and ROD, PrH_PDO_Only firms outperform PrH_PDO_NotOnly firms, with 66.02% of observations >0 compared to 52.04%. Conversely, for T, PrH_PDO_Only firms show lower results than PrH_PDO_NotOnly firms, with 4.85% of observations >1 versus 17.30%. Regarding ROS, PrH_PDO_Only firms demonstrate higher results than

Table 1
Descriptive Statistics FRs - n1 = 103 (PrH_PDO_Only firms).

Financial Ratio ID	Mean	Median	St. Dev. Sample	Skewness (g1)	Kurtosis (g2)	Shapiro-Wilk Test
ROE - return on equity	3.40%	2.79%	4.92%	0.32	1.96	W-Stat = 0.9487 p. value 0.0006*** alfa = 0.0500 - Not-Normal
ROA - return on asset	2.92%	2.82%	2.66%	0.72	1.29	W-Stat = 0.9625 p. value 0.0051** alfa = 0.0500 - Not-Normal
ROD - return on debts	2.59%	1.30%	17.56%	8.28	82.77	W-Stat = 0.1906 p. value 0.0000*** alfa = 0.0500 - Not-Normal
DER - debt equity ratio	99.42%	84.65%	97.20%	0.97	0.59	W-Stat = 0.9044 p. value 0.0000*** alfa = 0.0500 - Not-Normal
ROS – return on sales	4.78%	4.89%	4.69%	0.56	2.78	W-Stat = 0.9605 p. value 0.0036** alfa = 0.0500 - Not-Normal
T - Turnover	0.60	0.59	0.19	1.24	2.62	W-Stat = 0.9119 p. value 0.0004*** alfa = 0.0500 - Not-Normal
AR_DAYS	99.43	96.73	27.28	0.60	0.47	W-Stat = 0.9745 p. value 0.0438* alfa = 0.0500 – Not-Normal
INV_DAYS	380.13	373.06	86.80	0.47	0.93	W-Stat = 0.9783 p. value 0.0885 alfa = 0.0500 – Normal
AP_DAYS	74.04	67.03	28.43	1.80	5.85	W-Stat = 0.8662 p. value 0.0000*** alfa = 0.0500 – Not-Normal
CCC_DAYS	405.52	403.34	112.02	(−)0.16	0.48	W-Stat = 0.9893 p. value 0.5846 alfa = 0.0500 – Normal

***The relation is significant at the 0.001 level (2-tailed). ** The relation is significant at the 0.01 level (2-tailed). * The relation is significant at the 0.05 level (2-tailed).

Table 2
Descriptive Statistics FRs - n2 = 636 (PrH_PDO_NotOnly firms).

Financial Ratio ID	Mean	Median	St. Dev. Sample	Skewness (g1)	Kurtosis (g2)	Shapiro-Wilk Test
ROE - return on equity	(−)1.82%	2.66%	89.79%	(−)14.35	238.28	W-Stat = 0.1385 p. value 0.0000*** alfa = 0.0500 - Not-Normal
ROA - return on asset	2.67%	2.37%	6.10%	(−)1.16	14.91	W-Stat = 0.7068 p. value 0.0000*** alfa = 0.0500 - Not-Normal
ROD - return on debts	1.09%	1.93%	35.89%	(−)22.91	560.54	W-Stat = 0.0714 p. value 0.0000*** alfa = 0.0500 - Not-Normal
DER - debt equity ratio	161.90%	96.16%	244.39%	3.01	13.74	W-Stat = 0.0173 p. value 0.0000*** alfa = 0.0500 - Not-Normal
ROS – return on sales	1.95%	3.43%	27.30%	(−)15.44	309.67	W-Stat = 0.2638 p. value 0.0000*** alfa = 0.0500 - Not-Normal
T - Turnover	0.70	0.64	0.37	1.24	1.99	W-Stat = 0.0660 p. value 0.0000*** alfa = 0.0500 - Not-Normal
AR_DAYS	143.42	97.54	248.26	10.36	151.59	W-Stat = 0.2647 p. value 0.0000*** alfa = 0.0500 - Not-Normal
INV_DAYS	250.95	229.99	359.49	17.69	393.66	W-Stat = 0.3137 p. value 0.0000*** alfa = 0.0500 - Not-Normal
AP_DAYS	162.18	93.42	294.47	6.41	52.15	W-Stat = 0.3497 p. value 0.0000*** alfa = 0.0500 - Not-Normal
CCC_DAYS	232.19	225.42	452.75	13.30	297.80	W-Stat = 0.3137 p. value 0.0000*** alfa = 0.0500 - Not-Normal

***The relation is significant at the 0.001 level (2-tailed). ** The relation is significant at the 0.01 level (2-tailed). * The relation is significant at the 0.05 level (2-tailed.

Table 3
FRs: analysis by classes of values - PrH_PDO_Only firms (11 firms, 103 observations).

Financial Ratio ID	>0 (n.) For T, T > 1 (n.) For INV_DAYS, INV_DAYS >360 (n.)	≤0 (n.) For T, T ≤ 1 (n.) For INV_DAYS, INV_DAYS ≤360 (n.)	>0 (%) For T, T > 1 (%) For INV_DAYS, INV_DAYS >360 (%)	≤0 (%) For T, T ≤ 1 (%) For INV_DAYS, INV_DAYS ≤360 (%)
ROE - return on equity	87	16	84.47%	15.53%
ROA - return on asset	91	12	88.35%	11.65%
ROA – ROD	68	35	66.02%	33.98%
T – Turnover	5	98	4.85%	95.15%
ROS – return on sales	91	12	88.35%	11.65%
INV_DAYS	59	44	57.28%	42.72%
CCC_DAYS	103	0	100.00%	0.00%

Table 4
FRs: analysis by classes of values - PrH_PDO_NotOnly firms (78 firms, 636 observations).

Financial Ratio ID	>0 (n.) For T, T > 1 (n.) For INV_DAYS, INV_DAYS >360 (n.)	≤0 (n.) For T, T ≤ 1 (n.) For INV_DAYS, INV_DAYS ≤360 (n.)	>0 (%) For T, T > 1 (%) For INV_DAYS, INV_DAYS >360 (%)	≤0 (%) For T, T ≤ 1 (%) For INV_DAYS, INV_DAYS ≤360 (%)
ROE - return on equity	495	141	77.83%	22.17%
ROA - return on asset	530	106	83.33%	16.67%
ROA – ROD	331	305	52.04%	47.96%
T – Turnover	110	526	17.30%	82,70%
ROS – return on sales	530	106	83.33%	16.67%
INV_DAYS	148	488	23.27%	76.73%
CCC_DAYS	590	46	92.77%	7.23%

PrH_PDO_NotOnly firms, with 88.35% of observations >0 versus 83.33%. These findings indicate that PrH_PDO_Only firms are effectively utilizing their assets to generate higher returns. This suggests that their strategic focus on product quality and adherence to standards translates into improved profitability, as reflected in their higher return on Sales (ROS). This finding can be interpreted as a positive signal for investors, highlighting the potential for sustainable returns and long-term value creation within these firms. However, the lower values of T suggest that PrH_PDO_Only firms may face challenges in efficiently managing their working capital and converting sales into cash.

In terms of the duration of the inventory cycle expressed in days (INV_DAYS), PrH_PDO_Only firms show higher results compared to PrH_PDO_NotOnly firms, with 57.28% of observations >360 for the former versus 23.27% for the latter. Similarly, for the duration of the monetary conversion cycle expressed in days (CCC_DAYS), PrH_PDO_Only firms exhibit higher results than PrH_PDO_NotOnly firms, with 100.00% of observations >0 compared to 92.77%. The high proportion of PrH_PDO_Only firms with inventory cycles exceeding 360 days implies longer inventory holding periods, possibly due to longer maturing requirements or strategic inventory management for quality maintenance. While this ties up capital and raises storage costs, it demonstrates a commitment to PS. These firms also take longer to convert inventory into cash, likely due to the extended maturing process for PrH_PDO products. This emphasizes the need for financial planning to balance quality standards with liquidity needs.

