Microeconomic Resilience and Influence on Accounting Innovation With the Polythetic Cluster Modeling Techniques in the United States

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Accounting innovation defines world economics ambition as the significant level for increasing growth through driving business efficiencies and releasing creativity. Also, accounting innovation shapes at the global, national, and local levels and become an autotelic value in the age of economic globalization. A novel research approach uses the first time in financial economics the polythetic cluster modeling techniques to present the findings. The machine learning model justified the accuracy compare to previous research studies. The findings can contribute to a better understanding of the impact of business resilience on the accounting innovation used by business experts and policymakers around the World. The research results represent a further step towards developing more machine learning models into a future research study to achieve more accuracy in the findings and discussions. The concurrent cluster methods research presented here confirms that the business artificial intelligence methods and the human domain knowledge interpretation may support the current microbusiness leadership to better understand their essential business decision as a major part of the modern business behavioral prescriptive analytics. Therefore, this research study needs to be of value to all business owners worldwide that wish to significantly improve their behavioral business data insight for business strategy management decisions every day.

Keywords: resilience, microeconomics, accounting innovation, business artificial intelligence

INTRODUCTION

No know empirical research has focused on exploring relationship between microeconomic resilience and influence on accounting innovation with the Polythetic Cluster Modeling techniques.

The growing focus area of entrepreneur resilience which fits inside of entrepreneurial cognitions possesses many unexplained processes based on entrepreneur's behavior and decisions it has created a rich opportunity for researchers (Awotoye & Singh, 2017). This literature answered the call of Shepherd's (2015) article for exploring entrepreneurial cognition while incorporating a focus on microbusiness growth. There is limited quantitative literature on entrepreneur resilience and its relationship with small businesses. This led the researcher to the problem to what extent, if any there is a relationship between resilience and innovation in the microeconomics business market in the state of Michigan in the United States. We found the lack of significance outcome of our recent research under the statistical research methodology (Brown,

E. & Kasztelnik, K). Now, we used the machine learning model with more accurate result and confirmed by the polythetic cluster techniques that prove the quality of the artificial intelligence in the research project.

THEORETICAL FRAMEWORK

Prior research on resilience and innovation explores the evolution of the study to the problem that has evolved historically to strive to solve different problems in companies, mainly to gain a competitive advantage to grow their business. Diamond (1996) argued that innovation and technology failed because experts and managers ignore the psychological dynamics of change in the organization. Reinmoeller and Van Baardwijk (2005) article focused on multinationals resilient companies' ability to sustain superior performances through innovation. Moenkemeyer et al. (2012) developed the innovator resilience potential concept to seize new innovative opportunities and to help project managers cope with a future setback. This study will add to the background and literature on this topic to fill in the gap between the resilience and innovation relationship in microbusinesses.

Prior research on microbusiness's growth and survival has evolved historically to emphasize the need to incorporate the influence of location (Mason & Harrison, 1985) or the environment (Penrose, 1959) because microbusiness is more dependent on external factors than larger firms. This gap in research has emerged from the urban economic theory focusing on larger firms and overlooking organizations size (Potter & Moore, 2000). Microbusinesses that employ no or few employees are a critical and growing part of developed economies (Houston & Reuschke, 2017)). Nevertheless, there is scarce research on microbusiness, especially in cities.

Microbusinesses are unique in many ways that limit their growth (Anyadike-Danes et al., 2015). Two ways in particular, first, they suffer from a lack of funding. Second, psychological thresholds often need to be crossed on the journey out of micro status. Therefore, this study analyzed entrepreneurs' resilience in a collaborative environment to see if it drives innovation. Research has shown that entrepreneurs who start new small businesses have created most of the latest jobs in the United States economy over the last several decades (Birch, 1987; Kirchhoff & Greene, 1998; Scarborough, Wilson, & Zimmerer, 2009; Van Stel & Storey, 2004). Small and microbusinesses are essential for cities, regions, and states in the United States economy to thrive.

