

Article

Impact of Dynamic Capabilities on Performance in Dairy Sheep Farms in Spain

María Teresa Bastanchury-López ¹, Carmen De-Pablos-Heredero ²,
Jose Luis Montes-Botella ³, Santiago Martín-Romo-Romero ¹ and Antón García ^{4,*}

¹ Department of Business Economics (Administration, Management and Organization), Applied Economics II and Fundamentals of Economic Analysis, Rey Juan Carlos University, Paseo de los Artilleros s/n, 28032 Madrid, Spain; teresa.bastanchury@urjc.es (M.T.B.-L.); santiago.martinromo@urjc.es (S.M.-R.-R.)

² ESIC Business & Marketing School, Department of Business Economics (Administration, Management and Organization), Applied Economics II and Fundamentals of Economic Analysis, Rey Juan Carlos University, Paseo de los Artilleros s/n, 28032 Madrid, Spain; carmen.depablos@urjc.es

³ Department of Applied Economy I, Rey Juan Carlos University, Paseo de los Artilleros s/n, 28032 Madrid, Spain; joseluis.montes@urjc.es

⁴ Animal Production Department, University of Cordoba, Rabanales University Campus, 14071 Cordoba, Spain

* Correspondence: pa1gamaa@uco.es

Received: 5 March 2020; Accepted: 16 April 2020; Published: 21 April 2020



Abstract: This study links the dynamic capabilities (DCs) theory with performance in dairy sheep farms in Castilla La Mancha (central Spain). The approach is novel as it seeks to understand how best results can be achieved by deploying DCs in farms. The proposal is that dynamic capabilities are interrelated to each other and present a positive impact on the farm's economic sustainability. A mixed methods approach (a combination of qualitative and quantitative methods of research) was utilized. First, 30 indicators of dynamic capabilities (8 of absorption, 11 of integration, 9 of innovation, and 2 of profits) were selected by applying Delphi's methodology. Second, a structural equation model (SEM) was applied over a random sample of 157 dairy sheep farms to measure the relationship between DCs and the impact of each capability on farms' final performance. The existence of positive relationships amongst absorption, integration, and innovation capabilities was evidenced. Absorption and integration capabilities exhibited positive influences on a farm's final performance. The knowledge of the relationships amongst dynamic capabilities is a new orientation to increase farms' viability. These findings reveal that the application of the dynamic capabilities theory can explain best farms' economic sustainability.

Keywords: farm entrepreneurship; dynamic capabilities; viability; sustainability; technological innovation; new value creation

1. Introduction

In Spain, the dairy sheep industry suffers from an intense crisis as a consequence of a group of factors: lack of profitability, increased bureaucracy in management, absence of intergenerational relay that assures the continuity of the activity [1–3], changes in the habits of consumers with a reduction in the consumption of sheep meat and animal protein [4], and the need to mitigate climate change and reduce greenhouse gas emissions [5]. In Castilla La Mancha (central Spain), the producers have responded to the crisis: 33.7% of farms have abandoned the milking activity and the rest show a trend towards the intensification and specialization of production [6]. In Spain and within the framework of the Common Agricultural Policy (CAP), compensatory payments have been offered to producers for “loss of profits” as a strategy to preserve native breeds (Rural Development Plans, 2015–2020). However,

some challenges remain, i.e., the economic valuation of ecosystem environmental services developed by a mixed cereal–dairy sheep system [7]. Sectoral policies that directly impact the preservation of ecosystems favor the circular economy, increase the lifecycle of sub-products, and contribute to the reduction of greenhouse gases.

In this context of crisis and uncertainty, innovation and technology adoption constitute competitive advantages that favor the viability of livestock farms [8,9]. The lack of technological innovation in family livestock is due to multiple factors, such as small size, poor financial capability, lack of support for technology adoption, poor structures, risk aversion, misalignment between technological improvements and farm's objectives, etc. [10,11]. Human resource training has been described as a key factor in the success or failure of technology adoption [12,13]. The true sources of competitive advantage lie in the ability to adapt to a changing environment [14] and this is explained by the theory of dynamic capabilities (TDCs) [15–17]. The industry faces increasing competition due to the globalization of the economy and, therefore, farms need to readjust their strategies, through changes in their resources and capabilities that allow them to detect new market needs and develop more innovative products [18].

The authors of [19] classify dynamic capabilities (DC) into four types: (i) detection capability: the ability to diagnose the environment and understand the needs of the customers better than competitors; (ii) absorption capability: the ability to acknowledge the value of the new, assimilate the information, and apply it to commercial ends (previous studies [20–25] explain the importance of social capital at firms in the process of knowledge identification and acquisition); (iii) integration capability: it is the result of interacting; this means sharing and combining information [20] (integration arises from the members of a team that share individual knowledge [26]. Knowledge management and organizational routines enable the integration capability at firms [27]); (iv) innovation capability: developing new products and markets, through coordination towards a strategic orientation by applying innovative behaviors and processes.

Previous research has investigated the milk sheep productive industry in Castilla La Mancha with multivariate techniques: principal component analysis and cluster [28–30], Cobb–Douglas and translog functions, analysis of the allocative and costs efficiency [3], the management effectiveness of farms [3,12], the relationships of the quality of milk with the management of farms [31], and discriminant analysis and canonical correlations of the critical success and failure factors for technology adoption [2,8,9]. Farms' sustainability and economic results can be related by means of structural equation model (SEM) analysis [1]. Reference [32] proposed a theoretical allocation of technologies and innovations to the dynamic capabilities of detection, absorption, integration, and innovation in dairy sheep farms.

DCs have been applied to different fields of knowledge [32–40]. It is worthwhile to stress the approach of reference [41] that analyzed the impact of dynamic capabilities on financial results at firms by simple regression. In the meat sector, a dynamic capabilities model was developed based on a review and analysis of the literature [42]. Dynamic capabilities and small and medium-sized firms' (SMEs') growth in Spain have been linked by means of structural equations [43]. However, the benefit of the application of the dynamic capabilities theory to improve the viability of the farms seems not to be well understood yet.

Innovation capability supports a new strategic design that improves the viability of the farm [34]. This is relevant, according to the problems of these farms, where a limit on intensification has been reached. A change would be needed in the production model where the production method and the relationships with the different steps of the value chain are redesigned [9,44].

