VALUE OF MANAGEMENT SKILLS ON PROFITABILITY: EVIDENCE FROM MICRO BUSINESSES IN MEXICO

Master of Applied Economics

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Contents

Abstract:

The following capstone focuses on the value provided by management skills on the profitability of micro businesses in Mexico. Firstly, a literature review on the economics of micro, small and medium business is addressed. Secondly, a statistical description of micro businesses in Mexico is worked out with data from the National Survey of Micro Business 2012, retrieved from the National Institute of Statistics and Geography. Thirdly, the methodology on how to estimate the impact of the manager's and the business' features on profitability of a micro business by doing an Ordinary Least Squares (OLS) regression is performed. Fourthly, a discussion on the results from the estimated OLS is set forth, as well as an empirical example on how management skills can predict micro businesses profitability by training three different machine learning classifier algorithms: K-Nearest Neighbors, Naïve Bayes, and a Logistic Regression. Lastly, final comments and future work are discussed.

Keywords: *Economics, Small Business, Management Skills, Ordinary Least Squares*.

Introduction

The study of Micro, Small, and Medium Enterprises (MSMEs) has taken the attention of economists from the last 7 decades (Blank, 1961). According to the World Bank formal MSMEs contribute up to 60% of the total employment and up to 40% of Gross Domestic Product (GDP) of emerging economies.[1] MSMEs face important issues to maintain their profit margins, and the most important are the constraints on the cash flows, the management skills to operate them properly, and the restricted access to credit loans (Koreen et al., 2018).

This capstone works on answering the question: *What's the value of management skills on the profitability of micro businesses?* The question is answered with an empirical analysis using the National Survey of Micro Business 2012 from the National Institute of Statistics and Geography of Mexico. The survey has fruitful data, such as personal information from the managers and the costs and income, from 9 million micro businesses in Mexico. After running an OLS regression on the data, is shown that the management skills, some locations, and some sectors have statistical significance on the profitability of a micro business.

As a result of the OLS analysis three Machine Learning classifiers were trained to predict whether a micro business had a profitability ratio above 70% using only the five variables of significance from the OLS estimates. The algorithms provided a robust conclusion on the value of the management skills on predicting profitability, the accuracy of all three trained algorithms was computed above 60%. Having this accuracy without knowing the cashflows of the business provides promising usage of alternative information for access to credit to micro business and credit scoring for banks and FinTechs.[2]

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[1] World Bank. SME Finance. Retrieved May 5, 2019, from https://www.worldbank.org/en/topic/smefinance

[2] Fintech is used to describe new tech that seeks to improve and automate the delivery and use of financial services. Fintech, the word, is a combination of "financial technology". Definition retrieved from Investopedia https://www.investopedia.com/terms/f/fintech.asp.

Literature Review

The study of micro and small business was importantly portrayed in the *Small Business Economics* (Brock and Evans, 1989), where the authors describe the main characteristics and challenges of a small business. According to the authors, small businesses employ more part-time workers and are more labor intensive compared to larger firms. Small businesses tend to be transitory and will largely disappear in the long run, they also have more difficulty obtaining capital and have more liquidity constraints than large firms. One of the most important ideas discussed is that "[...] *smaller firms are more likely to be unable to obtain capital at market interest rates, therefore to be subject to credit rationing* [...]".

The Organisation for Economic Cooperation and Development (OECD) has very richful literature on Small and Medium Business (SME). In the *Small and Medium-sized Enterprises: Local Strength, Global Reach* (OECD, 2000) is mentioned that SME account for over 95% of firms in the world, and 60% - 70% of employment. According to this report most SME jobs are in the service sector and smaller firms have traditionally focused on domestic markets. By the year 2000, SME contribute between 25% - 35% of the world exports of manufactures and account for a small share of foreign direct investment. An important fact pointed by the OECD in this research is that small firms *need to upgrade their management skills*.

