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Scrutinizing Innovation Performance of Family Firms in Efficiency-Driven Environment

Abstract

Although family firms constitute the bulk of economic activity in many world economies, their behavior is still far from understood. This is particularly true when it comes to innovation activities of family firms in efficiency-driven environments with limited indigenous innovation potential, low quality of innovation systems and weak innovation policies. The sample consisting of 293 family firms and we reveal that in such setting internal competencies, collaboration, and public support facilitate innovativeness and diminish the negative effects of firm maturity and innovation barriers among family firms. Tacit R&D knowledge and internal absorptive capacity outweigh the negative effects on innovation of family firms.

Key words: *Family firms, innovation, public support, efficiency driven economy, SEM*

1. Introduction

Around the world, family firms (FFs) dominate the structure and output of many economies (Xi et al., 2015; Basly and Hammouda, 2020), but many aspects of their behaviour remain unexplored (Aiello et al., 2020). One such area is FFs' innovation behaviour (De Massis et al., 2013; Alrubaishi et al., 2020). According to KPMG (2017), innovation is among the top three concerns of FFs. Yet, family variables are rare in mainstream innovation studies (Calabro et al., 2019; Aiello et al., 2020) and FF literature has paid little attention to innovation (Kraus et al., 2012; De Massis et al., 2013; Camison Zornoza et al., 2020). Moreover, FF literature is mostly focused on Western European (Classen et al., 2014; Nieto et al., 2015; Sciascia et al., 2015; Camison Zornoza et al., 2020) or U.S. contexts (Zahra et al., 2004; Zahra, 2005; Block et al., 2013). This makes existing findings biased toward the specific contexts of these countries.

Both issues call for investigation of FFs innovation behaviour in efficiency-driven environments. Efficiency-driven environments refer to territories with structurally weak innovation systems, prevalence of production over innovation activities, and production efficiency as the main sources of competitive advantage (Porter et al., 2002; WEF, 2017). Whether in such setting innovation behaviour of FFs differs from the one observed in existing literature on advanced countries is unknown. The behaviour of FFs is shaped with the historical, temporal, institutional, spatial and social context in which they operate (Alrubaishi et al., 2020) and the same holds for their ability and willingness to innovate (Calabro et al., 2019). Risk averse, inward oriented and resilient to change FFs in efficiency-driven environments may prefer stability of production driven-business model over uncertainty of innovations more than their counterparts in advanced world (De Massis et al., 2013; Nieto et al., 2015; Duran et al., 2016; Aiello et al., 2020; Hu and Hughes, 2020).

The main research question of our study is whether and to what extent the innovation behaviour of FFs differs from the similar type of behaviour observed in advanced world by existing literature. We argue that risk aversion, resistance to change, and the search for stability make FFs in efficiency-driven setting averse towards innovation. The study asserts that the absence or weak quality of indigenous innovation competences and capabilities in such settings may increase FFs' dependence on external sources of innovation, such as public support and collaboration. The study explores how internal efforts, firm characteristics, collaboration within the innovation system, public support, and barriers influence the innovation performance of FFs. To the best of our knowledge, this is one of the first studies on the innovation behaviour of family firms in efficiency-driven economies.

Risk aversion makes FFs likely to follow the "strategic simplicity" path (Zahra, 2005), repeatedly using traditionally implemented routines (Camison Zornoza et al., 2020) and preventing any changes that entail excessive risk (Chirico and Salvato, 2008; Classen et al., 2014). In the innovation context, this corresponds to the DUI (doing-using-interacting) innovation regime that encompasses repetitive use of successfully proven manufacturing operations, deployment of relevant state-of-the-art technology, and trial-and-error processes (Apanasovich et al., 2016). Far more important for long-run viability of FFs are innovations that arise through an R&D-intensive STI (science-technology-innovation) regime (Hu and Hughes, 2020). Well known weaknesses of efficiency-driven economies such as weak innovation incentives (Stojcic, 2020) or lack of functional innovation policies make it worth investigating whether FFs in such settings engage in STI-based innovation efforts and whether such efforts lead to the introduction of novel products and services.

The empirical analysis is carried out with means of structural equation modelling (PLS-SEM) on a data sample from Turkey. A recent Global Competitiveness Report (WEF, 2017) defines Turkey as a large efficiency-driven economy on the path toward innovation-driven growth. FFs account for more than 95% of all firms and 75% of employment in Turkey. Theoretically, study establishes the bridge between the literature on the contextual determinants of FFs behaviour (Carnes and Ireland, 2013; Benavides Velasco et al., 2013) and the propositions from the economics of innovation about the innovation behaviour in different contextual settings (Radošević, 2017; Stojčić, 2020). This allows us to assess how innovation behaviour of FFs in efficiency-driven environment differs from theoretical constructs and empirical findings reported for advanced countries.

Our modelling strategy takes into account the specificity of innovation process in efficiency-driven environments. It is well established in innovation literature that innovation processes in innovation-driven and efficiency-driven settings follow different paths (Radosevic, 2017; Stojcic, 2020). In former settings, prevail the disruptive innovations that originate from R&D investment through science-technology-innovation (STI) regime. In efficiency-driven environments R&D is less important than use of novel technology, innovations are mostly incremental and developed through doing-using-interacting (DUI) regime. It is of paramount importance for aspiration of efficiency-driven economies to move towards the innovation-driven growth and the ability of their firms to compete through STI regime plays pivotal role in this. The model of investigation therefore focuses on the determinants of innovation performance in the STI regime. Specifically, the principal innovation input variable is R&D investment and innovation outcomes are measured with variables recognised as proxies for the disruptive innovations.

Our findings indicate that the innovation performance of FFs in efficiency-driven environments are positively driven by internal competencies embodied in R&D expenditure and R&D personnel; collaboration with suppliers, buyers, rivals, and the science community; and public support. Internal competencies and collaboration are particularly beneficial in this context. The former diminishes the negative effect of firm age and size, our proxies for firm maturity. Collaboration seems to diminish the negative effects of innovation barriers by helping FFs to supplement their own resources with those from the external environment. Together these findings signal that tacit R&D knowledge and high absorptive capacity of FFs facilitate creation of innovations among FFs in efficiency-driven environments.