Apart from this, in organizational innovation paths, new models of collaborative innovation emerge through the use of collaborative knowledge networks [45]. One innovative and transfer management tool is the use of information technology (IT) for the development of smart farms [1,46]. This way, IT has played an important role as a facilitator of knowledge management in organizations. The acquisition of IT-driven knowledge presents a positive impact on the capabilities of integration and innovation [26,47]. Innovative strategic planning requires setting objectives and the most appropriate

ways to achieve them; it implies knowing the existing resources in the company and making current decisions about the future of the company [48,49]. Ultimately, the application of integration and innovation concepts from the dynamic capabilities approach favors reconfiguring organizational activities aimed at the creation of value [50]. In addition, all this is framed within the existing problems in livestock farming, such as excessive bureaucracy, loss of profitability, and lack of generational change, all taking place in a society committed to the reduction of greenhouse gases and the development of systems of production that are environmentally friendly.

There is a lack of research to assess quantitatively the impact of dynamic capabilities on the viability and sustainability of farms. There is a need to go deeply into this topic to find out answers to questions such as: what is the impact of an increase of dynamic capabilities on a farm's economic sustainability? How does the process of technology adoption take place from the dynamic capabilities approach?

To go deeply into these questions for the case of Manchego dairy sheep farms would be a novel approach, and it constitutes needed research aimed to improve the viability and sustainability of farms. The ones that are generating increased added value could promptly develop a sustainable competitive advantage. If validated, its applicability could be extended to other livestock activities in a critical situation. So, the relevance of this article consists of finding out if relationships among elements of the dynamic capabilities theoretical framework [32] significantly impact financial results in sheep farming in Spain.

The main objective of this research consists of analyzing how farms' dynamic capabilities impact on their final performance. A dynamic capabilities (DC) model, with 49 indicators identified, was applied to this research [32,34]. Nevertheless, several questions that had to be solved before applying the model were raised: were the selected indicators appropriate? How was it decided that each indicator should be categorized in the specific latent variable? What effect did each construct show on the final results of the farm? Questions were evaluated by applying a mixed methods approach, combining qualitative and quantitative methodologies. For the selection and grouping of capabilities' indicators, Delphi's methodology was used [2,8]. Later on, a structural equation model (SEM) was built to evaluate interactions between the different dynamic capabilities and the impact of dynamic capabilities on farms' performance for Manchego dairy sheep farms in Castilla La Mancha, Spain [1,51,52].

2. Materials and Methods

2.1. Sample Collected and Indicators

The study area was the Spanish region of Castilla La Mancha (38°–41° N; 1°–5° W), with a surface area of roughly 800,000 ha and Mediterranean continental climate: dry winters and hot and dry summers. A random sample of 157 Manchego sheep dairy farms was selected, 17.2% of the whole population of 907 Manchego sheep farms from the "La Mancha" region. Data were collected by using in situ visits to the farms by the same person, with 5 h of duration each one, from 2012 to 2014, updated according to data from existing farms in 2018. References [2,30] describe the Manchego dairy mixed system in Castilla La Mancha. The questionnaire included 203 questions related to the use of land, facilities, flock, labor force, feeding, grazing, breeding, animal healthcare, milking and milk quality, and economic and social issues [29,30]. In 2018, the economic data (prices and costs) of each farm were updated, operative farms were identified (87% of the sample), and missing data on dynamic capabilities were collected.

Based on the model proposed by reference [32] for measurement of dynamic capabilities, the indicators were identified. Through the qualitative methodology in Section 2.2, we attempted to answer two questions: what are the indicators and why they were chosen? How was each item in the specific latent variable categorized? Later, through quantitative methodology, the relationship among constructs was found using SEM analysis. The model is proposed in Section 2.3, and the statistical analyses are described in Section 2.4.

2.2. Selection and Assignment of Dynamic Capabilities (DC) Indicators

Considering Delphi's methodology, 49 indicators of dynamic capabilities and performance were assessed (Supplementary Materials Table S1). The selection and assignment process consisted of experts' judgments by means of successive iterations of a questionnaire oriented to show convergence of opinions, and to identify dissent or non-convergence [2,11,12]. To do the Delphi, a workshop with face-to-face participation of 30 experts from the Animal Science Department at the University of Cordoba was held in May 2017. The workshop began with an introduction, oriented to explain the main objectives of the research and the concepts of DCs. The experts assessed each DC by using a Likert scale from one to five values, where one was the least important and five the most important. In the first round, the indicators were assessed and assigned by experts to dynamic capabilities, and a first draft of the metric was agreed upon.

In a second round, the indicators that did not reach consensus in first round were discussed. Once the indicators were finally chosen and assigned to dynamic capabilities by consensus, the questionnaire was sent to each expert to re-examine and reconsider his judgment.

Once the indicators of each DC were identified and considering the information obtained from the questionnaires sent to 157 farms, the proposed indicators were tested. Uncorrelated variables and the ones showing low coefficient of variation by pairs with linear dependence were removed. Detection capability indicators were excluded because they showed linear correlation with absorption and integration capabilities. Therefore, the initial model taken into consideration [32] was modified; only absorption, integration, and innovation capabilities were considered in a structural equation model. Finally, 30 indicators were selected, and four latent variables or constructs were built [53].

Absorption capability (absorp) included the variables: staff training (Abs_1), select personnel (Abs_2), information sources (Abs_3), advisors (Abs_4), type of advisors (Abs_5), advisory conditions (Abs_6), guild or farmers' association (Abs_7), and kind of guild (Abs_8). Integration capability (integ) was represented by the variables: record system (Int_1), performance of dairy control (Int_2), planning of the operative processes (Int_3), existence of genetic improvement plan (Int_4), feeding strategy (Int_5), use of minerals (Int_6), use of strategic supplements (Int_7), conserved forages (Int_8), grazing management strategies (Int_9), identifying non-productive animals (Int_10), and breeding program (Int_11). Innovation capability (innov) was composed of the following variables: preventive policy (Inn_1), program of milk quality (Inn_2), drying treatment (Inn_3), udder disinfection (Inn_4), milking system cleaning (Inn_5), reproductive techniques (Inn_6), reproductive rates (Inn_7), and artificial insemination (Inn_8). In addition, using economic and financial ratios for assessment of farms' economic sustainability [1,54,55], "profit" was used as the result of the efficiency ratios of returns on assets (ROA) and returns in investments (RF).