OECD's work *Effective Approaches for Implementing the G20/OECDE high-Level Principles on SME Financing* (2018) highlights the fact that by the year 2018 very few countries measure the financial skills of the SME owners and managers in order to identify their strengths and weakness. It also mentions that empirical evidence on the effectiveness of financial education and business training programs remains limited.

World Bank's *Micro, Small, and Medium Enterprise (MSME) Finance* (2013) mention that MSMEs are, collectively, the largest employers in many low-income countries and their growth is often stifled by restricted access to credit, equity and payments services. According to their work, access to financial services can boost job creation, raise income, reduce vulnerability and increase investments in human capital.

Peter Carroll and Ben Hoffman (2013) from Oliver Wyman[3] mention that semiautomated methods, using credit scores on the business or its owner as key inputs promised to reduce credit and marketing costs for the lenders. The authors argue that loan suppliers can lower their costs and attract qualified loan applicants by applying a pre-approved for a "new-form loan".

Taking into account a more holistic basis for small business lending and the evaluation of their profitability by making the entire small business and business owner relationship attractive is a proposal worth trying for loan suppliers (Wendel, 2015). Technological advances in computing power and online sources can provide a new approach for lending, including credit for micro business (Dudley, 2017), access to different information rather than the cash flows can lead to better decisions and enhance more credit.

It is noticeable that, micro, small, and medium business have an important role on the world's economy, and that the most important features for them to succeed are the management skills, cash flows, and access to credit. These three elements seem to be interconnected and lay down directly into the manager's characteristics.

Data Description and Methodology

For the purpose of this research the data from the National Survey for Micro Businesses (ENAMIN)[4] (2012) from Mexico was used to do the economic analysis and the machine learning algorithms to classify the profitability of the micro businesses.

Survey Data

The data can be obtained directly from the National Institute of Statistics and Geography of Mexico (INEGI) and provides information of the Micro Businesses in Mexico established by 2012. The survey took place in the year 2012 and asked around 100 questions to each firm's manager. In this way the ENAMIN is a very rich source for this research because it provides answers to significant questions that are relevant for the scope of this work. The ENAMIN provides a large data set that

[3] Oliver Wyman is an international management consulting firm with a large focus on banking and financial services.

[4] ENAMIN is the spanish acronym for the National Survey for Micro Business: "Encuesta Nacional de Micronegocios"

has specific information about the business and important information from the manager and was carried out to 27,666 micro and small[5] businesses in Mexico representing more than 9.3 million business.

An important fact about the survey data from the 27,666 observations, 2,216 were unsuccessful surveys, and some interview managers did not give an answer for some of the questions that are meaningful for this research, in order to have a clear relation between the variables some amputation technics where performed to ignore the observations that were not meaningful for this work, this means that the universe of businesses that were analyzed is close to 6 million.[6]

According to Mexico's Ministry of Economy, a micro business is one that employs less than 10 people. Businesses with 11 or more people are considered Small (11 to 50 people employed), Medium (51 to 250 people employed) or Large (251 or more people employed).[7] The ENAMIN has mostly data from micro business, very little of small business, and none from medium nor large firms.

For the purposes of this research, it's important to consider variables that, according to the literature review, explain the profitability of a micro and small business, such as the manager's management skills, the costs and sales of the business, the location, and business sector of the firm.

Location

From *Figure 1* it can be observed a complete geographic distribution of the micro and small firms in all the Mexican United States. The scale goes from low green to dark green, where the light tones represent States with a smaller number of micro and small business and the dark green colour represents more concentrated States. From this map it can be observed that the State of Mexico is the State with more micro and small business compared to the rest of the States, it has more than

[5] The percentage of small business in this dataset is less than 0.02%.

[6] Some important questions asked in the survey, such as the level of education of the manager and the years of the manager, where labeled in the ENAMIN with a code "99999999" which states that the manager did not want to give that information. Other important variables such as the total sales of the firm and the total expenditures of the firm had the code "99999999" or where reported as "0", the observations that had this flag had to be taken out of the analysis because they create a problem at the time I created the profit variable and the profit over sales ratio.

