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Mentoring Effects on Microbusiness Growth in Medellín, Colombia

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Microbusinesses are stagnant in growth across least developed countries due to their lack of managerial skills and limited access to the credit market. Current business methods aimed at increasing profitability for microentrepreneurs with limited capital in developing countries are only moderately successful in increasing growth. Having a mentor that has a localized business understanding can provide their mentee with the proper guidance on how to effectively manage their business to increase growth. This paper presents the results for a randomized controlled trial which identifies the average treatment effects of meeting with a mentor and observes the impact on business growth for female micro-entrepreneurs in Medellín, Colombia. I find that mentoring does not prove to be an effective intervention to increase business growth for female microentrepreneurs; however, the intervention did yield decreases in costs which is in parallel with recent literature. After implementing a LASSO regression, I observe that those who had less experience, had more than 40 years of age, and owned a clothing business, were subgroups that benefitted from mentoring the most. Thus, future mentoring interventions can consider these results for targeting microentrepreneurs in future mentoring interventions.

1. Introduction

Microentrepreneurs struggle in expanding their businesses without accessing the proper tools that allow them to oversee the issues in their business which prevent them from growing and sustaining their business in the long term. This matters in households on the poverty threshold as the profits of these businesses can often be the main source of income for the household and influences the amount of spending on basic needs. Existing interventions to improve business profits are micro-loans and business training which are proven to show a lack effectiveness in addition to being costly. Nonetheless, increasing growth of the many microbusinesses in least developed countries can lead to economic growth as much of the employment in these countries is made up of informal employment which includes microbusinesses. This study replicates a recent intervention that was proven effective in increasing profits for microentrepreneurs by as much as 20% in Kenya after providing small business owners with mentors (Brooks et al., 2017). I replicate their experiment in the context of Medellín, Colombia with female micro-entrepreneurs over one year. This paper aims to identify the average treatment effect of mentors on female microentrepreneurs in Medellín, Colombia on business growth outcomes while observing the microentrepreneurial characteristics that gain the most from a mentoring program.

Small businesses play an important role in developing economies as they are often some of the main contributors to the household and local economy (Nichter and Goldmark, 2009; Pisani, 2016). This occurs as small businesses are self-owned by entrepreneurs from various industries. This is of particular importance in the case of Colombia where they rank high in levels of inequality, fourth highest levels of inequality according to recorded data by the World Bank in 2017¹. In addition, Colombia has an informal sector that makes up 47% of total employment, as such the growth of these informal businesses is essential². Therefore, expanding profitability and the success of these small businesses is crucial to help lift families out of poverty and achieving levels of self-sufficiency to combat inequality. In Medellín, Colombia industries are highly diverse and are often the main source of household income for families.

¹ <https://data.worldbank.org/indicator/SI.POV.GINI>

² International Labour Organization. (2020). ILOSTAT database [Gran Encuesta Integrada de Hogares]. Available from <https://ilostat.ilo.org/data/>.

This randomized control study contains a sample of 107 women in Medellín, Colombia while pairing mentors with mentees, 52 of these women receive a mentor. Each mentor receives three to four mentees and meets with them once a week for five weeks, and once a month for five months thereafter to discuss topics that can serve to improve their business and current business practices. This experiment aims to identify what are the average treatment effects of mentoring on business growth outcomes namely revenue, profits, costs and business confidence. In doing so, other questions being addressed are changes in business growth over time, all in all, determining the relationship that exists between meetings with the mentor and profits.

To answer the questions above, I apply an ANCOVA specification to estimate the average treatment effect of receiving a mentor on profits in the short-run and after multiple follow-ups. Thus, accounting for autocorrelation across time by including the autoregressive term in the analysis. In addition, including this model increases power to my estimates given my sample of 107 as ANCOVA allows for smaller standard errors. The ANCOVA specification yields negative null effects for each wave, apart from endline where positive business growth outcomes are observed. Interestingly, business confidence remains higher for the treated group over the year that data are collected. Thus, the study disproves mentoring as an effective intervention for the average microentrepreneur especially in the context of Medellín, Colombia.

This study also observes which microentrepreneurs characteristics from the sample exhibit the potential of benefiting from a mentoring program. It does so by running a Least Absolute Shrinkage and Selection (LASSO) model which selects the coefficients that present the covariates which hold the strongest association with the mentoring which provide guidance on which microentrepreneurs are more likely to benefit from a mentoring program. The LASSO results vary depending on the business growth outcomes. Those that aim to have higher revenue benefit more from a mentoring program if they are older than 40 years of age, less than or equal to 11 years of education and have lower levels of business experience (less than or equal to 5 years). The LASSO results section also includes guidance on which subgroups were found to be less likely to benefit from a mentoring program.

1.1 Literature Review

Microentrepreneurial Growth Interventions

In the context of least developed countries, business training and microlending interventions have been the primary strategies to increase the survival of these small businesses (de Mel et al., 2014). However, the impact of business training is limited in the

ways in which entrepreneurs can directly apply this general training to their own industry, as well as their own business needs, making it difficult to sustain profits (de Mel et al., 2014). Some studies have attempted to increase profitability through business training and while there has generally been a high uptake of these trainings with attainment of business knowledge, there has not been a significant impact on profitability and business expansion (de Mel et al., 2014; Karlan, D. & Valdivia, M., 2011). Often these trainings tend to be costly and show little to no impact, so an alternative is needed to increase and sustain the profits of small business owners (de Mel et al., 2014; Karlan, D. & Valdivia, M., 2011; Brooks et al., 2017, McKenzie, D, Puerto, S & Odhiambo, F, 2019). Additionally, accessing microfinance is another intervention applied to expand small enterprises; however, this also results in very little business growth due to the lack of skills of novice entrepreneurs to properly manage their microloans as business capital (Acha, 2012; Mokhtar et al., 2012). Therefore, strategies in various fields are not accounting for the idiosyncratic differences in needs across businesses owners and fail to address issues pertaining to location, business type and needs of different business owners.

Social Learning and Mentoring

Brooks, et al.'s experiment on mentoring presented benefits in learning from others to achieve increases in knowledge attainment which is different than the normative in class training (2017). As such, having understanding of the literature which describes the benefits of social learning in the pursuit of better outcomes is part of the mentoring mechanism of this study. Examples of this mechanism can be observed in the Green Revolution where learning from social settings was shown to improve the adaptation of relevant efficient methods. For instance, a study in India found that small farmers adapt agricultural technologies via information exchanges with their neighbors and results in notable profit increases as peer learning increases managerial capital (Foster and Rosenzweig, 1995). Conley and Udry found that a similar relationship exists in Ghana when they observed rural households apply the agricultural methods of their neighbors, especially after observing their neighbor's successes (2010). After hearing new information, which was successful, and brought changes in farming behavior to increase outputs. Evidently, information from social settings brings relevant localized information as opposed to information that comes from an external source which is often not directly applicable.

On a similar note, learning from social settings can improve the adaptation of relevant efficient methods for small businesses. For instance, in the agricultural sector, where peer learning is crucial to gaining managerial capital, a study in India finds that small farmers adapt agricultural technologies from their neighbors and results in notable profit increases

(Foster, 1995). Moreover, a study in Ghana found a similar relationship when researchers observed rural households apply the agricultural methods of their neighbors, especially after observing their neighbor's successes (Conley and Udry, 2010). As seen in the agricultural sector, learning from peers leads to positive feedback in learning outcomes as well as, output.