Most of the indicators were taking a value of 0 to indicate the absence of an attribute and a value of 100 to indicate its degree of presence. Certain attributes were quantified by several excluding options. Categorical questions with four response options were assigned values of 0, 33, 66, and 100. In addition, categorical questions with five response options were assigned values of 0, 25, 50, 75, and 100. Finally, two financial ratios normalized, return of assets (ROA) and return on investments (RF), were selected as economic sustainability indicators. The metric applied for the measurement of each variable is shown in Table S1.

2.3. Hypotheses

The general hypothesis is: a farm's dynamic capabilities (DC) will positively influence its economic sustainability. Subsequently, relationships amongst the dynamic capabilities of absorption (absorp), integration (integ), and innovation (innov) were also analyzed. Eight variables of absorption, 11 of integration, 9 of innovation capabilities, and 2 of profits were included in the final model. Five hypotheses were formulated as displayed in Figure 1.

Hypothesis 1 (H1). *The absorption capability (absorp) will positively influence the integration capability (integ).*

Hypothesis 2 (H2). *The integration capability (integ) will positively influence the innovation capability (innov).*

Hypothesis 3 (H3). *The absorption capability (absorp) will positively influence a farm's results (profit); the return on assets (ROA) and return on investments (RF) are profit indicators (profit).*

Hypothesis 4 (H4). *The integration capability (integ) will positively influence the results (profit).*

Hypothesis 5 (H5). *The innovation capability will positively influence a farm's final results (profit).*

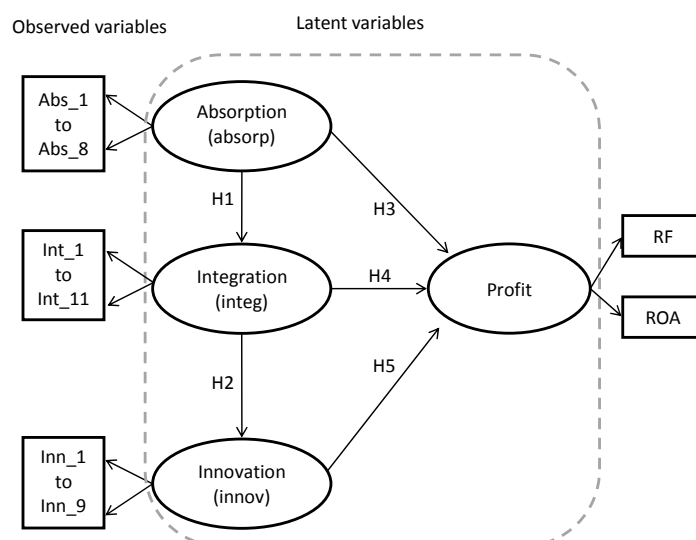


Figure 1. Hypotheses of dynamic capabilities model. ROA—returns on assets, RF—returns in investments.

2.4. Statistical Analyses

The values of each variable were calculated for each one of the 157 farms visited. Thirty indicators of dynamic capabilities and economic sustainability were analyzed.

The estimation of the structural equation model (SEM) evaluated the relationships amongst the different constructs (absorp, integ, innov, and profit), through path coefficients, significance level, and cross-validated redundancy. The focus was on graphs without feedback loops between nodes. The model was estimated by means of partial least squares (PLS) path modeling, which allows for estimating complex cause–effect relationships among and latent variables. To ensure the stability of the results, the number of bootstrap subsamples was set to 5000. The estimated parameters from the subsample's models were used to derive standard errors for the estimates and, consequently, the bootstrap 95% confidence intervals [51,56,57].

3. Results

3.1. Dynamic Capabilities Model

Quality criteria considered for the constructs in the final model are presented in Table 1. The square root of the average variance extracted (AVE) of each construct should be higher than its highest correlation with any other construct [58]. The variability of a latent variable attributable to indicators compared to variance derived from measurement errors gives a construct's AVE. Values for the AVE above 0.5 are acceptable [59]. This criterion is satisfied in Table 1, confirming convergent validity. Measures used to evaluate internal consistency reliability were Cronbach's alpha, Dillon–Goldstein's rho and eigenvalue analysis [60]. In the literature, there is no minimum acceptable value of Cronbach's alpha, sometimes levels above 0.7 are acceptable [61], and other values above 0.5 are consistent with models enjoying internal reliability [62].

Table 1. Model fit and quality indices overview.

Index	Dynamic Capabilities			Economic Sustainability
	(Absorp)	(Integ)	(Innov)	(Profit)
Average variance extracted (AVE)	0.6912	0.7691	0.8178	0.8654
Cronbach's alpha	0.5558	0.8476	0.7799	0.8478
Dillon–Goldstein's rho	0.8183	0.9087	0.9009	0.9293
1st eigenvalue	1.3849	2.3074	1.6393	1.7357
2nd eigenvalue	0.6151	0.5136	0.3607	0.2643
R ²	0.0000	0.2177	0.6394	0.2505
Communality	0.6912	0.7691	0.8178	0.8654
Redundancy	0.0000	0.1674	0.5229	0.2168

Two other metrics used to ascertain the correct outer model specification were also considered. Dillon–Goldstein's rho values were acceptable as they were higher than 0.7. First, eigenvalues were greater than 1, while second, eigenvalues were less than 1. This is as expected of reasonable constructs [60]. R² for innovation was high (0.6394) and low (below 0.3) for integration capability and profit. Average redundancy showed the ability of exogenous constructs to explain the average variation in the indicators of dependent latent variables. As the use of redundant items has adverse consequences for the measures' content validity, researchers are advised to minimize the number of redundant indicators. In this research, absorption, integration, and innovation predicted 21.7% of the variability of profit indicators. Communality shows how much reflective indicator variability is reproducible by the latent variable. A communality of 50% may be expected from a reflective block [61]. The R² and redundancy for absorption were both zero, as the construct was an exogenous latent variable [51,63].