[7] Definition of Micro Firms (2009), AGREEMENT establishing the stratification of micro, small and medium firms, retrieved from the Official Journal of the Federation ("*Diario Oficial de la Federación*") http://dof.gob.mx/nota_detalle_popup.php?codigo=5096849.

1.2 million firms, followed by the States of Mexico City (895 thousand), Jalisco (610 thousand), Veracruz (585 thousand), and Puebla (479 thousand). On the other hand, it is visible that the States with less number of micro and small firms are Baja California (63 thousand), Chihuahua (67 thousand), Aguascalientes (77 thousand), and Campeche (84 thousand).

Figure 1

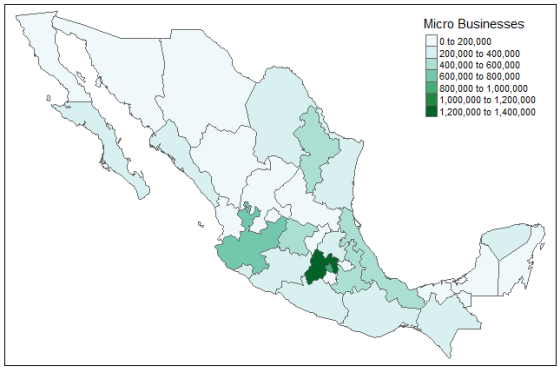


Figure 2

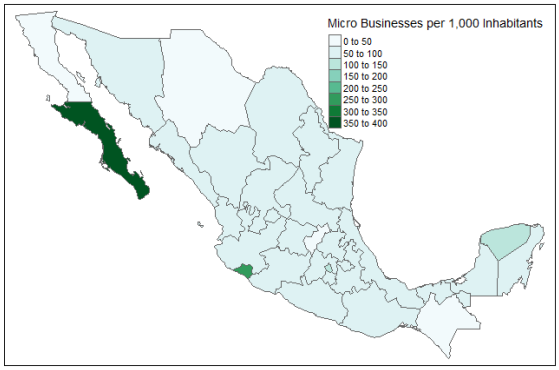


Figure 2 shows a map of the number of micro and small businesses per 1,000 inhabitants in each of the States. It can be noted that the State of Baja California Sur has more micro and small firms (378) which is 4.2 times higher than the average of 90 firms per one thousand inhabitants in all the country. It can also be seen that the States of Colima, Yucatan, and Mexico City has more than 100 micro and small firms per one thousand inhabitants. From this map we could think that the location of the firms may have some implications on the profitability, so a geographic term will be considered for the purposes of this research's analysis.

Sector

From the data, there are 4 main productive sectors in which each of the firms are classified: Commerce, Manufacture, Service, and Construction. These 4 sectors each have subcategories that in total add up to 57 subsectors, this capstone only focuses in the main 4 sectors.

From *Table 1* it can be seen that in the universe of 5.9 million firms almost half of them are dedicated to Commerce activities, Services activities represent almost a third of all firms, the Manufacture sector represents one sixth of the total firms, and only 1 out of 50 micro firms are dedicated to the Construction sector.

Table 1

Main Sector	Micro businesses	Percentage
Commerce	2,962,765	49%
Construction	104,385	2%
Manufacture	1,054,500	18%
Services	1,869,141	31%
Total	5,990,791	100%

Manager features

The manager features that are meaningful for this research paper are the ones that can give a sense of what is mentioned in the literature as the "Management Skills" as well as some personal characteristics of the manager. Both *Manager's personal features*: Age, Gender, and Ownership, and *Manager's Skills*: Education Level, Years of Experience, and Training for the job can be obtained from the data.