To evaluate whether the FRs observations are statistically significantly different, to answer RQ1, further analysis calculations were performed. For each FRs for n1 and n2, as calculated in Tables 3 and 4, the contingency tables have been calculated (see appendix, Tables 1.1–1.7); it was then verified whether the results observed for n1 and n2 are different from the expected values and, consequently, the difference between FRs in the two samples is statistically significant. To answer this question, the odds ratio (OR) and the chi-square (χ^2) test were calculated (Table 5). ROE and ROA ratios do not present statistically significant differences between n1 and n2, with "0″ value as the discriminating value. This allows us to conclude that, according to this first calculation, the income performances of the firms n1 and n2 are not different from each other; χ^2 test confirms that the differences are not statistically significant; (ROA-ROD) ratio presents statistically significant differences between n1 and n2, considering the "0″ value as the discriminating value. OR is 1.7902 and expresses the greater probability that (ROA - ROD) > 0 in the observations of n1 compared to n2. The data is of great interest because it highlights that n1 firms are more likely to be able to use financial leverage to cover their investments; χ^2 test

Table 5
FRs comparisons: Odds Ratio (OR) Test & χ^2 - Test
n1 = 103 (PrH_PDO_Only firms) & n2 = 636 (PrH_PDO_NotOnly firms).

Financial Ratio ID	Odds Ratio (OR) Test	χ^2 - Test
ROE – return on asset	SE = 0.3250 OR = 1.5489 Min 95% CI = 0.8803 Max 95% CI = 2.7252 Z-Stat. = 1.5177 p-value. = 0.1295 sig. = no	χ^2 = 2.3330 p-value = 0.1267 x-crit. = 3.8415 sig. = no
ROA - return on asset	SE = 0.2883 OR = 1.5167 Min 95% CI = 0.8021 Max 95% CI = 2.8679 Z-Stat. = 1.2815 p-value. = 0.2004 sig. = no	χ^2 = 1.6623 p-value = 0.1973 x-crit. = 3.8415 sig. = no
ROA - ROD	SE = 0.2227 OR = 1.7902 Min 95% CI = 1.1571 Max 95% CI = 2.7698 Z-Stat. = 2.6154 p-value. = 0.0091** sig. = yes	χ^2 = 6.6967 p-value = 0.0083** x-crit. = 3.8415 sig. = yes
T - Turnover	SE = 0.4703 OR = 0.2240 Min 95% CI = 0.0971 Max 95% CI = 0.6133 Z-Stat. = −2.995 p-value. = 0.0027** sig. = yes	χ^2 = 10.4420 p-value = 0.0012** x-crit. = 3.8415 sig. = yes
ROS – return on sales	SE = 0.2883 OR = 1.5167 Min 95% CI = 0.8021 Max 95% CI = 2.8679 Z-Stat. = 1.2815 p-value. = 0.2004 sig. = no	χ^2 = 1.6623 p-value = 0.1973 x-crit. = 3.8415 sig. = no
INV_DAYS	SE = 0.2202 OR = 4.4214 Min 95% CI = 2.8716 Max 95% CI = 6.8075 Z-Stat. = 6.7509 p-value. = 0.0000*** sig. = yes	χ^2 = 50.8509 p-value = 0.0000*** x-crit. = 3.8415 sig. = yes
CCC_DAYS	SE = 1.4259 OR = 15.9831 Min 95% CI = 0.9770 Max 95% CI = 261.4629 Z-Stat. = 2.0399 p-value. = 0.0417* sig. = yes	χ^2 = 6.8442 p-value = 0.0089** x-crit. = 3.8415 sig. = yes

For contingency Table see appendix 1.
***The relation is significant at the 0.001 level (2-tailed). ** The relation is significant at the 0.01 level (2-tailed). * The relation is significant at the 0.05 level (2-tailed).
SE is Standard Error; CI is Confidence Interval; OR is odds ratio; Z-Stat. = LN(OR)/SE; p-value with Distr-T.

confirms that the difference is statistically significant.

T presents statistically significant differences between n1 and n2, considering the "1″ value as the discriminating value. OR is 0.2240 and expresses the lower probability that T > 1 in the observations of n1 compared to n2. The data is of great interest because it highlights that n1 firms they have lower capital turnover; this aspect is subsequently explored in depth with the analysis of INV_DAYS and CCC_DAYS; χ^2 test confirms that the difference is statistically significant.

ROS ratios do not present statistically significant differences between n1 and n2 considering the "zero" value as the discriminating value; there is a trend difference in ROS between groups n1 and n2, but this is not statistically significant (OR is 1.5167, p-value 0.2004); χ^2 test confirms that the differences are not statistically significant (p-value 0.1973); it is necessary to observe that, discriminating for values greater or less than "zero", the ROS result is equal to the ROA result by definition.

INV_DAYS presents statistically significant differences between n1 and n2, considering the "360″ value as the discriminating value. OR is 4.4214 and expresses the higher probability that INV_DAYS >360 in the observations of n1 compared to n2; χ^2 test confirms that the difference is statistically significant; the result highlights the longer duration of INV_DAYS in n1 firms (PrH_PDO_Only) and, therefore, the effect of the PS in increasing the duration of the inventory stock in days. CCC_DAYS presents statistically significant differences between n1 and n2, considering the "0″ value as the discriminating value. OR is 15.9831 and confirms, as expressed by INV_DAYS calculation, the greater duration of CCC in the observations of n1 compared to n2; χ^2 test confirms that the difference is statistically significant.

To complete the analyzes, with the aim of answering RQ1, it is necessary to check whether there are statistically significant differences between the medians of n1 and n2, for any given FRs considered significant in the research. For this analysis we used the Mann-Whitney U-statistic, which allows us to test the null hypothesis that the observed values of the FRs in n1 and n2 come from the same statistical universe. In case of rejection of the null hypothesis, it can be concluded that the FRs observed in the two samples n1 and n2 come from two different statistical universes, at a level of significance given by the p-value.

The calculations (Table 6) of the U-statistics allow us to conclude that ROE and ROA are not statistically different in n1 and n2 (comparisons 1 and 2). Instead, the calculation of the U-statistic for (ROA-ROD) and T, comparisons 3 and 4, allows us to conclude that these FRs are statistically different in n1 and n2, with p-values of 0.323 and 0.268 respectively (two-tailed significance 0.05). For the calculation of ROS, it is interesting to note that the U-statistic, comparison 5, does not allow us to conclude that there is a statistically significant difference between the two samples, n1 and n2, but only a trend significance, with p-value 0.0716 (two-tailed statistics). Finally, comparisons 6 and 7 concern INV_DAYS and CCC_DAYS respectively; the U-statistic allows us to conclude that these FRs are different from each other in n1 and n2, with a significance level of 0.001 (two-tailed statistics). All the results of the calculations in Table 6 confirm the results of the odds ratio calculations and the χ^2 – Test of Table 5.

To answer research question RQ2, the results of the EM-Score scoring ratio are now exposed. This ratio was calculated for all the observations and two groups as before described: 1) first group, n1, of 103 observations, formed by the observations of PrH_PDO_Only firms; 2) second group, n2, of 636 observations, formed by the observations of PrH_PDO_NotOnly firms.

Table 6
FRs comparisons: Mann-Whitney U-statistic
n1 = 103 (PrH_PDO_Only firms) & n2 = 636 (PrH_PDO_NotOnly firms).

Comparisons n1 = 103 (PrH_PDO_Only firms) n2 = 636 (PrH_PDO_NotOnly firms)	U Mann-Whitney	Z-score	p-norm	p-exact
Comp. 1: ROE_n1 & ROE_n2	32,442	0.1550	0.8768	0.8770
Comp. 2: ROA_n1 & ROA_n2	31,061	0.8420	0.3997	0.4003
Comp. 3: (ROA-ROD)_n1 & (ROA-ROD)_n2	28,456	2.138	0.0325*	0.0323*
Comp. 4: T_n1 & T_n2	28,307	2.212	0.0269*	0.0268*
Comp. 5: ROS_n1 & ROS_n2	29,134	1.800	0.0717	0.0716
Comp. 6: INV_DAYS_n1 & INV_DAYS _n2	14,227	9.2177	0.0000***	0.0000***
Comp. 7: CCC_DAYS_n1 & CCC_DAYS _n2	13,696	9.4818	0.0000***	0.0000***

***The relation is significant at the 0.001 level (2-tailed). ** The relation is significant at the 0.01 level (2-tailed). * The relation is significant at the 0.05 level (2-tailed).

Table 7
EM-Score Class of values
n1 = 103 (PrH_PDO_Only firms) & n2 = 636 (PrH_PDO_NotOnly firms).