Mentors prompt social learning settings. Mentoring consists of an assigned relationship to consult mentees on specific challenges to achieve a goal through sharing knowledge and experience, providing emotional support, role-modeling and guiding (Mijares et al, 2012, Hallam, 2016, McLaughlin, 2010). Additionally, a business-mentoring program found that learning from others via mentoring can increase business knowledge attainment (St-Jean and Audet, 2009). The relationship that mentors establish allows them to build on business skills related to their specific needs, as opposed to traditional training which does not tailor its training to the skills that may be required to operate in that distinct industry. Entrepreneurial literature suggests that mentoring can be beneficial for building self-esteem, which is a benefactor not typically found in businesses training (Barrett, 2006; Brooks et al., 2017). As mentoring increases confidence and self-esteem for mentees, entrepreneurial development for small-business owners increases (Barrett, 2006). Additionally, mentoring allows for dissemination of business strategies from an experienced mentor which expands the entrepreneurial skill set (Hallam, 2016). Mentors can influence new ideas for their mentee which expands the mentee's business problem solving and managerial skills (Barrett, 2006). A crucial component of this is adapting skills that address business challenges which is found in various studies to reduce costs (McKenzie et al., 2019; Lafortune, 2018). Expanding on business capabilities via mentoring can thus act as an efficient approach to improving sustainable profit outcomes for female micro-entrepreneurs.

Mentoring Interventions for Microentrepreneurs

An important study to note the impact of mentoring on small business owners is a study in Kenya that randomly assigned mentees to mentors and found a 20% increase in profits over one year (Brooks et al, 2017). The authors constructed a randomized controlled experiment with three treatment arms (mentoring, business training and business training with mentoring) while observing the effects on profits for small businesses in Kenya (Brooks et al., 2017). Their experiment consisted of pairing small businesses owners (mentees) with mentors who had a running business over 40 years. They monitored their meetings over a year and observed profits over time and inferred the effects of mentoring.

Two additional and more recent mentoring treatment interventions took place in Kenya and Chile also show the benefits of mentoring; however, they find different results that shed

light on the mechanisms of mentoring. As such, these studies did not find mentoring to be a cost-effective intervention that increases profit growth. First, the study in Kenya, an impact evaluation of the Gender and Entrepreneurship Together training program (GET Ahead) which enhances women's opportunities in entrepreneurship through knowledge and skills development in business and management consisted of two treatment arms where part of the treatment group received a business course, and some went ahead to receive mentoring (McKenzie et al., 2019). McKenzie et al. finds that treatment impacts are stronger after three years than after one year, and interestingly, they find that mentoring profit effects is only slightly higher than training alone, thus, they did not recommend mentoring in cost-benefit framework. On the other hand, in Chile, their mentoring program finds that the program impacted a reduction costs, and not so much an increase in revenue (Lafortune, 2018). This finding is similar to the Brook et al. 2017 study which indicates that profit increases via mentoring are mostly driven by reducing costs and not so much revenue (Brook et al., 2017). However, challenges that have costs associated with it are heterogenous across time (Brook et al., 2017). Additionally, the training program in Chile finds the impact on profits after including a role model in a training program for microentrepreneurs. The authors discover that the mentor's presence increases aspirations and are beneficial for inexperienced and discouraged entrepreneurs. These studies show that mentoring allows for discussion and exchange of business strategies which is of importance to growing microbusinesses, particularly during times of hardship (McKenzie et al., 2019; Lafortune, 2018). Across the three mentoring interventions mentioned it is clear that changes in profits is a slow process, mentoring frequency is important to consider, and mentoring requires ongoing assistance since challenges are heterogenous over time (Brook et al., 2017)

Literature concludes that in development contexts, increasing profits for micro-entrepreneurs is not effective through broad business training and microfinancing without the effective and relevant businesses skills. Mentorship between peers in common business settings can fill some of the learning gaps that are present in business training and microfinance methods. Mentoring allows for discussion and exchange of business strategies which is of importance to small growing businesses, particularly in expanding the capacity of entrepreneurs during times of hardship (Hallam, 2016). Business mentoring literature suggests that mentoring is more effective in attaining relevant business knowledge and provides clear findings of significant increases in profits. This experiment contributes to the literature by confirming the external validity of Brooks et al.'s findings of the impact that mentoring can have on profits, as well as, employing machine learning methodology to assess heterogeneous treatment effects of mentoring to inform future interventions.

2. Experimental Design

2.1 Sample Selection

The sample for this experiment is women who currently run a small business in Medellín, Colombia. To participate in the study, other than owning a small business, two additional conditions were having less than 5 years of experience running a small business and being of strata levels 1 to 3. Colombia has six levels of their socioeconomic indicators assigned by the National Administrative Department of Statistics (DANE) in Colombia³. These socioeconomic Given these conditions, beginning in June 2018, the female microentrepreneurs that showed interest in the study and were recruited to participate in the program through their engagement with local service centers in Medellín. One of those centers being La Alcaldía de Itagüí located in the greater Medellín area. Itagüí is known to be a highly industrial area with high levels of entrepreneurship, the number of women at baseline from Itagüí is 52 women. The rest of the sample is selected from a microfinance organization called Banco de los Pobres (BLP) that provides loans to women in various low-income neighborhoods throughout Medellín, the sample size for these women is 55.

After baseline information was collected for these women, they were randomly assigned to the treated group using a covariate matching methodology which was feasible given the small sample size of 104. To ensure internal validity, randomization occurred at the individual level using pairwise covariate matching. The covariates matched on were first location, second business type and lastly years of experience. The primary purpose of stratification is statistically related to a limited sample size due to budget and time constraints. Therefore, matching increases the power of the estimate as this method matches on covariates minimizing the distance between each matched unit. To assign participants to the treatment and control group, participants were matched in pairs as closely as possible. After obtaining 52 matches, one from each pair was randomly selected into treatment by flipping a coin.

After randomly assigning each pair to treatment and control group, I tested for balance between the treatment group and the control group as a robustness check. Table 4 shows that treatment and control are balanced at baseline across several key baseline

³ Socio-economic stratification is a classification in strata of residential buildings that must receive public services. It is carried out mainly to collect differentially by strata the domiciliary public services allowing to assign subsidies and collect contributions in this area.

characteristics such as age, education, number of loans, log profits and experience; this also applies across the Itagüí sample and the BLP sample.

2.2 Mentoring Intervention

Once assignment occurred, the treated group was assigned a mentor that was within proximity of their business as well as a mentor that runs a business within the same industry as their own. For instance, matching a woman that manages a business that sells children's attire with a mentor that also has a business on children's attire. This allows for exchanging relevant and useful information that can adjust existing flaws in the mentees business in addition to filling gaps that may prevent them from increasing business growth as they are receiving information from someone that understands the business environment within proximity of their own business.

Each mentor received two to three mentees for which they met with once a week for five weeks then once a month for five months. In each group meeting with their mentor they discussed a topic of focus, one that gives attention to an area of business and another that addresses several perspectives of the woman's view of herself and her relationship with her microenterprise and others in the larger community. During each meeting, each mentor focuses on these topics, but can also discuss some of the challenges that each woman is facing in her business and be able to provide feedback by discussing their own past experiences.

After six months, mentors and mentees may continue to meet as frequently as they would like. Thereafter, I surveyed them for a one year follow up after baseline in which I can determine the sustainability of the treatment effects, that is, whether there are any changes in business growth continue to hold after no longer meeting with their mentor.