The paper is structured as follows. Section 2 presents the conceptual framework of the paper. We introduce the empirical design of the study in Section 3. Empirical findings are presented in section 4, while the final fifth section concludes.

2. Conceptual framework

2.1. The familiness and innovation behaviour of family firms

The unique traits of FFs such as inward orientation, risk aversion, longevity of relationships with the external environment, and the accumulation of knowledge (Duran et al., 2016) and financial resources (Zellweger, 2017) are commonly attributed to their *familiness*, a bundle of organizational resources, values, and characteristics responsible for unique traits of FFs behaviour (Munoz Bullon et al., 2020). In *resource-based view* fashion (Barney, 1991; Barney et al., 2001), familiness is a bundle of valuable, rare, inimitable, and non-substitutable resources that reduces transaction costs, facilitates knowledge flow, and accumulates creativity, knowledge, and skills within FFs (De Massis, et al., 2013; Casprini et al., 2020). It strengthens their external relationships (Ireland et al., 2002) and financial security (Dyer, 2006).

The *dynamic capabilities approach* (DC) (Teece et al., 1997; Winter, 2003) adds that routines and activities such as sensing, seizing, and transforming enable a recombination of knowledge in a way that ensures survival in a changing environment (Penrose, 1959; Zollo and Winter, 2002). Through the duality of family and business social systems, familiness creates the specific context in which repetitive interactions among strongly related group members facilitate recombination and integration of diverse knowledge residing within individuals (Kogut and Zander, 1992; Grant; 1996; Zollo and Winter, 2002; Zahra et al., 2007; Chirico and Salvato, 2008).

Under *behavioural theory*, firms pursue many objectives (Cyert and March, 1963). For most companies, the pursuit of profitability is among their key priorities (Berle and Means, 1965). FFs place greater value on preservation of socioemotional wealth and altruism towards other family members (Kotlar et al., 2014; Filser et al., 2017), but they must attach attention to performance objectives as these are seen as a way of preserving non-economic family objectives. This duality of objectives requires objective performance monitoring standards, discipline (Schulze et al., 2001), and governance structure that reduces *agency costs*, ensures effective decision making, and lays a foundation for continuity of the firm and maximization of family wealth. De Massis et. al. (2013) note that management and ownership of FFs are characterised by the distinctive properties of parsimony, personalism, and particularism, which reduce opportunism and remove internal bureaucratic constraints.

The role of familiness has largely been overlooked in innovation literature (Kraus et al., 2012; Alrubaishi et al., 2020). Limited evidence suggests that the FFs investment in R&D depends on family control and non-financial goals (Koropp et al., 2013; De Massis et al., 2015; Sciascia et al., 2015; Duran et al., 2016). FFs favour incremental innovations over radical ones (Hu and Hughes, 2020) since former fit more closely their preferences for stability (Camison Zornoza et al., 2020). They are less likely to invest in R&D (Chrisman and Patel, 2012; De Massis et al., 2015; Nieto et al., 2015; Kotlar et al., 2014) but seem more successful in the transformation of innovation inputs into innovation outputs (Classen et al., 2014; Duran et al., 2016). The uniqueness of internal R&D enables FFs to recognize, understand, and evaluate relevant external knowledge (Aiello et al., 2020; Munoz Bullon et al., 2020). Through collaboration, FFs extend their social capital and deepen long-lasting relationships (Matzler et al., 2015).

The explanations of the diverging behaviour and performance of FFs and non-family firms have also encompassed other internal factors. Evidence points out that innovation behaviour of FFs changes over time (Zahra, 2005). As inter-generational shifts in leadership takes place, attitudes of FFs towards risk, diversification, and technology change as well (Craig, 2006) and FFs become complacent and less innovative (Cassia et al., 2012; Duran et al., 2016; Alrubaishi et al., 2020; Hernandez-Perlines et al., 2020). The product innovation intensity seems also facilitated with introduction of organizational innovations (Kraus et al., 2012). FFs innovation investment and performance seem dependent on country-level factors such as institutional framework and the competencies and capabilities of the workforce (Duran et al., 2016).

2.2. Innovation milieu of an efficiency-driven economy

The behaviour and performance of firms also depends on the traits of wider socio-economic context (Boschma, 2005; Iammarino et al., 2012; Ramadani et al., 2019; Stojcic, 2020). This issue has hardly been touched by FF literature with nearly all studies addressing FFs in the U.S. and Western European context of innovation-driven economies. However, the issue is well acknowledged within economics of innovation where many studies have noted the distinctive features of the innovation process outside of innovation-driven economies.

As noted by Radosevic (2017), the R&D activities of firms in efficiency- or production-driven economies take the form of absorption of imported knowledge and technology (the doing-using-interacting or DUI regime) rather than research-driven innovation (the science-technology-innovation or STI regime). While firms in innovation-driven economies build their innovation capabilities through R&D investments, efficiency-driven environments are more inclined towards the acquisition of new machinery, software, or equipment. Another important feature of such economies is the weak potential for innovation either alone or in collaboration (Stojcic, 2020). The embeddedness in production activities of domestic businesses means that indigenous firms often lack internal resources for the autonomous development of innovations. At the same time, the prevailing focus on production activities implies that the external environment does not provide sufficient resources for successful completion of the innovation process. It has been reported that collaborative innovation with universities in such settings is incremental (Švarc and Dabić, 2019) and other firms do not provide knowledge of sufficient quality for innovation success.

The risk aversion of FFs makes them resilient to change and oriented towards expansion in a way that secures the inter-generational preservation of family wealth. This means that FFs are likely to follow a “strategic simplicity” path (Zahra, 2005), repeatedly using traditionally implemented and previously successful routines (Camison Zornoza et al., 2020) and preventing or even sabotaging any changes that entail excessive risk (Chirico and Salvato, 2008), including R&D-intensive innovation strategies (Classen et al., 2014). In the context of efficiency-driven environments, this has implications not only on the decision of FFs to innovate but also on their choice between different (DUI vs. STI) innovation regimes. The STI mode of innovation is primarily driven with organizational R&D activities, while DUI arises from non-scientific drivers such as learning-by-doing, learning-by-using, and learning-by-interacting (Jensen et al., 2007; Apanasovich et al., 2016).