Class of EM-Score	n1 = 103 (PrH_PDO_Only firms)			n2 = 636 (PrH_PDO_NotOnly firms)		
	(n. observ.)	(% observ.)	(%cumul. observ.)	(n. observ.)	(% observ.)	(%cumul. observ.)
D EM < 1.75	0	0.00%	0.00%	9	1.42%	1.42%
CCC- (1.75 ≤ EM < 2.50)	0	0.00%	0.00%	2	0.31%	1.73%
CCC (2.50 ≤ EM < 3.20)	0	0.00%	0.00%	14	2.20%	3.93%
CCC+ (3.20 ≤ EM < 3.75)	0	0.00%	0.00%	14	2.20%	6.13%
B- (3.75 ≤ EM < 4.15)	0	0.00%	0.00%	15	2.36%	8.49%
B (4.15 ≤ EM < 4.50)	0	0.00%	0.00%	8	1.26%	9.75%
B+ (4.50 ≤ EM < 4.75)	0	0.00%	0.00%	9	1.42%	11.16%
BBB+ (6.25 ≤ EM < 6.40)	0	0.00%	0.00%	14	2.20%	13.36%
BB- (4.75 ≤ EM < 4.95)	0	0.00%	0.00%	22	3.46%	16.82%
BB (4.95 ≤ EM < 5.25)	1	0.97%	0.97%	29	4.56%	21.38%
BB+ (5.25 ≤ EM < 5.65)	0	0.00%	0.97%	15	2.36%	23.74%
BBB- (5.65 ≤ EM < 5.85)	2	1.94%	2.91%	41	6.45%	30.19%
BBB (5.85 ≤ EM < 6.25)	0	0.00%	2.91%	13	2.04%	32.23%
A- (6.40 ≤ EM < 6.65)	1	0.97%	3.88%	21	3.30%	35.53%
A (6.65 ≤ EM < 6.85)	4	3.88%	7.77%	21	3.30%	38.84%
A+ (6.85 ≤ EM < 7.00)	4	3.88%	11.65%	22	3.46%	42.30%
AA- (7.00 ≤ EM < 7.30)	3	2.91%	14.56%	47	7.39%	49.69%
AA (7.30 ≤ EM < 7.60)	8	7.77%	22.33%	29	4.56%	54.25%
AA+ (7.60 ≤ EM < 8.15)	19	18.45%	40.78%	70	11.01%	65.25%
AAA (EM ≥ 8.15)	61	59.22%	100.00%	221	34.75%	100.00%

The data relating to the EM-Score highlight (Table 7), in the two groups of firms (PrH_PDO_Only and PrH_PDO_NotOnly) that.

1. There are no observations of firms belonging to the PrH_PDO_Only, n1 group, in the first 4 worst EM-Score classes, D to CCC+, characterized by higher risk, non-investment grade. Data highlights 39 observations of firms belonging to the PrH_PDO_NotOnly, n2 group, in the first 4 worst EM-Score classes, D to CCC+, characterized by higher risk, non-investment grade.
2. The data highlights that all 103 observations of firms belonging to the PrH_PDO_Only group, n1, are in the investment grade classes (EM-Score classes from B- to AAA) of which, 61 observations (59.22% of the sample) belong to the best Score AAA of the EM class, characterized by a lower risk; for group n2 (PrH_PDO_NotOnly firms), the data highlights that 597 observations of firms belonging to the PrH_PDO_NotOnly group, n2, are classified in the investment grade classes (EM-Score classes from B- to AAA) of which, 221 observations (34.75 % of the sample) belong to the best AAA score in the EM class.
3. The comparison between the frequency distribution of the two groups of firms shows that PrH_PDO_Only firms have better EM-Score results compared to PrH_PDO_NotOnly.

To carry out further analyzes on creditworthiness it is necessary, firstly, to calculate Shapiro-Wilk W-statistic, to test the null hypothesis of normality of the distribution of the EM-Score in n1 and n2 samples (Table 8). Sample n1, which includes 103 observations of PrH_PDO_Only firms, has a W-stat value of 0.0761, with p-value 0.0000; the result is significant, 0.001 level (2-tailed), and allows us to reject the null hypothesis of normal distribution. Sample n2, which includes 636 observations of PrH_PDO_NotOnly firms, has a W-stat value of 0.0248, with p-value 0.0000; the result is significant, 0.001 level (2-tailed), and allows us to reject the null hypothesis of normal distribution. For both samples of observations, the EM-Score therefore has a non-normal distribution, as already observed for the FRs. Non-parametric statistics tests are then applied for further calculation insights.

To evaluate whether the EM-Score observations are statistically significantly different, to answer RQ2, further analysis calculations were performed (Table 9), calculation detail are in contingency table (Tables 1.8 and in appendix). In our case, the cut-off value is 3.75, which distinguishes lower EM-Score classes (non-investment grade observations) from higher EM-Score classes (investment grade observations). In other words, observations with an EM-Score below the threshold of 3.75 represent investments with a low (risky) creditworthiness grade, indicating default risk. The opposite is true for observations with an EM-Score above the threshold of 3.75.

We calculate, on the basis of data of Table 9, odds ratio (OR) and the chi-square (χ^2) test for EM-Score (Table 10) discriminating for investment and non-investment grade. EM-Score presents statistically significant differences between n1 and n2. OR is 0.0750 and expresses the lower probability that EM-Score <3.75 in the observations of n1 compared to n2; χ^2 test confirms that the difference is statistically significant with a p-value of 0.0115.

Even for RQ3, we apply the Mann-Whitney U-statistic which allows us to test the null hypothesis that the observed values of the EM-Score in n1 and n2 come from the same statistical universe (Table 11). In case of rejection of the null hypothesis, it can be concluded that the EM-Score observed in the two samples, n1 and n2, come from two different statistical universes, at a level of significance given by the p-value. The calculations (Table 10) of the U-statistics allow us to conclude that EM-Score are statistically different in n1 and n2 (comparisons 8 of our research), with p-values of 0.000 (two-tailed significance 0.001). This result of the calculations confirms the result of the odds ratio calculations and the χ^2 – Test of Table 5.

At this point of the analysis, it could be useful to analyze the contribution of each variable in the EM-Score formula (8) to capture the determinants that influence the score of the observations in both groups. Using these findings, we aim to improve the answer to RQ3. Table 12 summarizes the descriptive statistics results for the EM-Score variables for the observations of n1. The distribution of all EM-Score variables in n1 group, calculated according to the Shapiro-Wilk statistics, differs from the normal distribution. It emerges that the greatest contribution to raising the EM-Score value is due to X1, which is (NWC: TA) • 6.56 (median value 3.8631); this finding is relevant because, as indicated in equations (3) and (7), an increase in INV_DAYS determines an increase in NWC. Therefore, data highlights that an increase in the duration of the maturing cycle, imposed by the PS, has the effect of increasing the EM-Score.

The detail of the values of the EM-score variables for n2 are shown in Table 13. As observed for n1, the distribution of all EM-Score variables in the n2 group, as assessed by the Shapiro-Wilk statistics, deviates from normal distribution. Data highlights that the greatest contribution to raising the EM-Score in n2 sample is due to X_4, which is (E: TL) • 1.05 (median value 3.8631).

Table 8
Descriptive Statistics EM-Score
n1 = 103 (PrH_PDO_Only firms) & n2 = 636 (PrH_PDO_NotOnly firms).

EM-Score	Mean	Median	St. Dev. Sample	Skewness (g1)	Kurtosis (g2)	Shapiro-Wilk Test
EM-Score n1 = 103 (PrH_PDO_Only firms)	309.18	8.46	2980.19	10.15	102.99	W-Stat = 0.0761 p. value 0.0000*** alfa = 0.0500 - Not-Normal
EM-Score n2 = 636 (PrH_PDO_NotOnly firms)	1434.10	6.88	7990.81	24.87	624.04	W-Stat = 0.0248 p. value 0.0000*** alfa = 0.0500 - Not-Normal

***The relation is significant at the 0.001 level (2-tailed). ** The relation is significant at the 0.01 level (2-tailed). * The relation is significant at the 0.05 level (2-tailed).

Table 9
EM-Score: analysis by classes of values (Non-investment grade & Investment grade)
n1 = 103 (PrH_PDO_Only firms) & n2 = 636 (PrH_PDO_NotOnly firms.