2.3 Data Collection

To collect data on the microentrepreneurs business, the participants would meet with us at different locations within Medellín and Itagüí, all of which was dependent on what was closest to them. For the BLP sample, the enumerators and I, met with the participants at different CEDEZOs (Zonal Business Development Centers). These CEDEZOS are part of a program designed by the Mayor's Office of Medellín, aimed at supporting entrepreneurship, income generation, development and consolidation of families and microenterprises in the city⁴. The intentions for these centers are to contribute to the economic development of the

⁴ <https://empresarismo.medellindigital.gov.co/index.php/empresarismo/programas/9-programas/11-cedezo>

territory in the intervention zone based on the strategic clusters of the city. We organized times to meet with the participants at five different CEDEZOS, named Popular, Manrique, Villa Hermosa, San Javier, and Castilla. Now for the Itagüí group, we met them directly at the Alcaldia de Itagüí to collect survey data. Occasionally, household surveys were necessary in cases where the participant was unavailable during the designated meeting time.

I along with a team of USF students, as well as the enumerators hired individually asked the participants the questions on the survey and collected the responses. These surveys were conducted in Spanish, and included approximately 85 questions regarding socioeconomic indicators, information on their business, business confidence, empowerment indicators, and recording number of meetings attended if they were the treated group.

Baseline surveys were thus collected in June 2018, during this time the participants received an accounting course to increase the accuracy of the responses particularly for information on business performance. The second follow-up, wave 2, was completed in July 2018, after mentor and mentees had five meetings. Wave 3 was conducted in January 2019 after mentors and mentees completed 10 meetings. It should be noted that mentees were paid 10,000 COP for each meeting they attended. The final follow-up, wave 4, was completed 12 months after baseline in June 2019. All participants were paid 15,000 COP for having taken the survey and participants were paid at the time we surveyed them.

3. Model

3.1 Analysis of Covariance Model

To determine the impact of receiving a mentor across business growth outcomes, I find this estimate using an Analysis of Covariance (ANCOVA) model as McKenzie recommends this as the best model to obtain higher power in small samples with multiple follow-ups particularly for assessing outcomes such as profits for microenterprises (McKenzie, 2012). The reasoning behind choosing this estimation is due to the various follow-ups after the intervention which results in autocorrelation over time. In choosing the ANCOVA model the baseline observations in the model will function as an autoregressive term. Baseline outcome observations function as an autoregressive term and controls for baseline difference in means according to degree of correlation between past and future outcomes observed. This allows for a more efficient estimator given that there will be three follow-ups after baseline. The model below oversees differences in effects on business growth outcomes across time. The model consists of an ANCOVA specification with the 5-week, 6-month and 12-month follow-up interacted with the treatment. The purpose behind this is to observe variation in the effectiveness of the treatment over time. Additionally, this increases power in my estimate as I follow observations over one year. The model will be as follows:

$$y_i = a + y_{0i}p + M_{it}\beta + X_i\eta + T_{it}\nu + \varepsilon_{it}$$

where y_i is the dependent variable and y_{0i} is the baseline level of output. M_{it} is observing the treatment which is determined by whether the mentee was assigned a mentor and received treatment across each wave with the exception to baseline, as such β is capturing the average treated on the treated effect of receiving a mentor. X_i is a vector of time-invariant baseline controls that influence the dependent variable. These controls are age, strata, education, Banco de Los Pobres dummy and business type. In addition, X_i includes a pair fixed effect. In addition, I include time dummies, T_{it} which captures the average of the control group across the different waves. I limit this to waves 2 and 4 to avoid the issue of collinearity. I assume that the error ε_{it} are independent across individual units with cross-sectional variance. Lastly, the model is clustered at the pair level since random assignment was done so at the pair level after implementing covariate matching.

The outcome variables for this specification are percentage change in revenue, percentage change in profits, percentage change in costs, and levels of business confidence. The business confidence index is constructed using a Likert scale from one to five that establishes how confident the female micro-entrepreneurs feel over their business. The five measures I am observing to create this index are support in her business, motivation to work in her business since last year, confidence as a micro-entrepreneur and satisfaction in her business. Each response is given equal weight when constructing the business confidence index thus forming a Kling index. Therefore, M_{it} will be capturing the ATT after 5-weeks, 6-months and 12-months on the business growth outcome variables.

3.2 Least Absolute Selection and Shrinkage Operator Model

The LASSO model will be applied to the data to determine heterogeneous causal effects, that is, which are the most important covariates in the model associated with treatment and thus showing which microentrepreneurial characteristics for which target a mentoring intervention for. The LASSO regression model I am applying is shown below.

$$\sum_{i=1}^n \left(y_i - \sum_j x_{ij}\beta_j \right)^2 + \lambda \sum_{j=1}^p |\beta_j|$$

LASSO regression imposes a constraint on the sum of the absolute value of the model parameters, where the sum has a specified constant as an upper bound. This is the regularization process where including this constraint causes regression coefficients for some variables to shrink towards zero (Tibshirani, 1996). This regularization process

identifies the covariates with the strongest association of the treatment as LASSO sets some of the β_j 's to zero. During this selection process, the subset of predictors that minimizes the prediction error is obtained thus improving prediction accuracy.

When running a LASSO regression, the regression coefficients for unimportant variables are reduced to zero which effectively removes them from the model and produces a simpler model that selects only the most important predictors. Below, λ lambda, is the parameters which penalizes the absolute value of the magnitude of the coefficients, as such, lambda is applied to determine penalty levels. Therefore, penalty level λ chosen by cross-validation in order to optimize out-of-sample prediction performance. Particularly for this study this self-selection process will capture which microentrepreneur characteristics appear to resemble a mentee that would benefit most from a mentoring program. That is, which covariates have a strong association with business growth outcomes after they are interacted with treatment in the LASSO model. The business growth outcomes observed in y_i are revenue in USD, costs in USD, profits in USD and business confidence index.

The controls, x_{ij} , for the LASSO regression are the following: strata, years of experience, and business type. These controls are not penalized in the regression. The covariates included in the regression reflect groups in the sample that were largest in the distribution and may lead to an understanding of groups that are more likely to benefit from a mentoring intervention. These results can provide recommendations as to which characteristics to target when considering implementing a mentoring program. These covariates are the following: ages between 20 to 40, ages greater than 40, less than 11 years of education, more than 12 years of education, clothing business, personal services business, attended 9+ meetings, attended <9 meetings, less than or equal to 5 years of experience, more than five years of experience, mentor-mentee age match, mentor profits low and mentor profits high. In the regression, I include the covariates, as well as their interaction with the treatment which identifies the group that were more influenced by the treatment that has the strongest association with the corresponding business growth outcomes. Finally, the variables that are penalized in the regression are the covariates mentioned and their interaction with treatment while the non-penalized terms are the treatment term and the control variables.

4. Results

In this section, I will present the results of the mentoring intervention across four main business growth outcomes, percentage change in revenue, percentage change in costs, percentage change in profits, and changes in the business confidence index. I will show

these results across the different waves to present treatment effects at different treatment dosages using the ANCOVA model. Lastly, I will observe which sub-groups from the sample appear to have strong associations with benefiting from the mentoring program by using a LASSO regression.

Prior to diving into the deeper models, I observe visually how the treatment and control groups varied across time to provide insight on the outcomes over time. I observe the difference between the two groups by looking at the averages of profits, revenue, costs and business confidence index for each wave. Graph 1 shows how business confidence shifted over time between the treatment and control group, I observe that there was strong parallel trends between the control group and treated group, confidence increased over time and was highest in wave 3 during January 2019 then dropped backdown at endline during June 2019. Next, I observed the business growth by looking at shifts over time for profits, revenue and costs. Graph 2 shows that revenue was higher for the control group over time with a particularly large gap at endline. Graph 3 shows the changes in profits over time where the control group has much larger profits over time which has a larger and increasing gap between the control group and the treatment group over time. Lastly, costs between the treatment and control group varies across time, initially costs are slightly higher for the control group as seen in Graph 4. In July 2018, the gap between treatment and control increases where costs are higher for the control group, however, for third wave in January 2019 costs for treatment and control are nearly the same as costs increased for the treated group and decreased for the control. At endline, there is large gap between treatment and control as the costs increase much higher than those in the treated group. Having visually observed the average results of the treatment, the empirical results can be assessed.