In *Figure 3* it can be observed that the distribution and boxplot of the age among the surveyed managers. The computed statistics are the following: the minimum age of a manager is 12 years old, 1st quantile is 35 years old, the median is 44 years old, the 3rd quantile is 54 years old, the maximum age is 98 years old, and the mean is 45 years old. From the boxplot we can see that there are outliers above the age of 80 years old. In order get rid of these outliers in the Age of the Manager distribution some amputation techniques were held to the data in order to analyze managers that more than 80 years old.

Figure 4 depicts the distribution and boxplot for the Age of the Manager feature after getting rid of the outliers. The computed statistics are: the minimum age of a manager is 12 years old, 1st quantile is 35 years old, the median is 44 years old, the 3rd quantile is 54 years old, the maximum age is 80 years old, and the mean is 45 years old. As we can see the amputation technic did not distorted the distribution of our variable. From the boxplot it can be observed that there are no more outliers,

this amputation corresponded to 0.83% of the total of firms in our analysis, which means that we have now a total of 5,941,305 micro and small firms.[8]

Figure 3

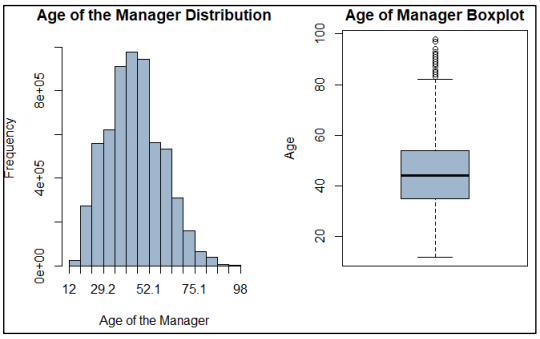


Figure 4

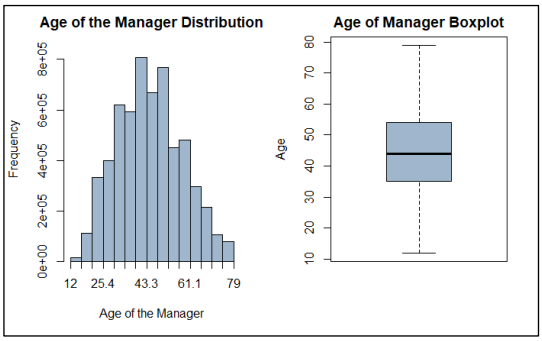


Figure 5 shows that the experience of the manager distribution presents a lot of concentration in with few years of experience and declines over time, from the box plot it is shown that there are some outliers above the 95% percentile. The computed statistics for the experience of the manager are as follows: the minimum years of experience are 0 years, the 1st quartile is 2 years of experience, the median value is 6 years of experience, the 3rd quartile are 14 years of experience, the maximum years of experience is 68, and the mean is 9 years. The outliers should not be a problem because valuable information can be taken from those observations, and a previous amputation was performed with the Age of the manager variable as criteria.

From the *Table 2* it can be observed that almost two thirds of the managers (62.7%) have elementary and middle school studies and only 10.4% have professional education. It is expected that this difference in the level of education produce different outcomes in terms of profitability for the firm, a higher education level of the manager should provide a higher profitability for the business.

[8] After the amputation the total number of *Table 1* changed but the proportions did not.

Figure 5

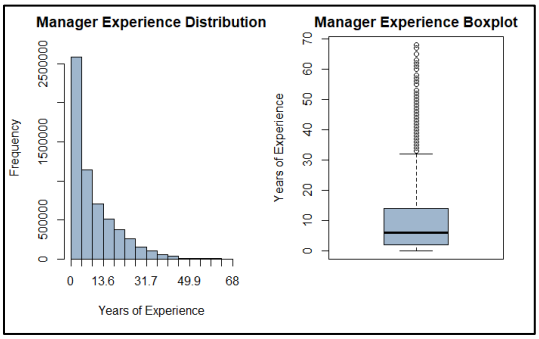


Table 2

Level of Education	Managers	Percentage
None	328,230	5.52%
Kindergarten	4,472	0.08%
Elementary School	2,143,530	36.08%
Middle School	1,583,361	26.65%
High School	882,807	14.86%
Teacher Technician	21,992	0.37%
Technical Bachelor	358,810	6.04%
Undergraduate Degree	598,063	10.07%
Master's Degree	18,336	0.31%
Doctorate Degree	1,704	0.03%
Total	5,941,305	100%