3.2. Hypotheses Assessment

The inner-plot is shown in Figure 2, and Table 2 presents the structural model, testing the hypotheses presented above. Statistically significant relationships have p-values lower than 0.05. Absorption capability positively impacted integration at a 1% level of significance. Integration had a positive influence on innovation at a 1% significance level. Absorption and integration capabilities positively influenced economic sustainability at 1% and 5%, respectively. Innovation had no statistically significant influence on profit. Although innovation appeared to negatively influence profitability, the relationship was not statistically significant. Hypothesis 5 may, therefore, be rejected.

The DC models' goodness-of-fit was 0.5380. This index was calculated as the geometric mean of the average communality and the average R² value. A severe shortcoming with this index is that there was no threshold allowing to determine its statistical significance [56,57]. Although this was below the threshold level of 0.7 to be considered "acceptable", the prediction power was fairly substantial. The higher this measure is, the more appropriate the model is [61]. Bootstrapping results are shown in Table 2. Original path coefficients are compared with the results after bootstrapping. Confidence intervals assist in ascertaining the significance of the relationships examined. At a 95% confidence level, innovation did not impact profitability in this industry, given the available data.

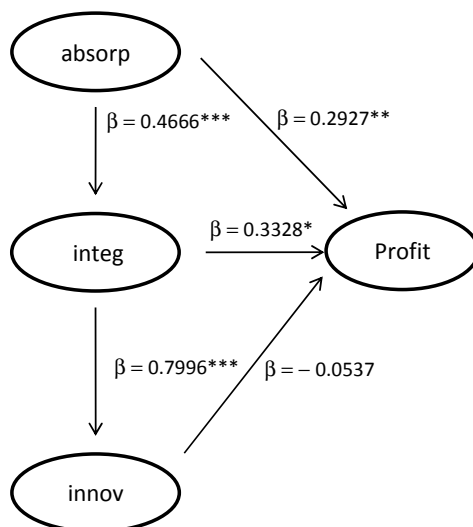


Figure 2. Final model with path coefficients and level of significance (p values = * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$).

Table 2. Hypotheses testing and bootstrap.

	Structural Model			Bootstrap Path Coefficients		
	Estimate	Std. Error	p -Value	Mean	Perc (0.025)	Perc (0.0975)
H1: absorp $\rightarrow$ integ	0.4666	0.0894	0.0000	0.4730	0.3268	0.6153
H2: integ $\rightarrow$ innov	0.7996	0.0607	0.0000	0.8030	0.7173	0.8774
H3: absorp $\rightarrow$ profit	0.2927	0.0100	0.0043	0.3009	0.0896	0.4830
H4: integ $\rightarrow$ profit	0.3328	0.1556	0.0345	0.3268	0.0930	0.6344
H5: innov $\rightarrow$ profit	−0.0537	0.1472	0.7163	−0.0450	−0.3263	0.1727

The impact that each construct had on the rest of the latent variables is shown in Table 3. The total effects are the sum of direct and indirect effects. Additionally, the impact of absorption (absorp) over innovation capability (innov) is shown in Table 3; this last relationship was not considered in the initial model (Figure 1).

Table 3. Total effects between constructs (direct, indirect, and total).

Relationships	Effects		
	Direct	Indirect	Total
Absorp $\rightarrow$ integ	0.4666	0.0000	0.4666
Absorp $\rightarrow$ innov	0.0000	0.3731	0.3731
Absorp $\rightarrow$ profit	0.2927	0.1352	0.4280
Integ $\rightarrow$ innov	0.7996	0.0000	0.7996
Integ $\rightarrow$ profit	0.3328	−0.0429	0.2899
Innov $\rightarrow$ profit	−0.0537	0.0000	−0.0537

4. Discussion

The theoretical framework supporting the model of this research was based on the resource-based view and the dynamic capabilities approach according to references [16,32,50,64–75].

Thirty indicators of dynamic capabilities were selected by a panel of experts. A random sample of 157 dairy sheep farms in Spain was selected. Results showed the association amongst the capabilities of absorption, integration, and innovation (Hypotheses 1 and 2 were accepted) and the impact of dynamic capabilities in farms' profit was evaluated (Hypotheses 3 and 4 were accepted and hypothesis 5 was rejected).

Absorption capability showed a positive influence on integration (Hypotheses 1) and on the economic result (Hypotheses 3) in a direct and indirect way. Farms recognize the value of external information and new technologies, assimilate and apply them to commercial ends [2,9]. Farmers in central Spain mainly responded to the economic crisis by increasing the sizes of their flocks, increasing the intensification and specialization in a productive activity, and reducing diversity and resilience of the farming system [3,6,30]. This situation entails a high level of technology adoption by establishing priorities to those technologies that impact on final results in the short term. In this sense, farmers that have implemented local breeding programs achieve improvements in their farms' viability [2].

The technologies implemented must be assembled with other areas of the farm, such as feed and animal health. This need to articulate knowledge is reflected in the existence of a direct effect (0.2927) between the absorption capability and economic results, and one indirect effect (0.1352) that generates a total effect $\text{absorp} \rightarrow \text{profit}$ (0.4280) (Table 3). These results agree with previous models [32]. On the contrary, these farms maintain a strategy opposed to the dual-purpose systems described in Latin American and Caribbean countries, with very low technological levels [44,76,77]. For smallholders of dual-purpose cattle farms in Mexico, low technological levels are described [9]. In this case, their strategy is oriented to small-scale production, low levels of technology, scarce external inputs, and low risk.

In this research, integration capability showed a high positive influence over innovation (hypothesis 2 accepted); although, at the same time, integration did not show any indirect effect on innovation (Table 3). That is, DCs' impacts appeared to happen sequentially and cumulatively [17]. The interaction of activities demonstrated the use and interchange of information amongst functional units. In the dairy sheep industry, those producers adopting quality improvement programs need an integrated technology adoption in different fields of the farm [31]. In this same sense, producers included within the breeding planning need to improve other technological areas (health, feeding, etc.) to achieve the success of the program [2]. DCs consider the organization as a whole, as well as its relationship with the environment, facilitating the coordination of employees and the development of behavior patterns [78]. In this regard, authors of [8,9] explain the need to assemble the different technological areas in the company (feeding, reproduction, health, management, land use, quality of the milk) to achieve higher levels of efficiency. The results showed a direct effect of the integration capability on a farm's performance (hypothesis 4 accepted).