4.2 Analysis of Covariance Results

Given that this study was randomized, the ANCOVA specifications are modeled here in order to obtain smaller standard errors by including the baseline outcome in our specification. The reasoning behind choosing this estimation is due various follow-ups after the intervention which results in autocorrelation over time, as such, the ANCOVA model will include the baseline observations in the model as an autoregressive term. Thus, allowing for a more efficient estimator given the three follow-ups after baseline. This is applied for all four of the outcomes while controlling for a vector of time invariant controls which are age, strata, and education, in addition to pair and BLP fixed effects.

The ANCOVA model gives closer attention to the different treatment dosage, that is effects after having more frequent meetings over a shorter period of time, less frequent meetings over longer periods of time, and lastly meetings that occurred without incentive.

Table 1. ANCOVA Model: Business Growth Outcomes with Controls

	Log Profits	Log Costs	Log Revenue	Business Confidence Index
Mentoring after 5-weeks	-0.258 (0.945)	0.540 (0.759)	-0.130 (0.678)	0.116 (0.156)
Mentoring after 6-months	-0.584 (0.601)	0.0170 (0.601)	-0.0994 (0.594)	0.154 (0.185)
Mentoring after 12-months	-0.476 (0.876)	-0.626 (0.862)	-0.568 (0.928)	0.0432 (0.229)
5-weeks	-1.396* (0.795)	-0.798 (0.762)	-0.457 (0.619)	-0.212 (0.198)
6-months	-1.066 (0.701)	-0.104 (0.655)	-0.552 (0.668)	-0.196 (0.236)
Controls	Yes	Yes	Yes	Yes
Baseline Outcomes	Yes	Yes	Yes	Yes
Constant	6.845** (3.147)	4.636 (3.168)	4.430 (4.380)	-0.502 (0.996)
Observations	234	234	234	234

Standard clustered errors in parentheses

* p<.10 ** p<.05*** p<.01

Table 1 shows the results for the ANCOVA model where the ATT effects are observed by estimating average effects on those who were treated during the indicated wave, that is, if they were assigned to treatment and were surveyed. Business confidence on average over one year increased, although this was not significant, and it was largest in magnitude when there were meetings at a higher frequency which occurred after 5-weeks. Mentoring increased business confidence .04 standard deviations from the mean after one year. After five weeks having received a mentor increased business confidence by .11 standard deviations, then increased by .15 standard deviations after 6 months.

Next, I take note on the average changes on business growth outcomes over one year, both percentage changes in revenue and profits were negative as seen in Table 1. After 12 months, revenue decreased by 53% and profits by 47% both estimates were insignificant. After 6 months, profits decreased by 58% while revenue also decreased by 12% although not significant. The immediate effects, at 5 weeks, were also negative but smaller in magnitude and not significant. Also in Table 1, costs appear to have shown an immediate

increase of 54%, then a non-significant increases of 1% after the 6 months followed by a large non-significant decrease of 63%. Possibly suggesting that changes to business methods allows for a significant reduction in costs, and over time this led to a large reduction in costs as businesses practices improved. In addition, revenue can also be a seasonal factor which is affecting the performance of businesses, however, this does not explain the large gap between treatment and control which is noted in **Error! Reference source not found..**

These results were mostly unchanged when the controls were removed as seen in

Table 6.

4.2 Least Absolute Selection and Shrinkage Regression Results

Error! Reference source not found. shows the results for the LASSO regression. Based on the model described in section 3.2 Least Absolute Selection and Shrinkage Operator Model, the model selected which covariates are most strongly associated with its corresponding outcome. Prior to the selection of the covariates, the model identifies the penalization term λ which minimizes the mean-squared prediction error. Thus, controlling the strength of the penalty where as λ increases, more and more coefficients are set to zero and eliminated. As such, after the penalty term is found, the model selected two types of covariates, those interacted with treatment and those that are not. The penalty terms for each regression are seen in Table 2 shows that the regression for profits in USD had the largest penalty and business confidence had the smallest when observing the λ chosen for each of these.

Table 2. LASSO Model: Business Growth Outcomes

	Revenue in USD	Costs in USD	Profits in USD	B.C.I.
<i>Non-Penalized Terms</i>				
Mentoring	-171.3	-111	-7.305	0.21
Baseline Strata	-1.93	1.657	-0.335	-0.0715
Baseline Years of Experience	3.116	2.841	0.448	-0.0142
Baseline Business Type	-12.08	-8.812	-6.711	-0.00482
Meal Difficulty	-55.86	-40.56	-14.89	-0.319
Ages >40	-74.32	-49.44	-23.87	0.0149
Education <= 11	-70.63	-25.97	-21.35	-0.171
Clothing Business	-5.916	-20.5	6.275	-0.0147
Personal Services Business	219.5	41.78	160	0.203
>9 meetings	-4.996	-8.744	18.15	-0.12
Low Experience	-40.27	5.105	-30.37	0.165
Mentor-Mentee Age Match	-56.88	-44.95	6.114	-0.552
Mentoring Profits High	-20.21	-8.279	-36.45	-0.0233
<i>Penalized Terms</i>				
Meal Difficulty x Mentoring	7.154	19.3		
Age >40 x Mentoring	65.45	57.54		
Education <= 11 x Mentoring	106.4	48.55		
Clothing Business x Mentoring	48.54	48.49		
Personal Services Business x Mentoring	-105.6			
Low Experience x Mentoring	42.27	15.3		
Constant	310.6	164.7	115.8	0.386
Observations	337	337	337	337
lambda	2224.8	1790.5	8969.8	114.8

The covariates interacted with mentoring selected were ages greater than 40, less than 11 years of education, clothing service, whether the individual had difficulties obtaining sufficient meals, personal services business and having low levels of experience. These covariates inform us on which covariates independent of treatment assignment influence the respective business growth outcome the most. It appears being older in age within this sample, is most likely to benefit is high revenue. In addition, lower levels of education also result in higher revenue. Those with clothing services may lead to higher levels of revenue. Lastly, those with lower levels of experience benefit positively from the mentoring program.

Those that were interacted with the treatment identified the groups that were most influenced by the treatment that has the strongest association with the corresponding business growth outcomes. These inform us on which microbusiness appear to benefit the most or the least from a mentoring program. These covariates interacted with treatment are the following: ages greater than 40, more than 12 years of education, clothing business, personal services business, difficulty obtaining sufficient meals, having more than five years of experience, and mentor-mentee age match. Given that the data are pooled for the purposes of running a LASSO regression, I focus on the sign of the selected variables and less on magnitude.

First, I observed the associations that mentoring had with revenue in USD. Table 2 shows those that were older than 40 years of age and received mentoring are associated with having higher levels of revenue. Sub-groups with higher levels of education (more than 12 years) did not appear to exhibit higher levels of revenue from the mentoring intervention. Next, the two main businesses in the sample were clothing and personal services. However, those that had a clothing business benefited positively from the mentoring intervention while those with personal services did not.

Table 2 also shows that the LASSO model did not select interactions terms that were associated with changes in profits or business confidence. The LASSO regression not only informed on microentrepreneurs to target but also which factors seem to be less important with regards to a mentoring program. In this regard, the LASSO model did not select whether the mentee attended 9 meeting or more, mentor-mentee have similar age, and whether the mentor profits were high. This suggests the factors do not influence the likelihood of benefitting from a mentoring program less. In addition, those aiming to increase revenue but have higher years of education, higher levels of education, younger and have a personal business might be less likely to benefit from a mentoring program. These LASSO results can provide guidance for selecting the appropriate beneficiaries for a mentoring program which are also dependent on the needs and goals of the microentrepreneurs.

