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ABSTRACT

Managerial Performance of a Female-Owned and Home-Based Firm

Female entrepreneurship has been regarded as inferior to its male equivalent in terms of performance. Literature on gender differences in entrepreneurship focus mostly on showing the differences, but not much literature discusses where the differences come from, and how to mitigate them. This paper empirically examines the joint effect of female ownership and being home-based on owners' managerial performance. We estimate the average treatment effect of female-owned and homebased firms on return on assets (ROA) using the 2007 Survey of Business Owners (SBO) micro data. From the main estimation result, the marginal effects of female ownership and home-based business are both negative. The estimated ROA gains of female ownership and home-based business are about -37.20% and -67.17%, respectively. In contrast, we find that the joint effect of female ownership and home-based business is about 39.53% ROA gain. Our finding suggests that female-owned firms can outperform under the appropriate supporting conditions, such as if they are able to remove travel time and costs by establishing their businesses at home.

JEL Classification: L25, L26, J16

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1 Introduction

Women earn less than men and are significantly underrepresented in leadership positions (Bertrand et al. (2011); Blau et al. (2010)). This discrepancy in labor market outcomes has been found to increase with age is greater among college graduates than others, and even larger in sectors known to penalize workers for job schedule flexibility, shorter hours and time off (Bertrand et al. (2010)). Job autonomy, hours flexibility and the ability to work a nonstandard work week are factors cited as favoring the decision to be self-employed, especially for women (Devine (2001); Hundley (2000); Lombard et al. (2001)) and workers nearing retirement (Fuchs (1982)). Goldin (2014) stipulates that gender gap in pay would be considerably reduced and might disappear altogether if firms did not have an incentive to disproportionately reward individuals who labored long hours and worked particular hours. Many firms indeed maintain "flexibility" policies designed to mitigate conflict between work and family life.[1] However, the general consequence of reduced-hours flexibility policies, for example, is to maintain women's labor market attachment at the cost of their achievement (Mandel and Semyonov (2006); Williams et al. (2013)).

Even as many women venture into self-employment to better manage the demands of household production and the labor market, across countries, women own significantly fewer businesses than men (Blanchflower (2004); Minniti and Nardone (2007)). Women are less confident in their entrepreneurial skills, have different social networks and exhibit higher fear of failure than men, which explains, in part, their lower propensity to start a business (Koellinger et al. (2013)). Self-employed women earn less on average than self-employed men do, as well as less than employees of either gender that are not self-employed. Some of this has been attributed to women working more frequently in lower-paying sectors such as service and retail sectors, which are more competitive and also exhibit lower business survival rates (Devine (1994)). Research shows that female-owned businesses are less successful than male-owned businesses, for a variety of reasons, for example, for being less likely to enter competitive situations than men Niederle and Vesterlund (2007,0), Sutter and Glätzle-Rützler (2015), Agarwal et al. (2016); for differences in core values and risk attitudes Adams and Funk (2012); because they have less startup capital, less business human capital acquired through prior work experience in a similar business, and less prior work experience in a family business (Fairlie and Robb (2009)). The literature finds that women-owned firms were more likely to close and had lower levels of sales, profits, and employment (Kalleberg and Leicht (1991); Rosa et al. (1996); Robb (2002); Robb and Wolken (2002)), this last study finding that a female-owned firm generates only 78 percent of the profits of a comparable business

[1] For a recent review, see Kossek and Lautsch (2018).

owned by a man. According to Loscocco and Robinson (1991), women generate only one-quarter of men's average business receipts. After correcting for various factors such as size and sectoral distribution, women's failure rates are not significantly different from those of men (Kepler et al. (2007); Perry (2002)).

This paper empirically examines the joint effect of female ownership and being home-based on business owners' managerial performance. Using the 2007 SBO public use micro sample (PUMS), we create a firm-level dataset of their business operation with the owners' demographic characteristics. Our dataset includes single-owner firms only to identify the owners' gender effect, and the sample size is 663,385 out of the total 2,165,683 firm records in the 2007 SBO. We estimate the average treatment effects (ATEs) of female ownership and being home-based, jointly and marginally, on return on assets (ROA). Home-based businesses are assumed to have no commute time and lower costs for the owners, and therefore we can reevaluate female owners' managerial performance under the conditions that the female owners have workplace flexibility. The ATE for the joint effect is identified using a differences-in-differences (DID) method, and estimated using ordinary least squares (OLS) with fixed effects.

From the main estimation result, we find that the ATE for the joint effect is significantly positive, and the estimated ROA gain of female-owned and home-based firms is 39.53%. In contrast, the marginal effects of female ownership and being home-based are each significantly negative, with estimated ROA gains of -37.20% and -67.17%, respectively. Our result suggests that female-owned businesses and home-based businesses are inferior to their counterparts in terms of the market performance. However, female-owned businesses that are home-based perform better than the other types of businesses. This indicates a possibility that female owners can perform better than their male counterparts, if they are able to run their businesses with workplace flexibility.

To check endogeneity due to sample selection, we perform a propensity score matching estimation, for the ATE, for the joint effect of female ownership and being home-based. The propensity score matched estimate is significantly positive, which is consistent with the DID estimate, whereas the non-matched ATE estimate is significantly negative. This suggests that the marginal effects of female ownership and being home-based are both estimated as significantly negative due to the sample selection, where potentially productive female entrepreneurs are less likely to have their own business. In other words, the prospect of having workplace flexibility might be an incentive for the potentially productive female entrepreneurs to run their own businesses, instead of working as employees.

