Logistic regression: Positive Delay Rate – QuickPay (2009-2012)

Nov 22, 2021

1 Logistic Regressions (Positive Delay)

$$I(Delay_{it} > 0) = \beta_0 + \beta_1 Treat_i + \beta_2 Post_t + \beta_3(Treat_i \times Post_t) + e_{it}$$

$$\begin{aligned} I(Delay_{it} > 0) = \quad & \alpha + \beta_0 Treat_i + \beta_1 Post_t + \beta_2(Treat_i \times Post_t) \\ + \quad & X_i + (Post_t \times X_i) + \mu_t + \theta_{firm} + \lambda_{task} + \epsilon_{it} \end{aligned}$$

2 Contract Financing

$$CF_i = \begin{cases} 1, & \text{if project } i \text{ receives contract financing} \\ 0, & \text{otherwise} \end{cases}$$

$$\begin{aligned} I(Delay_{it} > 0) = \quad & \beta_0 + \beta_1 Treat_i + \beta_2 Post_t + \beta_3(Treat_i \times Post_t) \\ + \quad & \beta_4 CF_i + \beta_5(CF_i \times Post_t) + \beta_6(Treat_i \times Post_t \times CF_i) \\ + \quad & X_i + (Post_t \times X_i) + \mu_t + \theta_{firm} + \lambda_{task} + \epsilon_{it} \end{aligned}$$

3 Competition

3.1 Impact on delays

Define

$$SA_i = \begin{cases} 1, & \text{if project was signed after QuickPay} \\ 0, & \text{otherwise} \end{cases}$$

$$SB_i = \begin{cases} 1, & \text{if project was signed before QuickPay} \\ 0, & \text{otherwise} \end{cases}$$

3.1.1 Subsample model

For a subsample of competitive or noncompetitive projects:

$$\begin{aligned} I(Delay_{it} > 0) = \quad & \beta_0 + \beta_1 Treat_i + \beta_2 SA_i + \beta_3 Post_t \\ + \quad & \beta_4(Treat_i \times Post_t \times SA_i) + \beta_5(Treat_i \times Post_t \times SB_i) + e_{it} \end{aligned}$$

- According to our hypothesis, β_4 should be positive and significant for competitive projects, and insignificant for non-competitive projects.

- In the following regressions, we also control for the project's age. Project's age is defined as the number of quarters since it first showed up in the sample. We include the terciles of project's age as a control variable.

	$I(Delay_i t > 0)$				
	(1)	(2)	(3)	(4)	(5)
Constant	-2.05^{***}	-0.94^{***}			
	(0.01)	(0.02)			
$Treat_i$	-0.42^{***}	-0.24^{***}	-0.24^{***}	-0.17^{***}	-0.27^{***}
	(0.02)	(0.02)	(0.02)	(0.03)	(0.07)
$Post_t$	0.10^{***}	-0.32^{***}			
	(0.02)	(0.03)			
$Treat_i \times Post_t$	0.18^{***}	0.16^{***}	0.16^{***}	0.13^{***}	0.17^{***}
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Duration, Budget, Bids	No	Yes	Yes	Yes	Yes
$Post_t \times$ (Duration, Budget, Bids)	No	Yes	Yes	Yes	Yes
Year-Quarter FE	No	No	Yes	Yes	Yes
Task FE	No	No	No	Yes	Yes
Contractor FE	No	No	No	No	Yes
AIC	192105.94	169728.46			
BIC	192148.21	169833.28			
Log Likelihood	-96048.97	-84854.23			
Deviance	192097.94	169708.46	168714.31	155008.15	132964.53
Num. obs.	287530	263488	263488	260905	216602

Each observation is a project-quarter. SEs are robust and clustered at the project level.