The development of innovations through an STI regime requires investment in scientific human capital and innovation infrastructure with uncertain outcomes. The DUI regime, on the other hand, relies on repetitive use of successfully proven manufacturing operations, deployment of relevant state-of-the-art technology, and trial and error processes (Apanasovich et al., 2016). It builds innovation competencies required for mastering the creation of products and services novel to the firm but known to the market through fitting, recombining, reusing, and adopting the existing knowledge (Colombo et al., 2017), while an R&D-intensive STI regime builds innovation capabilities required for mastering the creation of products and services that are novel for both the firm and for the market (Iammarino et al., 2012; Stojcic, 2020). Due to its nature, the DUI regime is more likely to deliver incremental rather than radical innovations.

As such, a DUI innovation regime bears little uncertainty and risk and thus may be more aligned with the preferences of FFs for stability.

This, in turn, has important implications for the prospects of FFs. Radical innovations, if successful, produce large financial gains, customer benefits, and efficiency improvements. (Kyriakopoulos et al., 2016). Incremental ones are associated with less uncertainty, but this comes at a cost of modest novelty, weaker potential for differentiation, and smaller financial gains (Slater et al., 2013). It is for these properties that the absence of radical innovations may constrain the long-run viability of FFs (Hu and Hughes, 2020). However, FFs are long-run-oriented, prefer stable environments, and are generally risk averse. In the absence of external incentives, they will prefer less uncertain business paths such as those associated with a DUI regime and incremental innovations (Nieto et al., 2015). Efficiency-driven environments are known for weak innovation incentives (Stojcic, 2020). It is thus worth investigating whether FFs in such settings engage in STI-based innovation efforts and whether such efforts lead to the introduction of novel products and services.

The above market failure also suggests that in efficiency-driven economies, an external incentive to motivate innovation activities might be needed. Even though the issue has not been investigated within the FF literature, the innovation literature established that push incentives such as subsidies and pull incentives in the form of innovation procurement facilitate both the decision of firms to innovate in such settings as well as their innovation output (Stojcic et al., 2020). On the one hand, while such incentives may resolve informational asymmetries and thus reduce risk and point FF innovation activities in the right direction, they may also serve as a source of financing for development of novel products and services. However, the success of such incentives in efficiency-driven settings depends also on the knowledge of public stakeholders, which may be absent due to their focus on development of production competences and capabilities.

2.5. Research model and hypotheses development

Building on what is stated earlier, we now move to the development of a research model and hypotheses. In their life, organizations follow multiple objectives and innovation is one of them. Firms, for example, may simultaneously pursue the development of novel products and processes, but at the same time, they may be involved in patenting their discoveries (Dziallas and Blind, 2019). This paves the way for criticism of those studies focusing on single measures of innovation. Our study overcomes this issue and utilizes a composite indicator that is based on the tendency to create novel products and services, measured by the percentage of sales coming from new products and services, and data on organizational patenting activity, measured by the number of patent applications by enterprise. The choice of such indicator is drawn with the fact that truly novel products and patents can be interpreted as indicators of radical innovation efforts that are at the core of STI innovation regime.

Our discussion indicated that the primary source of innovation in STI regime is research and development. FFs literature mentioned in previous sections acknowledges that specialised tacit knowledge resides accumulated in R&D activities and R&D employees. Vega-Jurado et al. (2008) note that R&D expenditure as a proxy for internal competencies constitutes the most important determinant of innovation performance. Indicators of R&D investment and R&D personnel expenditures have been used in other studies as well as indices of internal innovation resources (Galende and Fuente, 2003). In our study we use indicators composed of measures of R&D employment and R&D expenditures. It is expected that internal innovation competencies embodied in R&D facilitate innovation performance if firms pursue innovations under STI regime. We thus formulate our first hypothesis as follows:

H_1: *Internal R&D competencies positively influence the innovation performance of family firms in efficiency driven environment*

Evidence from analyzed studies pointed to the fact that the propensity of FFs toward innovation and their success in the innovation process also depend on the stage in their life cycle. Inter-generational governance shift, for example, may push FFs towards innovation. While unable to directly control for these characteristics, they can be proxied through organizational age and size. Maturity of organizations comes with time and growth and may signal that firms are at stage of inter-generational shift in governance as younger family members engage in business activities. Huergo and Jaumandreu (2004) suggested that new entrant FFs have the highest probability of innovation, whereas the oldest tend to show lower innovative possibilities.

Coad at al. (2016a), examine the role of firm age in the relationship between innovation and the growth of Spanish firms for the period 2004 to 2012. The authors concluded that the impact of R&D on firm growth has been positive for young firms. However, they emphasize that this effect is more stable for older firms. We must also acknowledge that the impact of firm size and age on organizational innovation activities and outcomes may be driven with other determinants. As firms get older and larger, they may adopt the "quiet-life" behaviour pattern that manifests itself in reliance on existing products and reduced incentives to innovate, while organizational complexity acts as a barrier to new innovation efforts. The existence of such effects has already been suggested in studies on innovation behaviour of firms in efficiency-driven environments (Hashi and Stojcic, 2013). However, even in such cases, the hypothesised effect of maturity on the innovation should remain the same.

***H_2**: Innovation performance of family firms deteriorates with their maturity in efficiency driven environment*

In their innovation activities, FFs combine their own and external knowledge. As innovation literature argues, collaboration with actors from the innovation system (suppliers, rivals, clients, science and technology institutions) provides firms with products, services, and concrete and abstract technological and non-technological resources that are relevant in the innovation process (Granstrand and Holgersson, 2020). This is particularly true for firms in efficiency-driven economies that lack some of the resources required for innovation. As our earlier discussion highlighted, FFs have the ability to screen the environment for relevant resources and may particularly benefit from collaboration with actors from their innovation system. To estimate the contribution of the innovation system to the innovation performance of FFs, we use a composite indicator that encompasses contributions of competitors, suppliers, universities, and buyers to organizational innovation performance. Accordingly, we develop the following hypothesis:

H₃*: The collaboration within innovation system positively contributes to innovation performance of family firms in efficiency driven environment*

In a situation when their own incentives for innovation are weak and firms lack relevant resources to perform their innovation activities, a public incentive may be required to remedy market failures. Public support is commonly viewed as financial aid to organizational innovation efforts. However, Stojcic et al. (2020) note that public innovation incentives from the push and particularly pull sides also help firms in resolving informational asymmetries and reducing risk aversion. This may be particularly relevant for FFs and in efficiency-driven economy context since firms in this context may lack proper knowledge about market trends (Griffith, et al., 2012); and some of them, like FFs, may be averse to innovation due to preferences for stability and fear of failure. We are able to control for public support in the form of national public innovation subsidies. Accordingly, we formulate our fourth hypothesis:

H₄: *Public subsidies facilitate innovation performance of family firms in efficiency driven environment*

Apart from earlier statements, in their innovation activities firms encounter institutional and systematic barriers such as the growth of new initiatives and resource constraints.