From the DID estimates by industry, we find a notable heterogeneity of the DID estimates over the industries. The DID estimates differ substantially by industry both coefficient signs

and significances. Presence of industry specific production technology might be a reason for the heterogenous female-owned and home-based firm effects across industry. In other words, there are some industries that could be better off by establishing their businesses at home, or placing women in charge. To check the robustness of our result, we perform the DID estimates by age and education level and find that, in overall, they are consistent with the main result in both sign and significance.

Our unique contribution to the literature is finding a condition under which female firm owners can outperform their male counterparts in the market. Our work is closely related to recent works by Amore et al. (2014), Niessen-Ruenzi and Ruenzi (2019), Agarwal et al. (2016), Adams and Funk (2012). Amore et al. (2014) empirically examine gender differences in firm performance using Italian family-controlled firms. They find that the presence of female directors on corporate boards improve the profitability of companies led by female CEOs. Niessen-Ruenzi and Ruenzi (2019) empirically examine gender differences in single managed U. S. equity mutual fund. They find no statistically significant gender differences in performance, though female-managed funds have significantly low inflow than male-managed funds. Agarwal et al. (2016) examine a statistical association between informal networking activities and likelihoods of serving on corporate boards by gender. Using Singapore data, they find that women playing golf are more likely to serve on corporate boards than men, and this tendency is greater in large firms. Adams and Funk (2012) conduct a survey of Swedish firms and examine gender differences in CEOs and resident directors' managerial characteristics such as core values and risk attitudes. They find that female directors are more likely to be benevolent but less power oriented and less security and tradition oriented than male directors.

The finding of poorer performance of female-owned firms has been further scrutinized in the literature. de Mel et al. (2009) report on a field experiment providing random grants to microenterprise owners in Sri Lanka. The grants generated large profit increases for male owners but not for female owners. They show that the gender gap does not simply mask differences in ability, risk aversion, entrepreneurial attitudes, or differences in reporting behavior, but there is some evidence that the gender gap is larger in female-dominated industries. In trying to understand differences between outcomes for females and males, they accounted not only for credit constraints but also competing demands from the household and intrahousehold bargaining. Bernhardt et al. (2019) find that some studies like de Mel et al. (2009) that reported positive returns to grants for male-owned and not female-owned enterprises largely overlooked that male and female micro-entrepreneurs often belong to the same household, and that low average returns for female-owned enterprises are observed because women's capital is invested into their husbands' enterprises rather than their own.

Our work is motivated in part by the labor economics literature on gender differences in the demand for workplace flexibility. Goldin and Katz (2011) show that female workers in high-powered professions are disadvantaged in their careers if they demand workplace flexibility due to family related issues. Edwards and Field-Hendrey (2002) use 1990 Census data and find that female workers are likely to choose home-based work, especially for those who have higher fixed costs of work. Mas and Pallais (2017) perform a field experiment on the employment process of a national call center, and they find that women are more likely to choose flexible work schedules than men. A similar work is done by Wiswall and Zafar (2018) that estimate willingness to pay (WTP) for jobs with flexible schedules. They find that on average, women have a higher WTP for jobs with greater flexibility for work schedule than men.

The rest of this paper is organized as follows. Our data is presented in Section 2 while Section 3 outlines our empirical framework and methodology. Section 4 presents our results and Section 5 sums up our conclusions.

2 Data

Using the 2007 SBO data, we create a firm-level dataset containing information about business operations, and the owner's demographic characteristics. The U.S Census Bureau conducts a firm-level economic survey once every five years to produce the SBO data. The sample firms in the SBO data were randomly selected from a list of all firms operating during the survey year with receipts of $1,000 or more. Information about the sample firms's business operation, such as receipts, payrolls, employments, come from the Internal Revenue Service (IRS) tax filing records.[2] Other information about the sample firms' business and demographic characteristics are collected via mailed surveys. We use the 2007 SBO's public use microdata sample (PUMS).

Table 1 presents descriptive statistics for the 2007 SBO data. The raw data have 2,165,683 firm records. We use 663,385 single owner firms as our sample to identify and evaluate the effect of owner's gender on firm performance. As shown in the first two rows in Table 1, about 36.3% firms are female owned and 57.6% firms are home-based businesses in our dataset. The revenue, labor cost, and employment variables are IRS tax records. The revenue is the total receipts in 2007 U.S. dollars $1.000, and the labor cost is the total payrolls. The start-

[2]The SBO exclude firms in the following NAICS industries: crop and animal production (NAICS 111, 112), scheduled passenger air transportation (NAICS 481111), Rail Transportation (NAICS 482), Postal Service (NAICS 491), Funds, Trusts, and Other Financial Vehicles (NAICS 525), Religious, Grantmaking, Civic, Professional, and Similar Organizations (NAICS 813), Private Households (NAICS 814), Public Administration (NAICS 92). Please see the SBO methodology for more detail.