EM-Score	Non-investment grade EM-Score <3.75 (n.)	Investment grade EM-Score ≥3.75 (n.)	Non-investment grade EM-Score <3.75 (%)	Investment grade EM-Score ≥3.75 (%)
EM-Score n1 = 103 (PrH_PDO_Only firms)	0(1)	103	0.00%	100.00%
EM-Score n2 = 636 (PrH_PDO_NotOnly firms)	39	597	6.13%	93.87%

(1) For calculation in contingency table, value approximated at 0.5.

Table 10
EM-Score comparisons: Odds Ratio (OR) Test & χ^2 - Test
n1 = 103 (PrH_PDO_Only firms) & n2 = 636 (PrH_PDO_NotOnly firms).

Financial Ratio ID	Odds Ratio (OR) Test	χ^2 - Test
EM-Score	SE = 1.4273 OR = 0.0750 Min 95% CI = 0.0046 Max 95% CI = 1.2308 Z-Stat. = 3.460 p-value. = 0.0005*** sig. = yes	χ^2 = 6.3852 p-value = 0.0115* x-crit. = 3.8415 sig. = yes

For contingency Table see appendix.
***The relation is significant at the 0.001 level (2-tailed). ** The relation is significant at the 0.01 level (2-tailed). * The relation is significant at the 0.05 level (2-tailed).
SE is Standard Error; CI is Confidence Interval; OR is odds ratio; Z-Stat. = LN (OR)/SE; p-value with Distr-T.

Table 11
EM-Score comparisons: Mann-Whitney U-statistic
n1 = 103 (PrH_PDO_Only firms) & n2 = 636 (PrH_PDO_NotOnly firms).

Comparisons n1 = 103 (PrH_PDO_Only firms) n2 = 636 (PrH_PDO_NotOnly firms)	U Mann-Whitney	Z-score	p-norm	p-exact
Comp. 8: EM-Score_n1 & EM-Score _n2	21,256	5.7205	0.0000***	0.0000***

***The relation is significant at the 0.001 level (2-tailed). ** The relation is significant at the 0.01 level (2-tailed). * The relation is significant at the 0.05 level (2-tailed).

Even for RQ3, we apply the Mann-Whitney U-statistic to the EM-score variables (Table 14); it is a comparison between unpaired samples, n1 and n2 respectively, which has the objective of verifying the equality of the medians for each EM-Score variable. The calculation involves 4 comparisons, one for each variable (comparisons from 9 to 12). Only for the case of comparison 9, which concerns the variable X_1•6.56, the null hypothesis with p-values of 0.000 (two-tailed significance 0.001) is rejected. We can observe that the difference observed in the median values of X_1•6.56 (3.8631 for n1 and 0.4817 for n1), is statistically significant, with value in n1 higher than value in n2. Data highlights trend differences for X_3•6.72 and X_4•1.05 but these are not statistically significant (p-value 0.1456 and 0.0866 respectively). This finding is particularly noteworthy as it underscores that the variance in EM-Scores between n1 and n2 is primarily attributed to a singular significant difference in variable value (X_1•6.56).

4. Discussion

Before delving into the discussion, we would briefly first summarize the main topics of the research to provide context. The research examines all firms affiliated with the PrH_PDO Consortium. It's worth noting that the ham production specification mandates a minimum maturation duration of 12 months, recently increased to 14 months, resulting in heightened investments in both fixed and working capital. Consequently, the production specification has tangible effects on investment decisions. The research utilizes data from all firms associated with the PrH_PDO Consortium. PrH_PDO_Only firms (sample n1) have strategically opted to exclusively produce PrH_PDO, meaning that the constraints of the Production Specification (PS) significantly influence their production, and overall business strategies. On the other hand, PrH_PDO_NotOnly firms, (sample n2) have chosen to diversify their

Table 12
Descriptive Statistics EM-Score variable - n1 = 103 (PrH_PDO_Only firms).

EM-Score variables	Mean	Median	St. Dev. Sample	Skewness (g1)	Kurtosis (g2)	Shapiro-Wilk Test
X_1 = (NWC: TA) • 6.56	3.7792	3.8631	0.9149	−0.6146	1.0935	W-Stat = 0.9580 p. value 0.0026** alfa = 0.0500 - Not-Normal
X_2 = (E: TA) • 3.26	0.0502	0.0395	0.0679	0.9380	1.6527	W-Stat = 0.9419 p. value 0.0002*** alfa = 0.0500 - Not-Normal
X_3 = (EBIT: TA) • 6.72	0.1963	0.1892	0.1787	0.7165	1.2907	W-Stat = 0.9630 p. value 0.0060** alfa = 0.0500 - Not-Normal
X_4 = (E: TL) • 1.05	301.9002	1.0500	2980.3121	10.1482	102.9905	W-Stat = 0.0760 p. value 0.0000*** alfa = 0.0500 - Not-Normal

***The relation is significant at the 0.001 level (2-tailed). ** The relation is significant at the 0.01 level (2-tailed). * The relation is significant at the 0.05 level (2-tailed).

Table 13
Descriptive Statistics EM-Score variable – n2 = 636 (PrH_PDO_NotOnly firms).

EM-Score variables	Mean	Median	St. Dev. Sample	Skewness (g1)	Kurtosis (g2)	Shapiro-Wilk Test
X_1 = (NWC: TA) • 6.56	0.9243	0.4817	1.8048	−0.7755	0.4917	W-Stat = 0.9501 p. value 0.0000*** alfa = 0.0500 - Not-Normal
X_2 = (E: TA) • 3.26	0.0579	0.0393	0.1937	−3.4900	40.9253	W-Stat = 0.6557 p. value 0.0000*** alfa = 0.0500 - Not-Normal
X_3 = (EBIT: TA) • 6.72	0.2098	0.1661	0.4100	−1.1645	14.9081	W-Stat = 0.8062 p. value 0.0000*** alfa = 0.0500 - Not-Normal
X_4 = (E: TL) • 1.05	1429.6522	1.5941	7990.8083	24.8734	624.0397	W-Stat = 0.0248 p. value 0.0000*** alfa = 0.0500 - Not-Normal

***The relation is significant at the 0.001 level (2-tailed). ** The relation is significant at the 0.01 level (2-tailed). * The relation is significant at the 0.05 level (2-tailed).

Table 14
EM-Score variables comparisons: Mann-Whitney U-statistic
n1 = 103 (PrH_PDO_Only firms) & n2 = 636 (PrH_PDO_NotOnly firms).

Comparisons n1 = 103 (PrH_PDO_Only firms) n2 = 636 (PrH_PDO_NotOnly firms)	U Mann-Whitney	Z-score	p-norm	p-exact
Comp. 9: X_1 • 6.56_n1 & X_1 • 6.56_n2	15,568	8.5505	0.0000***	0.0000***
Comp. 10: X_2 • 3.26_n1 & X_2 • 3.26_n2	30,999	0.8729	0.3827	0.3832
Comp. 11: X_3 • 6.72_n1 & X_3 • 6.72_n2	29,827	1.4560	0.1454	0.1456
Comp. 9: X_4 • 1.05_n1 & X_3 • 1.05_n2	29,309	1.7144	0.0865	0.0866

***The relation is significant at the 0.001 level (2-tailed). ** The relation is significant at the 0.01 level (2-tailed). * The relation is significant at the 0.05 level (2-tailed).

production by manufacturing various food products, also different than PrH_PDO. It's important to note that other delicatessen products, such as non-PDO hams and other cured meats, often have shorter maturation periods than PrH_PDO. This diversification allows firms to potentially reduce inventory turnover and minimize investments in maturation facilities.

First, we would like to discuss the results to answer RQ1, to analyze whether firms associated with the PrH_PDO Consortium that produce exclusively PrH_PDO (PrH_PDO_Onl36y), included in n1, have different FRs compared to firms that produce not exclusively PrH_PDO (PrH_PDO_NotOnly), included in n2. The research data firstly confirms various studies on the subject, which highlight that the distribution of FRs is not symmetrical, and differs from the normal distribution. This property has been the subject of study in some now classic works [159,160], and has also had recent developments which have confirmed that the majority of FRs present a distribution different from the normal one in the samples observed [161–164] also in the context of food firms [165–167]. Contrary to the trend, some isolated research indicate that FRs are normally distributed [168], however calculated on small samples.