Due to the technological advances and the success of Amazon and many other online stores, it identifies how this information leads to the gap for the current study. More individuals are going to need to start their own business due to retail stores closing. There is a growing concern about the declining United States businesses as entrepreneurship, and economic dynamism has continued to decline in recent years (Hathaway & Litan, 2014; Singh & Ogbolu, 2015). Innovation is a significant driver of the success of small and microbusinesses and has been considered many times as the solution, but alone has failed. Due to the fact small and microbusiness do not have the resources to invest in technology advances and R & D the way larger businesses to become more innovative.

Collaboration for innovation has been a vehicle for small businesses to take advantage of to help them succeed. Zach (2016) stated there is a need to find more collaboration for innovation drivers in entrepreneurship to benefit microbusiness. Determining the relationship between resilience and innovation in a shared workspace environment has never been considered but could point us to more growth and surviving businesses in the future. This led to the problem statement: It is not known if and to what extent there is a relationship between resilience and innovation in the microeconomics business market in the state of Michigan in the United States

PROBLEM STATEMENT

Previous to this research, it was not known if and to what extent a relationship existed between resilience and innovation in the microeconomics business market in Michigan in the United States.

There are growing concerns about the declining United States business dynamism (Singh & Ogbolu, 2015). Based on the necessity of cities, regions, and states in the United States economy to thrive, there is

a need to explore the problems associated with the dynamism of small and microbusinesses. The elevated failure rates recorded in entrepreneurship (Awotoye & Singh, 2017) suggest that entrepreneurship is not an easy process. Therefore, entrepreneurs must become more resilient to overcome adversities while becoming more innovative to grow their business.

Zach (2016) suggested that future research on the effects of other innovation drivers on collaboration for innovation, such as entrepreneurship, needs to be investigated. This study fills this gap by analyzing innovation with an attribute of entrepreneurship resilience. Yang and Danes (2015) revealed that collaboration and innovation drive micro companies' performance and success. Awotoye and Singh (2017) argued that entrepreneur resilience diminishes the negative impact that causes hardship and stress, such as the more entrepreneurial resilience they have, the better they can overcome failure in business. Therefore, this study will be on the relationship between an entrepreneur's resilience and collaboration for innovation in microbusinesses to address this gap and extend entrepreneurship literature.

Collaboration for innovation and entrepreneur resilience both drive microbusinesses growth, yet their relationship was not known. This gap in the literature was addressed in this study to help entrepreneurs in microbusinesses to become more innovative to survive, to grow their business, and to create jobs for economic growth in Michigan.

The important consideration in formulating a research problem is the ethical issues involved. The population of interest is roughly 108,875 microbusiness owners in Detroit, Michigan. These microbusiness owners have 0-10 employees. They all run their businesses inside coworking spaces, their building, or in their homes. While conducting a research study, the study population may be adversely affected by some of the questions (directly or indirectly), deprived of an intervention, expected to share sensitive and private information, or expected to be merely experimental. The unit of analysis is the entrepreneurs.

RESEARCH QUESTIONS AND HYPOTHESES

The following are the variables and the description for each: the predictor variable is resilience. The criterion variables are the level of accounting innovation. The sub-variables of resilience interrelated components will be personal competence and trust. The sub-variables for innovation are the individual, the leader, workgroup, and the climate for innovation. For this study the predictor variable is resilience and the criterion variable is innovation.

The following are the research question and hypothesis:

RQ1: *Is there a statistically significant difference on accounting innovation by microeconomic resilience in the United States?*

H10: *There is not a statistically significant difference on accounting innovation by microeconomic resilience in the United States.*

H1a: *There is a statistically significant difference on accounting innovation by microeconomic resilience in the United States.*

RQ2: *Is there a statistically significant difference on accounting innovation by personal competence in the United States?*

H20: *There is not a statistically significant difference on accounting innovation by personal competence in the United States.*

H2a: *There is a statistically significant difference on accounting innovation by personal competence in the United States.*

RQ3: *Is there a statistically significant difference on accounting innovation by trust in the United States?*