From the total of managers, 58.83% are female and 41.17% are male and; 14% of the surveyed managers own their business. 15.5% of the managers reported to have received some training for their jobs, this training is specified with a question that is asked in the ENAMIN to the manager as "Have you received any training to perform this job?". The training refers to training on sales, providing some service, machinery operations, quality control, computation, marketing, security and hygiene.

Business features

The business features that were taken into account are the years of the business, the number of employees in the firms, whether the employees have taken any training for their job, whether the business has gotten a loan to start their business, whether the firm has asked for a loan once established, and the amount of the loan.

From the *Table 3* can be observed that almost 80% of the micro and small firms had less than 2 years operating and 15.7% have 3 or more years. The computed mean of the surveyed firms is 1.5 years.

Table 3

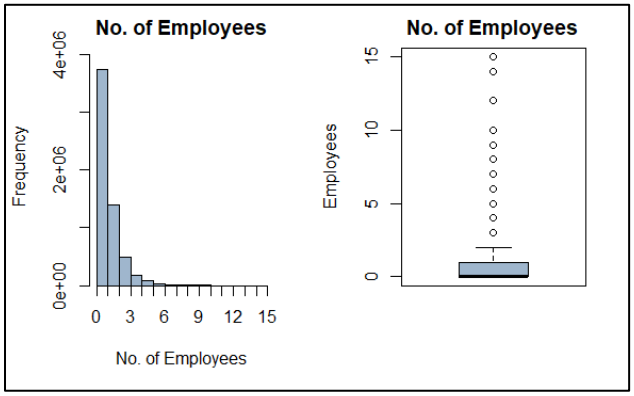
Years of Business	Number of Businesses	Percentage
1	4,718,390	79.4%
2	289,438	4.9%
3	555,181	9.3%
4	94,170	1.6%
5	254,863	4.3%
6	29,263	0.5%
Total	5,941,305	100%

In *Figure 6* the frequency of the number of employees in each firm is shown, according to the computed statistics, the mean of employees in a firm besides the manager is 0.63, and 37% of the firms have employees beside the manager.

According to the data only 9.9% of the employees received any kind of training; 25.6% asked for a loan to start their business; 20% of the firms got a loan once the firm was established; and the amounts of loans go from $100 MXN to $15 million MXN[9], with a mean of $25,659 MXN.

[9] Even though this amount of loan seems very high ($15 million MXN) when we take into account the factor of expansion it may be significant for this analysis.

Figure 6



Profitability

Now that the corresponding independent variables have been described its time to proceed on formulating the dependent variable. Firstly, the amount of profit for each firm *i* was computed. Profit is defined as the total amount of sales minus the total amount of expenditures for every firm *i*, such that:

$$Profit_i = Total\ Sales_i - Total\ Expenditures_i$$

Secondly, profitability computed as the ratio between profit and the total amount of sales. Profitability is a number between 0 and 1, such that:

$$Profitability_i = \frac{Profit_i}{Total\ Sales_i}$$

Profitability is the dependent variable which will be explained by the independent variables that have been previously described.

Figure 7 depicts clear that there are some values that do not make sense, the histogram seems concentrated near zero with very negative values, the boxplot shows some outliers that suggest negative ratios higher than 4,000%, and from the scatterplot it can be seen that there's a condensed cloud near zero. The statistics for the *Profitability* variable show that the minimum value is -446.96, the 1st quartile with a value of 0.582, the median is 0.733, the 3rd has a value of 0.87, a maximum value of 0.999, and a mean value of 0.52. With this information, a procedure to cut the bottom values of the dependent variable and set a range between zero and one was performed.