5. Robustness Checks

5.1 *Difference-in-Difference*

Besides running the ANCOVA model, I apply a difference-in-difference model to determine the robustness of the results while applying a different model which also captures ATT. The model below will show the ATT effects of the intervention by observing the interaction between mentor and wave, $M_{it} \cdot \theta_{it}$, which yields the difference-in-difference

estimator. M_{it} is observed for each wave and each individual as not all those who were assigned to the treated group were surveyed for each wave. Again, X_i is a vector of time-invariant controls that influence the dependent variable. The model is clustered at the pair level. This specification will observe the same business growth outcomes that the mentoring intervention was targeting. Here, y_{it} will be the effects of mentoring on log profits, log revenue, log costs and business confidence index. All of which are outcomes seen in the literature that business mentoring can have an influence over. Thus, the differences-in-differences specification controls for changes that occurred at 5-weeks, 6-months and 12-month follow up.

$$y_{it} = a + M_i\beta + \theta_t z + M_{it} \cdot \theta_{it} s + X_i\eta + \varepsilon_{it}$$

Across all ATT specifications I include the same controls; these controls being age, years of education, business type, difficulties obtaining sufficient meals, strata and a fixed effect for being in the BLP group as well as a fixed effect for pair assignment. The ATT is observed in the specification where treatment is interacted with time. In this case time being wave for which there are four different points in time over one year.

Table 3. Difference-in-Difference Model: Business Growth Outcomes with Controls

	Log Revenue	Log Profits	Log Costs	Business Confidence Index
5-weeks	-0.561 (0.525)	-0.314 (0.707)	-1.062* (0.585)	0.484*** (0.163)
6-months	-0.162 (0.417)	1.053** (0.511)	-0.334 (0.463)	0.651*** (0.238)
12-months	-0.802 (0.683)	-0.0737 (0.866)	-0.530 (0.724)	0.475** (0.225)
Treatment	-0.557 (0.400)	0.239 (0.669)	-0.782* (0.440)	0.192 (0.241)
Mentor * 5-weeks	0.198 (0.742)	-0.343 (1.047)	1.029 (0.832)	-0.102 (0.202)
Mentor * 6-months	0.276 (0.634)	-0.662 (0.720)	0.527 (0.638)	-0.0113 (0.241)
Mentor * 12-months	-0.0455 (1.080)	-0.475 (1.116)	0.0660 (0.995)	-0.113 (0.273)
Controls	Yes	Yes	Yes	Yes
Constant	12.34*** (2.268)	9.508*** (2.470)	12.07*** (2.210)	-1.014 (1.050)
Observations	338	338	338	338

Standard clustered errors in parentheses

* p<.10 ** p<.05 *** p<.01

Given that the mentoring literature discusses increased levels of empowerment that evolve with any changes in business growth, I first observe differences on business confidence. The business confidence index measures business confidence based on several proxies that were collected using the survey instrument. Overall, the treatment effects of the mentor on business confidence, as seen in Table 3, were positive across time though larger in magnitude when compared to the ANCOVA regression. The other business growth outcomes were also negative after one year similar to the ANCOVA estimates, and again smaller in magnitude. However, the short-term effects were positive for log-revenue and log-profits in the DiD model while in the ANCOVA model these negative. These results suggest that the ANCOVA model increases power for the regression to determine possible impact. The trends in the DiD model are similar to the ANCOVA and graphs presented; thus, the ANCOVA model is the best specification give the data.

6. Discussion and Conclusion

The impact results presented for this study follow trends in recent literature as it relates to mentoring for microentrepreneurs. As such, the null negative results in business growth outcomes are contributing to current recommendations in which mentoring does not have a large immediate impact on microentrepreneurs. Although literature suggests social learning as an effective approach, it is possible the strategies learned through mentoring are not sufficiently concrete to yield immediate positive impacts for business growth. Also similar to other mentoring studies, the results did find a reduction in costs in the long term, although not significant, estimates were large in magnitude after one-year. This suggests mentoring may provide recommendations on reducing business costs but requires longer periods of time to enforce the changes which mentoring consults on. This also applies to driving any increases in revenue simultaneously. Interestingly, business confidence showed similar patterns from the treatment and control group. Business confidence displays signs of resilience and is essential for successful business growth, however, the lack of impact may suggest mentoring does not provide encouragement for microentrepreneurs in the context of Medellín, Colombia.

After observing the null negative results on business growth outcomes, the LASSO results aimed to delve deeper and show which microentrepreneurs subgroups did benefit from the mentoring program. Targeting microenterprise characteristics for future intervention to achieve growth is a potential solution to the stagnant microenterprise problem as it targets those which are most likely to yield positive growth outcomes. The LASSO results also showed that there is not a strong association between mentor-mentee match but rather the

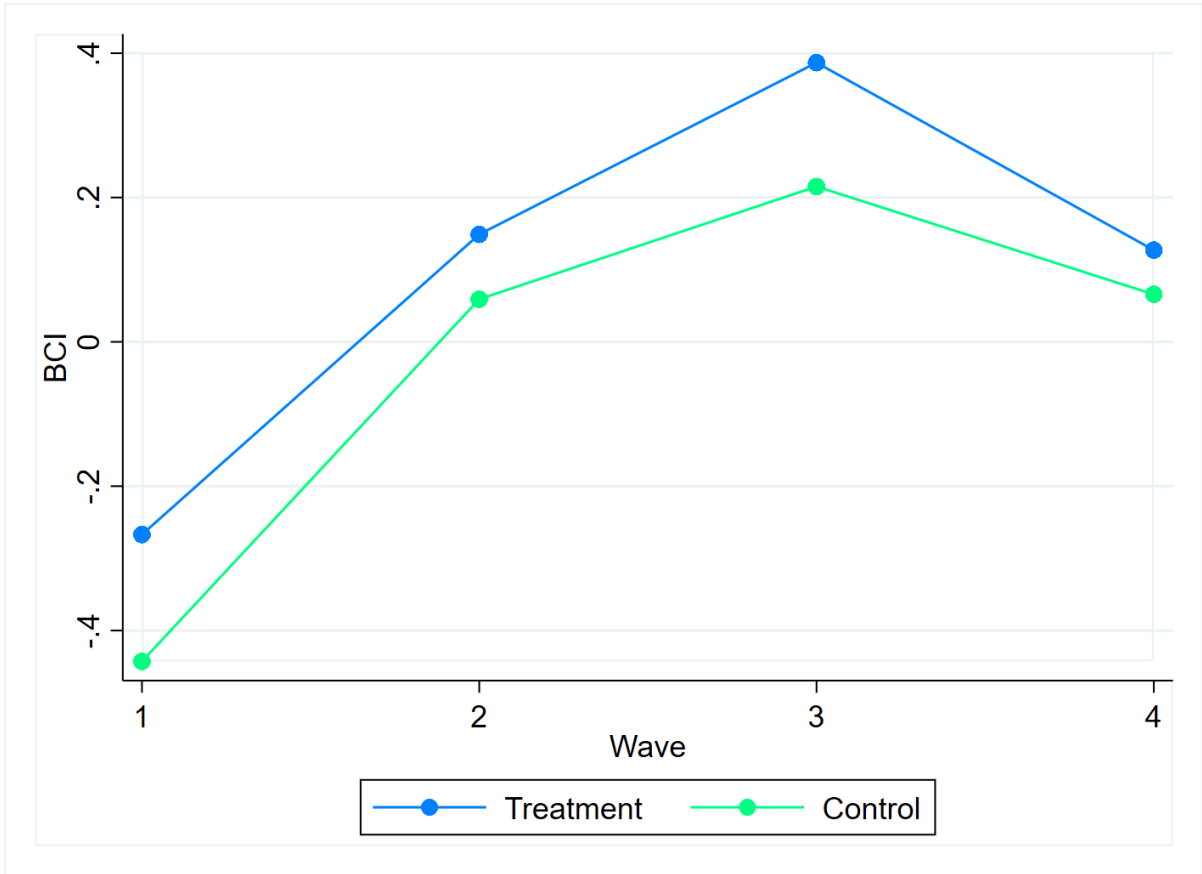
microentrepreneurs characteristics such as age levels, education levels and type of business. Similarly, these results also provide recommendation on which subgroups not to target for a mentoring intervention.