Integration capability is the ability to integrate different patterns of interaction through contribution, representation, and interrelation [32,41,73]. This way, integration capability refers to the ability to properly combining human, technological, and organizational resources [19]. Firms may have similar resources, but the way they combine them can be different and, therefore, turn in a variety of degrees of integration capability [68,71].

We suggest improving the 18 organizational routines and practices in absorption and integration capabilities (Table S1); e.g., migrating from a batch control to individual control, by productive objectives and applying IT in decision-making in dairy sheep farms.

Contrary to expectations, innovation capability did not exhibit a significant effect on results and hypothesis 5 was rejected. Bravo and Herrera [27] found a positive effect between innovation and economic performance. In the same vein, a positive relationship between innovation capability and growth in SMEs in Spain was verified [43]. To a contrary extent, references [1,11] indicate that the technical innovations allowed an increase in the gross margin in the short term, although it was not sustainable in the long term. Further, in adverse political and economic conditions, innovations are not enough to mitigate the negative effects of crises. Apart from this, advances in animal health innovation and milk quality are bound by the country's regulations, which causes them to have a negative or null impact on the results [9].

These findings suggested that dairy sheep farmers have made a great effort for implementing technology adoption in Spain (absorption capability) [2,29]. Currently, they are adapting it to the production process and to the other areas of the farm (integration capability) [7,27]. However, they

have not yet reached the innovation phase that favors the creation of additional value and the deployment of sustainable competitive advantages. Once the integration in processes is optimized, the innovation phase, where the productive models must be redefined, arises [44]. The adoption sequence of capabilities could be an explanation, as no positive relationship between innovation and profit in the dairy sheep sector was found.

The increase of a farm's performance is proposed from the deployment of dynamic capabilities in dairy sheep farms in Spain. An integrative and complementary vision to previous ones aimed to explain the reasons why some farms have developed certain dynamic capabilities that have allowed them to reach the best results would be of great interest. Dynamic capabilities (intangible factors) have been related to farms' final performance through an SEM model. The deployment of DCs allows improving economic results in the short run and thinking in a strategic change of the productive model in the long run.

The research presented significant limitations. First, because the conceptualization of dynamic capabilities is relatively new, much remains to be learned about the nature of the synergies and trade-offs between absorption, integration, and innovation components [79–82]. There is little empirical research upon which to base the selection of one modeling approach, however, there are other approaches theorizing in the dynamic capabilities context that should be evaluated [83]. Likewise, it would be necessary to confront the proposed model with other species, production systems, and socio-economic contexts that would allow it to be completed and validated [9]. This research used a cross-sectional research method. In the future, longitudinal studies in the farms should be considered for understanding how the growth of these capabilities influences economic sustainability [2].

5. Conclusions

The appropriate variables to assess each of the dynamic capabilities and profit indicators were agreed by 30 experts in dairy sheep farms. In the case of Castilla La Mancha (Spain), the dynamic capabilities of absorption, integration, and innovation were identified as significant intangible constructs. After the selection of the 30 indicators, data were collected from 157 farms. A structural equation model (SEM) measured the relationships of these variables and their effect on the improvement of production results. The results evidenced the existence of interrelations between absorption, integration, and innovation (hypotheses 1 and 2 were accepted). In addition, absorption and integration capabilities showed a positive impact on the results (hypotheses 3 and 4 were accepted), although it cannot be confirmed for the case of innovation (hypothesis 5 was rejected).

This study addressed a gap between the dynamic capabilities perspective and the economic sustainability of the farms, linking from an interdisciplinary way, strategic management theory with animal science. This research took a novel approach as it quantified the relationship amongst dynamic capabilities (absorption, integration, and innovation) and their impacts on farms' final performance.

The improvement of dynamic capabilities favors an increase in farms' viability. Technological absorption is a first step, although it is not sufficient to create competitive advantages. These results suggest that the farms should develop organizational routines and practices oriented to create absorption and integration capabilities aimed to reach the best managerial results.

Thus, dynamic capabilities theory provides an interesting theoretical foundation for studying the link between absorption, integration, and innovation capabilities and firms' performance. In addition, it allows us to deepen in the knowledge of the mechanisms by which organizations achieve superior performance levels and sustainability. Finally, the DCs perspective could allow farms to reach sustainable competitive advantages.

Supplementary Materials: The following are available online at <http://www.mdpi.com/2071-1050/12/8/3368/s1>, Table S1: Indicators of dynamic capabilities.

Author Contributions: Conceptualization and methodology, all authors. Formal analysis, software, data curation, data processing, M.T.B.-L., J.L.M.-B., and S.M.-R.-R.; statistical analysis, J.L.M.-B.; validation and investigation, M.T.B.-L., C.D.-P.-H., A.G.; supervision, A.G., C.D.-P.-H., M.T.B.-L.; project administration, A.G., C.D.-P.-H.; data

acquisition, A.G., M.T.B.-L. All authors have been involved in developing, writing, commenting, editing, and reviewing the manuscript. All authors read and approved the final manuscript.

Funding: This research received no external funding.

Acknowledgments: The authors thank Research Project on agricultural resources and technology run by the Spanish National Institute of Agricultural and Food Research and Technology in conjunction with regional authorities (RTA2011-00057C02) for providing financial support to the study. We also thank the three anonymous reviewers for their efforts and valuable comments.

Conflicts of Interest: The authors declare no conflicts of interest.

