Question 1

a

We need to assume that $c'(0) < s + \Delta s + p$ and $c'(e) > s + \Delta s + p$ for e that is sufficiently large to guarantee interior solution. The first order condition is

$$s + \Delta s + p = c'(e) \implies e^* = (c')^{-1}(s + \Delta s + p) \tag{1}$$

b

The elasticity is $\frac{1}{\gamma}$

c

The elasticity is $\frac{1}{\gamma e^*}$, where e^* is the optimal level of effort.

d

In case of power utility function elasticity has an structural interpretation, that is the inverse of effort cost curvature. This is not the case for exponential utility function, where the elasticity is the inverse of curvature re-scaled by level of effort.

e

α is the altruistic parameter which measures how sensitive you are to the return to charity. a is the warm-glow parameter where you feel good about donation for every unit of effort exert, but you don't care about the return to charity due to donation at all. If case where $\alpha > 0$ but $a = 0$, you are responsive to charity piece rate; in case where $\alpha = 0$ but $a > 0$, you are *not* responsive to charity piece rate.

f

The ratio is:

$$\frac{e_{gift}}{e_0} = (\frac{s + \Delta s}{s})^{\frac{1}{\gamma}}$$

The intuition is that the proportional increase in level of effort due to gift exchange is affected by the relative magnitude of gift exchange Δs, using baseline motivation, s as the benchmark. This ratio is also affected by the curvature of cost function γ negatively as the more convex the cost is, the less the optimal level of effort is.

g

$$e_{gift} - e_0 = \frac{1}{\gamma} ln(\frac{s + \Delta s}{s})$$

Since the cost function is now exponential, the increase in level of effort is no longer proportional, but additive: for any given s, Δs, γ, the increase in absolute level of effort due to gift exchange is constant regardless of the initial level of effort e_0. Still, it's the relatively magnitude of s and Δs that affects increase in effort and the curvature of function negatively affects the response of effort due to gift exchange.

h

The cost function is assumed to be power function in this case. k is heterogeneous with regard to different demographics and an error term ϵ_i. Subjects are heterogeneous in terms of level of cost of effort k, but homogeneous in the sense that they share the same γ, s and Δs.

j

No. We could add more treatments to back out the curvature of cost function and "altruistic function" with regard to return to employer. Specifically we need more exogenous variation in piecerate and specify return to employer, as DellaVigna, List, Malmendier and Rao (2016) did.

Question 2

b

Table 1: Summary Stat

treatment	mean_treatment	sd_treatment
piece rate 0	1520.68	725.6491
piece rate 1 per 100	2029.444	648.8939
piece rate 4 per 100	2131.858	626.2335
piece rate 10 per 100	2174.618	577.7483
crowdout	1883.193	663.6439
social preference 1 per 100	1906.995	632.067
social preference 10 per 100	1918.415	607.5864
discount: two weeks delay 1 per 100	2004.206	638.6904
discount: four weeks delay 1 per 100	1970.365	672.4991
gain and loss: 40 if greater than 2000	2135.952	575.6501
gain and loss: lose 40 if smaller than 2000	2154.772	532.494
gain and loss: 80 if greater than 2000	2187.857	530.209
probability weighting: 1%, 100 per 100	1895.539	669.9219
probability weighting: 50%, 2 per 100	1977.144	589.4723
social comparisons	1848.365	737.1965
ranking	1761.293	713.8233
task significance	1739.536	676.9047
gift exchange	1601.899	694.92

c

Note that for estimation purpose we need to re-scale k and s: the true k is the value in total multiplied by $1e-16$, and the true s is the value in table multiplied by $1e-6$. The estimation fluctuate a bit but not much: if you try to use the estimates here to predict 1 cent treatment, you'll find that the prediction is pretty close to the average of 1 cent treatment.

Note: initial value matters and scale of k and s matters for estimation. Inappropriate choice may result in different estimates. (You can use question e as "double check").

Table 2: questionc

	(1) buttonpresses
gamma	
_cons	0.0214
	(0.0180)
k	
_cons	0.00000579
	(0.000224)
s	
_cons	0.0821
	(0.939)
N	1668

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

d

The predicted value is 1960 whereas the true average is about 1883, which means that the model can predict this treatment reasonably well. This suggests that the effect of potential crowd-out is limited in this setting.

e

A quick way to do this is just to type "predict" in STATA after you have run the NLS (since there is no variation within treatment, the predicted value would be homogenous). The parameters are just-identified, so it should be that the estimates can perfectly predict the treatment effects! (If not, it could be that the NLS estimation in STATA does not work appropriately...)

f

Note that here the point estimate of k should be divided by 1E+16 and s by 1E+6

Table 3: questionc

	(1)
	buttonpresses
gamma	
_cons	0.0156***
	(0.00391)
k	
_cons	1.514
	(12.54)
rank	
_cons	0.000138
	(0.000204)
tasksigf	
_cons	0.0000974
	(0.000150)
s	
_cons	3.276
	(7.852)
gift	
_cons	0.0000210
	(0.0000425)
beta	
_cons	1.075
	(1.122)
delta	
_cons	0.767**
	(0.243)
alpha	
_cons	0.00301
	(0.0100)
a	
_cons	0.135
	(0.133)
N	6065

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

g

The prediction for the three treatments are roughly 2034, 2033, 2043. You might be surprised that the effect is shockingly similar (compared to the case with 1 cent piece rate but no psychological factors, which is 2029, see Q2(b)). Intuitively, in this horse race, monetary incentive dominates the psychological incentives (typically 100 or even 1000 times in terms of piece rate), under assumption of additivity with log transformation this naturally lead to absence of psychological factors.

h

Different people have different views about this of course (that's why forecast is interesting...). Many ways of reasoning are listed below, all of which are possible but not necessarily reflect the truth:

1. Crowd-out. For example, in Benabou&Tirole's world, the incentive from money and red-cross donation may interfere with each other as it obscures people's motives (either in terms of social image or self image). Since the piecerate is additive in log transformation, some crowd-out effect has been captured by the model. Whether there is stronger crowd-out (i.e. charity+money is less than money and charity) is an empirical question.

2. The validity of gift exchange and relative thinking. Existing literature suggests that one-shot, short-run gift exchange may only have limited effects on effort. The task is meaningless, cannot invoke reciprocity. The gift is monetary and amount is tiny, etc. On the other hand, the money from gift exchange may even *decrease* the salience of 1 cent piece-rate: 40 cent is a large amount relative to 1 cent, in which case gift exchange may even decrease the utility from pressing button for another 100 times (I use "salience" rather than "marginal utility" because the amount is too small to incur change in marginal utility)

3. Comparison becomes more plausible when task becomes meaningful: as the stake of tasks increases, comparing "how much you earn" to others might become a meaningful question despite the task itself is meaningless per se. In this case the social comparison incentive and monetary incentive act as compliments, which imply that the model is mis-specified.

i

In this case, the parameters are just-identified, which means that the process of minimizing distance is essentially solving a system of non-linear equations. Therefore, the weighting matrix is not relevant. This also implies that NLS and minimum distance is identical and would yield numerically equivalent results because they are all solving the same 3-equation system.

Table 4: Results using 0c, 4c, 10c treatment

γ	0.02143
	(0.00213)
k	5.79E-22
	(1.08E-05)
s	8.21E-08
	(0.00242)