Table 1: Descriptive Statistics: SBO

	# of Firms	Mean	Standard Deviation	Percentile	
				5^{th}	95^{th}
Revenue ($1,000)	663,385	286	4,611	0	810
Labor Cost ($1,000)	663,385	52.4	738	0	200
Employment	663,385	1.67	26.7	0	7
Start-up Capital ($1,000)	437,326	39.2	122.2	2.5	175
Female	663,385	0.363	0.481	0	1
Home-based Firm	652,389	0.576	0.494	0	1
Hours per week $\geq$40	663,385	0.475	0.499	0	1
Education	646,818	4.5	1.99	1	7
Age	650,172	3.92	1.28	2	6
Years of operation	618,206	4.43	2.65	0	8
Nonwhite	663,385	0.115	0.319	0	1
Founded Business	645,008	0.883	0.322	0	1
Purchased Business	645,008	0.0934	0.291	0	1
Inherited Business	645,008	0.0103	0.101	0	0
Managing Business	649,536	0.469	0.499	0	1
Having Financial Control	649,536	0.37	0.483	0	1

The reported statistics are weighted by the SBO weight. Educational attainment is a categorical variable that is: 1 for less than high school; 2 for high school; 3 for technical school; 4 for some college (college drop out); 5 for associate's degree; 6 for bachelor's degree; and 7 for master's or above. Age is a categorical variable that is: 1 for age under 25; 2 age between 25 and 34; 3 age between 35 and 44; 4 for age between 45 and 54; 5 for age between 55 and 64; and 6 for age older than 64.

up capital variable is coded as a categorical variable with its value: 1 for start-up capital less than $ 5,000; 2 for start-up capital between $5,000 and $10,000; etc. We convert the start-up capital variable with eight categories to a dollar-valued variable by assigning the mid-range value for each category. The bottom five variables are indicator variables for firm ownerships. The founder is an indicator variable for firms in which the owner is a founder; purchase is an indicator for firms where the owner purchased the business; inherit is an indicator for which the owner was bequeathed the business; the manage is an indicator for which the owner has managed the business; and financial control is an indicator for firms over which the owner has financial control. These five indicator variables, along with the five owner characteristic variables, the hours per week, education, age, years of operation, nonwhite indicator are used as control variables in our model estimations.

The descriptive statistics reported in Table 1 indicate that the firms in our dataset are relatively small.[3] The average firm size by employment is 1.67, and the average revenue and labor cost are $286,000 and $52,400 respectively. The average educational attainment of the owners is 4.5 that is between college drop out and associate degree. The average age group

[3]There are 387,477 self-employed firms having zero employee in our dataset, which is about 58.4% of the sample firms. And, there are 244,251 self-employed firms out of 437,326 firms reporting start-up capital size, which is about 55.9%.

is 3.9 that is between ages 45 and 54. The average years of operation is 4.43, which is a measure of firm duration. About 11.5% of the owners are non white. The fraction of owners who are founders of their businesses is 88.3%. The fractions of owners who have managed and financially controlled their firms are 46.9% and 39%, respectively.

3 Empirical Framework

We use a difference-in-differences method to estimate the average treatment effect (ATE) of female-ownership and being home-based on managerial performance. The main goal is to identify and consistently estimate the ATE of the firm owners' gender and their workplace location simultaneously. An indicator variable for home-based firms is used as a measure of the workplace location, along with a female owner indicator variable for the gender effect. The interaction term of these two indicators is then used to estimate the ATE.

To illustrate our empirical framework, consider an econometric model:

$$y_i = \beta_0 + \delta_1 \cdot T_{1i} + \delta_2 \cdot T_{2i} + \delta_3 \cdot (T_{1i} \cdot T_{2i}) + \mathbf{x}_i \boldsymbol{\beta} + \epsilon_i, \tag{3.1}$$

where y_i is return on assets for firm i, T_{1i} is the indicator variable for female owner, T_{2i} is the indicator variable for home-based firms, and $\mathbf{x}_i$ is a vector of control variables. δ_3 is our target parameter that is the ATE with respect to the interaction term $T_{1i} \cdot T_{2i}$. The dependent variable y_i is firm i's return on assets (ROA) calculated as (revenue minus labor cost)/startup capital. The control variables in $\mathbf{x}_i$ are: owners' education; years of operation; and indicator variables for nonwhite; founder; purchased business; bequeathed; having managerial and financial controls. We also consider the state and year fixed effects when we estimate the model.

Our main focus is examining the effect of female ownership and being home-based on the firm owner's managerial performance. This idea is motivated by labor economics literature on female labor supply and preference for work flexibility. Edwards and Field-Hendrey (2002) show that females have lower reservation wages and hours for which they are able to work at home. This leads to females being more likely to participate in labor market activities and increases female labor supply. Further, female home-based workers with a greater potential for joint home production and market work are more likely to choose self-employment. Edwards and Field-Hendrey (2002) explain their result using the fixed costs of working (e.g., time costs and expenses for commuting), and incentive to engage in home production (e.g, caring for children or elderly relatives). However, Edwards and Field-