Figure 7

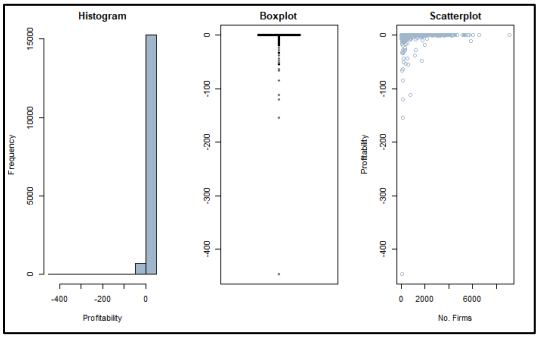
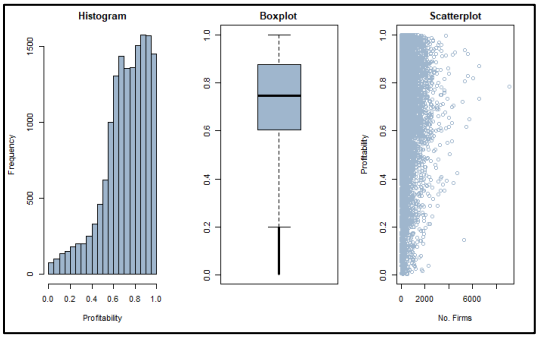


Figure 8



When getting rid of the observations that had values lower than zero, the loss was only 0.83% of the observations. After this, the distribution of the *Profitability* variable improved significantly. In *Figure 8* the reader can observe the goodness of the former amputation technic. As it can be seen from the histogram, the distribution is now centered around 0.7. The boxplot still shows some outliers below values of 0.2, but those observations may contain significant information for our further analysis. The scatterplot mirrors the histogram and the cloud of observations is now visible.

The statistics for the modified *Profitability* variable are the following: the minimum value is 0.002, the 1st quantile has a value of 0.6, the median has a value of 0.74, the 3rd quantile has a value of 0.87, the maximum value is 0.97, and the mean is 0.71. As it can be shown the amputation technic worked in a very good fashion, now the econometric analysis can be performed.

Model

In order to explain the relation among the previously mentioned variables and *Profitability*, two models are estimated with an Ordinary Least Squares Estimates *(OLS)* method. The first model is a "*Partial Model*", which only considers variables related to the manager and the firm. The second model is a *"Full Model"* that includes the location and sector dummy variables as controls for the "Partial Model".

According to the literature review previously discussed, it is expected that the manager skills: level of education, years of experience and training have a positive relation with the profitability of the micro business. From the businesses features it is expected that the number of employees, the training of the employees, and getting a loan have a positive impact on profitability.

Results

Ordinary Least Squares Estimates

The Ordinary Least Squares Estimates (OLS) for both the Partial Model and the Full Model where first run with a *Mallow CP* criterion for model selection where all the variables mentioned previously where used as predictors. From the Mallow CP, the variables that showed significance were used to estimate the Partial and the Full Model accordingly. After running the Partial and Full, the models showed the presence of heteroskedasticity when testing by the Breusch-Pagan test. In order to correct this issue, the estimations were corrected with the Newey-West estimator to fix the standard errors.

Results from *Table 4* suggest an existing and positive relation between the manager skills and the profitability of the business. The variables Education Level and Training are significant at the 99.9% statistical confidence in both the partial and the full model, while the Years of experience variable is significant at a 95% confidence in the partial model and at the 99% in the full model.

The variables Sex, Owner, and Amount of Loan are only significant in the partial model and were not used for the estimates of the Full Model due to the Mallow CP method for model selection. Even though the Mallow CP method for model selection suggested the variable *Years of Experience*^{2} on the Partial Model, after correcting for heteroskedasticity was not significant. The variable *Got the loan* is a significant variable in both estimations and has a negative impact on the profitability, this may be because the micro firm reduces its margin of profitability by paying the loan.

