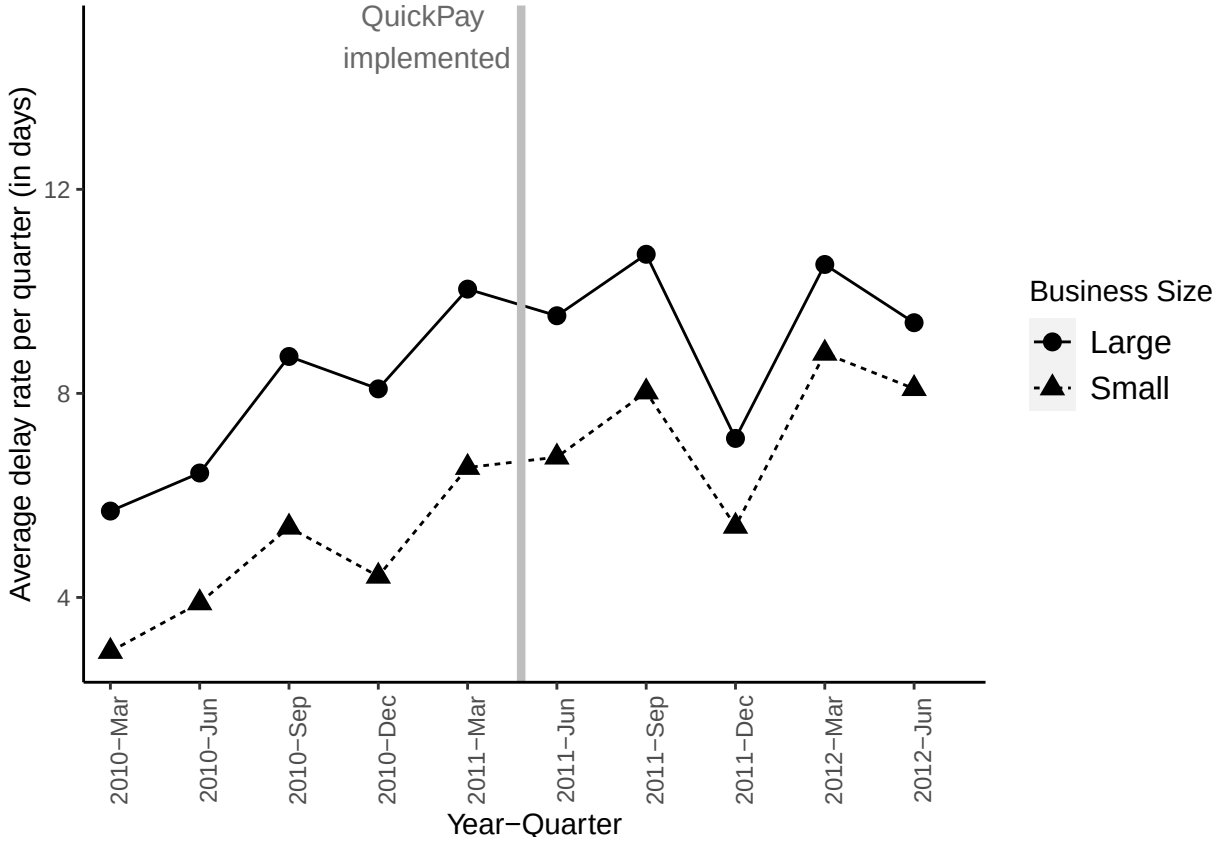
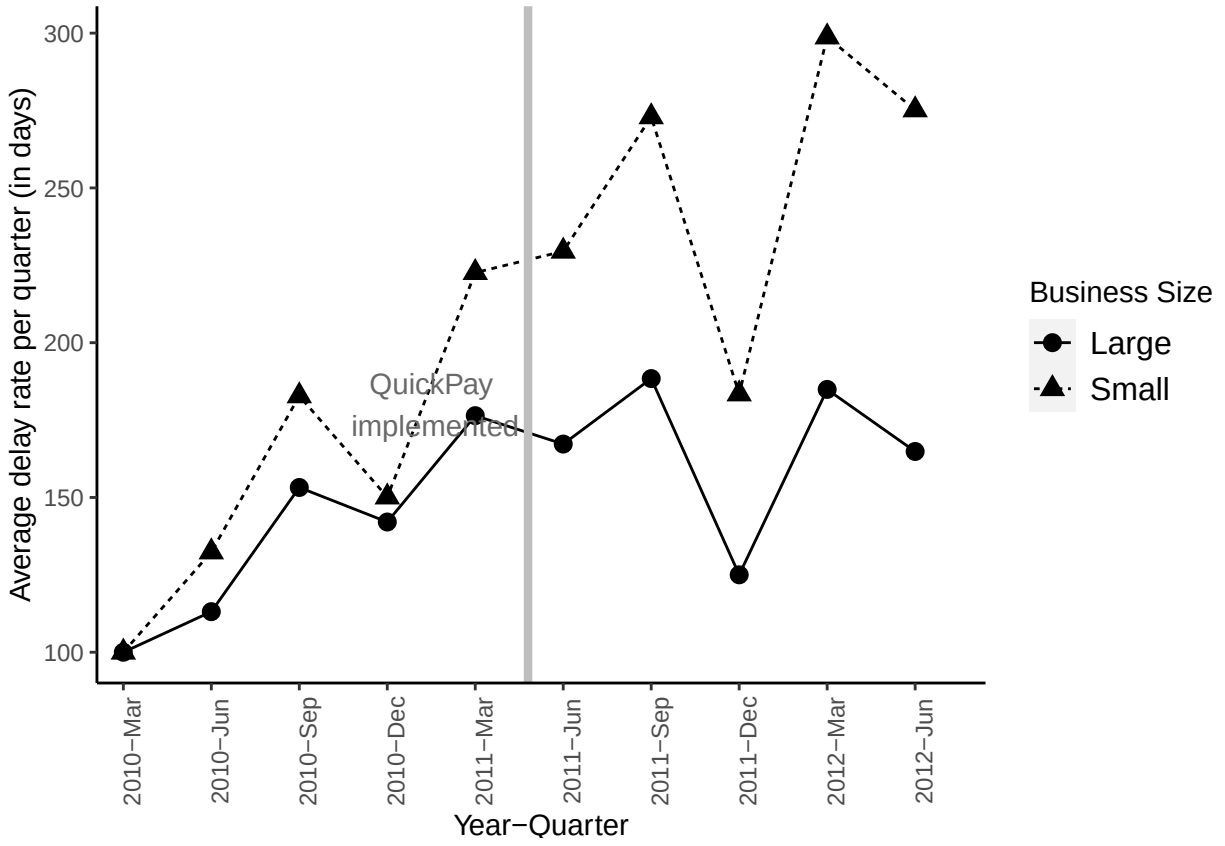
First Implementation of QuickPay (2009-2012)