H30: *There is not a statistically significant difference on accounting innovation by trust in the United States.*

H3a: *There is a statistically significant difference on accounting innovation by trust in the United States.*

The research questions in the study are relevant to the problem's microbusiness owners face while striving to grow their business. The relationship between microeconomic resilience and accounting innovation is lacking in empirical literature, especially in microbusiness. This research could help microbusiness owners investigate starting in more collaborative inexpensive environments, promoting more training in entrepreneur resilience, and move the government to approve more collaborative workspace in downtown areas to help grow microbusinesses around the World. This led the researcher to the problem to Is there a statistically significant difference on accounting innovation by microeconomic resilience in the United States?

ADVANCING SCIENTIFIC KNOWLEDGE AND SIGNIFICANCE OF THE STUDY

Starting a new business is a demanding, and stressful process creating significant changes in a business owner's life (Yang & Danes, 2015). Due to the financial crisis which caused a Chapter 9 bankruptcy in a few years ago and the current insufficiency of jobs in Detroit, Michigan, many individuals had to start their microbusiness. Detroit, Michigan suffered the most extensive municipal bankruptcy filings in American history with a debt estimation close to twenty billion dollars (Gillette & Skeel, 2015). Many entrepreneurs did not have a choice but to start their own business in Detroit, Michigan. Today, entrepreneurs are stressed out, because of the lack of resources needed to provide for themselves and their families while striving to grow their business. If entrepreneurs are not resilient and innovative, they will not survive.

There is a strong need for microbusiness owners to gain more insight into the relationship between resilience and innovation to survive and grow their business. Winterhalter, Weiblen, Wecht, and Gassmann (2017) stated that smaller firms lack the resources of larger organizations to invest in innovation to grow their business. Smallbone, Deakins, Battisti, and Kitching (2012) stated that small businesses are commonly considered less resilient than larger businesses due to lack of resources, bargaining power, and are unable to spread risk across a large customer base.

Resilience and innovation are both key drivers of microbusinesses' success and survival (Fisher et al., 2016; Zach, 2016). Bristow and Healy (2018) stated there is a need for further reflection on the relationships, if any, between the role of innovation in resistance and recovery. Therefore, the researcher analyzed the relationship between resilience and innovation.

The two theories for this study that provide the theoretical foundation are the resilience theory by Connor and Davidson (2003) and the theory on individual innovative behavior by Scott and Bruce (1994). The study extended entrepreneur literature by analyzing the relationship between resilience and innovation in microbusiness within the state of Michigan in the United States. It gives insight into the relationship between resilience and innovation to help entrepreneurs in microbusinesses survive, grow, and to create new jobs for economic growth.

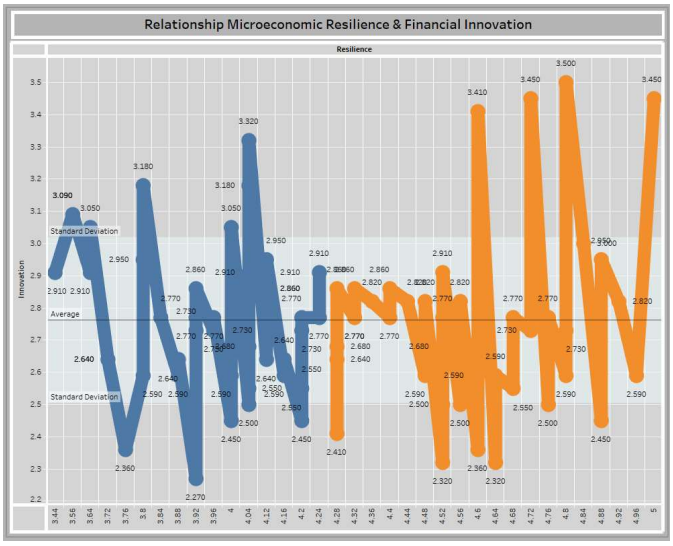
RESEARCH FINDINGS AND DISCUSSION

The two theories that used for this study are the resilience theory by Connor and Davidson (2003) and the individual innovative behavior theory by Scott and Bruce (1994). The resilience theory model has five components: personal competence, acceptance of change, trust, control, and spiritual influences (Connor & Davidson, 2003). The theory of individual innovative behavior draws on the idea that any innovative venture and outcome results from the activity of creative individuals who propose new ideas and engage in collaborative efforts toward evaluation and implementation (Kanter, 1988). The theory of individual innovative behavior has four components: individual, leader, workgroup, and climate for innovation (Scott