According to Coad et al. (2016b), removing the obstacles to innovation is required to enable firms to innovate and enhance their own productivity. Barriers can be divided into three sub-groups: supply, demand, and the environment. Among the barriers related to supply, there are difficulties in providing technological information, raw materials, and funding. Demand-related barriers are related to customer needs, perceptions of innovation risk, and internal or external market constraints. Environmental barriers include various government regulations, antitrust measures, and policy actions. In our study, we include a composite indicator that consists of barriers such as lack of experience, lack of skilled labour, lack of information on property rights, lack of information on R&D and innovation support, and difficulties in obtaining support for R&D and innovation projects. To this end, we formulate our fifth hypothesis:

***H*$_5$*: Barriers to innovation deteriorate innovation performance of family firms in efficiency driven environment*

Over the past decade, the research on family firms suggested that FFs are a heterogeneous group in which the effect of some variables on firm performance is also influenced by a variety of mediating and moderating factors (De Massis et al., 2013; Hernandez-Perlines et al., 2020). In our model, we hypothesize the existence of two such linkages. The first link concerns the relationship between organizational maturity, R&D competencies and firm performance. As argued earlier, the propensity toward innovation declines as organizations mature and grow and younger family members take over governance positions from initial owners. We expect that internal R&D competencies embodied in R&D staff and activities financed through R&D expenditure may act as mediator that reduces the negative effect of maturity on innovation performance of FFs. To this end:

***H*$_6$*: Internal R&D competencies mediate the relationship between organizational maturity and innovation performance in family firms in efficiency driven environment*

H_{6a}: Organizational maturity negatively affects internal R&D competencies of family firms in efficiency driven environment

***H_{6b}**: Internal R&D competencies positively influence innovation performance of family firms*

Another mediating variable concerns the relationship between barriers to innovation and innovation performance. As argued, organizations do not possess all resources required for innovation, for which reason the lack of some resources may prove as a barrier. To this end, we expect that collaboration with actors from the external environment and the use of other external resources may reduce or offset the impact of barriers on innovation performance. Accordingly, we formulate our seventh hypothesis:

***H_7**: The innovation system mediates the relationship between barriers to innovation and innovation performance of family firms in efficiency driven environment*

***H_{7a}**: Barriers to innovation negatively affect collaboration of family firms with the innovation system in efficiency driven environment*

***H_{7b}**: The innovation system positively affects innovation performance of family firms in efficiency driven environment*

Together, these hypotheses depict the model of investigation that is presented in Fig. 1. According to Fig. 1, the dependent variable is firm innovation performance. Barriers to innovation, collaboration with actors from the innovation system, public support to innovation, organizational life cycle, and internal innovation competencies of the firm are independent variables.

Insert Figure 1 about here

3. Data and methods

Our analysis is based on data collected from 293 family firms through a survey of companies in Turkey. According to European Innovation Scoreboard 2020, Turkey belongs to a group of European economies classified as moderate innovators. Global Competitiveness Reports (WEF, 2017) refer to Turkey as efficiency-driven economy in transition towards innovation-driven growth. This group of countries is characterized by innovation performance that falls below benchmark, which in the case of European Innovation Scoreboard, is the European Union’s average innovation performance. In terms of quality of human resources, the attractiveness of research system, financing of innovation, collaboration potential, and intellectual assets, Turkey is positioned below 50 percent of the EU average while, according to the criteria for an innovation-friendly environment, investments in R&D and impacts of innovation on firm sales is ranked between 50 percent and 95 percent of the EU average. The areas where Turkey is ranked high in terms of innovation performance are in-house innovation activities, marketing and organizational innovations, and product innovations introduction. Such findings are typical for economies in which the principal source of competitiveness is production efficiency and those economies in transition from efficiency- to innovation-driven growth.

Insert Table 1 about here

The analysis is undertaken with means of Structural Equation Modeling (SEM). SEM analysis is a well-known technique for studying the relationships between multivariate data (Bentler and Yuan, 1999). It enables the modeling of latent structures that affect innovation performance in addition to observed variables[1]. It is widely used in studies interested in examination of direct and indirect effects of particular variables on investigated outcomes (i.e., mediated effects), including innovation related studies (Wang et al., 2018; Cegarra-Navarro & Martelo-Landroguez, 2020; Dabic et al., 2021). As our analysis hypothesizes the existence of several mediation channels, the SEM emerges as a logical choice of estimation technique.

[1] Latent structures (variables or factors) are variables that cannot be directly observed or measured. But they can be inferred from a series of observed variables that we actually measure using surveys etc. (Schumacker and Lomax, 2010: 3).

The SEM Analysis consists of four components (Schumacker and Lomax, 2010): Regression Analysis, Path Analysis, Confirmatory Factor Analysis, and Structural Equation Modeling. A standard SEM application that includes these relevant analyses is carried out in four stages (Weston and Gore, 2006; Schumacker and Lomax, 2010) defined as model estimation, evaluation, modification, and interpretation. Using the SEM framework, a model is estimated on the basis of variables presented in Table 1.

4. Findings

4.1. Estimation results

The starting point of SEM analysis is the selection of estimation techniques for the estimation of parameters in the measurement model and in the structural model (Schumacker and Lomax, 2010). Our analysis opens with explanatory factor analysis (EFA) that serves to reduce each structure[2]. Following the evaluation of the reliability analysis of the factors with Cronbach's Alpha Coefficient, confirmatory factor analysis (CFA) has been applied to determine how much the observed variables express the latent structures in accordance with the SEM[3] analysis procedure. The results are presented in Table 2.