References

- De-Pablos-Heredero, C.; Montes-Botella, J.L.; García-Martínez, A. Sustainability in smart farms: Its impact on performance. *Sustainability* **2018**, *10*, 1713. [CrossRef]
- Rivas, J.; Perea, J.M.; De-Pablos-Heredero, J.; Angón, E.; Barba, C.; García, A. Canonical correlation of technological innovation and performance in sheep's dairy farms: Selection of a set of indicators. *Agric. Syst.* **2019**, *176*, 102665. [CrossRef]
- Toro-Mújica, P.; García, A.; Aguilar, C.; Vera, R.; Perea, J.; Angón, E. Economic Sustainability of Organic Dairy Sheep Systems in Central Spain. *Ital. J. Anim. Sci.* **2015**, *14*, 193–201. [CrossRef]
- Escriba-Perez, C.; Baviera-Puig, A.; Buitrago-Vera, J.; Montero-Vicente, L. Consumer profile analysis for different types of meat in Spain. *Meat Sci.* **2017**, *129*, 120–126. [CrossRef] [PubMed]
- FAO. Soluciones Ganaderas Para el Cambio Climático. 2018. Available online: <http://www.fao.org/3/I8098ES/i8098es.pdf> (accessed on 20 January 2020).
- Angón, E.; Perea, J.; Toro-Mújica, P.; Rivas, J.; De-Pablos, C.; García, A. Pathways towards to Improve the Feasibility of Dairy Pastoral System in La Pampa (Argentina). *Ital. J. Anim. Sci.* **2015**, *14*, 643–649. [CrossRef]
- Asai, M.; Moraine, M.; Ryschawy, J.; de Wit, J.; Hoshide, A.K.; Martin, G. Critical factors for crop-livestock integration beyond the farm level: A cross-analysis of worldwide case studies. *Land Use Policy* **2018**, *73*, 184–194. [CrossRef]
- García-Martínez, A.; Rivas-Rangel, J.; Rangel-Quintos, J.; Espinosa, J.A.; Barba, C.; De-Pablos-Heredero, C. A Methodological Approach to Evaluate Livestock Innovations on Small-Scale Farms in Developing Countries. *Future Internet* **2016**, *8*, 25. [CrossRef]
- Rangel, J.; Perea, J.; De-Pablos-Heredero, C.; Espinosa-García, J.A.; Toro-Mújica, P.; Feijoo, M.; Barba, C.; García, A. Structural and technological characterization of tropical smallholder farms of dual-purpose cattle in Mexico. *Animals* **2020**, *10*, 86. [CrossRef]
- Ryschawy, J.; Choisis, N.; Choisis, J.P.; Joannon, A.; Gibon, A. Paths to Last in Mixed Crop-Livestock Farming: Lessons from an Assessment of Farm Trajectories of Change. *Animal* **2013**, *7*, 673–681. [CrossRef]
- Ryschawy, J.; Joannon, A.; Choisis, J.P.; Gibon, A.; Le Gal, P.Y. Participative assessment of innovative technical scenarios for enhancing sustainability of French mixed crop-livestock farms. *Agric. Syst.* **2014**, *129*, 1–8. [CrossRef]
- Morantes, M.; Dios-Palomares, R.; Peña, M.E.; Rivas, J.; Perea, J.; García, A. Management and productivity of dairy sheep production systems in Castilla-La Mancha, Spain. *Small Rumin. Res.* **2017**, *149*, 62–72. [CrossRef]
- Noltze, M.; Schwarze, A.; Qaim, M. Understanding the adoption of system technologies in smallholder agriculture: The system of rice intensification (SRI) in Timor Leste. *Agric. Syst.* **2012**, *108*, 64–73. [CrossRef]
- Prahalad, C.K.; Hamel, G. The Core Competence of the Corporation. *Harv. Bus. Rev.* **1990**, *68*, 79–91.
- Helfat, C.; Peteraf, M. Understanding dynamic capabilities: Progress along a developmental path. *Strateg. Organ.* **2009**, *7*, 91–102. [CrossRef]
- Teece, D.; Pisano, G.; Shuen, A. Dynamic Capabilities and Strategic Management. *Strateg. Manag. J.* **1997**, *18*, 509–533. [CrossRef]
- Teece, D.J. Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance. *Strateg. Manag. J.* **2007**, *28*, 1319–1350. [CrossRef]
- Grande, J. New venture creation in the farm sector—Critical resources and capabilities. *J. Rural Stud.* **2011**, *27*, 220–233. [CrossRef]
- Hou, J.; Chang, H. Exploring the Core Components of Dynamic Capabilities. In Proceedings of the Presented at the BAI 2008 International Conference on Business and Information, Seoul, Korea, 7–8 July 2008.