Jan 16, 2022

1 Delays over Time

- Sample restricted to projects for which start dates matches the one in API
  - This is done by using first reported "action_date" and "date_signed"
- $DelayRate_{it} = Deadline_{i,t} - Deadline_{i,t-1}$





2 Notation

- Project i, Year-Quarter t
- X_i denotes project level controls: initial duration, initial budget, number of offers received
- $\mu_t, \theta_{firm}, \lambda_{task}$: Year-Quarter, Firm, and Product/Service code Fixed effects
- All continuous variables are winsorized at the 5% level

$$Treat_i = \begin{cases} 1, & \text{if project } i \text{ is a small business} \\ 0, & \text{otherwise} \end{cases}$$

$$Post_t = \begin{cases} 1, & \text{if year-quarter } t > \text{ April 27, 2011} \\ 0, & \text{otherwise} \end{cases}$$

3 Summary Statistics

4 Parallel Trends Test

Let $Time$ denote q-th quarter since the beginning of time horizon. For $Post_t = 0$, we run the following regression:

$$Delay_{it} = \alpha + \beta_0 Treat_i + \beta_1 (Treat_i \times Time) + \beta_2 X_i + \mu_t + \theta_{firm} + \lambda_{task} + \epsilon_{it}$$

The coefficient of interest is β_1. If this is significant, we would find evidence of a linear time trend before quickpay implementation – violating the parallel trends assumption.

Table 1: Linear Time Trend Before QuickPay

	Dependent variable:
	$Delay_{it}$ (in days)
$Treat_i$	-1.00^{**}
	(0.51)
$Treat_i \times Time$	-0.14
	(0.11)
Fixed effects	Firm, Task, and Year-Quarter
Controls	Budget, Duration, Bids, Project Age
Observations	99,007
R^2	0.14
Adjusted R^2	0.13
Note:	*p<0.1; **p<0.05; ***p<0.01
	Each observation is a project-quarter.
	SEs are robust and clustered at the project level.
	Observations are for quarters before quickpay.