According to the results of the factor analysis in Table 2, Bartlett's Sphericity Test shows that there is an adequate relationship for all structures. The Kaiser-Meyer-Olkin (KMO) Test, which measures the adequacy of the sample, is satisfactory. Factors have been identified by Principal Components Analysis and Varimax Transformation. While the cumulative explained variance is 74.9 percent, the factor with the highest explanation rate is the I_SOURCE with 29.4 percent.

Insert Table 2 about here

[2] SPSS Statistics Version 25 has been used in the measurement model estimation.
[3] AMOS program has been used while performing SEM Analysis

All factor loads are positive and statistically significant and they are also above the recommended value of 0,30-0,40 (Floyd and Widaman, 1995). Cronbach's Alpha values are respectively 0,89-0,88-0,62-0,60 for the factors and are higher than the recommended value of 0,6 (Liao and Rice, 2010) for the SEM analysis. Through the measurement model results, it has been confirmed that our observed variables are good indicators of our latent structures. Descriptive Statistics for latent structures (Means, Standard Deviations, and Correlations) are given in Table 3.

In Table 3, it is noteworthy that the correlations between the barriers and the other structures, except the organizational life cycle, are negative. In addition, the correlation between barriers and innovation sources is statistically significant. This result is compatible with Hartono and Kusumawardhani (2019) and Coad et al. (2016b). Also, correlations between each pair of latent constructs do not exceed the square root of each construct's AVE (Fornell and Larcker, 1981), confirming the model's discriminant validity.

Insert Table 3 about here

Next, we move the estimation to the SEM analysis stage. In order for the structural model to be estimated using the maximum likelihood estimator, the data must provide the normal distribution assumption. When the skewness and kurtosis values of the variables are examined individually, it is seen that they provide the normal distribution assumption in general, but the related values of the observed variables used in obtaining the dependent latent variable are not in the range of -2 / + 2 suggested by George and Mallery (2010). Since the Multivariate c.r. value is high, it is concluded that the normal distribution assumption cannot be achieved. For this reason, the Asymptotically Distribution-Free Estimates estimator has been used. Before interpreting the path coefficients in SEM analysis, the model evaluation must be done by model fit statistics. The results are given in Table 4 according to various model fit statistics.

Insert Table 4 about here

In Table 4, the first column shows the type of statistics, the second column is the statistics of the research model, and the third column is the proposed decision criterion. Accordingly, it is concluded that the hypothetical model generally fulfills the statistical properties and fits well with the sample. The interpretation of the results of SEM analysis also known as path coefficients can be divided into two groups: direct and indirect effects. The former reflects the direct effect of explanatory variables on the dependent construct of our interest, while the latter refers to the mediating effect going from mediated through mediating variables on the dependent variable. Figure 2 provides the path diagram of our findings.

Insert Table 5 about here

We next move to the results presented in Fig. 2. For expositional convenience, these are grouped in tables as direct, indirect, and mediating effects. Table 5 presents the direct effects of our variables of interest obtained through SEM analysis. Starting with internal competencies, we obtain a positive and statistically significant coefficient confirming our H_1. The effect of the life cycle is not significant, thus leading to rejection of H_2. Both collaboration and public support for innovation positively and significantly influence the innovation performance of FFs. This enables us to accept also H_3 and H_4. The rejection of H_2 and H_5 may be related to the introduction of mediating effects.

Insert Figure 2 about here

Insert Table 6 about here

Table 6 provides the path coefficients for the indirect effects. Both indirect effects are highly statistically significant and negative. As a final stage of analysis, we look into the total mediation effect on firm performance in Table 7. The results reveal that internal competencies and collaboration are meaningful mediators between barriers and life cycle on the one hand, and innovation performance on the other. When the mediation relationships are included in the model, the variables lose their significance completely, which can be interpreted as a sign of full mediation.

Insert Table 7 about here

4.2. Discussion of results

Over past decades family firms have been subject of investigation of many studies. The accumulated body of knowledge shed light on many aspects of their behaviour (Carney et al. 2015; Duran et al. 2016; Urbinati et al. 2017) including their risk aversion (Zahra, 2005; Naldi et al., 2007; Kellermans et al., 2012), inward focus (Martin Santana et al., 2020), market orientation (Zachary et al., 2011) and trade-off between economic and non-economic (family) goals (Habbershon and Williams, 1999; Kotlar et al., 2014; Martin-Santana et al., 2020; Munoz Bullon et al., 2020). Yet, many other aspects of FFs behaviour are unknown and call for further investigation (Aiello et al., 2020).

Few gaps are particularly worth noting. First, FFs literature devoted surprisingly little attention to their innovation behavior (De Massis et al., 2013; Alrubaishi et al., 2020). Equally important is that majority of studies focused on Western European (Classen et al., 2014; Nieto et al., 2015; Sciascia et al., 2015; Munoz Bullon et al., 2020; Camison Zornoza et al., 2020; Aiello et al., 2020) or U.S. contexts (Zahra et al., 2004; Zahra, 2005; Block et al., 2013). Even within literature on FFs innovation behaviour gaps exist that call to be filled. For example, majority of studies reviewed for the purpose of this analysis are concerned with distinction between family and non-family firms or they focus on effects of various aspects of FFs behaviour, including innovation on their overall performance but effects of different factors on innovation behaviour of family firms were only peripherally investigated within FFs literature.

The above puts our study in somewhat unique position as the one that explores determinants of innovation outcomes of FFs in efficiency-driven economy and the one that tries to assess the impact of internal and external factors on FFs innovation outcomes. However, it also means that our findings are not directly comparable with those from other studies as their research questions and geographical focus are different from ours. Despite exhaustive literature review we were not able to identify studies that bring together all factors included in our analysis in both advanced and advancing economies. Moreover, only few of reviewed studies have focused on the determinants of innovation inputs and outputs (Classen et al., 2014; Sciascia et al., 2015; Nieto et al., 2015; Munoz Bullon et al., 2020; Aiello et al., 2020) which allows us to compare our findings with their results. Having said that, we turn to discussion of the results presented.

Our findings indicate that internal tacit knowledge embodied in FFs R&D human capital and innovation infrastructure facilitates innovation performance. Similar findings were reported for Spain (Nieto et al., 2015) and Italy (Aiello et al., 2020). The direct effect of organizational maturity is not significant in our analysis in line with findings from Classen et al. (2015) for Germany and Aiello et al. (2020) for Italy. These findings can be taken as evidence that FFs in efficiency driven environments develop innovations through STI innovation regime.