20. Okhuysen, G.A.; Eisenhardt, K.M. Integrating knowledge in groups: How formal interventions enable flexibility. *Organ. Sci.* **2002**, *13*, 370–386. [[CrossRef](#)]
21. Ortiz, B. Relaciones Entre el Capital Social, La Capacidad de Absorción y la Adquisición Externa Como Antecedentes de la Capacidad de Innovación. Una Aplicación en Sectores Intensivos en Conocimiento. Ph.D. Thesis, University of Castilla-La Mancha, Albacete, Spain, 2016.
22. Ebers, M.; Maurer, I. Connections count: How relational embeddedness and relational empowerment foster absorptive capacity. *Res. Policy* **2014**, *43*, 318–332. [[CrossRef](#)]
23. González-Campo, C.H.; Hurtado, A. Influencia de la capacidad de absorción sobre la innovación: Un análisis empírico en las mipymes colombianas. *Estud. Gerenc.* **2014**, *30*, 277–286. [[CrossRef](#)]
24. Helfat, C.; Finkelstein, S.; Mitchell, W.; Peteraf, M.; Singh, H.; Teece, D.; Winter, S. *Dynamic Capabilities: Understanding Strategic Change In Organizations*; Blackwell Publishing: Malden, MA, USA, 2007.
25. Wang, E.; Klein, G.; James, J. IT support in manufacturing firms for a knowledge management, dynamic capability link to performance. *Int. J. Prod. Res.* **2007**, *45*, 2419–2434. [[CrossRef](#)]
26. Li, H.; Zhang, Q.; Zheng, Z. A mediating Effect of Knowledge Integration and Moderating Effect of Organizational Task Environment. *Enterp. Inf. Syst.* **2019**, *13*, 1324–1346. [[CrossRef](#)]
27. Bravo Ibarra, E.R.; Herrera, L. Capacidad de innovación y configuración de recursos organizativos. *Intang. Cap.* **2009**, *5*, 301–320.
28. Caballero, R. Stakeholder interactions in Castile-La Mancha, Spain's cereal-sheep system. *Agric. Hum. Values* **2009**, *26*, 219–231. [[CrossRef](#)]
29. Toro-Mújica, P.; García, A.; Gómez Castro, G.; Perea, J.; Rodríguez, V.; Angón, E. Organic dairy sheep farms in south-central Spain: Typologies according to livestock management and economic variables. *Small Rumin. Res.* **2012**, *104*, 28–36. [[CrossRef](#)]
30. Rivas, J.; Perea, J.; Angón, E.; Barba, C.; Morantes, M.; Dios-Palomares, R.; García, A. Diversity in the Dry Land Mixed System and Viability of Dairy Sheep Farming. *Ital. J. Anim. Sci.* **2015**, *14*, 179–186. [[CrossRef](#)]
31. Jiménez-Sobrino, L.; Poveda-Colado, J.M.; Garzón-Sigler, A.I.; Martínez-Marín, A.L.; Núñez-Sánchez, N.; Romero-Asensio, J.; Pérez-Guzmán-Palomares, M.D.; Arias-Sánchez, R. Composition and colour indices of sheep's bulk tank milk are influenced by production practices. *Ital. J. Anim. Sci.* **2018**, *17*, 477–488. [[CrossRef](#)]
32. Bastanchury-López, M.T.; De-Pablos-Heredero, C.; García-Martínez, A.; Martín-Romo-Romero, S. Review of the measurement of dynamic capabilities: A proposal of indicators for the sheep industry. *Cienc. Tecnol. Agropecu.* **2019**, *20*, 371–386.
33. Alfirevic, N.; Talaja, A. Managing knowledge through dynamic capabilities. In *Learning Models for Innovation in Organizations: Examining Roles of Knowledge Transfer and Human Resources Management*; Soliman, F., Ed.; Business Science Reference: Hershey, PA, USA, 2013; pp. 157–172.
34. Bastanchury-López, M.T. El Desarrollo de las Capacidades Dinámicas a Través del uso de Paquetes Tecnológicos en el Sistema Productivo Ovino Lechero de la Denominación de Origen Protegida (DOP) Queso Manchego. Ph.D. Thesis, University Rey Juan Carlos, Madrid, Spain, 2017.
35. De-Pablos-Heredero, C.; López Berzosa, D. La importancia de los mecanismos de coordinación organizativa en la excelencia del sistema español de trasplantes. *Intang. Cap.* **2012**, *8*, 17–42.
36. Blanco-Callejo, M.; De-Pablos-Heredero, C. Co-innovation at Mercadona: A radically different and unique innovation model in the retail sector. *J. Bus. Retail Manag. Res.* **2019**, *13*, 326–341.
37. De-Pablos-Heredero, C.; Fernández-Valero, G.; Blanco-Callejo, M. Supplier Qualification Sub-Process from a Sustained Perspective: Generation of Dynamic Capabilities. *Sustainability* **2017**, *9*, 730. [[CrossRef](#)]
38. Rengkung, L.R. Modelling of dynamic capabilities: A system dynamics approach. *Acad. Strateg. Manag. J.* **2018**, *17*, 1–14.
39. Talaja, A. Adaptive capabilities, competitive advantage and company's performance. *Econ. Rev.* **2013**, *64*, 49–63.
40. Talaja, A. Innovative capabilities, firm performance and foreign ownership: Empirical analysis of large and medium-sized companies from all industries. *Bus. Econ. Horiz.* **2013**, *9*, 69–78. [[CrossRef](#)]
41. Cruz González, J.; López Sáez, P.; Martín de Castro, G. La Influencia de las Capacidades Dinámicas sobre los Resultados Financieros de la Empresa. *Cuad. Estud. Empres.* **2009**, *19*, 105–128.
42. Valencia-Rodríguez, M. Dynamic capabilities, product innovation and organizational learning pymes in the meat sector. *Ing. Ind.* **2015**, *36*, 297–305.