Table 2: Descriptive Statistics by Gender and Workplace Location

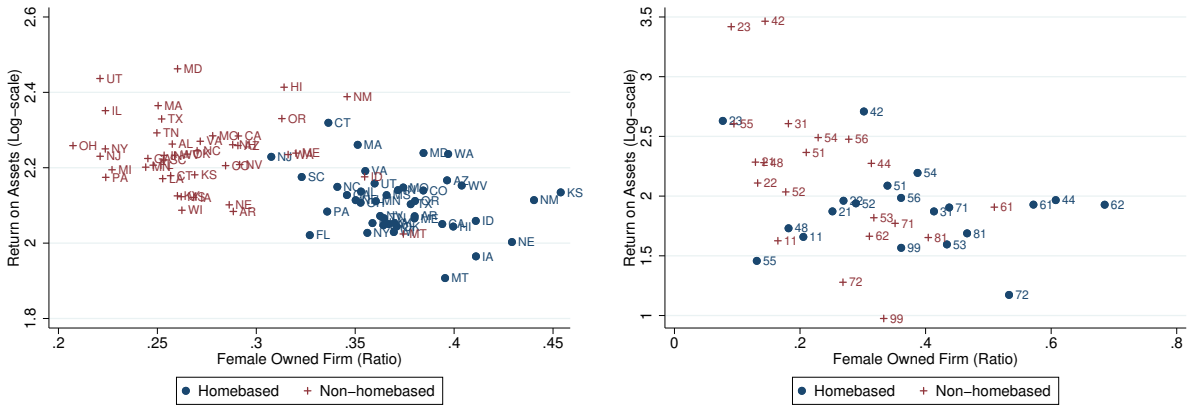
	Home-based Establishment									
	Female Owner					Male Owner				
	# of Firms	Mean	Std	5^{th}	95^{th}	# of Firms	Mean	Std	5^{th}	95^{th}
ROA	64,427	9.95	48.5	0	36	112,191	18	103	0	64
Revenue ($1,000)	64,427	43.8	236	0	150	112,191	101	490	0	360
Labor cost ($1,000)	64,427	4.77	49.9	0	20	112,191	11.3	72.6	0	60
Employment	64,427	0.198	1.91	0	1	112,191	0.393	2.66	0	3
Start-up Capital ($1,000)	64,427	10.8	49.4	2.5	37.5	112,191	18.6	66.1	2.5	77.5
	Non-home-based Establishment									
ROA	56,711	20.5	223	0	60	163,907	50	887	0	140
Revenue ($1,000)	56,711	248	1,686	0	850	163,907	746	7,648	0	2,300
Labor cost ($1,000)	56,711	57.6	622	0	230	163,907	143	1,047	0	560
Employment	56,711	2.44	27.9	0	10	163,907	4.42	37.9	0	14
Start-up Capital ($1,000)	56,711	50.6	132	2.5	175	163,907	82.7	181	2.5	625

The reported statistics are calculated from annual statistics. "Std", "5^{th}", "95^{th}" stand for standard deviation, 5^{th} percentile, and 95^{th} percentile, respectively. ROA is calculated by subtracting labor cost from revenue, and divide it by start-up capital. Revenue, labor cost, and start-up capital are in thousand dollar.

Hendrey (2002)'s analysis cannot address gender differences because their study focused only on female labor forces. Goldin and Katz (2011) demonstrate a model for family related amenities that demand workplace flexibility, and show that individuals with higher demand for the amenities are willing to accept jobs with lower wages. They then estimate the earnings penalty for women with workplace flexibility, and find a substantial compensating differential between women and men in high-end professions, that is consistent with the earnings penalty.

Recent papers by Mas and Pallais (2017) and Wiswall and Zafar (2018) examine the gender differences in workplace preferences. Mas and Pallais (2017) conduct a field experiment in the employment process for a national call center, and estimate willingness to pay (WTP) for scheduling flexibility. They find that female applicants are more likely to choose flexible work arrangements, and have higher WTP than males for working from home. Wiswall and Zafar (2018) conduct a survey of preferences for workplace attributes to undergraduate students, and find a substantial difference in WTP for flexible work by gender. They estimate that women have higher WTP for jobs with greater flexibility and job stability, whereas men have greater WTP for jobs with higher earnings growth.

A descriptive analysis using the 2007 SBO indicates that female owners have, on average, smaller size firms than male owners, for both home-based and non-home-based businesses. Table 2 presents descriptive statistics of the four firm size variables (revenue, labor cost, employment, and start-up capital) and ROA, a measure of firm performance by owner's



(a) Scatter Plot for State

(b) Scatter Plot for Industry

Figure 1: Scatter Plots: ROA vs Female Firm Ratio

gender and workplace location. The means of the firm size variables for male owners are about twice as large as that of female owners for home-based firms, reported in the top panel of Table 2. For non-home-based firms, in contrast, the mean differences of the firm sizes by owner's gender are greater than that of home-based firms.

The descriptive characteristic of ROA by owner's gender and workplace location is similar to that of the four firm size variables. The mean difference of ROA between female and male owners is -8.05 $(= 9.95 - 18)$ for home-based firms, and $-29.5(= 20.5 - 50.0)$ for non-home-based firms. This result suggests that the gender difference in managerial performance is endogenous due to the firm size difference. In other words, male-owned firms perform better because their firms are bigger in terms of production inputs and outputs, and have more production factors than female owned firms. This finding is consistent with Edwards and Field-Hendrey (2002) that home-based workers are similar to women who are out of the labor force in a way that the home-based workers characteristics are associated with larger fixed costs of working on site. In Edwards and Field-Hendrey (2002)'s descriptive analysis, the home-based workers are more likely to be: living in rural areas, married, having children under age 18, and disabled.

Next, we aggregate the data by state and industry (2-digit NAICS codes) and plot the average ROAs versus the percentages of female owner firms, grouped by workplace location. Figure 1 presents the scatter plots across state and industry. Interesting patterns are shown in the plot for state variation in panel 1(a) that i) home-based and non-home-based firms are separately clustered, ii) and a downward linear trend is shown over those two clusters. The cluster for home-based firms is at the bottom right corner and the non-home-based firms' cluster is at upper left corner. The steeper downward trend is shown in the plot for industry

variation in panel 1(a), but it does not appear to have the clusters shown in panel 1(b).

These patterns shown in Figure 1 indicate that the average firm performance is negatively correlated with the fraction of female firms. Moreover, this negative relationship becomes clear when we separate the data by workplace location, that is, whether the firm is home-based or not. Different firm sizes by owner's gender and workplace location can be a cause of this negative relationship. As shown in Table 2, the firm size variables for female-owned and home-based firms are smaller than for male owned and non-home-based firms. In the same way, the average ROAs for female-owned and home-based firms are smaller than their counterparts.