5 Baseline Regressions

$$Delay_{it} = \alpha + \beta_0 Treat_i + \beta_1 Post_t + \beta_2 (Treat_i \times Post_t) + \epsilon_{it}$$

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

Table 2: Quickpay 2009-2011

	$Delay_{it}$ (in days)				
	(1)	(2)	(3)	(4)	(5)
$Treat_i$	-3.34^{***}	-2.26^{***}	-2.28^{***}	-1.94^{***}	-2.01^{***}
	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)
$Post_t$	1.02^{***}	-1.86^{***}			
	(0.15)	(0.31)			
$Treat_i \times Post_t$	1.34^{***}	1.57^{***}	1.59^{***}	1.39^{***}	1.41^{***}
	(0.19)	(0.19)	(0.19)	(0.19)	(0.19)
Constant	8.35^{***}	14.51^{***}			
	(0.12)	(0.23)			
Duration, Budget, Bids	No	Yes	Yes	Yes	Yes
$Post_t\times$ (Duration, Budget, Bids)	No	Yes	Yes	Yes	Yes
Project Age Tercile	No	Yes	Yes	Yes	Yes
Year-Quarter Fixed Effects	No	No	Yes	Yes	Yes
Task Fixed Effects	No	No	No	Yes	Yes
Industry Fixed Effects	No	No	No	No	Yes
Observations	287,530	263,488	263,488	263,488	263,488
R^2	0.004	0.08	0.08	0.11	0.11
Adjusted R^2	0.004	0.08	0.08	0.10	0.11

Note: *p<0.1; **p<0.05; ***p<0.01
Each observation is a project-quarter.
SEs are robust and clustered at the project level.

6 Competition

$$Competition_i = \begin{cases} 1, \text{ if project was subject to full and open competition} \\ \text{(extent competed code is not B, C, G, E, or "")} \\ 0, \text{ otherwise} \end{cases}$$

Hypothesis:

- QuickPay increased competition for small projects.
- This led to more aggressive bids. That is, contractors quoted unrealistically small timelines for the projects.
- As a result, we should see "artificial delays" on these projects as they revert to their realistic timelines later.
- **Note:** This hypothesis only applies to projects that were signed after QuickPay. We, therefore, need the effect coming from projects that were signed after QuickPay.

6.1 Impact on bids, duration, and budget

$$y_{it} = \beta_0 + \beta_1 Treat_i + \beta_2 (Treat_i \times Post_t) + \mu_t + \lambda_{task} + e_{it}$$

where y_{it} denotes bids, duration, or budget of project i signed in quarter t.

- $Post_t$ is a dummy that equals one if t is a quarter after QuickPay was launched.
- μ_t denotes fixed effects for the quarter in which the project was signed.

Table 3: Effect of Competition After QuickPay: Quickpay 2009-2011

	$NumberOfBids_{it}$	$InitialDuration_{it}$	$InitialBudget_{it}$
	(1)	(2)	(3)
$Treat_i$	0.89^{***}	-7.33^{***}	$-10{,}203.21^{***}$
	(0.09)	(0.70)	(1,103.25)
$Treat_i \times Post_t$	0.27^{**}	-3.26^{***}	$-22{,}048.85^{***}$
	(0.12)	(0.98)	(1,580.03)
Task fixed effects	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes
Observations	227,318	220,524	227,358
R^2	0.25	0.20	0.27
Adjusted R^2	0.24	0.19	0.26

Note: *p<0.1; **p<0.05; ***p<0.01
Each observation is a project-quarter.
SEs are robust and clustered at the project level.
Sample restricted to fully competed projects.

6.2 Impact on bids

Table 4: Effect of Competition After QuickPay: Quickpay 2009-2011

	$NumberOfBids_{it}$		
	(1)	(2)	(3)
$Treat_i$	0.25^{***}	0.25^{***}	0.89^{***}
	(0.10)	(0.10)	(0.09)
$Post_t$	-0.34^{***}		
	(0.11)		
$Treat_i \times Post_t$	0.30^{**}	0.30^{**}	0.27^{**}
	(0.13)	(0.13)	(0.12)
Constant	5.07^{***}		
	(0.08)		
Year-Quarter Fixed Effects	No	Yes	Yes
Task Fixed Effects	No	No	Yes
Observations	227,318	227,318	227,318
R^2	0.0002	0.0003	0.25
Adjusted R^2	0.0002	0.0003	0.24

Note: *p<0.1; **p<0.05; ***p<0.01
Each observation is a project-quarter.
SEs are robust and clustered at the project level.
Sample restricted to fully competed projects.