& Bruce, 1994). Scott and Bruce (1994) used the climate for innovation instruments to measure individual innovative behavior.

The purpose of this study is to determine if is there a statistically significant difference of accounting innovation by microeconomic resilience in the United States? To answer each question, the researchers used the polythetic cluster modeling techniques analysis.

FIGURE 1
RELATIONSHIP RESILIENCE & INNOVATION



Data Source: Compiled by Author. Data is presented as mean [+, -] standard deviation.

CHART SUMMARY:

Inputs for Clustering

Variables:	Microeconomic Resilience
	Accounting innovation
Level of Detail:	Microeconomic Resilience, Accounting innovation
Scaling:	Normalized

Summary diagnostics shows the variation between the means of the groups and the variation within each group, also known as residual variance. We observe that the average variation between groups is large enough compared to the average variation within groups, then we can conclude that at least one group mean is not equal to the others. Thus, it is possible to evaluate whether the differences between the group means are significant by comparing the two variance estimates.

SUMMARY DIAGNOSTICS

Number of Clusters:	2
Number of Points:	84
Between-group Avg of Squares:	3.3896
Within-group Avg of Squares:	5.0817

Total Avg of Squares: 8.4713

Clusters	Number of Items	Centers	
		Avg of Resilience	Innovation
Cluster 1	44	3.9636	2.7655
Cluster 2	40	4.591	2.7572
Not Clustered	0		

We measure the proportion of the variance of innovation and resilience explained by the group members using Huygens Theorem.

$$TOTAL.SS = BETWEEN\text{-}CLUSTER.SS + WITHIN - CLUSTER.SS$$

$$T = B + W$$

$$\sum_{i=1}^{n}(x_i - \bar{x})^2 = \sum_{g=1}^{G} n_g(\bar{x}_g - \bar{x})^2 + \sum_{g=1}^{G}\sum_{i=1}^{n_g}(x_i - \bar{x}_g)^2$$

Source: Huygens Theorem

Evaluating the proximity between the clusters. Distance between the centroids as Squared Euclidean distance for this pair of variables. The centroids are close to each other therefore our results have been confirmed by the variables innovation and resilience.

MODEL #1:
Analysis of Variance:

Variable	F-statistic	p-value	Model		Error	
			Sum of Squares	DF	Sum of Squares	DF
Resilience	57.7	4.385e-11	3.389	1	4.816	82
Innovation	0.02091	0.8854	0.0009322	1	3.656	82

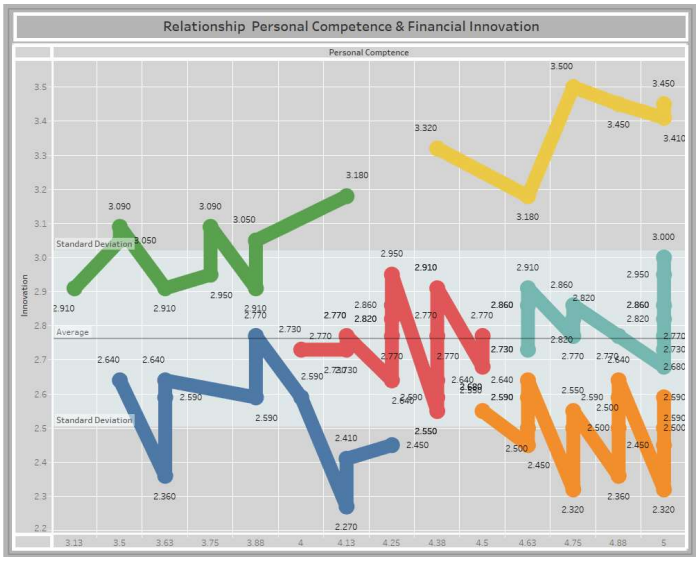
The overall F-test of overall significance is the hypothesis test for our relationship above. Our result in F-test is significant, and we can conclude that R-squared does not equal zero, and our correlation between the resilience and innovation variable is statistically significant. Our F for resilience is more than one indicates a significant difference between the sample's means being compared. Simultaneously, we found that the innovation cannot predict innovation since resilience is not significant. As a result, the centroid's average distance is lowest for Variable Innovation (0.0009322); this indicates that Variable Innovation has the least variability in the group. We observe on the chart that Variable Innovation that the greater resilience then the innovation is increasing.