Our finding in Figure 1(a), especially the scatter plot for state in panel 1(a), is similar to Amore et al. (2014)'s analysis on Italian female CEO firms' different performance by region. They report that firms with a lone female CEO have much less performed in southern Italy, where valuing women's traditional role in family is known institution. Amore et al. (2014)'s analysis implies that women in different states value home production activities differently and their reservation wages and hours differ by state. Therefore, women in some states are willing to become a self-employed or open their own businesses at home, even though they can earn more by either being employed or running their businesses outside the home.

Overall, our descriptive analysis suggests that sample selection can be an issue in the estimating the gender effect on managerial performance, and therefore controlling for endogeneity due to the sample selection is important to identify the gender effect and estimate it consistently. The goal is to examine presence of intrinsic gender difference in managerial ability. But female owners have smaller size firms on average and sometimes their business activities are subject to different institutions by region. A negative female owner effect on firm performance due to these differences in given condition is not the intrinsic gender difference. Fortunately, our data have enough information to test the presence of the sample selection in our estimation and control for it. The details are discussed in the next section.

4 Empirical Results

Table 3 reports the main model estimates for (3.1) using ordinary least squares (OLS) with state and industry fixed effect dummy variables. The DID coefficients, reported in the first row in Table 3, are estimates of the target parameter δ_3. The ATE estimates for firm owner's gender and workplace location are reported in the second and third rows in table 3, respectively. Each column in table 3 report model estimates with different specification by different combinations of the state and industry fixed effects. Note that we use the log of ROA as the dependent variable in (3.1). Thus, the ATEs of ROA can be calculated by

Table 3: Main Model Estimates

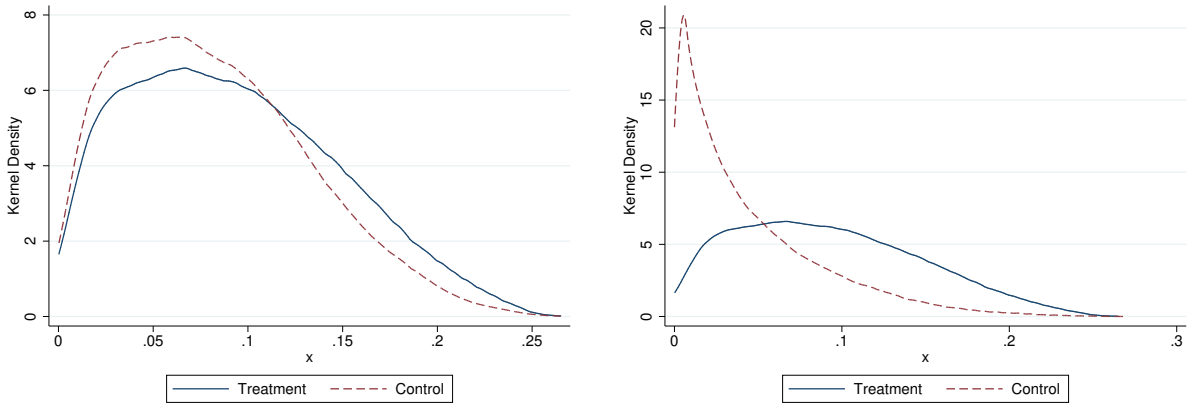
	Model Specification			
	(1)	(2)	(3)	(4)
DID	0.2869***	0.2890***	0.3319***	0.3331***
	[0.014]	[0.013]	[0.014]	[0.014]
Female	-0.5831***	-0.5850***	-0.4632***	-0.4652***
	[0.017]	[0.017]	[0.015]	[0.015]
Homebase	-0.8219***	-0.8241***	-0.9448***	-0.9461***
	[0.012]	[0.012]	[0.014]	[0.014]
State Fixed	No	No	Yes	Yes
Industry Fixed	No	Yes	No	Yes
# of Obs	355,346	355,346	355,346	355,346
R^2	0.4292	0.4304	0.4790	0.4800

Notes: Heteroskedasticity robust standard errors clustered by state are reported in square brackets. The symbols, *, **, and *** indicate respectively that the estimated coefficient is statistically significant at the 10%, 5%, and 1% significance levels.

$100 \times [exp(\delta_j) - 1]$, $i = 1, 2, 3$.

The DID coefficients are significantly positive at the 1% significance level in all four model estimates. The DID coefficient in the full model estimate, reported in column (4) in table 3, is 0.3331 and is greater than the coefficients in the other three model estimates. However, the size of these coefficients are not substantially different so that we can conclude that the state and industry variations are exogenous. The same patterns appear in the coefficients of the female owner effect, reported in the second row, but they are all significantly negative at the 1% significance level. The coefficients for the home-based firm effect reported in the third row are all significantly negative, but the full model estimate has the smallest coefficient.

From the main result reported in column (1), we find that the female-owned and home-based firms are likely to perform better than others, and their estimated ROA gain is 39.53% ($= 100 \times [exp(0.3331) - 1]$). The estimated marginal effects for female ownership and home-base firm are -37.20% and -67.17% ROA gains, respectively. Our result suggests that female-owned businesses and home-based businesses are inferior to their coun- terparts in terms of the market performance. However, female-owned businesses that are home-based perform better than the other types of businesses. In other words, female owner firms can outperform, if they are able to remove travel time and costs by establishing their businesses at home. This result consistently holds in other model specifications, reported in columns (1), (2) and (3).