Our findings also signal that FFs supplement their own missing resources with those of their rivals, suppliers, customers, and the science community. Several studies have reported similar findings for FFs across advanced economies (Nieto et al. 2015, Munoz Bullon et al., 2020; Aiello et al., 2020). As Aiello et al. (2020) note FFs particularly benefit from diversity of partners involved in R&D collaboration. This is in line with our construction of innovation system variable. Findings from Nieto et al., (2015) suggest that collaboration may be relevant only for incremental innovations but not for radical ones. This issue was not explored by other studies and construction of our dataset prevents us from exploring the issue in greater detail.

Stojcic et al. (2020) have recently found positive effects from both push (subsidies) and pull (public procurement) public incentives on the introduction and commercialization of innovations in efficiency driven economies. The study explains that public support helps firms to overcome financial barriers to innovation and also helps in correction of informational market failures of innovation process. Our findings are consistent with theirs. Both collaboration and public support can be viewed as factors that help FFs to reduce risks, search for information and to engage in innovation with less uncertainty. In FFs context, only Kotlar et al. (2014) explored effect of financial R&D support on R&D investment but, to the best of our knowledge, none of studies within FFs literature explored the effect of public subsidies on innovation performance which makes our research somewhat unique.

Our findings suggest that R&D competencies and collaboration mediate the relationship between maturity and external barriers on the one hand and innovation performance of FFs on the other hand. The negative effect of maturity on internal R&D competencies can be associated with thesis that inter-generational shift within FFs and their desire for stability reduce the efficiency of internal resources. As noted by Kotlar et al. (2014), the importance of family-centred noneconomic goals increases as organizations mature and motivate FFs managers to reduce risky activities such as R&D investment.

At the same time, the mediating effect of collaboration in relationship between barriers and innovation performance with negative sign on the part of relationship between barriers and innovation system signal that barriers reduce access to knowledge and other resources found in external environment. This issue has not been previously explored in FFs context but innovation literature on efficiency-driven economies suggests that elements entering in our measure of barriers (lack of expert support, information and human capital) constrain innovation efforts of firms in such settings (Stojcic, 2020).

5. Conclusion

Due to their number, and contribution to GDP and employment of many world economies, family firms attract behavior of researchers across the world. The evidence gathered so far highlighted their distinction from non-family firms and various dimensions of performance such as turnover, productivity, and internationalization. It has been also noted that family firms matter for innovation, but this aspect of their performance was investigated to a lesser extent. There is an evident gap in the literature and ambiguity of findings when it comes to understanding not only the differences between family and non-family firms' innovation performance, but also of intrinsic and extrinsic drivers behind their ability to innovate. Furthermore, there is surprisingly little work undertaken on understanding innovation behaviour of firms in some groups of countries such as efficiency-driven economies. Motivated with these insights we conducted study that derives theoretical, policy and managerial implications for innovation behaviour of family firms.

5.1. Theoretical implications

The innovation behaviour belongs to unexplored areas of FFs literature. Neither family variables entered mainstream innovation studies (Aiello et al., 2020) nor FFs literature paid particular attention to their innovation activities (Kraus et al., 2012; Camison Zornoza et al., 2020). Rare investigations of FFs innovation activities have been focused on determinants of investment in R&D (Kotlar et al., 2014; Sciascia et al., 2015) or effects of innovativeness on firm performance (Hernandez-Perlines et al., 2020). The determinants of internal and external factors on outcomes of innovation process such as patenting, introduction of innovations or commercialization of novel products were investigated by only few studies. We know that internal factors such as socioemotional wealth (Filser et al., 2017) or R&D investment (Nieto et al., 2015) facilitate introduction of innovations and that collaboration helps FFs to supplement lack of own resources required for innovation (Munoz-Bullon et al., 2020; Aiello et al., 2020).

The research contributes to both family business and innovation literature by introducing *familiness* into understanding of firm innovation behaviour and by explaining the importance of FF innovation behaviour in a specific socio-economic context of efficiency-driven economies. Theoretical framework of FFs behaviour suggests that familiness makes these firms inward oriented (Duran et al., 2016). Our findings show that internal innovation competencies matter for success of innovation process but they are not the sole contributor to introduction of novel products and services. FFs rely on external resources coming through horizontal and vertical channels of collaboration with innovation system. Another theoretical contribution of study comes from its focus on efficiency-driven economies. The research on innovation behaviour of FFs in such settings is practically non-existent and our study offers first answer to question whether innovation behaviour of FFs in efficiency-driven economies differs from those observed in advanced ones.

Our findings show that the "familiness" of family firms contributes to innovation in two ways. First, it enables accumulation of specific tacit knowledge within organizations that directly influences innovation performance; and second, it enhances absorptive capacity of FFs by increasing their ability to screen, absorb, and reconfigure external knowledge in a way that is complementary to their internal competencies and capabilities. This ability helps FFs to reduce the negative effects of barriers to innovation. If one recalls that risk aversion and the pursuit of stability act as disincentives of FFs to innovate, while their specific tacit knowledge and absorptive capacity enhance their ability to innovate, our findings imply that the latter effect outweighs the former one. Furthermore, literature tells us that FFs favour activities with little or no risk and uncertainty. Our analysis reveals that FFs also practice STI innovation regime that is characterised with high uncertainty and can lead to radical innovations.

5.2. Policy implications

Policy implications of our study fall in two areas. We show that the innovation behaviour of FFs depends on the interplay between their internal strengths but also on public support and resources found in their innovation system. The relevance of public support is particularly important. Public push incentives for innovation are known for their ability to supplement missing financial resources of firms but they also can be helpful in solving of informational failures (Stojcic et al., 2020). Both issues are likely to be more pronounced in efficiency-driven settings than in advanced economies and our findings can serve as implications for policy makers.

Another policy implication of our study arises from findings on the contribution of innovation system to innovation outcomes of FFs. As evidence shows, diverse innovation system facilitates the success of innovation process directly through provision of missing resources but also indirectly as mediator that diminishes negative effect of barriers to innovation. By strengthening the quality of innovation system policy makers can increase the efficiency of innovation process. Our findings also signal that lack of human capital, protection of property rights and informational failures act as barriers to innovation that reduce the efficiency of collaboration with innovation system. Each of these barriers can be taken as direction for policy intervention.