Although much of literature suggests that having a strong microentrepreneurs mindset is essential for business growth, a mentoring intervention in the context of Medellín, Colombia did not influence their business confidence. This was observed both in the ANCOVA and LASSO results.

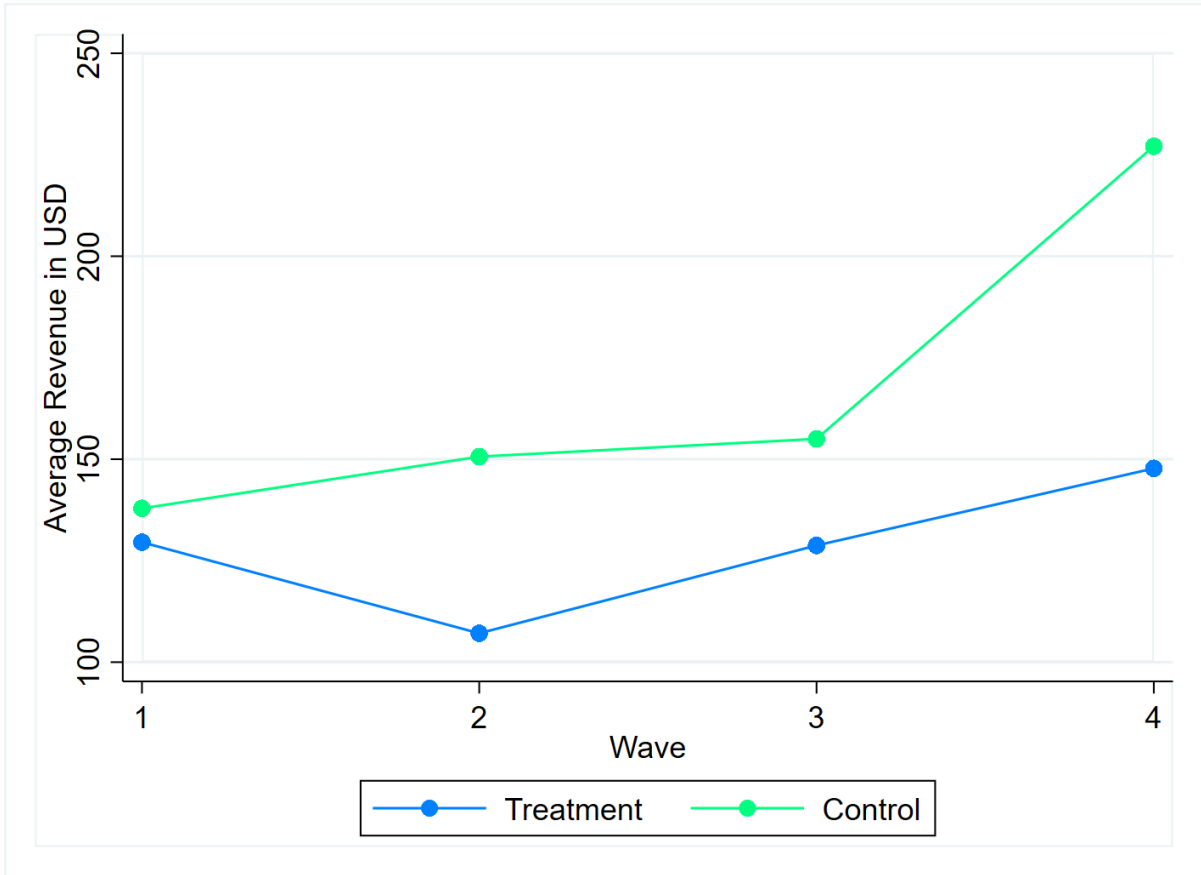
This study contributes to the understanding of possible mechanisms to improve business growth for the many struggling microbusiness in less developed countries. These understandings will inform public service centers like those that we worked with on how to better assist the microentrepreneurs so they may succeed and improve local economies.

Tables and Graphs

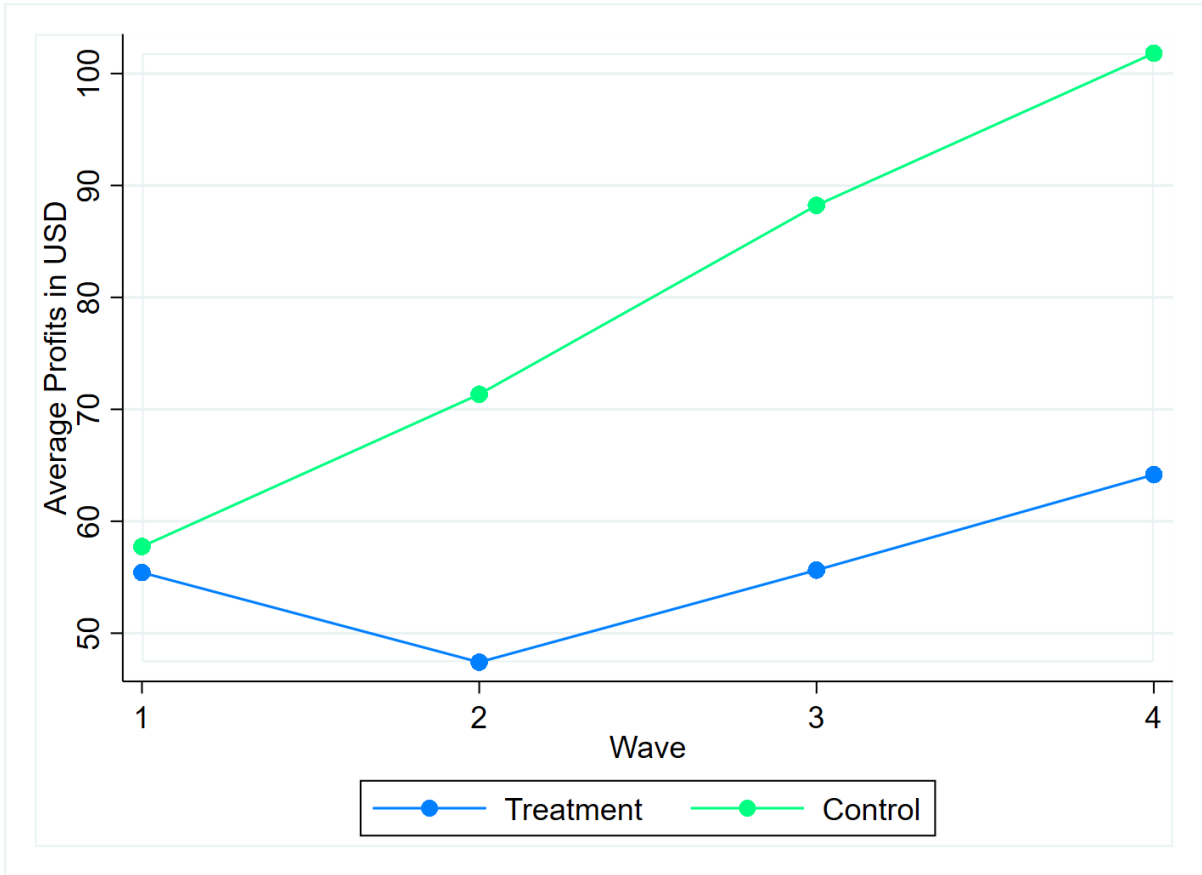
Graph 1. Average Business Confidence Over Time