6.3 Impact on Initial Duration

Table 5: Effect of Competition After QuickPay: Quickpay 2009-2011

	$InitialDuration_{it}$			
	(1)	(2)	(3)	(4)
$Treat_i$	-18.02^{***}	-17.61^{***}	-7.33^{***}	-7.31^{***}
	(0.70)	(0.70)	(0.70)	(0.70)
$Post_t$	1.27			
	(0.88)			
$Treat_i \times Post_t$	2.84^{***}	2.52^{**}	-3.26^{***}	-3.17^{***}
	(1.06)	(1.06)	(0.98)	(0.97)
Constant	136.56^{***}			
	(0.58)			
Year-Quarter Fixed Effects	No	Yes	Yes	Yes
Task Fixed Effects	No	No	Yes	Yes
Industry Fixed Effects	No	No	No	Yes
Observations	220,524	220,524	220,524	220,524
R^2	0.01	0.01	0.20	0.21
Adjusted R^2	0.01	0.01	0.19	0.21

Note: *p<0.1; **p<0.05; ***p<0.01
Each observation is a project-quarter.
SEs are robust and clustered at the project level.
Sample restricted to fully competed projects.

6.4 Impact on Initial Budget

Table 6: Effect of Competition After QuickPay: Quickpay 2009-2011

	$InitialBudget_{it}$			
	(1)	(2)	(3)	(4)
$Treat_i$	$-64{,}224.13^{***}$	$-60{,}124.82^{***}$	$-10{,}203.21^{***}$	$-8{,}224.51^{***}$
	(1,020.96)	(1,135.76)	(1,103.25)	(1,098.84)
$Post_t$	23.31^{***}			
	(2.08)			
$Treat_i \times Post_t$	$-7{,}454.09^{***}$	$-17{,}016.07^{***}$	$-22{,}048.85^{***}$	$-21{,}625.77^{***}$
	(1,339.70)	(1,810.34)	(1,580.03)	(1,554.76)
Constant	$-217{,}694.10^{***}$			
	(31,218.93)			
Year-Quarter Fixed Effects	No	Yes	Yes	Yes
Task Fixed Effects	No	No	Yes	Yes
Industry Fixed Effects	No	No	No	Yes
Observations	227,358	227,358	227,358	227,358
R^2	0.03	0.04	0.27	0.29
Adjusted R^2	0.03	0.04	0.26	0.28

Note: *p<0.1; **p<0.05; ***p<0.01
Each observation is a project-quarter.
SEs are robust and clustered at the project level.
Sample restricted to fully competed projects.

6.5 Impact on delays

Define

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

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

6.5.1 Subsample model

For a subsample of competitive or noncompetitive projects:

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

- 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.

Table 7: Subsample of Competitive Projects: Quickpay 2009-2011

	$Delay_{it}$ (in days)				
	(1)	(2)	(3)	(4)	(5)
$Treat_i$	-4.23^{***}	-2.75^{***}	-2.82^{***}	-1.98^{***}	-2.08^{***}
	(0.17)	(0.16)	(0.16)	(0.17)	(0.17)
SA_i	-5.24^{***}	-3.39^{***}	-5.60^{***}	-5.54^{***}	-5.52^{***}
	(0.24)	(0.24)	(0.27)	(0.27)	(0.27)
$Post_t$	4.18^{***}	0.39			
	(0.22)	(0.38)			
$Treat_i \times SB_i \times Post_t$	-0.21	0.97^{***}	1.12^{***}	1.11^{***}	1.11^{***}
	(0.27)	(0.29)	(0.29)	(0.28)	(0.28)
$Treat_i \times SA_i \times Post_t$	2.03^{***}	1.91^{***}	1.89^{***}	1.98^{***}	1.99^{***}
	(0.25)	(0.24)	(0.24)	(0.23)	(0.23)
Constant	8.84^{***}	15.05^{***}			
	(0.14)	(0.26)			
Duration, Budget, Bids	No	Yes	Yes	Yes	Yes
$Post_t \times$ (Duration, Budget, Bids)	No	Yes	Yes	Yes	Yes
Project age	No	Yes	Yes	Yes	Yes
Year-Quarter Fixed Effects	No	No	Yes	Yes	Yes
Task Fixed Effects	No	No	No	Yes	Yes
Industry Fixed Effects	No	No	No	No	Yes
Observations	234,573	214,421	214,421	214,421	214,421
R^2	0.01	0.08	0.09	0.12	0.12
Adjusted R^2	0.01	0.08	0.09	0.11	0.11

Note: *p<0.1; **p<0.05; ***p<0.01
Each observation is a project-quarter.
SEs are robust and clustered at the project level.
Sample restricted to fully competed projects.

