PROBLEM SET 1

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Due on Tuesday, February 14, 2023

IDENTIFICATION

(1) Your information

Jacob Jameson

(2) Group Members (please list below the classmates you worked with on this problem set):

Bohan Li, Jenna Rogers

(3) Compliance with Harvard Kennedy School Academic Code

I certify that my work in this problem set complies with the Harvard Kennedy School Academic Code

Conceptual Questions (30 points + 8 extra points)

1. Read the paper. Clearly state the primary research question that the authors are trying to answer. What makes this an interesting question? (2 points)

The primary research question that the authors are trying to answer is whether or not capital in the form of in-kind grants such as inventory, supplies, and tangible resources – or cash is more effective in spurring economic growth for male and female owned organizations. The reason that this is an interesting question is because standard models of investment state that for credit-constrained it should not matter whether or not the firm is receiving capital in the form of cash or in-kind grants, either should lead to the same increase in growth.

2. Explain the main finding of the paper (including what the 'flypaper effect' is) using non-technical jargon, as if you were writing a brief policy memo. Provide two versions:

a. In 3-5 sentences (without copying the article abstract or the text): (2 points)

The flypaper effect is a concept from the field of public finance that suggests that a government grant to a recipient municipality increases the level of local public spending more than an increase in local income of an equivalent size. The main finding of the paper is that they find evidence of the flypaper effect among Ghanaian microenterprises, most notably for certain female entrepreneurs. They also found that in-kind grants lead to large increases in profits among female-owned firms with higher initial profitability.

b. In a tweet, i.e. 280 characters or less: (1 point)

c

3. Summarize the specific details of the treatment that participating businesses in this country underwent. (2 points)

The treatment

4. The authors note that their experimental design is very similar to an earlier study in Sri Lanka. What reasons do they give to conduct a separate study, rather than expecting the findings of that research to apply in this context? (2 points)

5. The authors used a randomized control trial because they believed an observational analysis of similar policies would be insufficient. Imagine that another country implemented the investment program without randomizing treatment, and that you were trying to understand the effect of this program on food security in that country. What are two possible confounders (omitted variables) that would bias the results from your observational analysis? Explain the mechanism of the omitted variable and use the omitted variable bias formula to argue whether it would lead to an understatement or overstatement of the true effect. (3 points)

6. Let Y_{0i} be the business profits in the absence of the grants program and let $D_i = 1$ denote participation in the program. If there were no RCT and individuals were allowed to opt-in to the program, critics might point out that: (3 points)

$$E(Y_{0i}|D_i = 1) < E(Y_{0i}|D_i = 0)$$

Explain this equation in words, explain why it is a problem, and give a plausible scenario in which that may be the case.

7. Defining treatment as being assigned to the grants program, what is the difference between the ITT and TOT in this context? Which do the authors report and why do they make this decision? Write an equation (using potential outcomes notation) that shows what the authors are trying to estimate. (3 points)

The difference between the ITT (Intent-to-Treat) and TOT (Treatment-on-the-Treated) is as that the ITT estimates the average treatment effect among all individuals who were randomly assigned to the grants program, regardless of whether they actually received the treatment (participation in the program) or not, where the TOT estimates the average treatment effect among only those individuals who actually received the treatment (participated in the program).

Fafchamps et al. report the ITT, as they aim to estimate the average effect of being assigned to the grants program, rather than just the effect of participating in the program.

The equation showing what the authors are trying to estimate can be expressed as:

$$Y_{it} = \beta_0 + D\beta_1 + \varepsilon_i$$

Where Y_{it} is the potential outcome (profits) of individual i in wave t if they were assigned to the grants program, D is a binary variable indicating treatment assignment (1 if assigned to the grants program, 0 otherwise), β_0 is the average potential outcome in the control group, β_1 is the average treatment effect, and ε_i is the error term.

Hence the authors are estimating β_1, the average treatment effect of being assigned to the grants program on the potential outcome Y_{it}.

8. At what level do the authors clustered their standard errors of the main results of the paper (if at all)? Briefly note why the authors cluster the standard errors and why this is the appropriate level to cluster at. (2 extra points)

In the main results of their paper, the authors cluster their standard errors at the firm level. This is the appropriate level to cluster at

9. To assess whether treatment was actually randomly assigned, we can examine the results of a balance test, presented in Table 2. Do the results in this table make you more or less confident about the validity of the paper's results? Interpret one of the p-values from column (5). (3 points)

Looking at Table 2, the results of the balance test, I am made more confident about the results that estimate using the full sample, but the trimmed sample seems less balanced (especially on baseline profits). That poor balance makes me skeptical of results that come from estimates on the trimmed sample. In the full sample, the p-value corresponding to the F-test of equality of means across the three groups is 0.985 for baseline profits, which indicates that we cannot reject the null hypothesis that the means are equal.