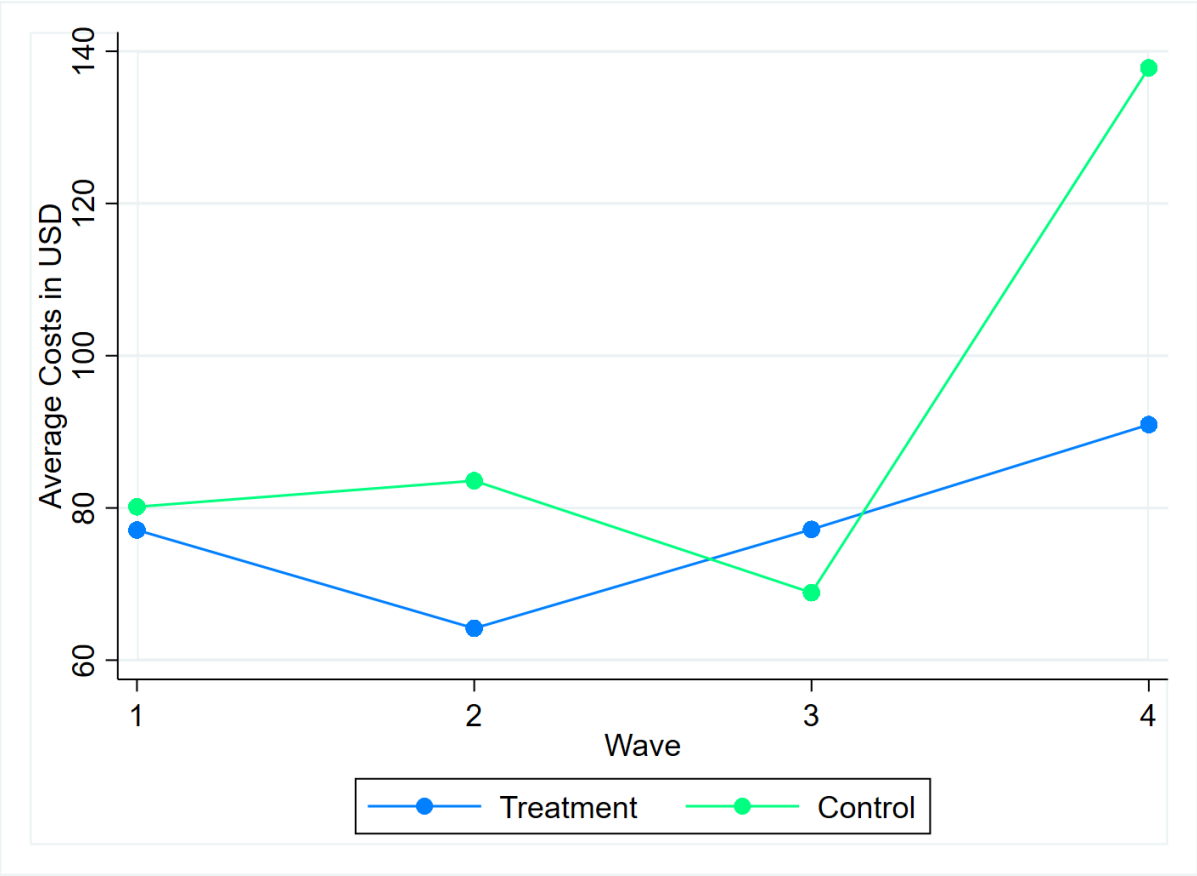
Graph 2. Average Revenue Over Time



Graph 3. Average Profits Over Time



Graph 4. Average Costs Over Time



Graph 5. Average Profits by Business Type

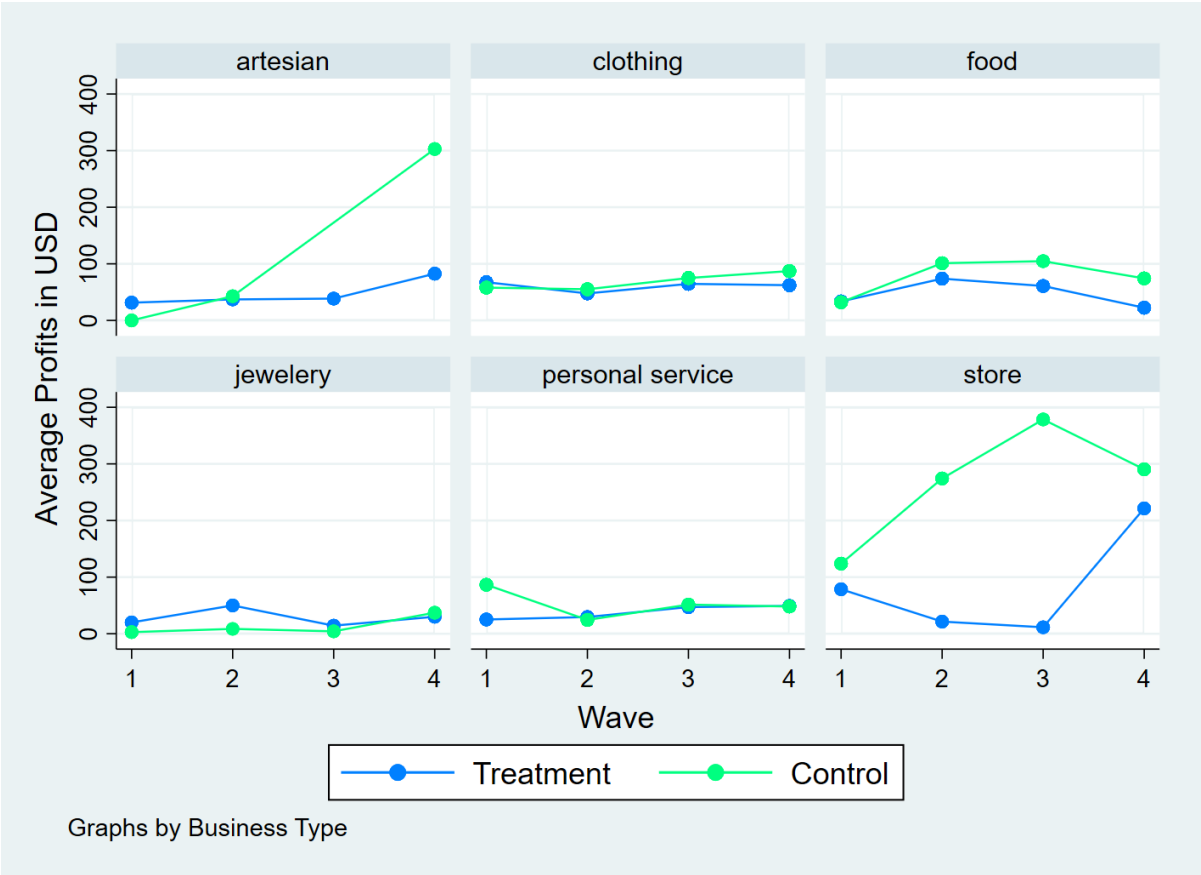


Table 4. Balancing Tests on Baseline Characteristics

	Control Mean	Control SD	Treatment Mean	Treatment SD
Experience	5.4	6.9	5.8	6.2
Age	39.4	10.6	40.6	11.9
Education	11	3.4	10.8	3.2
Strata	2.1	0.8	2.1	0.7
Clothing	0	0.2	0.1	0.2
Food	0.7	0.5	0.6	0.5
Store	0.1	0.3	0.1	0.3
Artesian	0	0.2	0	0.2
Personal Service	0	0	0	0
Jewelry	0.1	0.3	0.1	0.3
Other	0.1	0.2	0	0.2