For the Full model it can be observed that the control variables corresponding to the States of Guanajuato and Oaxaca are significant at the 99% and 95% statistical confidences respectively and have a negative relation with the profitability of the micro firm. The control variables Service and Construction, both related to the sector dimension, are significant at the 99% statistical confidence and have a positive relation with the profitability variable.

Table 4

Results on Profitability	**Partial Model**			**Full Model**		
	Estimate	*Std. Error*	*p-value*	*Estimate*	*Std. Error*	*p-value*
(Intercept)	*6.49E-01*	*7.02E-03*	*< 2e-16****	*6.22E-01*	*6.51E-03*	*< 2e-16****
Sex	*2.81E-02*	*5.81E-03*	*1.36E-06****			
Education Level	*9.51E-03*	*1.49E-03*	*2.01E-10****	*7.37E-03*	*1.40E-03*	*1.48E-07****
Years of Experience	*1.85E-03*	*7.58E-04*	*1.49E-02**	*8.45E-04*	*2.79E-04*	*2.43E-03***
Years of Experience^2	*-3.36E-05*	*2.18E-05*	*1.24E-01*			
Training	*5.00E-02*	*7.58E-03*	*4.44E-11****	*2.56E-02*	*7.48E-03*	*6.22E-04****
Owner	*9.00E-03*	*8.81E-03*	*3.07E-01*			
Got the loan	*-2.85E-02*	*7.43E-03*	*1.26E-04****	*-2.05E-02*	*7.15E-03*	*4.06E-03***
Amount of loan	*-1.07E-07*	*6.48E-08*	*9.92E-02.*			
Guanajuato				*-3.93E-02*	*1.24E-02*	*1.52E-03***
Oaxaca				*-5.04E-02*	*1.09E-02*	*3.97E-06****
Services				*1.63E-01*	*5.31E-03*	*< 2e-16****
Construction				*1.90E-01*	*2.26E-02*	*< 2e-16****
Significance codes:	*"***" 0.001,*	*"**" 0.01,*	*"*" 0.05,*	*"." 0.1,*	*" " 1*	
Residual standard error	*3.929 on 1,564 DF*			*3.645 on 1564 DF*		
R^2	*0.02894*			*0.164*		
Adjusted R^2	*0.02843*			*0.1636*		
F-statistic	*21.89 on 8 and 1564 DF, p-value : < 2.2e-16*			*155.6 on 8 and 1564 DF, p-value: < 2.2e-16*		

The *Adjusted* R^2 metric increases significantly when the control variables for location and sector are added. The *Adjusted* R^2 for the Partial Model is estimated to be 0.02894, this means that the Partial model explains 2.8% of the variance from the *Profitability* variable. The Full Model reports an adjusted R^2 value of 0.1636, which means that this model explains 16.36% of the variance from the Profit over Sales ratio variable.

As mentioned before, *Management Skills* represented in this work as *Education Level, Years of Experience*, and *Training* variables report significant and positive estimators for the dependent variable *Profitability*. These results are robust in the econometric and the theoretical dimensions and can provide meaningful information to the micro business economics.

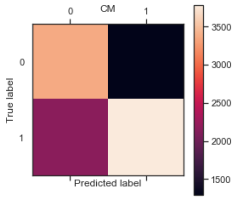
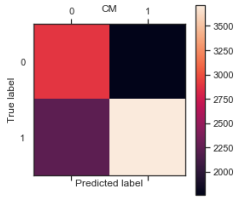
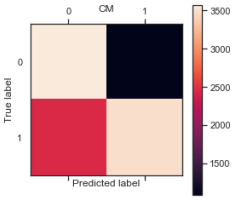
Training Classifiers with Management Skills to predict Profitability

The value of the information provided by the management skills can be used for predicting profitability. For the purposes of this capstone the same data from the ENAMIN is used to train three different classifiers: *K Nearest Neighbors, Naïve Bayes, and Logistic Regression.* These classifiers were trained to predict whether a business is profitable or not by using the Profit over Sales ratio above 70%[10], as the class to predict and the Education Level, Years of Experience, Training, Location, and Sector features.