Our p-value is less than 0.05 to mean that the probability that chance is responsible for finding is less than 5% and that the probability that the finding is a true finding and the resilience has the impact on the innovation is more than 95%.

The resilience is statistically significantly different for different levels of clusters, F (57.7) = 4.385r-11, p < .05 and the innovation is not statistically different for different levels of clusters, F (0.02091) = 0.8854, p < .05

In summary, we can predict that resilience is greater with the greater innovation, and if the innovation is decreasing, then the resilience is decreasing. The squares' residual sum tells us how much of the dependent variable's variation our model did not explain. It is the sum of the squared differences between the actual Y (Innovation) and the predicted Y (Innovation). We found a minimal residual sum of squares to prove that our model fits excellent to our data.

FIGURE 2
RELATIONSHIP PERSONAL COMPETENCE & ACCOUNTING INNOVATION



Data Source: Compiled by Author. Data is presented as mean [+, -] standard deviation.

CHART SUMMARY:

Inputs for Clustering

Variables:	Personal Competence
	Innovation
Level of Detail:	Innovation
Scaling:	Normalized

Summary diagnostics shows the variation between the means of the groups and the variation within each group, also known as residual variance. We observe that the average variation between groups is large enough compared to the average variation within groups, then we can conclude that at least one group mean is not equal to the others. Thus, it is possible to evaluate whether the differences between the group means are significant by comparing the two variance estimates.

SUMMARY DIAGNOSTICS

Number of Clusters:	6
Number of Points:	84
Between-group Sum of Squares:	7.2866
Within-group Sum of Squares:	1.4258
Total Sum of Squares:	8.7124

Our metric quantifying the separation between clusters as a sum of squared distances between each cluster's centre (average value), weighted by the number of data points assigned to the cluster, and the centre of the data set is larger than within-group metric, it means that we have the better separation between clusters. The smaller value of within-group sum of squares means that the more cohesive all our clusters use to our model. Finally, total sum of squares is the ratio gives us the value more than between 0 and 1 and indicates that we have a good reliable model for the personal competence and the innovation.

		Centers	
Clusters	**Number of Items**	**Personal Competence**	**Innovation**
Cluster 1	10	3.866	2.531
Cluster 2	18	4.8011	2.5128
Cluster 3	23	4.2909	2.747
Cluster 4	18	4.835	2.8222
Cluster 5	9	3.6833	3.0156
Cluster 6	6	4.7733	3.385
Not Clustered	0		

We measure the proportion of the variance of innovation and resilience explained by the group members using Huygens Theorem.

$$TOTAL.SS = BETWEEN\text{-}CLUSTER.SS + WITHIN - CLUSTER.SS$$

$$T = B + W$$

$$\sum_{i=1}^{n}(x_i - \bar{x})^2 = \sum_{g=1}^{G} n_g(\bar{x}_g - \bar{x})^2 + \sum_{g=1}^{G}\sum_{i=1}^{n_g}(x_i - \bar{x}_g)^2$$

Source: Huygens Theorem

Evaluating the proximity between the clusters. Distance between the centroids as Squared Euclidean distance for this pair of variables. The centroids are close to each other therefore our results have been confirmed by the variables innovation and resilience.