Business Type	Control	Treatment	%
Artesian	2	3	4%
Clothing	36	33	65%
Food	6	7	12%
Jewelry	2	2	4%
Personal Service	6	5	10%
Store	3	2	5%

Table 5. ANCOVA Model: Business Growth Outcomes with Controls

	Log Profits	Log Costs	Log Revenue	Business Confidence Index
Mentoring after 5-weeks	-0.258 (0.945)	0.540 (0.759)	-0.130 (0.678)	0.116 (0.156)
Mentoring after 6-months	-0.584 (0.601)	0.0170 (0.601)	-0.0994 (0.594)	0.154 (0.185)
Mentoring after 12-months	-0.476 (0.876)	-0.626 (0.862)	-0.568 (0.928)	0.0432 (0.229)
5-weeks	-1.396* (0.795)	-0.798 (0.762)	-0.457 (0.619)	-0.212 (0.198)
12-months	-1.066 (0.701)	-0.104 (0.655)	-0.552 (0.668)	-0.196 (0.236)
Baseline Age	-0.00672 (0.0202)	0.00870 (0.0187)	0.00353 (0.0202)	0.00809 (0.00582)
Meal Difficulty	0.124 (0.305)	0.304 (0.253)	0.275 (0.272)	-0.0904 (0.118)
Baseline Strata	-0.244 (0.470)	0.0142 (0.443)	0.226 (0.417)	0.0562 (0.114)
Baseline Education	0.0795 (0.103)	0.0769 (0.101)	0.0673 (0.105)	0.0292 (0.0373)
Banco de Los Pobres	2.110* (1.147)	1.157 (1.161)	1.662 (1.203)	0.128 (0.383)
Baseline Business Type	-0.0998 (0.176)	-0.0958 (0.169)	-0.138 (0.178)	0.0316 (0.0433)
Baseline Years of Experience	-0.00580 (0.0537)	-0.00338 (0.0577)	0.00959 (0.0547)	-0.0142 (0.0122)
Pair	0.0633 (0.0444)	0.0121 (0.0408)	0.0266 (0.0430)	0.00182 (0.0111)
Baseline log profits	0.238** (0.115)			
Baseline log costs		0.420*** (0.140)		
Baseline log revenue			0.432* (0.234)	
Baseline business confidence				0.272*** (0.0564)
Constant	6.845** (3.147)	4.636 (3.168)	4.430 (4.380)	-0.502 (0.996)
Observations	234	234	234	234

Standard clustered errors in parentheses

* p<.10 ** p<.05 *** p<.01

Table 6. ANCOVA Model: Business Growth Outcomes without Controls

	Log Profits	Log Costs	Log Revenue	Business Confidence Index
Mentoring after 5-weeks	-0.192 (0.915)	0.896 (0.754)	-0.117 (0.666)	0.122 (0.150)
Mentoring after 6-months	-0.521 (0.556)	0.0480 (0.572)	-0.111 (0.611)	0.150 (0.186)
Mentoring after 12-months	-0.448 (0.920)	-0.549 (0.875)	-0.493 (0.939)	0.0681 (0.247)
5-weeks	-1.337* (0.753)	-1.102 (0.798)	-0.462 (0.622)	-0.213 (0.196)
12-months	-1.035 (0.718)	-0.135 (0.683)	-0.596 (0.708)	-0.204 (0.242)
Baseline log profits	0.255** (0.107)			
Baseline log costs		0.413*** (0.147)	0.262 (0.183)	
Baseline business confidence				0.293*** (0.0502)
Constant	9.118*** (1.238)	6.675*** (1.804)	9.415*** (2.233)	0.356* (0.179)
Observations	235	235	235	235

Standard clustered errors in parentheses

* p<.10 ** p<.05 *** p<.01

Table 7. Difference-in-Difference Model: Business Growth Outcomes with Controls

	Log Revenue	Log Profits	Log Costs	Business Confidence Index
5-weeks	-0.561 (0.525)	-0.314 (0.707)	-1.062* (0.585)	0.484*** (0.163)
6-months	-0.162 (0.417)	1.053** (0.511)	-0.334 (0.463)	0.651*** (0.238)
12-months	-0.802 (0.683)	-0.0737 (0.866)	-0.530 (0.724)	0.475** (0.225)
Treatment	-0.557 (0.400)	0.239 (0.669)	-0.782* (0.440)	0.192 (0.241)
Mentor * 5-weeks	0.198 (0.742)	-0.343 (1.047)	1.029 (0.832)	-0.102 (0.202)
Mentor * 6-months	0.276 (0.634)	-0.662 (0.720)	0.527 (0.638)	-0.0113 (0.241)
Mentor * 12-months	-0.0455 (1.080)	-0.475 (1.116)	0.0660 (0.995)	-0.113 (0.273)
Baseline Age	-0.0128 (0.0166)	-0.0232 (0.0178)	-0.0188 (0.0196)	-0.00556 (0.00754)
Meal Difficulty	-0.187 (0.257)	-0.331 (0.270)	-0.0979 (0.273)	-0.195 (0.129)
Baseline Strata	0.0102 (0.357)	0.0170 (0.435)	0.0594 (0.335)	0.0794 (0.139)
Baseline Education	0.0303 (0.0799)	0.0974 (0.0919)	0.0178 (0.0986)	0.0297 (0.0356)
Banco de Los Pobres	0.976 (1.210)	1.906 (1.147)	0.678 (1.181)	0.443 (0.328)
Baseline Business Type	0.0399 (0.158)	0.0678 (0.164)	0.0338 (0.147)	0.00698 (0.0410)
Baseline Years of Experience	-0.0231 (0.0346)	-0.0407 (0.0420)	-0.0409 (0.0419)	-0.0237* (0.0122)
Pair	0.000158 (0.0301)	0.0113 (0.0356)	-0.00293 (0.0321)	0.0118 (0.0114)
Constant	12.34*** (2.268)	9.508*** (2.470)	12.07*** (2.210)	-1.014 (1.050)
Observations	338	338	338	338

Standard clustered errors in parentheses

* p<.10 ** p<.05 *** p<.01

Table 8. Difference-in-Difference Model: Business Growth Outcomes without Controls

	Log Revenue	Log Profits	Log Costs	Business Confidence Index
5-weeks	-0.537 (0.519)	-0.325 (0.680)	-1.364** (0.605)	0.502*** (0.156)
6-months	-0.0983 (0.414)	1.081** (0.497)	-0.298 (0.455)	0.658*** (0.226)
12-months	-0.735 (0.661)	-0.0243 (0.832)	-0.497 (0.692)	0.509** (0.222)
Treatment	-0.534 (0.395)	0.197 (0.648)	-0.802* (0.444)	0.176 (0.243)
Mentor * 5-weeks	0.192 (0.713)	-0.274 (1.028)	1.341 (0.809)	-0.0859 (0.196)
Mentor * 6-months	0.189 (0.617)	-0.707 (0.708)	0.479 (0.632)	-0.00419 (0.234)
Mentor * 12-months	-0.0893 (1.090)	-0.452 (1.130)	0.0461 (0.992)	-0.115 (0.278)
Constant	12.52*** (0.184)	10.73*** (0.451)	11.71*** (0.278)	-0.443** (0.185)
Observations	342	342	342	342

Standard clustered errors in parentheses

* p<.10 ** p<.05 *** p<.01

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