Regarding RQ1, it is interesting to interpret the result in terms of signaling theory. This approach, due to Spence's seminal work [169,170], has also been widely used in the analysis of company performance [171–174] including in the food sector [175–177]; for the purposes of our research, the signal is the return on capital, expressed by the two main FRs (ROA and ROE). If these signals give a positive result, information asymmetry is reduced and firms are able to attract investments, in terms of equity and in terms of financial debt; in our case, if ROE and ROA have a value that market operators think is adequate for investors' expectations, in terms of risk, firms are able to attract investments. The results of the research highlight that the two main overall profitability ratios (ROE and ROA) are similar in the two groups of firms, and this emerges in particular in the median values. We can therefore state that, in the Parma PDO Ham sector, there are no significant differences in performance, valuated with ROA and ROA, between firms that only produce PDO Parma Ham (PrH_PDO_Only firms, group n1) and firms that have chosen to also produce other products (PrH_PDO_NotOnly firms, group n2). ROA and ROE could be useful signals to express firms' ability to attract investment in the sector, confirming the results of other research [178–180], also in the food sector [181–184]. The application of the production specification therefore has no effect on these ratios, and this allows a first answer to RQ1. However, other FRs need to be considered. However, the method of generating profitability is different, and this is evident from the analysis of the ROS and T ratios which are used to break down the ROA according to formula (2).

Slightly higher result in terms of ROE of the PrH_PDO_Only firms is confirmed by also analyzing the difference between ROA and ROD. Data highlight, for both groups of firms (n1 and n2) that cost of financial debt has too high interest rates, and therefore it is not a possible financing option, for a portion significant number of firms. This finding is interesting because it expresses that the firms operating in PrH_PDO sector, in general, even if they have income FRs (ROA and ROE) which express a signal of capital attraction, are not able to express a sufficient return to cover the cost of debt. This consideration is important, also in perspective, given the higher cost of financial debt today compared to the past [185,186]. Further research on this topic can be carried out comparing the performance in the sector being analyzed, considering the level of risk and the size of the company [187,188]. However, given the average size of the firms, which are only SMEs, it is difficult to generalize a comparison between the return on capital of the firms included in the research and average market returns.

As is known, several studies have analyzed the capital rotation strategy in terms or Turnover to increase performance, while other research has studied the margin generation strategy, in terms of ROS, to achieve higher performance [189–191]. The evidence of the data therefore confirms that PrH_PDO_Only firms have a lower capital turnover (T) compared to PrH_PDO_NotOnly firms; the greater turnover of the capital of the PrH_PDO_NotOnly firms is due to the fact that these firms produce other cured meats compared to PDO Parma ham alone which have shorter maturing times which is imposed by the Parma ham consortium with the specification, which is binding for all producers. This result is statistically significant and allows us to observe that PrH_PDO_Only firms implement a business strategy based on the generation of margins on sales (ROS) which allows them to compensate for the disadvantage given by the low T.

As observed (Tables 1 and 2) firms in the PrH_PDO_Only firms group have a higher duration of INV_DAYS and CCC_DAYS than PrH_PDO_NotOnly firms. In terms of duration, the research confirms the rule imposed by the Consortiums' Production Specification; in fact, all the observations of the PrH_PDO_Only firms have a duration of CCC_DAYS >0, in contrast to the PrH_PDO_NotOnly firms. For PrH_PDO_NotOnly firms it is therefore rational to try to reduce the capital turnover cycle (CCC_DAYS), because a significant portion of the observations show that an increase in debt to increase investments would generate a reduction in the return for shareholders (ROE).

This topic is particularly relevant, and widely studied in literature;

several authors have highlighted that working capital management (WCM) has a greater impact on SMEs' performance than in larger firms, and the causes are to be found in the insufficient amount of liquidity, worse access to credit and high cash flow volatility that often characterize SMEs [192]. Other authors have studied the relationship that exists between WCM and profitability; many studies have highlighted that the increase in the duration of the WCM cycle, expressed in CCC_DAYS or INV_DAYS, is negatively correlated with profitability, even in the case of food firms [193–196].

These considerations on FRs open to RQ2, i.e. whether the credit risk perceived by financial intermediaries and, consequently, the ease of access to credit, are different between PrH_PDO_Only firms (sample n1) and PrH_PDO_NotOnly firms. As we explained in the methodology, we chose the EM-Score as the expressive index of credit scoring. This choice already requires evaluation, in fact, many other indices are widely used and some authors have highlighted the lack of univocally in identifying optimal credit scoring [197]. Furthermore, other authors have highlighted the difficulty of identifying credit scoring for SMEs, due to the presence of information asymmetries and external control deficiencies [198]. Many interesting studies have systematically reviewed the most recent developments in credit scoring, which introduce the calculation of neural networks, artificial intelligence, elements of behavioral finance for the purpose of predicting default risk [199]. Since the topic is constantly evolving, the choice of the EM-Score was made in order to use a widely known credit scoring. Other authors have produced equally well-known credit scoring ratios [200] and, moreover, at least the larger banks have each developed their own creditworthiness system, which is constantly updated. The choice of the EM-Score has the aim of approximating the point of view of financial intermediaries, without claiming to replace it with an approach aimed at the replicability of the results and the dissemination results to operators. The research has results that also emerge on the topic of financial risk. PrH_PDO_Only firms have a positioning in lower risk classes, investment grade for the totality of observations. The difference between groups n1 and n2, in terms of EM-Score, was significant and sample n1 was perceived as less risky than n2. Precisely on this point the results are significant. In fact, the production specification requires an increase in maturing, and this determines an increase in INV_DAYS and consequently in CCC_DAYS. The resulting increase in NWC duration, as we have explained in the literature analysis, is associated with a reduction in profitability. In the case of the EM-Score, we have demonstrated that the variable between groups, improving the scoring of n1 observations accordingly. We can therefore state that, if other research has highlighted that the relationship between NWC and profitability was inverse, our research highlights that an increase in NWC improves the scoring of firms, in particular those of n1. The fact is of great interest, because PS of Parma PDO Ham requires a mandatory increase in the duration of NWC. A further important aspect that emerges from the research concerns the aspects of managing the duration of working capital; PrH_PDO_Only firms have a high duration of CCC_DAYS due to the constraint of the PS, fixing a minimum required maturing today of 14 months. In the discussion, as a premise, it should be pointed out that, among the PrH_PDO_Only firms, there are no case that market, except to a minimal extent, PrH_PDO produced by other firms. During the interviews with the opinion leaders it emerged that firms PrH_PDO_Only firms base their strategy on the firm brand and, therefore, for customer loyalty they have chosen to implement the strategy of selling, exclusively or almost exclusively, products of their own production.

This result allows us to answer the third research question (RQ3), i.e. whether FRs highlight different business strategies between PrH_PDO_Only and PrH_PDO_NotOnly Firms.

About this topic, it is to consider that single production, implemented by PrH_PDO_Only involves a market risk [201] which derives from the dependence of the company's performance on the appreciation of the single production on the market. About this topic, several research has highlighted that the company that specializes in a single production can improve its ability to produce better quality products with greater production efficiency [202]. Other research has shown that firms operating in the agricultural and agri-food sector are able to achieve lower unit production costs. This effect could be considered qualified as intangible capital within the firm and due to the greater specialization of workers as other authors have illustrated [203–206].

PrH_PDO_Only firms (n1 sample) have much more similar performances to each other, and this highlights that the single production direction appears to determine the performance of the firms. On the contrary, for PrH_PDO_NotOnly firms (n2 sample), which are not tied to a single production, it emerges that there is a much higher variability in FRs, particularly for ROE, DER and the duration of INV_DAYS and CCC_DAYS; these firms, by not adopting a single production marketing strategy, can choose the preferable production mix and therefore vary the strategy much more than PrH_PDO_NotOnly firms, and therefore they can expand their strategic options, with consequent advantages on the market, which various studies have also shown for the food sector [207–210].

5. Conclusion and recommendations

The research presents, among the first research in this field, a comparison of performances between firms producing GIs as a single production (PrH_PDO_Only firms), and firms producing GIs associated with other productions (PrH_PDO_NotOnly firms). The research reaches some conclusions.