10. Attrition in experiments like this one is often a concern for internal validity. Does the particular sort of attrition mentioned in this article give you reason to be concerned about the validity in this study? Describe using particular aspects of the experiment or its implementation. (1 point)

11. What other threats to internal validity may have affected this this experiment? Choose one threat and explain how it might bias the coefficient of interest. (2 points)

12. Describe four specific problems involved with generalizing the results of this study as a result of using an RCT. Hint: review the Muralidharan and Niehaus (2017) or Banerjee et al. (2017) papers discussed in class. (4 points)

13. List at least two strategies the authors use to address some of the concerns you described above. (2 points)

14. Why do the authors include Table 4? (2 extra points)

15. Do you think the main results would be the same if this experiment were expanded to slightly larger businesses? Describe plausible scenarios in which providing the same transfer to these different businesses could both lead to (i) a larger increase in profits, and (ii) a smaller increase in profits. (2 extra points)

16. If you were a researcher at the World Bank interested in scaling up one or several of these treatments, what follow-up study would you propose to expand on these findings? Explain in 4-5 sentences as if you were trying to convince a policymaker of the need for additional research. (2 extra points)

Data Analysis Questions (22 points + 2 extra points)

17. Produce a well-organized descriptive statistics table that includes (i) the number of households, (ii) the number of geographic units, (iii) the number of units of randomization, alongside (iv) the sample mean and standard error of the income and revenue index in the control group, and (v) the same sample mean and standard error of the same index but in the treatment group. In other words, the table should have one row (countries), and six columns (including country).

a. Print your table below. (6 points)

```
data <- read_dta("data/ReplicationDataGhanaJDE.dta")

num_obs <- data %>%
  filter(wave == 2) %>%
  mutate(count = sum(experimentsample)) %>%
  select(count)

num_obs <- num_obs[[1]][1]
country <- 'Ghana'
```

b. Are the differences in baseline profits between the control and treatment groups significant at the 0.05 level? (3 points)

```
data <- data %>%
  filter(experimentsample == 1) %>%
   mutate(`Study Arm` = case_when(
     cashtreat == 1 ~ 0,
     equiptreat == 1 ~ 1,
     assigntreat == 0 ~ 2),
     `Study Arm` = recode_factor(`Study Arm`,
                                 "0" = "Cash",
                                 "1" = "In-kind",
                                 "2" = 'Control')) %>%
  arrange(sheno, questionnaire_date)

data$baseline_profit <- data$realfinalprofit
var_label(data$baseline_profit) <- "Baseline Profit"

data %>%
  filter(wave == 2) %>%
  select(baseline_profit, `Study Arm`) %>%
  tbl_summary(by = `Study Arm`, type = all_continuous() ~ "continuous2",
              statistic = all_continuous() ~ c("{mean} ({sd})"),
              missing_text = "(Missing)") %>%
  add_p(pvalue_fun = ~style_pvalue(.x, digits = 2),
        test = list(all_continuous() ~ "aov")) %>%
  add_overall() %>%
  modify_header(label ~ "**Variable**") %>%
  modify_caption("**Balance Test Baseline Profits for Control vs. Treatment Groups**") %>%
  bold_labels()
```

Table 1: **Balance Test Baseline Profits for Control vs. Treatment Groups**

Variable	**Overall**, N = 793	**Cash**, N = 198	**In-kind**, N = 198	**Control**, N = 397	**p-value**
Baseline Profit					0.98
Mean (SD)	130 (281)	132 (395)	131 (200)	128 (245)	
(Missing)	12	5	2	5	

There are no observable differences in baseline profits between the control and treatment groups. Using an ANOVA test we can see that the difference are not significant at the 0.05 level. This table matches the results in Table 2 by Fafchamps et. all.

18. Reproduce the coefficient estimate and standard error estimates in columns (1-2) of Table 3: these correspond to the main pooled OLS specifications (Equation 5 in the paper) without and with sample trimming respectively. (3 points)

```
reg1 <- felm(realfinalprofit ~ atreatcash + atreatequip |groupnum + wave|0|sheno,
             data)

reg2 <- felm(realfinalprofit ~ atreatcash + atreatequip|groupnum + wave |0|sheno,
             filter(data, is.na(trimgroup)))

fe.reg1 <- felm(realfinalprofit ~ atreatcash + atreatequip |groupnum +
               wave + sheno|0|sheno, data)

fe.reg2 <- felm(realfinalprofit ~ atreatcash + atreatequip|groupnum +
               wave + sheno |0|sheno,filter(data, is.na(trimgroup)))

stargazer(reg1, reg2, fe.reg1, fe.reg2,
          type = "latex", title = 'Main Treatment Effects',
          column.labels = c('OLS Full',
                            'OLS Trimmed',
                            'FE Full','FE Trimmed'),
          dep.var.labels = 'Real monthly profits (cedi)',
          covariate.labels = c('Cash Treatment', 'In-kind Treatment'),
          style = 'qje')
```

Table 2: Main Treatment Effects

	Real monthly profits (cedi)			
	OLS Full	OLS Trimmed	FE Full	FE Trimmed
	(1)	(2)	(3)	(4)
Cash Treatment	14.503*	9.589	3.962	0.482
	(8.679)	(7.318)	(13.882)	(8.223)
In-kind Treatment	38.597***	36.752***	43.227***	30.873***
	(11.206)	(10.670)	(12.306)	(10.725)
N	4,354	4,203	4,354	4,203
R^2	0.277	0.327	0.520	0.616
Adjusted R^2	0.242	0.294	0.379	0.503
Residual Std. Error	180.116 (df = 4152)	118.825 (df = 4007)	163.066 (df = 3361)	99.698 (df = 3244)