(a) Matched Sample

(b) Unmatched Sample

Figure 2: Propensity Scores: Distribution

Table 4: Propensity Score Matching Estimation

Sample Type	# of Obs		Mean		Difference	Std Error (Difference)	T-stat
	Treated	Controls	Treated	Controls			
Unmatched	9,275	187,774	2.4740	2.5469	-0.0729	0.0219	-3.33***
Matched (ATT)	9,275	7,711	2.4740	2.4110	0.0630	0.0288	2.18**

The symbols, *, **, and *** indicate respectively that the estimated coefficient is statistically significant at the 10%, 5%, and 1% significance levels.

4.1 Propensity Score Matching

Next, we perform a propensity score matching estimation for the ATE of female ownership and being home-based. The main focus is to check whether the main result in Table 3 is biased due to sample selection. As shown in Table 2 and Figure 1, the assignment of owners' gender and workplace location does seem to be neither balanced nor random. Female-owned firms and home-based firms are smaller than their counterparts in terms of start-up capital size, revenue, labor cost and employment. By using propensity score matching, we can obtain a subset of the control group firms with balanced propensities, or likelihoods, of being the treatment group firms. Then, the mean comparison of ROA between the treatment and control group firms can identify the ATE and estimate it consistently. Note that we obtain the predicted propensities from a probit regression with the female-owned and home-based firm indicator as a dependent variable. And, all the control variables used for estimating the model (3.1) are used as control variables in the probit regression estimation.

Figure 2 presents the nonparametric distributions of the predicted propensities. As shown in panel 2(b), the propensity distribution of the unmatched control group is skewed toward

Table 5: Main Model Estimates for Matched Sample

	Model Specification			
	(1)	(2)	(3)	(4)
DID	0.5557***	0.5508***	0.6347***	0.6282***
	[0.046]	[0.045]	[0.046]	[0.044]
Female	-0.3528***	-0.3521***	-0.2844***	-0.2833***
	[0.039]	[0.039]	[0.038]	[0.038]
Homebase	-0.4341***	-0.4300***	-0.5999***	-0.5958***
	[0.030]	[0.030]	[0.036]	[0.037]
State Fixed	No	No	Yes	Yes
Industry Fixed	No	Yes	No	Yes
# of Obs	16,986	16,986	16,986	16,986
R^2	0.5283	0.5310	0.5743	0.5769

Notes: Heteroskedasticity robust standard errors clustered by state are reported in square brackets. The symbols, *, **, and *** indicate respectively that the estimated coefficient is statistically significant at the 10%, 5%, and 1% significance levels.

zero, and is quite different from that of the treatment group. The nonparametric distribution of predicted propensity for a matched sample from the comparison group is presented in panel 2(a). It's shape becomes similar to the treatment group propensity distribution. Note that we use nearest-neighbor matching with one matched control group observation for each treatment group observation.

The propensity score matching estimate is consistent with the DID estimates in a way that it is significantly positive. Table 4 reports the mean comparison of ROA (the log of) with the unmatched and matched control groups. The mean difference of the unmatched group is -0.0729 and is statistically significant at the 1% significance level. In contrast, the mean difference of the matched sample is 0.063 and it is also statistically significant at the 5% significance level. This propensity score matching estimation suggest that estimation of the ATE of female-owned and home-based firms may be biased due to sample selection. As a result, the estimates of the female owner effect, or the home-based firm effect are negative but turn out to be positive when we control for the sample selection bias.

We obtain the consistent result from OLS estimations for the model (3.1) using the propensity score matched sample. Table 5 reports replicated model estimations in Table 3 using the matched sample. Note that 7,711 control group observations are matched with 9,275 treatmeat group observations. The estimation results in Table 5 and Table 3 are identical in terms of coefficient signs and significances. All of the four DID coefficients are significantly positive, all of the four female owner effect estimates are significantly negative,

Table 6: Main Model Estimates by Industry

	2-Digit NAICS Industry					
	Wholesale Trade	Retail Trade	Educational Services	Health Care	Arts and Entertainment	Other Services
DID	0.0687	0.3056***	0.0776	-0.0158	0.2879***	0.3382***
	[0.069]	[0.036]	[0.067]	[0.037]	[0.055]	[0.042]
Female	-0.3665***	-0.7373***	-0.3604***	-0.3903***	-0.5097***	-0.6390***
	[0.060]	[0.029]	[0.060]	[0.015]	[0.057]	[0.032]
Homebase	-1.2105***	-1.0124***	-0.5526***	-0.6123***	-0.8428***	-0.6410***
	[0.046]	[0.041]	[0.068]	[0.028]	[0.084]	[0.044]
State Fixed	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed	Yes	Yes	Yes	Yes	Yes	Yes
# of Obs	17,593	40,470	4,884	32,109	9,933	28,032
R^2	0.4876	0.4514	0.5171	0.5985	0.4815	0.5584
	Information	Finance and Insurance	Real Estate	Professional and Scientific	Management	Accommodation and Food Services
DID	0.2243***	0.0787	0.2940***	0.0423**	0.5605	-0.0454
	[0.078]	[0.051]	[0.034]	[0.018]	[1.406]	[0.080]
Female	-0.3169***	-0.1807***	-0.3736***	-0.1164***	-0.1838	-0.4342***
	[0.063]	[0.032]	[0.026]	[0.017]	[0.322]	[0.032]
Homebase	-0.9285***	-0.6114***	-0.6851***	-0.6164***	-1.9404***	-1.0158***
	[0.069]	[0.031]	[0.025]	[0.021]	[0.393]	[0.063]
State Fixed	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed	Yes	Yes	Yes	Yes	Yes	Yes
# of Obs	6,749	18,010	21,693	66,197	278	10,980
R^2	0.5630	0.5211	0.5858	0.4964	0.6664	0.5901

Notes: Heteroskedasticity robust standard errors clustered by state are reported in square brackets. The symbols, *, **, and *** indicate respectively that the estimated coefficient is statistically significant at the 10%, 5%, and 1% significance levels.

and all of the four home-based firm effect estimates are significantly negative. This result indicates that the OLS estimation of the model (3.1) is not affected by endogeniety due to the sample selection.