1. The observations for two groups of firms, PrH_PDO_Only (n1) and PrH_PDO_NotOnly (n2), indicate that median values of ROA and ROE are not statistically different. However, there is greater asymmetry and significantly different kurtosis in the distribution of observations in n2 compared to n1. PrH_PDO_Only firms show relatively similar results within the group, while PrH_PDO_NotOnly firms exhibit greater variability due to potentially different product strategies. Furthermore, PrH_PDO_Only firms have a significantly lower capital turnover (T) because of the longer working capital cycle imposed by the PS. The research highlights that the mandatory PS rules for Parma PDO Ham lead to increased duration of the inventory cycle (INV_DAYS) and financial conversion cycle (CCC_DAYS), which is statistically significant and reflected in the calculated FRs for groups n1 and n2. These findings provide insights to address RQ1.
2. EM-Score ratio shows lower risk in PrH_PDO_Only observations (n1) compared to PrH_PDO_NotOnly (n2). Research indicates that firms in group n1, exclusively producing PrH_PDO, do not experience negative effects on the EM-Score. The observations lead to the conclusion that the increase in the duration of the inventory cycle, mandated by the PrH_PDO production specifications, significantly contributes to higher EM-Score values in n1 firms, addressing RQ2.
3. PrH_PDO_Only firms pursue a high-margin strategy (ROS) to compensate for low capital turnover (T), resulting in similar results across these firms. In contrast, PrH_PDO_NotOnly firms exhibit significant variability in ROS, with many adopting a strategy of reduced ROS compensated by increased T. This shift is achieved by modifying the production mix to include cold cuts products with shorter maturation durations, deviating from a standalone PrH_PDO strategy. Only for production of PrH_PDO is mandatory the application of PS. In fact, the interest of the PrH_PDO Consortium is not to limit the strategic action of firms, but to guarantee compliance with the PS, thus focusing its attention and scope of intervention to a product-side approach. This findings address RQ3.

When presenting the results, it is essential to acknowledge any limitations of the research: 1) Some internal firm data, regarding the detailed breakdown of sales between different products and the length of the maturing period, for each product, were not utilized due to their confidential nature; 2) Firms operating as individual entities, or

partnerships, were excluded from the sample, due to their non-compulsory filing of annual reports and the confidential nature of their fiscal data.

Research results can be useful for operators in the PrH_PDO, producer organizations and policy makers, who may have information relating to the effects of the application of the PS on the performance of firms and the resulting strategies. Furthermore, this research holds practical relevance for stakeholders in the PrH_PDO sector, including producer organizations, policymakers, and financial intermediaries. They can benefit from insights into the financing risks faced by firms in the sector, aiding in the evaluation of whether the current credit scoring methods accurately assess credit risk. The research findings suggest potential applications such as creating financial instruments to support the maturation period of PrH_PDO, customizing credit evaluation criteria for banks, sharing results with sector operators, and providing firms with tools to assess benefits of extending product maturation.

Ethics approval and consent to participate

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CRediT authorship contribution statement

Mattia Iotti: Writing – original draft, Validation, Supervision, Methodology, Formal analysis, Data curation, Conceptualization. **Giovanni Ferri:** Writing – original draft, Data curation, Conceptualization. **Federica Bonazzi:** Writing – original draft, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Acknowledgments

Not applicable.

Appendix 1

Table in Appendix 1.1
Contingency Table ROE >0

ROE - return on equity – Observed values	ROE >0	ROE ≤0	Total observations
n1 = 103 (PrH_PDO_Only firms)	87	16	103
n2 = 636 (PrH_PDO_NotOnly firms)	495	141	636
Total observations	582	157	739
ROE - return on equity – Expected values	ROE >0	ROE ≤ 0	Total observations
n1 = 103 (PrH_PDO_Only firms)	81	22	103
n2 = 636 (PrH_PDO_NotOnly firms)	501	135	636
Total observations	582	157	739
ROE - return on equity – Expected values	ROE >0	ROE ≤ 0	Total observations
Differences (observed/expected)	6	−6	0
Differences (observed/expected)	−6	6	0

Table in Appendix 1.2
Contingency Table ROA >0

ROA - return on asset – Observed values	ROA >0	ROA ≤0	Total observations
n1 = 103 (PrH_PDO_Only firms)	91	12	103
n2 = 636 (PrH_PDO_NotOnly firms)	530	106	636
Total observations	621	118	739
ROA - return on asset – Expected values	ROA >0	ROA ≤ 0	Total observations
n1 = 103 (PrH_PDO_Only firms)	87	16	103
n2 = 636 (PrH_PDO_NotOnly firms)	534	102	636
Total observations	621	118	739
ROA - return on asset – Expected values	ROA >0	ROA ≤ 0	Total observations
Differences (observed/expected)	4	−4	0
Differences (observed/expected)	−4	4	0

Table in Appendix 1.3
Contingency Table (ROA-ROD) > 0

(ROA – ROD) - Observed values	(ROA-ROD) > 0	(ROA-ROD ≤0	Total observations
n1 = 103 (PrH_PDO_Only firms)	91	12	103
n2 = 636 (PrH_PDO_NotOnly firms)	530	106	636
Total observations	399	340	739
(ROA – ROD) – Expected values	ROA >0	ROA ≤0	Total observations

(*continued on next page*)

Table in Appendix 1.3 (*continued*)

(ROA – ROD) - Observed values	(ROA-ROD) > 0	(ROA-ROD ≤0	Total observations
n1 = 103 (PrH_PDO_Only firms)	56	47	103
n2 = 636 (PrH_PDO_NotOnly firms)	343	293	636
Total observations	399	340	739
(ROA – ROD) – Expected values	ROA >0	ROA ≤0	Total observations
Differences (observed/expected)	12	−12	0
Differences (observed/expected)	−12	12	0

Table in Appendix 1.4
Contingency Table Turnover (T) > 1

T - Turnover – Observed values	T > 1	T ≤ 1	Total observations
n1 = 103 (PrH_PDO_Only firms)	5	98	103
n2 = 636 (PrH_PDO_NotOnly firms)	110	526	636
Total observations	115	624	739
T - Turnover – Expected values	T > 1	T ≤ 1	Total observations
n1 = 103 (PrH_PDO_Only firms)	16	87	103
n2 = 636 (PrH_PDO_NotOnly firms)	99	537	636
Total observations	115	624	739
T - Turnover – Expected values	T > 1	T ≤ 1	Total observations
Differences (observed/expected)	11	−11	0
Differences (observed/expected)	−11	11	0

Table in Appendix 1.5
Contingency Table ROS >0

ROS - return on sales – Observed values	ROS >0	ROS ≤0	Total observations
n1 = 103 (PrH_PDO_Only firms)	91	12	103
n2 = 636 (PrH_PDO_NotOnly firms)	530	106	636
Total observations	621	118	739
ROS - return on sales – Expected values	ROS >0	ROS ≤0	Total observations
n1 = 103 (PrH_PDO_Only firms)	87	16	103
n2 = 636 (PrH_PDO_NotOnly firms)	534	102	636
Total observations	621	118	739
ROS - return on sales – Expected values	ROS >0	ROS ≤0	Total observations
Differences (observed/expected)	4	−4	0
Differences (observed/expected)	−4	4	0

Table in Appendix 1.6
Contingency Table INV_DAYS >360

INV_DAYS – Observed values	INV_DAYS >365	INV_DAYS ≤365	Total observations
n1 = 103 (PrH_PDO_Only firms)	59	44	103
n2 = 636 (PrH_PDO_NotOnly firms)	148	488	636
Total observations	207	532	739
INV_DAYS – Expected values	INV_DAYS >365	INV_DAYS ≤365	Total observations
n1 = 103 (PrH_PDO_Only firms)	29	74	103
n2 = 636 (PrH_PDO_NotOnly firms)	178	458	636
Total observations	207	532	739
INV_DAYS – Expected values	INV_DAYS >365	INV_DAYS ≤365	Total observations
Differences (observed/expected)	30	−30	0
Differences (observed/expected)	−30	30	0

Table in Appendix 1.7
Contingency Table CCC_DAYS >360

CCC_DAYS – Observed values	CCC_DAYS >0	CCC_DAYS ≤0	Total observations
n1 = 103 (PrH_PDO_Only firms)	103	0[(1)]	103
n2 = 636 (PrH_PDO_NotOnly firms)	590	46	636
Total observations	693	46	739
CCC_DAYS – Expected values	CCC_DAYS >0	CCC_DAYS ≤0	Total observations
n1 = 103 (PrH_PDO_Only firms)	97	6	103
n2 = 636 (PrH_PDO_NotOnly firms)	596	40	636

(*continued on next page*)

Table in Appendix 1.7 (*continued*)

CCC_DAYS – Observed values	CCC_DAYS >0	CCC_DAYS ≤0	Total observations
Total observations	693	46	739
CCC_DAYS – Expected values	CCC_DAYS >0	CCC_DAYS ≤0	Total observations
Differences (observed/expected)	6	−6	0
Differences (observed/expected)	−6	6	0

(1) For calculation in contingency table, value approximated at 0.5.