Table 1:

	$I(Delay_i t > 0)$				
	(1)	(2)	(3)	(4)	(5)
Constant	-2.19^{***}	-0.99^{***}			
	(0.02)	(0.02)			
$Treat_i$	-0.41^{***}	-0.27^{***}	-0.27^{***}	-0.18^{***}	-0.28^{***}
	(0.02)	(0.02)	(0.02)	(0.03)	(0.07)
$Post_t$	0.09^{***}	-0.30^{***}			
	(0.02)	(0.03)			
CF_i	0.78^{***}	0.62^{***}	0.60^{***}	0.08^{**}	0.07^{*}
	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)
$Treat_i \times Post_t$	0.13^{***}	0.16^{***}	0.16^{***}	0.12^{***}	0.20^{***}
	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)
$Post_t \times CF_i$	0.01	-0.06	-0.05	0.05	0.17^{***}
	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)
$Treat_i \times Post_t \times CF_i$	0.29^{***}	0.08^{**}	0.09^{**}	0.02	-0.11^{*}
	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)
Duration, Budget, Bids	No	Yes	Yes	Yes	Yes
$Post_t \times$ (Duration, Budget, Bids)	No	Yes	Yes	Yes	Yes
Year-Quarter FE	No	No	Yes	Yes	Yes
Task FE	No	No	No	Yes	Yes
Contractor FE	No	No	No	No	Yes
AIC	188883.22	168397.79			
BIC	188957.20	168534.05			
Log Likelihood	-94434.61	-84185.89			
Deviance	188869.22	168371.79	167397.17	154961.96	132915.92
Num. obs.	287530	263488	263488	260905	216602

Each observation is a project-quarter. SEs are robust and clustered at the project level.

Table 2: Contract Financing

	$I(Delay_i t > 0)$				
	(1)	(2)	(3)	(4)	(5)
Constant	−1.98***	−0.90***			
	(0.02)	(0.02)			
$Treat_i$	−0.55***	−0.31***	−0.31***	−0.17***	−0.31***
	(0.02)	(0.02)	(0.03)	(0.03)	(0.09)
SA_i	−0.41***	−0.53***	−0.79***	−0.70***	−0.65***
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
$Post_t$	0.35***	0.01			
	(0.02)	(0.03)			
$Treat_i \times SB_i \times Post_t$	0.07**	0.15***	0.17***	0.14***	0.20***
	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)
$Treat_i \times SA_i \times Post_t$	0.24***	0.17***	0.16***	0.21***	0.22***
	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)
Duration, Budget, Bids	No	Yes	Yes	Yes	Yes
$Post_t \times$ (Duration, Budget, Bids)	No	Yes	Yes	Yes	Yes
Year-Quarter FE	No	No	Yes	Yes	Yes
Task FE	No	No	No	Yes	Yes
Contractor FE	No	No	No	No	Yes
AIC	158229.54	139557.11			
BIC	158291.74	139680.42			
Log Likelihood	−79108.77	−69766.56			
Deviance	158217.54	139533.11	138121.15	126129.81	108438.07
Num. obs.	234573	214421	214421	212123	173025

Each observation is a project-quarter. SEs are robust and clustered at the project level. Sample restricted to fully competed projects.

Table 3: Full Competition

	$I(Delay_i t > 0)$				
	(1)	(2)	(3)	(4)	(5)
Constant	-2.40^{***}	-0.92^{***}			
	(0.04)	(0.21)			
$Treat_i$	0.27^{***}	0.17^{***}	0.19^{***}	-0.16^{**}	-0.10
	(0.05)	(0.06)	(0.06)	(0.07)	(0.18)
SA_i	-0.14^{***}	-0.29^{***}	-0.49^{***}	-0.53^{***}	-0.62^{***}
	(0.05)	(0.05)	(0.06)	(0.07)	(0.08)
$Post_t$	-0.02	0.03			
	(0.05)	(0.22)			
$Treat_i \times SB_i \times Post_t$	0.28^{***}	0.28^{***}	0.28^{***}	0.29^{***}	0.39^{***}
	(0.07)	(0.08)	(0.08)	(0.08)	(0.10)
$Treat_i \times SA_i \times Post_t$	0.11	0.04	0.05	0.08	0.09
	(0.08)	(0.08)	(0.08)	(0.09)	(0.11)
Duration, Budget, Bids	No	Yes	Yes	Yes	Yes
$Post_t \times$ (Duration, Budget, Bids)	No	Yes	Yes	Yes	Yes
Year-Quarter FE	No	No	Yes	Yes	Yes
Task FE	No	No	No	Yes	Yes
Contractor FE	No	No	No	No	Yes
AIC	32508.38	28815.35			
BIC	32561.64	28920.97			
Log Likelihood	-16248.19	-14395.68			
Deviance	32496.38	28791.35	28610.62	26220.54	21209.53
Num. obs.	52957	49067	49067	47130	36044

Each observation is a project-quarter. SEs are robust and clustered at the project level. Sample restricted to non-competed projects.