5.3. Managerial implications

Our study argues that innovation behaviour of firms in efficiency-driven economies depends on the interplay between internal forces, features of their innovation system, and public support for innovation. Innovation performance of FFs in efficiency-driven economies depends on internal R&D resources, but it is evident that family firms supplement missing capabilities with resources from their suppliers, rivals, customers, and the science community (Radas et al., 2009; Ratten et al., 2020). Evidence on innovation behavior of firms also suggests that the propensity toward innovation and innovation-related knowledge diminishes with inter-generational shifts in governance. Consistent with this line of reasoning, our findings show that innovation performance weakens as FFs grow old and increase in size. However, it is evident from our findings that the strengthening of organizational R&D capacities may offset this negative effect.

5.4. Limitations and directions for future research

While revealing in many aspects our study also has several limitations. First, it focuses on a single economy, which although relevant in global context, does not provide opportunity for cross-country verification of our findings. Second, our approach to innovation performance does not distinguish between incremental and radical innovations. There is ongoing debate over the question of whether FFs are more inclined to incremental or radical innovation that would be worth investigating in the context of efficiency-driven economies. Third, our approach to public policy is based on push or supply side instruments. It would be worth investigating whether equal or better results from a policy perspective could be achieved with pull or demand side instruments such as public procurement of innovations. Finally, the cross-sectional nature of our dataset prevents us from investigating whether innovation behaviour of FFs changes over time. All of these limitations have their roots in the lack of relevant data and it remains for future studies to address them.