Table in Appendix 1.8
Contingency Table EM-Score (Non-investment grade & Investment grade)
n1 = 103 (PrH_PDO_Only firms) & n2 = 636 (PrH_PDO_NotOnly firms

EM-Score – Observed values	EM-Score <3.75	EM-Score ≥3.75	Total observations
n1 = 103 (PrH_PDO_Only firms)	0	103	103
n2 = 636 (PrH_PDO_NotOnly firms)	39	597	636
Total observations	39	700	739
EM-Score – Expected values	EM-Score <3.75	EM-Score ≥3.75	Total observations
n1 = 103 (PrH_PDO_Only firms)	5	98	103
n2 = 636 (PrH_PDO_NotOnly firms)	34	602	636
Total observations	39	700	739
EM-Score – Expected values	EM-Score <3.75	EM-Score ≥3.75	Total observations
Differences (observed/expected)	−5	5	0
Differences (observed/expected)	5	−5	0

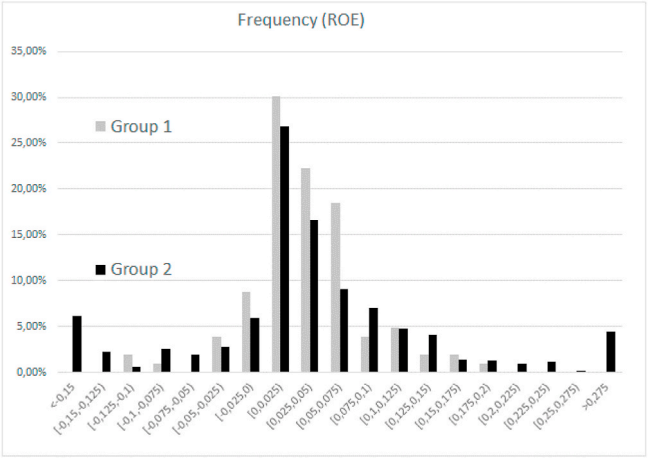


Fig. A. (data appendix 1). ROE Frequency (% observations)

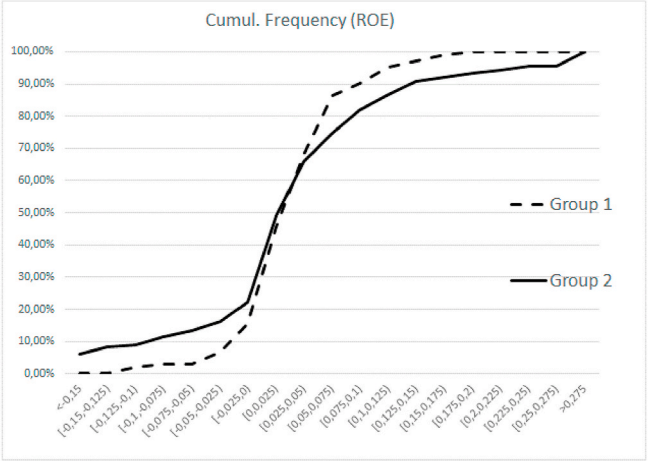


Fig. B. (data appendix 1). ROE Cumulative Frequency (% observations)

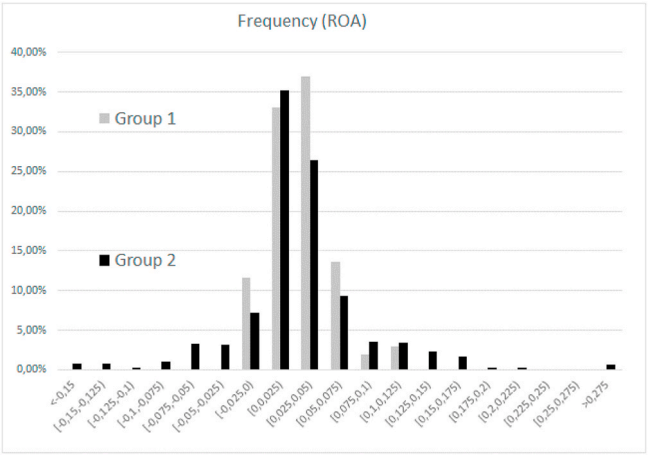


Fig. C. (data appendix 1). ROA Frequency (% observations)

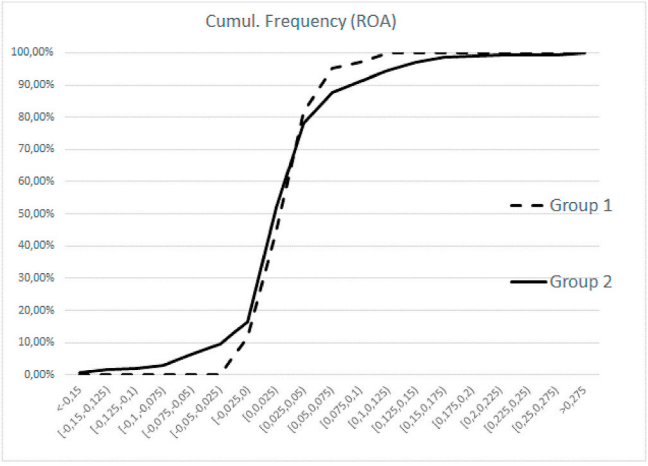


Fig. D. (data appendix 1). ROA Cumulative Frequency (% observations)

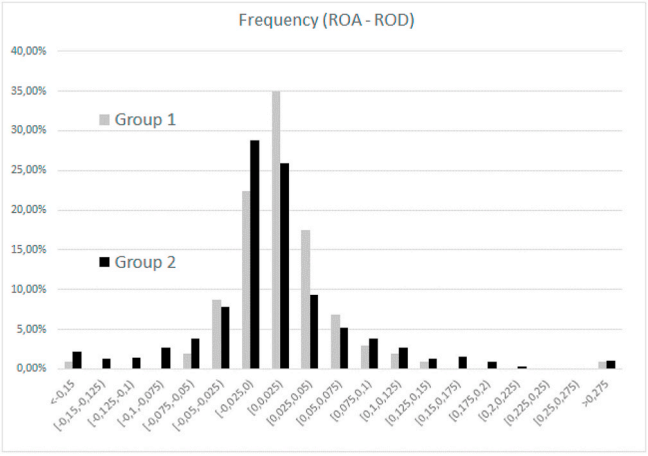


Fig. E. (data appendix 1). ROA - ROD Frequency (% observations)

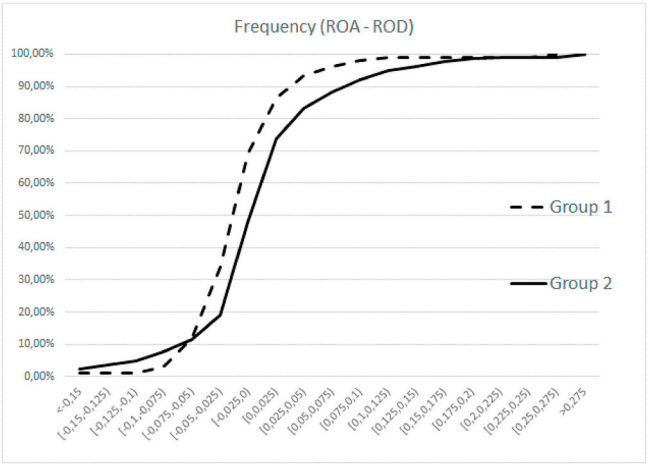


Fig. F. (data appendix 1). ROA - ROD Cumulative Frequency (% observations)