4.2 The DID Estimates by Industry

We estimate the model (3.1) by NAICS 2-digit industry, and find a notable heterogeneity of the DID estimates over the industries. Table 6 reports the model estimates by industry. As shown in the first row, the DID estimates differ substantially by industry in terms of coefficient signs and significances. The DID estimates are significantly positive in: retail trade, art and entertainment, other services, information, real estate, professional and scientific. The DID estimates of the remaining six industries: wholesale trade, educational service, health-care, finance and insurance, management, accommodation and food services are insignificant at the 10% significance level. In contrast. the estimates of female owner

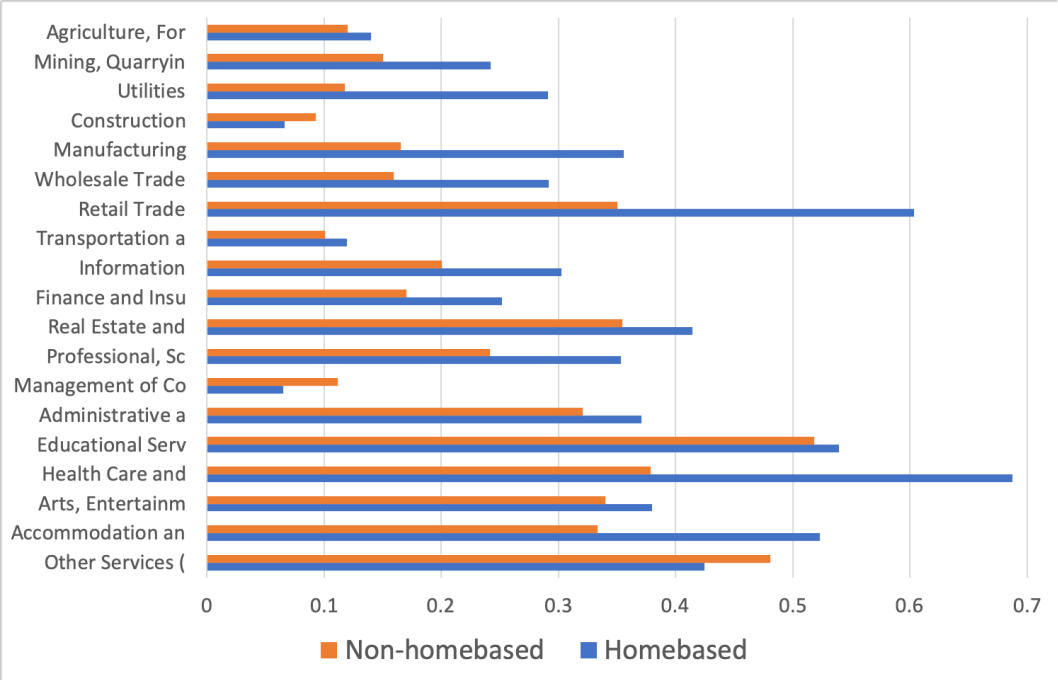


Figure 3: Female Owner Firm Ratio by Industry

effect and home-based firm are consistent that all of the coefficients are significantly negative at the 1% significance level.

Presence of industry specific production technology might be a reason of the heterogenous female-owned and home-based firm effect across industry estimates. In other words, there are some industries that could be better off by establishing their businesses at home, or placing women in charge of the businesses. In contrast, different fractions of female-owned and home-based firms do not seem to explain the heterogenous effect. These fractions by NAICS 2-digit industry are presented in Figure 3. The fractions of home-based firms within female-owned firms are much larger in both retail and health-care industries, for example, but their DID estimates are quite different. Another example is the education industry which seems to be female-owner dominant. The fractions of female owners exceed 5% for both home-based and non-home-based firms. However, its DID estimate is not statistically significant at the 10% significance level.

4.3 Robustness Check

We then estimate the model (3.1) by age and education level to check the robustness of our result. The model estimates by owner's educational attainment are reported in Table 7. Overall, they are consistent with the main result in Table 3 in terms of sign and significance. All of the DID coefficients are significantly positive, whereas the coefficients for female owner

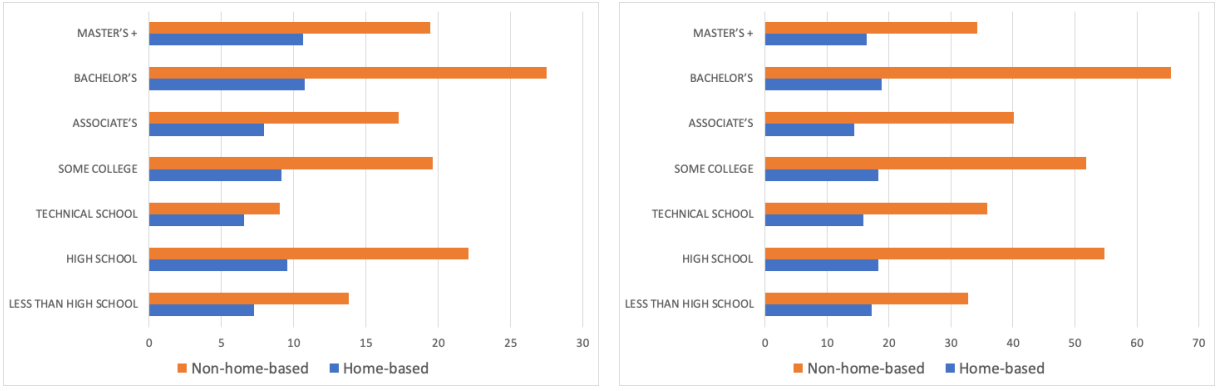
Table 7: Main Model Estimates by Educational Attainment