Table 4: Non-competitive projects

3.1.2 Four-way interaction

We run the following model:

$$
\begin{aligned}
I(Delay_{it} > 0) = \quad & \beta_0 + \beta_1 Treat_i + \beta_2 StartedAfterQP_i + \beta_3 Post_t + \beta_4 Competitive_i \\
& + \beta_5 (Treat_i \times Competitive_i) + \beta_6 (Post_t \times Competitive_i) \\
& + \beta_7 (StartedAfterQP_i \times Competitive_i) + \beta_8 (Treat_i \times Post_t) \\
& + \beta_9 (Treat_i \times Post_t \times Competitive_i) \\
& + \beta_{10} (Treat_i \times Post_t \times StartedAfterQP_i) \\
& + \beta_{11} (Treat_i \times Post_t \times StartedAfterQP_i \times Competitive_i) + e_{it}
\end{aligned}
$$

Interpretation:

- β_9 is the difference between treatment effect for competitive and non-competitive projects signed before quickpay.
- $\beta_9 + \beta_{11}$ is the difference between treatment effect for competitive and non-competitive projects signed *after* quickpay.
- β_{11} is our coefficient of interest because it tells us how much of the difference is there due to "aggressive bidding" after the policy.

	$I(Delay_it > 0)$				
	(1)	(2)	(3)	(4)	(5)
Constant	−2.40***	−1.09***			
	(0.04)	(0.04)			
$Treat_i$	0.27***	0.16***	0.17***	−0.17***	−0.34***
	(0.05)	(0.06)	(0.06)	(0.06)	(0.10)
$StartedAfterQP_i$	−0.14***	−0.27***	−0.55***	−0.54***	−0.63***
	(0.05)	(0.05)	(0.06)	(0.06)	(0.07)
$Competitive_i$	0.42***	0.18***	0.20***	−0.08	−0.27***
	(0.04)	(0.04)	(0.05)	(0.05)	(0.07)
$Post_t$	−0.02	−0.26***			
	(0.05)	(0.06)			
$Treat_i \times Competitive_i$	−0.82***	−0.48***	−0.49***	−0.01	0.06
	(0.06)	(0.06)	(0.06)	(0.07)	(0.10)
$Post_t \times Competitive_i$	0.37***	0.31***	0.31***	0.14**	0.16**
	(0.06)	(0.06)	(0.06)	(0.06)	(0.07)
$StartedAfterQP_i \times Competitive_i$	−0.27***	−0.26***	−0.24***	−0.16**	−0.02
	(0.06)	(0.06)	(0.06)	(0.07)	(0.07)
$Treat_i \times Post_t$	0.28***	0.29***	0.29***	0.19**	0.33***
	(0.07)	(0.08)	(0.08)	(0.08)	(0.09)
$Treat_i \times Post_t \times Competitive_i$	−0.21***	−0.13	−0.12	−0.05	−0.14
	(0.08)	(0.08)	(0.09)	(0.09)	(0.10)
$Treat_i \times Post_t \times StartedAfterQP_i$	−0.17**	−0.25***	−0.23***	−0.20**	−0.23**
	(0.07)	(0.08)	(0.08)	(0.09)	(0.10)
$Treat_i \times Post_t \times StartedAfterQP_i \times Competitive_i$	0.34***	0.27***	0.22**	0.26***	0.24**
	(0.08)	(0.08)	(0.09)	(0.09)	(0.11)
Duration, Budget, Bids	No	Yes	Yes	Yes	Yes
$Post_t \times$ (Duration, Budget, Bids)	No	Yes	Yes	Yes	Yes
Year-Quarter FE	No	No	Yes	Yes	Yes
Task FE	No	No	No	Yes	Yes
Contractor FE	No	No	No	No	Yes
AIC	190737.92	168464.56			
BIC	190864.75	168653.23			
Log Likelihood	−95356.96	−84214.28			
Deviance	190713.92	168428.56	166855.10	153931.94	132175.22
Num. obs.	287530	263488	263488	260905	216764

Each observation is a project-quarter. SEs are robust and clustered at the project level.

Table 5: Competition: Four-way Interaction