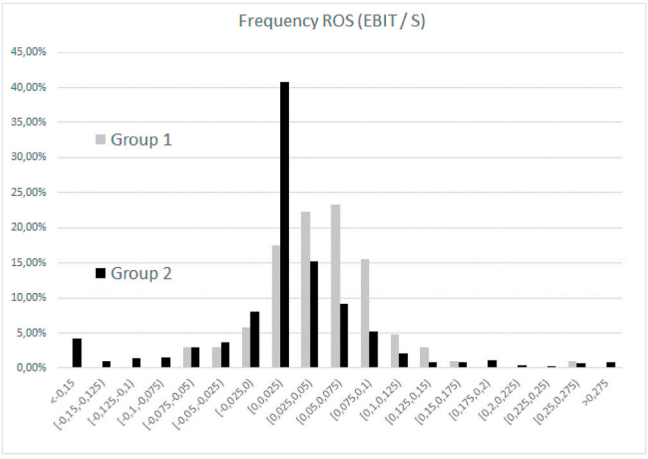
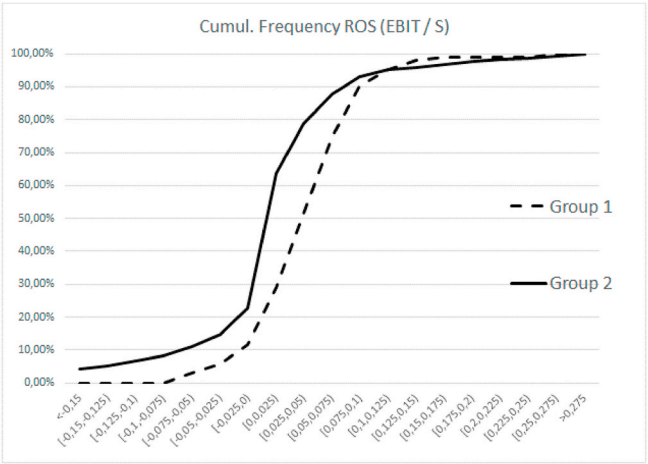


Fig. G. (data appendix 1). ROS Frequency (% observations)



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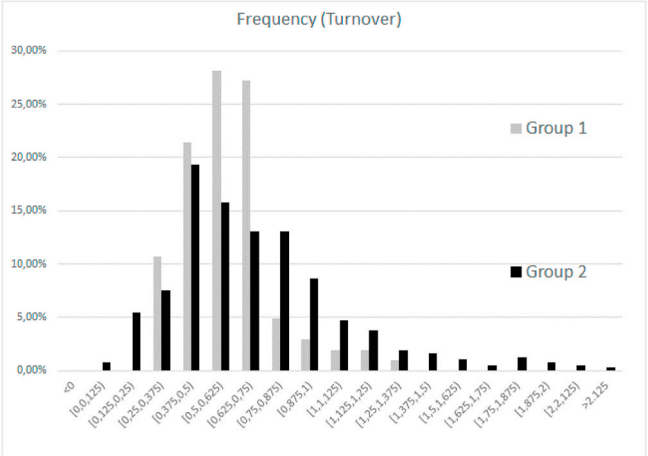
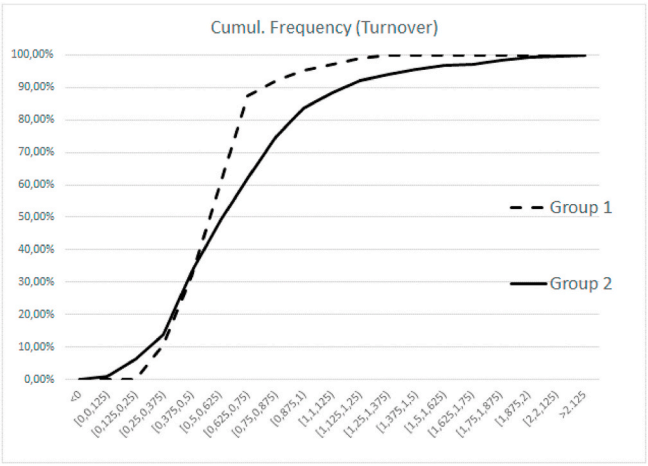


Fig. I. (data appendix 1). T Frequency (% observations)



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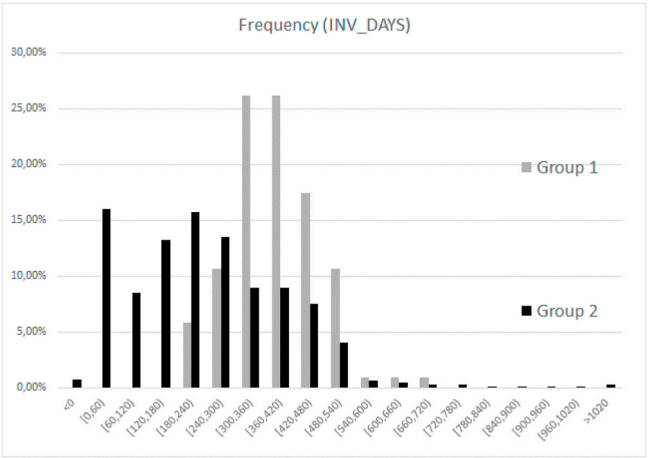
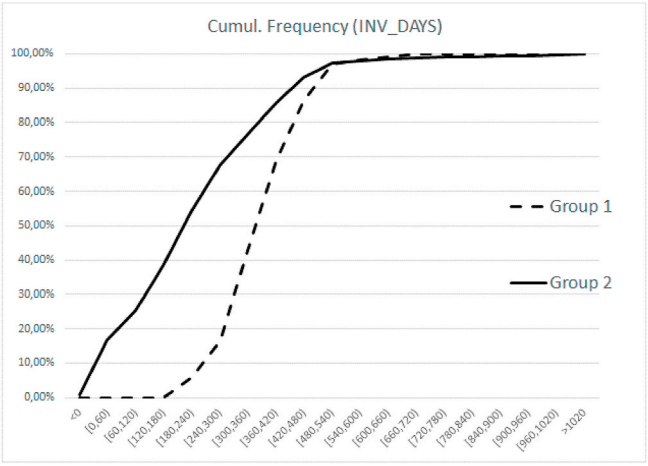


Fig. K. (data appendix 1). INV_DAYS Frequency (% observations)



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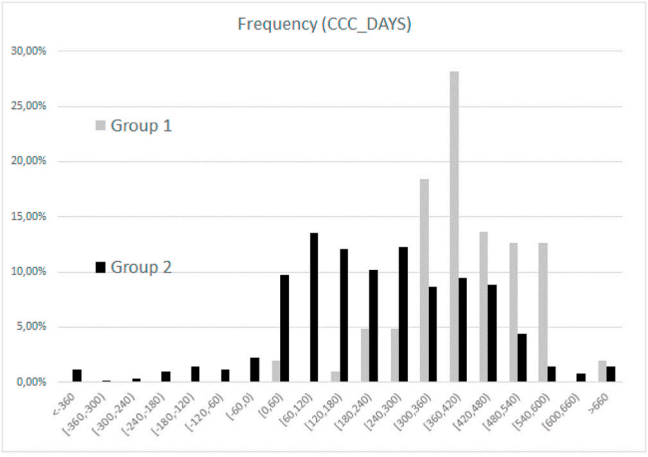

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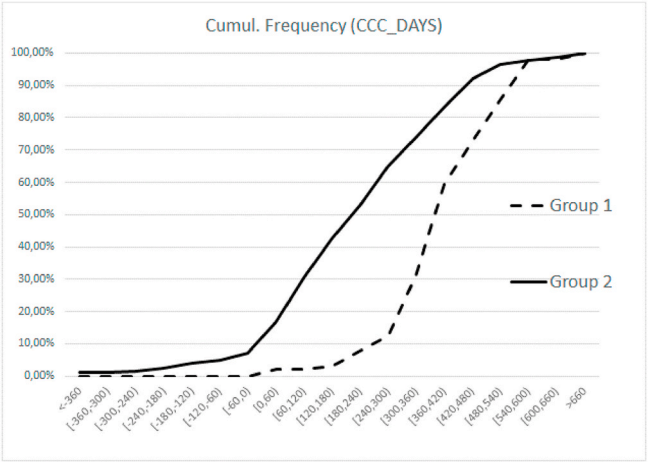

Fig. N. (data appendix 1). CCC_DAYS Cumulative Frequency (% observations)

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