	Educational Attainment					
	Less than High School	High School	Some College	Associate	Bachelor	Master or more
DID	0.2388***	0.3290***	0.3951***	0.3325***	0.3415***	0.1791***
	[0.053]	[0.032]	[0.030]	[0.034]	[0.022]	[0.022]
Female	-0.3857***	-0.4838***	-0.5093***	-0.4294***	-0.4446***	-0.3691***
	[0.041]	[0.026]	[0.023]	[0.036]	[0.023]	[0.010]
Homebase	-0.6832***	-0.9973***	-0.9547***	-0.9179***	-1.0675***	-0.7250***
	[0.050]	[0.034]	[0.027]	[0.034]	[0.018]	[0.020]
State Fixed	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed	Yes	Yes	Yes	Yes	Yes	Yes
# of Obs	14,774	61,322	60,252	18,978	97,852	81,241
R^2	0.4692	0.4842	0.5054	0.4834	0.4674	0.5341

Notes: Heteroskedasticity robust standard errors clustered by state are reported in square brackets. The symbols, *, **, and *** indicate respectively that the estimated coefficient is statistically significant at the 10%, 5%, and 1% significance levels.

are significant ly negative. The DID coefficient for graduate degrees (masters or higher) is smaller than any other categories, even though the graduate degree is the highest educational attainment category. This might be due to the estimated marginal effect of female ownership for those with graduate degrees, which at -0.3691 is larger than for other firm owners.

The ROA difference between home-based and non-home-based firms is greater when the owner is male, for all education level. Figure 4 presents the weighted average ROA for home-based firms and non-home-based firms by owner's gender and educational attainment. For every category, the average ROA for male-owner firms is greater than for their female-owner



(a) Bar Plot for Female

(b) Bar Plot for Male

Figure 4: Bar Plots: ROA by Gender and Workplace

Table 8: Main Model Estimates by Age Group

	Age Group					
	Under 25	25 to 34	35-44	45 to 54	55 to 64	65 or over
DID	-0.0260	0.1071***	0.2428***	0.3445***	0.4048***	0.2884***
	[0.084]	[0.031]	[0.018]	[0.024]	[0.019]	[0.037]
Female	-0.1998***	-0.3611***	-0.4119***	-0.4720***	-0.5236***	-0.4824***
	[0.071]	[0.032]	[0.022]	[0.019]	[0.017]	[0.031]
Homebase	-0.1568***	-0.4851***	-0.7839***	-0.9864***	-1.0669***	-1.1820***
	[0.057]	[0.033]	[0.016]	[0.021]	[0.022]	[0.030]
State Fixed	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed	Yes	Yes	Yes	Yes	Yes	Yes
# of Obs	3,505	31,358	78,465	114,420	91,377	36,221
R^2	0.4517	0.4931	0.4939	0.4966	0.4695	0.4926

Notes: Heteroskedasticity robust standard errors clustered by state are reported in square brackets. The symbols, *, **, and *** indicate respectively that the estimated coefficient is statistically significant at the 10%, 5%, and 1% significance levels.

counterpart. In addition, the gap of average ROA between home-base firms and non-home-based firms is greater for male owners. Higher education does not seems to narrow the ROA gaps by either owners' gender nor workplace location.

The model estimates by firm owners' age, reported in Table 8, are also consistent with the main result in table 3 in terms of coefficient sign and significance. Except for firm owners aged under 25, all of the DID coefficients are significantly positive, and get bigger as the age group gets older. The exception for the DID coefficient size trend over age is firm owners aged over 65, but this group is in the retirement age range. The DID coefficient for firm owners' age under 25 is even negative but insignificant at the 10% significance level. The coefficients for female ownership and home-based firm are significantly negative for all firm owners' age groups.

5 Conclusion

This paper empirically examines the joint effect of female ownership and being home-based on owners' managerial performance. Using the 2007 SBO micro data, we estimate the ATE of the female-owned and home-based firm on ROA with a difference-in-differences approach. From the main estimation result, we find that the joint effect of female ownership and home-based business is about 39.53% ROA gain. In contrast, the marginal effects of female ownership and home-based business are both negative, at about -37.20% and -67.17%, respectively. This result is highly significant and confirmed by a battery of robustness tests.

Having uncovered in our results that female-owned firms can improve their performance and indeed outperform other types of firms when the business is home-based, we would recommend that policymakers better support female entrepreneurs. From an efficiency perspective, the goal should be for the economy to get the highest returns from its scarce resources. This will involve putting deliberate efforts into ensuring that all resources, female entrepreneurs included, are appropriately supported to maximize their potential. What are those conditions that being home-based typify for the worker? Reduced expenses in terms of both cash and opportunity costs, schedule flexibility, opportunity to multitask between work activities, control over working conditions, to name a few. Our research shows that significant efficiency gains can be achieved if some of these conditions can be implemented on a wider scale in the labor force for females, as they bear a disproportionately larger responsibility for household production activities.

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