Table 5 shows the outputs for the metrics for the test data for each trained classifier. The three classifiers work very similar with accuracy levels above 60% and below 70%. The classifier that has the best accuracy score is the K Nearest Neighbors with a 67.3%, followed by the Logistic Regression with a 66.6%. This simple classification exercise demonstrates how important the management skills are to predict whether a micro firm has a profit over sales ratio above 0.7 with more than two thirds of accuracy. The other third can be obtained using more information such as the balance sheet of the firm. An important thing to address is that if a Fintech could use only the management skills as decision tools it can give a loan charging a 33% annual rate. In the financial market is not common to give loans without looking at the balance sheet or the credit score, but the value of the management skills can be added to the supply of credit in order to have more accurate predictions.

[10] This benchmark was determined due to the mean of the profitable micro firms was 71% which is very to close to 70%.

Table 5

Metric	K Nearest Neighbors		Naïve Bayes		Logistic Regression	
Confusion Matrix						
	True Condition		*True Condition*		*True Condition*	
Prediction	*3,367*	*1,295*	*2,899*	*1,763*	*3,576*	*1,086*
Condition	*2,168*	*3,783*	*2,234*	*3,717*	*2,453*	*3,498*
Accuracy	*67.37%*		*62.33%*		*66.65%*	
AUC	*67.89%*		*62.32%*		*67.74%*	
Recall	*63.59%*		*62.46%*		*58.78%*	
Precision	*74.49%*		*67.82%*		*76.3%*	
F1	*68.6%*		*65.03%*		*66.4%*	

Final Comments

The capstone's results confirm how management skills represent a very important feature on the profitability of micro businesses in Mexico. According to the OLS estimates computed, the *Education Level, Years of Experience*, and *Training* variables show a positive and statistically significant effect on the dependent variable *Profitability*. These management skill features can be of great use for loan suppliers such as banks and fintech companies, as they can use them as an alternative approach for selecting their clients rather than just the conservative credit scoring method.

It is reasonable to think that, if micro businesses' managers decide to improve their education level and take some training on sales and accountability the profitability of their business would increase, and their businesses may have access to credit loans for their expansion.

Some future work can explore the impact of management skills on credit access for micro business and how new financial services platforms, such as banks and FinTechs, can develop new products for this market.

In conclusion, *the value of a micro business and its profitability is inherent to the value of its manager's management skills*.

References

Blank, S. (1961). *Small Business Tight Money*. Wiley for American Finance Association, Vol. 16

Brock, W., & Evans, D. (1989). *Small Business Economics*. Small Business Economics, Vol 1.

Carroll, P., & Hoffman, B. (2013). *Financing Small Business: How "New-Form Lending" Will Reshape Banks' Small Business Strategies*. Oliver Wyman.

Dudley, W. C. (2017). *FinTech credit: Market structure, business models and financial stability implications.* Basel: BIS.

Koreen, M., Laboul, A., & Smaini, N. (2018). *Effective Approaches for Implementing the G20/OECD High-Level Principles on SME Financing*. OECD.

Policy Brief. (2000). *Small and Medium-sized Enterprises: Local Strength, Global Reach. OECD.*

Roper, S. (1999). *Modelling Small Bussiness Growth and Profitability*. Small Business Economics, Vol. 13.

Spence, T., & Epshteyn, A. (2013). *Small Business Banking: Challenging Conventional Wisdom to Achieve Outsize Growth and Profitability*. Oliver Wyman.

Wendel, Mr. (2015). *Making Small Business Loans Profitably*. FIC Advisors, Inc.

World Bank. (2013). *Micro, Small, and Medium Enterprise (MSME) Finance*. World Bank.