MODEL #2:
Analysis of Variance:

			Model		Error	
Variable	**F-statistic**	**p-value**	**Sum of Squares**	**DF**	**Sum of Squares**	**DF**
Innovation	13.06	3.088e-09	3.06	5	3.656	78
Personal Competence	13.04	3.169e-09	4.227	5	5.057	78

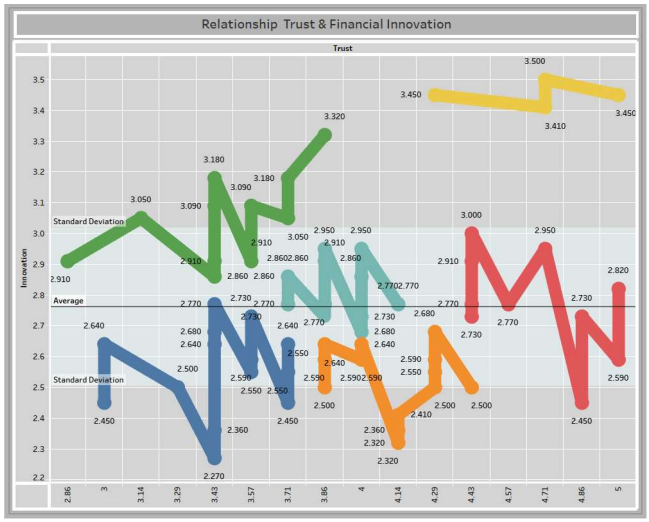
The overall F-test of overall significance is the hypothesis test for our relationship above. Our result in F-test is significant, and we can conclude that R-squared does not equal zero, and our correlation between the personal competence and innovation variable is statistically significant. Our F for personal competence is more than one indicates a significant difference between the sample's means being compared. Simultaneously, we found that the personal competence can predict innovation since innovation is significant. As a result, the centroid's average distance is lowest for Variable Innovation (3.06); this indicates that Variable Innovation has the least variability in the group. We observe on the chart that Variable Innovation that the greater personal competence then the innovation is increasing.

Our p-value is less than 0.05 to mean that the probability that chance is responsible for finding is less than 5% and that the probability that the finding is a true finding and the trust has the impact on the innovation is more than 95%.

The innovation is statistically significantly different for different levels of clusters, F (13.06) = 3.088e-09, p < .05 and the personal competence is statistically different for different levels of clusters, F (13.04) = 3.169e-09, p < .05

In summary, we can predict that personal competence is greater with the greater innovation, and if the innovation is decreasing, then the personal competence is decreasing. The squares' residual sum tells us how much of the dependent variable's variation our model did not explain. It is the sum of the squared differences between the actual Y (Innovation) and the predicted Y (Innovation). We found a minimal residual sum of squares to prove that our model fits excellent to our data.

FIGURE 3
RELATIONSHIP TRUST & ACCOUNTING INNOVATION



Data Source: Compiled by Author. Data is presented as mean [+, -] standard deviation.

CHART SUMMARY:

Inputs for Clustering

Variables:	Trust
	Innovation
Level of Detail:	Innovation, Trust
Scaling:	Normalized

Summary diagnostics shows the variation between the means of the groups and the variation within each group, also known as residual variance. We observe that the average variation between groups is large enough compared to the average variation within groups, then we can conclude that at least one group mean is not equal to the others. Thus, it is possible to evaluate whether the differences between the group means are significant by comparing the two variance estimates.