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Figure 1: Conceptual model

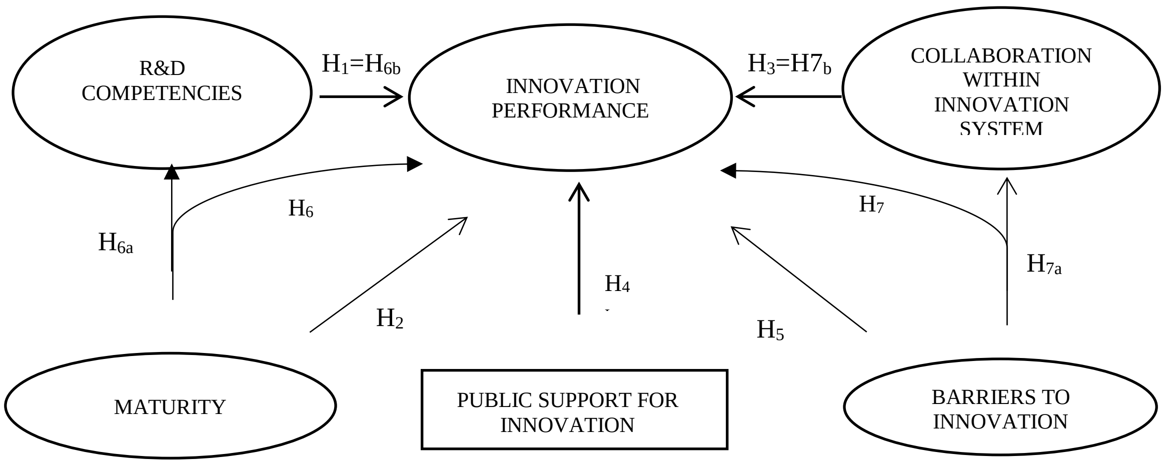

Figure II. The Path Diagram

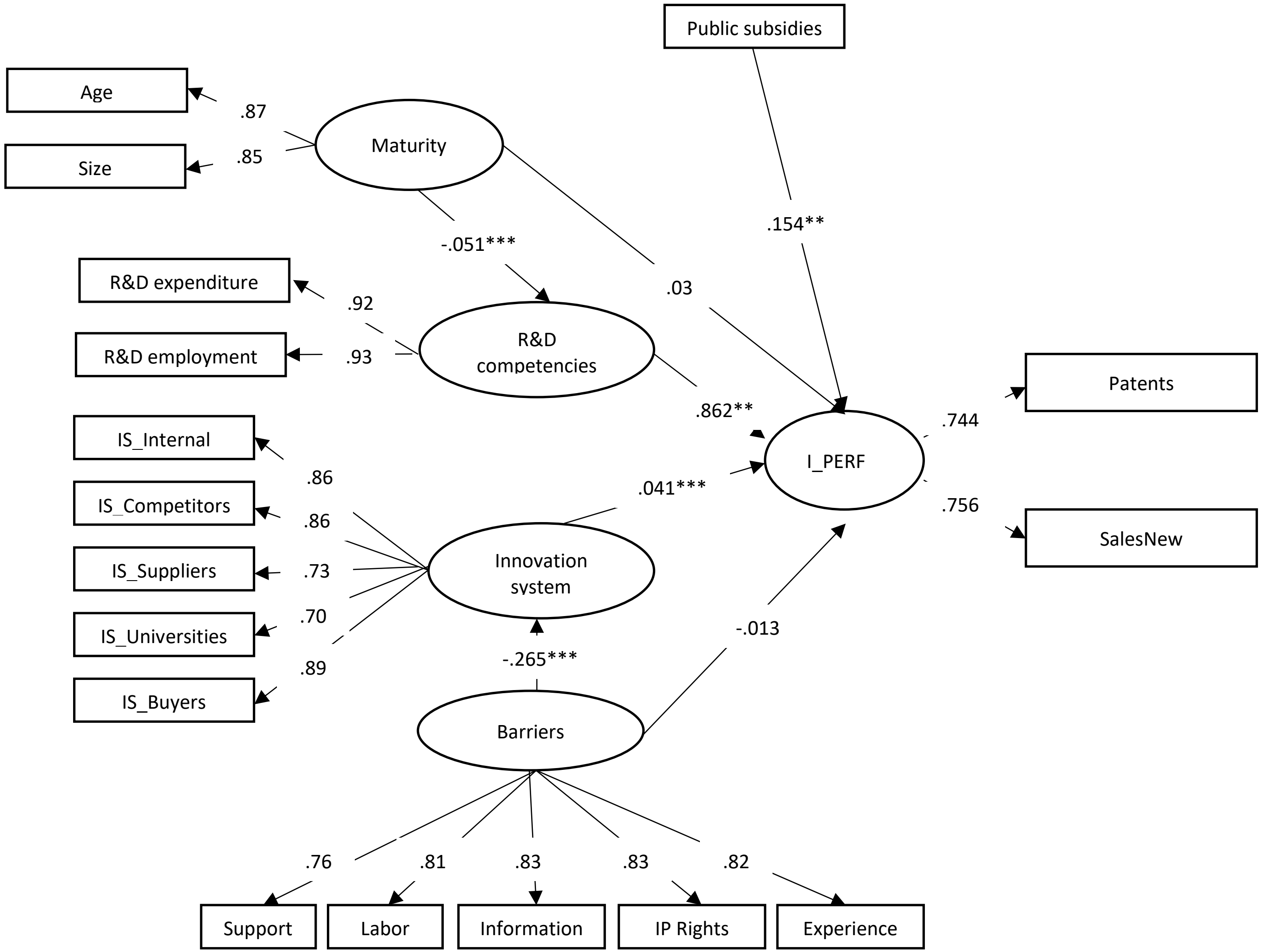

Table I. Definition of Variables in Measurement Model

Innovation performance	**I_PER**
Total Patent Application – logarithm	LPATENT_T
% of Sales from New to Enterprise and New to the Market products	LNBOTH
Organizational life cycle	**LIFE_CYCLE**
Firm Age - logarithm	LAGE
Total Employment - logarithm	LEMP_T
Internal innovation efforts of the firm	**INTERNAL**
Total RD Employment - logarithm	LRDEMP_T
Total RD Spending - logarithm	LSPENDING_T
Barriers to innovation	**BARRIERS**
Lack of support – ordinal	B_S
Lack of labor – ordinal	B_L
Lack of information support – ordinal	B_IS
Lack of information property rights – ordinal	B_IP
Lack of experience - ordinal	B_E
Collaboration with innovation system	**I_SOURCE**
Own source of innovation – ordinal	SI_OWN
Source of innovation from competitors - ordinal	SI_C
Source of innovation from suppliers – ordinal	SI_S
Source of innovation from universities – ordinal	SI_U
Source of innovation from buyers - ordinal	SI_B
Public support for innovation - dichotomous	**S_PUBLIC**

Table II. Factor Findings

Factors	**Variables**	**Factor Loading**	**Cronbach's Alpha**	**% of Explained Variance**
I_SOURCE	SI_B	.897	.892	25,409
	SI_OWN	.867		
	SI_C	.860		
	SI_S	.738		
	SI_U	.708		
BARRIERS	B_IS	.833	.884	24,651
	B_IP	.832		
	B_E	.823		
	B_L	.815		
	B_S	.768		
LIFE_CYCLE	LAGE	.875	.623	13,802
	LEMP_T	.855		
INTERNAL	LRDEMP_T	.938	.602	11,075
	LSPENDING_T	.929		
Cumulative Explained Variance				**74,938**

	Bartlet's Test of Sphericity		
KMO	**Chi Squared**	**Df**	**Significance**
,811	2396	91	,000
The number of observations: 293			

Source: Authors calculations

Table III. Descriptive Statistics for Latent Structures (Means, Standard Deviations, and Correlations)

Mean	S.D.	AVE sqrt		(1)	(2)	(3)	(4)
1.233	0.538	0.770	LIFE_CYCLE (1)	1			
0.655	1.262	0.943	INTERNAL (2)	,076	1		
1.424	1.424	0.700	I_SOURCE (3)	,056	,426***	1	
2.901	1.252	0.686	BARRIERS (4)	,190***	-,017	-,271***	1
0.128	0.336	0.752	I_PER (5)	,024	,525***	,341***	-,084
The number of observations: 293							

***. Correlation is significant at the 0.01 level (2-tailed).

Source: Authors' calculations

Table IV: Model Fit Statistics

Model Fit Statistics	***Value***	***Proposed Value (Bartels et al.,2014)***	
		Good Fit	Acceptable Fit
χ^2/df test statistic	2.762	0<CMIN/DF≤2	2<CMIN/DF≤3
Goodness of Fit Index (GFI)	0.947	0.95≤GFI≤1.00	0.90≤GFI<0.95
Comparative Fit Index (CFI)	0.917	0.97≤CFI≤1	0.95≤CFI<0.97
Root Mean Square Error of Approximation (RMSEA)	0.075	0≤RMSA≤0.05	0.05<RMSA≤0.08

Source: Authors' calculations

Table V. The Path Coefficients of the Direct Effects on Innovation Performance

Hypotheses	Path			Path Coefficients	S.E.	P	Decision
H_1	R&D COMPETENCIES	→	I_PERF	.862	.212	***	H_1 Accept
H_2	MATURITY	→	I_PERF	.031	.017	.107	H_2 Rejection
H_3	INNOVATION SYSTEM	→	I_PERF	.041	.015	***	H_3 Accept
H_4	PUBLIC SUBSIDIES	→	I_PERF	.154	.064	**	H_4 Accept
H_5	BARRIERS	→	I_PERF	-.013	.011	.243	H_5 Rejection
***: 1%; **: 5% significance level							

Source: Authors' calculations

Table VI. The Path Coefficients of the Indirect Effects

Hypotheses	Path			Path Coefficients	Decision
H_{6a}	MATURITY	→	R&D COMPETENCIES	-.051***	H_{6a} Accept
H_{6b}	R&D COMPETENCIES	→	I_PERF	.862***	H_{6b} Accept
H_{7a}	BARRIERS	→	INNOVATION SYSTEM	-.265***	$H7_{a}$ Accept
H_{7b}	INNOVATION SYSTEM	→	I_PERF	.041***	$H7_{b}$ Accept
***: 1% significance level					

Source: Authors' calculations

Table VII. The Determination of the Mediator Relationships

Hypotheses	Path					Path Coefficients	Mediation
H_6	MATURITY	→	R&D COMPETENCIES	→	I_PER	-0.044***	Full Mediation
H_7	BARRIERS	→	INNOVATION SYSTEM	→	I_PER	-0.011***	Full Mediation
***: 1% significance level							