43. Peñate Santana, Y. Factores Determinantes del Crecimiento de las PYMES. El Papel de las Capacidades Dinámicas y la Orientación Emprendedora. Ph.D. Thesis, University of Oviedo, Oviedo, Spain, 2013.
44. Hernández-Castellano, L.E.; Nally, J.E.; Lindahl, J.; Wanapat, M.; Alhirdary, I.A.; Frangueiro, D.; Grace, D.; Ratto, M.; Bambou, J.C.; Almeida, A.M. Dairy science and health in the tropics: Challenges and opportunities for the next decades. *Trop. Anim. Health Prod.* **2019**, *51*, 1009–1017. [[CrossRef](#)]
45. Zurbriggen, C.; Sierra, M. Innovación colaborativa: El caso del Sistema Nacional de Información Ganadera. *Agrociencia Urug.* **2017**, *21*, 140–153.
46. Petter, S.; Delone, W.; McLean, E.R. The Past, Present, and Future of “IS Success”. *J. Assoc. Inf. Syst.* **2012**, *13*, 341–362. [[CrossRef](#)]
47. Beath, C.; Becerra-Fernandez, I.; Ross, J.; Short, J. Finding Value in the Information Explosion. *MIT Sloan Manag. Rev.* **2012**, *53*, 18–20.
48. Lozano, R. Creativity and organizational learning as means to foster sustainability. *Sustain. Dev.* **2014**, *22*, 205–216. [[CrossRef](#)]
49. Chou, S.; Chen, J.C. Six Sigma-Based Optimization of Shrinkage Accuracy in Injection Molding Processes. *Int. J. Ind. Manuf. Eng.* **2018**, *5*, 3.
50. Lavie, D. The competitive advantage of interconnected firms: An extension of the resource-based view. *Acad. Manag. Rev.* **2006**, *31*, 638–658. [[CrossRef](#)]
51. Vinzi, V.E.; Trinchera, L.; Amato, S. “PLS path modeling: From foundations to recent developments and open issues for model assessment and improvement”. In *Handbook of Partial Least Squares*; Exposito Vinzi, V., Chin, W., Henseler, J., Wang, H., Eds.; Springer: Heidelberg, Germany, 2010.
52. Hair, J.F.; Ringle, C.M.; Sarstedt, M. “PLS-SEM: Indeed a silver bullet”. *J. Market. Theory Pract.* **2011**, *19*, 139–152. [[CrossRef](#)]
53. Aldás, J.; Uriel, E. *Análisis Multivariante Aplicado Con R*, 2nd ed.; Ediciones Paraninfo: Madrid, Spain, 2017.
54. Laaksonen, O.; Peltoniemi, M. The essence of dynamic capabilities and their measurement. *Int. J. Manag. Rev.* **2018**, *20*, 184–205. [[CrossRef](#)]
55. Zorn, A.; Esteves, M.; Baur, I.; Lips, M. Financial Ratios as Indicators of Economic Sustainability: A Quantitative Analysis for Swiss Dairy Farms. *Sustainability* **2018**, *10*, 2942. [[CrossRef](#)]
56. Chin, W.W. “The Partial Least Squares Approach to Structural Equation Modeling”. In *Modern Methods for Business Research*; Marcoulides, G.A., Ed.; Lawrence Erlbaum Associates Publisher: Mahwah, NJ, USA, 1998; pp. 295–336.
57. Tenenhaus, M.; Vinzi, V.E.; Chatelin, Y.M.; Lauro, C. PLS Path Modeling. *Comput. Stat. Data Anal.* **2005**, *48*, 159–205. [[CrossRef](#)]
58. Fornell, C.; Larcker, D.F. Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. *J. Mark. Res.* **1981**, *18*, 39–50. [[CrossRef](#)]
59. Nunnally, J.C.; Bernstein, I.H. *Psychometric Theory*; McGraw-Hill: New York, NY, USA, 1994.
60. Sanchez, G.; Trinchera, L. *Package ‘plsmp’*; Citeseer: State College, PA, USA, 2013.
61. Sanchez, G. *PLS Path Modeling with R*; Trowchez Editions: Berkeley, CA, USA, 2013.
62. Pinto, F.S.T.; Fogliatto, F.S.; Qannari, E.M. A method for panelists’ consistency assessment in sensory evaluations based on the Cronbach’s alpha coefficient. *Food Qual. Prefer.* **2014**, *32*, 41–47. [[CrossRef](#)]
63. Hair, J.F.; Hult, G.T.M.; Ringle, C.M.; Sarstedt, M. *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*, 2nd ed.; SAGE Publications: Thousand Oaks, CA, USA, 2017.
64. Nelson, R.; Winter, S.G. *An Evolutionary Theory of Economic Change*; The Belknap Press of Harvard University Press: Cambridge, MA, USA, 1982.
65. Nelson, R. Why do firms differ, and how does it matter? *Strateg. Manag. J.* **1991**, *12*, 61–74. [[CrossRef](#)]
66. Collins, D. A Resource-Based Analysis of Global Competition: The Case of Bearing Industry. *Strateg. Manag. J.* **1991**, *12*, 49–68. [[CrossRef](#)]
67. Henderson, R.M.; Cockburn, I.M. Measuring competence? Exploring Firm Effects in Pharmaceutical Research. *Strateg. Manag. J.* **1994**, *15*, 63–84. [[CrossRef](#)]
68. Teece, D.; Pisano, G. The Dynamic Capabilities of Firms: An Introduction. *Ind. Corp. Chang.* **1994**, *3*, 537–556. [[CrossRef](#)]
69. Zollo, M.; Winter, S.G. Deliberate learning and the evolution of dynamic capabilities. *Organ. Sci.* **2002**, *13*, 339–351. [[CrossRef](#)]

70. Makadok, R. Toward a Synthesis of the Resource-Based and Dynamic-Capability Views of Rent Creation. *Strateg. Manag. J.* **2001**, *22*, 387–401. [\[CrossRef\]](#)
71. Winter, S.G. Understanding dynamic capabilities. *Strateg. Manag. J.* **2003**, *24*, 991–995. [\[CrossRef\]](#)
72. Zahra, S.; Sapienza, H.; Davidsson, P. Entrepreneurship and Dynamic Capabilities. *J. Manag. Stud.* **2006**, *43*, 917–955. [\[CrossRef\]](#)
73. Wang, C.; Ahmed, P. Dynamic capabilities: A review and research agenda. *Int. J. Manag. Rev.* **2007**, *9*, 31–51. [\[CrossRef\]](#)
74. Hou, J. Toward a Research Model of Market Orientation and Dynamic Capabilities. *Soc. Behav. Personal.* **2008**, *36*, 1251–1268. [\[CrossRef\]](#)
75. Miranda Torrez, J. El modelo de las capacidades dinamicas en las organizaciones. *Investig. Adm.* **2015**, *44*, 116.
76. Torres, Y.; Rivas, J.; De-Pablos-Heredero, C.; Perea, J.; Toro-Mújica, P.; Angón, E.; García, A. Identificación e implementación de paquetes tecnológicos en ganadería vacuna de doble propósito; Caso Manabí-Ecuador. *Rev. Mex. Cienc. Pecu.* **2014**, *5*, 393–407. [\[CrossRef\]](#)
77. Cuevas Reyes, V.; Loaiza Meza, A.; Espinosa García, J.A.; Vélez Izquierdo, A.; Montoya Flores, M.D. Typology of dual-purpose cattle production farms in Sinaloa, Mexico. *Rev. Mex. Cienc. Pecu.* **2016**, *7*, 69–83. [\[CrossRef\]](#)
78. Daneels, E. Trying to become a different type of Company: Dynamic capability at Smith Corona. *Strateg. Manag. J.* **2010**, *32*, 1–31. [\[CrossRef\]](#)
79. Chakravarthy, B.J. Adaptation: A promising metaphor for strategic management. *Acad. Manag. Rev.* **1982**, *7*, 35–44. [\[CrossRef\]](#)
80. Cohen, M.A.; Levinthal, D. Absorptive capacity: A new perspective on learning and innovation. *Adm. Sci. Q.* **1990**, *35*, 128–152. [\[CrossRef\]](#)
81. Kostopoulos, K.; Papalexandris, A.; Papachroni, M.; Ioannou, G. Absorptive capacity, innovation, and financial performance. *J. Bus. Res.* **2011**, *64*, 1334–1343. [\[CrossRef\]](#)
82. Fabrizio, K.R. Absorptive capacity and the search for innovation. *Res. Policy* **2009**, *38*, 255–267. [\[CrossRef\]](#)
83. Torres, R.; Sidorova, A.; Jones, C. Enabling firm performance through business intelligence and analytics: A dynamic capabilities perspective. *Inf. Manag.* **2018**, *55*, 822–839. [\[CrossRef\]](#)



© 2020 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0/>).