SUMMARY DIAGNOSTICS

Number of Clusters:	6
Number of Points:	84
Between-group Avg of Squares:	6.0264
Within-group Avg of Squares:	1.4051
Total Sum of Squares:	7.4314

		Centers	
Clusters	**Number of Items**	**Trust**	**Innovation**
Cluster 1	17	3.4782	2.5729
Cluster 2	18	4.0961	2.5306
Cluster 3	10	4.672	2.772
Cluster 4	24	3.8988	2.8167
Cluster 5	11	3.4673	3.05
Cluster 6	4	4.6775	3.4525
Not Clustered	0		

We measure the proportion of the variance of innovation and resilience explained by the group members using Huygens Theorem.

$$\text{TOTAL.SS} = \text{BETWEEN-CLUSTER.SS} + \text{WITHIN-CLUSTER.SS}$$

$$T = B + W$$

$$\sum_{i=1}^{n}(x_i - \bar{x})^2 = \sum_{g=1}^{G} n_g(\bar{x}_g - \bar{x})^2 + \sum_{g=1}^{G}\sum_{i=1}^{n_g}(x_i - \bar{x}_g)^2$$

Source: Huygens Theorem

Evaluating the proximity between the clusters. Distance between the centroids as Squared Euclidean distance for this pair of variables. The centroids are close to each other therefore our results have been confirmed by the variables innovation and resilience.

MODEL #3:
Analysis of Variance:

			Model		Error	
Variable	**F-statistic**	**p-value**	**Sum of Squares**	**DF**	**Sum of Squares**	**DF**
Trust	12.71	4.892e-09	3.076	5	3.776	78
Innovation	12.59	5.694e-09	2.951	5	3.656	78

The overall F-test of overall significance is the hypothesis test for our relationship above. Our result in F-test is significant, and we can conclude that R-squared does not equal zero, and our correlation between the trust and innovation variable is statistically significant. Our F for trust is more than one indicates a significant difference between the sample's means being compared. Simultaneously, we found that the trust can predict innovation since innovation is significant. As a result, the centroid's average distance is lowest for Variable Innovation (2.951); this indicates that Variable Innovation has the least variability in the group. We observe on the chart that Variable Innovation that the greater trust then the innovation is increasing.

Our p-value is less than 0.05 to mean that the probability that chance is responsible for finding is less than 5% and that the probability that the finding is a true finding and the trust has the impact on the innovation is more than 95%.

The innovation is statistically significantly different for different levels of clusters, F (12.71) = 4.892e-09, $p < .05$ and the trust is statistically different for different levels of clusters, F (12.59) = 5.694e-09, $p < .05$

In summary, we can predict that trust is greater with the greater innovation, and if the innovation is decreasing, then the trust is decreasing. The squares' residual sum tells us how much of the dependent variable's variation our model did not explain. It is the sum of the squared differences between the actual Y (Innovation) and the predicted Y (Innovation). We found a minimal residual sum of squares to prove that our model fits excellent to our data.

SUMMARY OF FINDING AND CONCLUSION

Microbusiness owners must be aware that resilience, personal competence, and trust are positively correlated with innovation. It was a significant positive relationship; it means when resilience increased, then innovation increased. When personal competence increased, then innovation increased. When trust increase, then innovation increased. Entrepreneurs must consider rethinking how their resilience, personal competence, and trust help or harm their business from growing and find a good balance to grow by adjusting the resilience, personal competence, and trust. Innovation is one of the leading variables to help companies survive and grow their business. Therefore, finding variables that relate to innovation in microbusinesses owners could affect the way their business operates.

The first question asked: Is there a statistically significant difference on accounting innovation by microeconomic resilience in the United States? The second question asked: Is there a statistically significant difference on accounting innovation by personal competence in the United States? The third question asked: Is there a statistically significant difference on accounting innovation by trust in the United States? Our results of the polythetic cluster modeling technics analysis revealed there was a significant relationship between all three components (resilience, personal competence, trust) and innovation: The results in this study do align with previous statistical research study (Bristow & Healy, 2018; Sameer, 2018). Previous research found that there was a significant statistical relationship between resilience and innovation. This study's results do not align with our previous statistical research study (Brown, E. & Kasztelnik, K, 2020).

We validated that the machine learning approach provided more accuracy in analyzing the same data collection source compared to the statistical data analysis that we concluded in our previous research study. this research study needs to be of value to all business owners worldwide that wish to significantly improve their behavioral business data insight for business strategy management decisions every day.

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