WRITTEN PAPER III (ECON 4135)

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Firms exit through acquisitions, merger, buyout and dissolutions. Economists are interested in the factors that contribute to exit. For example, does increased research and development programs (R&D) make exit more or less likely at the firm level? To examine this question, we will use some data which are taken from the Compustat data base[1]. The data can be found in the accompanying STATA file comp2new.dta. The variables are described in Table 1. There are 964 observations (firms) in the file.

Table 1: **Variable list**

Variable	**Description**
exit	dummy: 1 if the firm exits during the observation period
emply	log of employment (in 1000s)
rs	ratio of R&D investment to sales
cc	ratio of cash flow to the net value of the capital stock
q	Tobin's q: a measure of the (stock) value of the firm relative to the value of its physical capital

We are interested in specifying a relationship between the binary dependent variable Y = "exit", and the other variables in Table 1 (the regressors): *emply, rs, cc, q*. Let Y_i denote the value of the variable "exit" for firm i.

1 . A student suggests to run an OLS regression of Y on emply, rs, cc and q, including a constant term. Estimate this linear model. Explain briefly what are the main problems with linear regression for this problem.

[1]The data set used here is made available by Prof. D. McFadden (UC Berkely).

2. Another student suggests instead to apply a probit model. Specify a probit model for this problem, i.e. write down an expression for the conditional probability of exit given the explanatory variables, i.e. $P(Y = 1|\text{emply, rs, cc, q})$.

Hint: For detailed instructions and examples on estimation of Probit and Logit models in STATA (and more generally about running STATA) see the home page of the Statistics Department at UCLA at http://www.ats.ucla.edu/STAT/STATA/ *. Then choose* "Logistic (and Categorical) Regression"*. Here you'll even find movies! (Of course, STATA's Help menu may also be useful).*

3. With the help of STATA, estimate the parameters of the probit model. Predict the exit probabilities of the firms in the sample, i.e., calculate $P(Y = 1|\text{emply, rs, cc, q})$ for each firm. (Hint: Use the predict command).

Define the "residual" of the model as the difference between the binary variable Y_i and the conditional expectation, $E(Y_i|\text{emply,rs,cc,q})$:

$$\varepsilon_i = Y_i - E(Y_i|\text{emply,rs,cc,q}) \tag{1}$$

Show that

$$\varepsilon_i = \begin{cases} 1 - P(Y = 1|\text{emply,rs,cc,q}) & \text{if } Y_i = 1 \\ -P(Y = 1|\text{emply,rs,cc,q}) & \text{if } Y_i = 0 \end{cases}$$

Calculate R^2 defined as

$$\mathrm{R}^2 = 1 - \frac{\sum_{i=1}^{n} \varepsilon_i^2}{\sum_{i=1}^{n} (Y_i - \overline{Y})^2},$$

where n is the number of firms and $\overline{Y}$, as usual, denotes the mean of the Y_i.

4. Test the hypothesis that R&D does not influence the probability of exit.

5. Explain how you will calculate the marginal effect of Tobin's q on the probability of exit for the Probit model. Calculate the marginal effect of Tobin's q for the following to firms:

	emply	cc	rs	Tobin's q
Firm 1	3	20	0	1
Firm 2	−5	−7	10	1

6. What is the difference between the Probit model and the Logit model? Estimate a Logit model with the same regressors as you used in the Probit model. What are the ratios between the estimated regression coefficients in the Logit model and in the Probit model (calculate one ratio for each coefficient)? Also predict the probability of exit for each firm in the data set, and compare with the predicted exit probabilities for the Probit model by graphing the two predicted exit probabilities against each other.

Why does the estimated regression coefficients in the two regression models differ so much, whereas the predicted exit probabilities tend to be very similar ?