Notes:

***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

19. Represent the values of column (5), rows 3 onward in Table 3 as a well-labeled coefficient plot. This corresponds to the main (untrimmed) OLS analysis finding treatment effects by gender and treatment type (Equation 6 in the paper). The figure must: (6 points)

- Print the rounded coefficients and standard errors next to each point.
- Define and use your own function for at least one part to avoid repetition.
- Be estimated from the regression specification described in the paper. Therefore, all the numbers should match exactly as reported in Table 3.
- Be clean and well-labeled (i.e., have clear axis labels, no chartjunk, understandable to a reader who has not read the paper).

```
outcome <- "realfinalprofit"

vars <- c("atreatcashfemale", "atreatequipfemale",
          "atreatcashmale", "atreatequipmale")

fe_1 <- ("groupnum + wave + wave2_female +
         wave3_female + wave4_female + wave5_female + wave6_female")

fe_2 <- ("groupnum + sheno + wave + wave2_female +
         wave3_female + wave4_female + wave5_female + wave6_female")

iv <- "0"
cluster <- "sheno"

# helper function to create formula
helper <- function(outcome, vars, fe, iv, cluster) {
  as.formula(
    paste(paste(paste(outcome, ' ~ '), paste(vars, collapse = ' + ')),
          fe, iv, cluster, sep = ' | ')
  )
}
reg.1 <- felm(helper(outcome, vars, fe_1, iv, cluster), data)
reg.2 <- felm(helper(outcome, vars, fe_1, iv, cluster), filter(data, is.na(trimgroup)))

reg.3 <- felm(helper(outcome, vars, fe_2, iv, cluster), data)
reg.4 <- felm(helper(outcome, vars, fe_2, iv, cluster), filter(data, is.na(trimgroup)))

stargazer(reg.1, reg.2, reg.3, reg.4,
          type = "latex", title = 'Main Treatment Effects',
          column.labels = c('OLS Full',
                            'OLS Trimmed',
                            'FE Full','FE Trimmed'),
          dep.var.labels = 'Real monthly profits (cedi)',
          covariate.labels = c('Cash Treatment*female',
                               'In-kind Treatment*female',
                               'Cash Treatment*male',
                               'In-kind Treatment*male'),
          style = 'qje')
```

Table 3: Main Treatment Effects

	Real monthly profits (cedi)			
	OLS Full	OLS Trimmed	FE Full	FE Trimmed
	(1)	(2)	(3)	(4)
Cash Treatment*female	5.206	5.167	1.224	−2.298
	(8.469)	(8.545)	(9.335)	(8.758)
In-kind Treatment*female	35.753**	37.653**	35.609***	32.867**
	(14.937)	(14.943)	(13.541)	(13.194)
Cash Treatment*male	28.993	16.814	8.739	5.132
	(17.683)	(13.253)	(31.545)	(16.083)
In-kind Treatment*male	43.377***	35.451**	55.146**	27.825
	(16.801)	(14.044)	(23.030)	(18.130)
N	4,354	4,203	4,354	4,203
R^2	0.280	0.328	0.523	0.617
Adjusted R^2	0.244	0.294	0.415	0.530
Residual Std. Error	179.947 (df = 4145)	118.839 (df = 4000)	158.322 (df = 3548)	96.916 (df = 3425)

Notes:

***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

Try implementing the fixed effects specification either for question 18 or 19 above, and report your coefficients as a table or coefficient plot respectively. (2 extra points)

Done (see FE regression in 18 and 19)

20. Submit your R script to the Canvas assignment as a separate .R file (or .Rmd file, if you used Rmarkdown). We may pass submissions through a program to check if they run. To pre-test your code, you can verify it runs on our environment. Go to the math camp space and copy the project API-210_PS-01_eval. The dataset is already uploaded in that project, so if you copy your R code and source/run everything after aligning the file paths, it should produce the correct figures and tables. (4 points)

Done

RCTs in Your Own Work (8 points)

21. Propose a specific policy question that could best be answered using an RCT. Explain the question in non-technical terms in no more than 3-5 sentences. Write out the empirical specification you would use. (4 points)

Done

22. Describe your treatment group. Propose a comparison group and explain why you chose that group. (2 points)

My treatment group would be recruited patients that have been randomized to the free/reduced dental care arm of the experiment. The comparison group would be those that were randomized to the control arm. This comparison makes sense because after randomization, the two groups should be balanced on characteristics that impact overall health.

23. Is it possible that the control group could be "contaminated" as a result of interacting with the treatment group? Explain which measures you would take to limit this contamination. (2 points)

In this case, it is very unlikely that the control group could be contaminated. The reason is because the treatment is being offered free/reduced dental care, and that benefit to the treatment group will not make those in the control group more likely to pursue dental care that they were not previously receiving.