Table 8: Subsample of Non-competitive Projects: Quickpay 2009-2011

	$Delay_{it}$ (in days)			
	(1)	(2)	(3)	(4)
$Treat_i$	1.30^{***}	0.60	0.65^{*}	-1.43^{***}
	(0.37)	(0.37)	(0.37)	(0.40)
SA_i	-1.80^{***}	-0.52	-1.69^{***}	-1.79^{***}
	(0.32)	(0.32)	(0.41)	(0.41)
$Post_t$	0.64^{**}	-0.04		
	(0.32)	(0.81)		
$Treat_i \times SB_i \times Post_t$	2.78^{***}	3.16^{***}	3.17^{***}	3.29^{***}
	(0.56)	(0.60)	(0.60)	(0.61)
$Treat_i \times SA_i \times Post_t$	0.71	-0.11	-0.02	0.12
	(0.52)	(0.51)	(0.51)	(0.52)
Constant	6.29^{***}	13.61^{***}		
	(0.25)	(0.63)		
Duration, Budget, Bids	No	Yes	Yes	Yes
$Post_t \times$ (Duration, Budget, Bids)	No	Yes	Yes	Yes
Project age	No	Yes	Yes	Yes
Year-Quarter Fixed Effects	No	No	Yes	Yes
Task Fixed Effects	No	No	No	Yes
Observations	52,957	49,067	49,067	49,067
R^2	0.01	0.07	0.07	0.11
Adjusted R^2	0.005	0.07	0.07	0.09

Note: *p<0.1; **p<0.05; ***p<0.01
Each observation is a project-quarter.
SEs are robust and clustered at the project level.
Sample restricted to non-competed projects.

6.5.2 Four-way interaction

We run the following model:

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

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.

Table 9: Effect of Competition After QuickPay: Quickpay 2009-2011

	$Delay_{it}$ (in days)					
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_i$	1.30^{***}	0.53	0.41	0.47	-1.51^{***}	-1.74^{***}
	(0.37)	(0.37)	(0.37)	(0.37)	(0.38)	(0.37)
$StartedAfterQP_i$	-1.80^{***}	-2.80^{***}	0.08	-1.97^{***}	-2.28^{***}	-2.32^{***}
	(0.32)	(0.32)	(0.31)	(0.33)	(0.34)	(0.33)
$Competitive_i$	2.56^{***}	1.08^{***}	1.04^{***}	1.13^{***}	-0.04	-0.01
	(0.28)	(0.28)	(0.28)	(0.28)	(0.29)	(0.29)
$Post_t$	0.64^{**}	0.64	-2.10^{***}			
	(0.32)	(0.43)	(0.43)			
$Treat_i \times Competitive_i$	-5.52^{***}	-3.83^{***}	-3.21^{***}	-3.33^{***}	-0.58	-0.41
	(0.41)	(0.41)	(0.40)	(0.40)	(0.41)	(0.41)
$Post_t \times Competitive_i$	3.54^{***}	2.90^{***}	2.86^{***}	2.89^{***}	1.88^{***}	1.88^{***}
	(0.39)	(0.40)	(0.40)	(0.40)	(0.40)	(0.40)
$StartedAfterQP_i \times Competitive_i$	-3.44^{***}	-3.65^{***}	-3.62^{***}	-3.56^{***}	-3.16^{***}	-3.10^{***}
	(0.40)	(0.39)	(0.39)	(0.39)	(0.39)	(0.38)
$Treat_i \times Post_t$	2.78^{***}	3.15^{***}	3.12^{***}	3.20^{***}	2.81^{***}	2.90^{***}
	(0.56)	(0.60)	(0.60)	(0.60)	(0.60)	(0.60)
$Treat_i \times Post_t \times Competitive_i$	-2.98^{***}	-1.99^{***}	-2.15^{***}	-2.09^{***}	-1.71^{***}	-1.80^{***}
	(0.62)	(0.67)	(0.66)	(0.66)	(0.66)	(0.66)
$Treat_i \times Post_t \times StartedAfterQP_i$	-2.07^{***}	-3.28^{***}	-3.31^{***}	-3.24^{***}	-3.07^{***}	-3.12^{***}
	(0.59)	(0.61)	(0.60)	(0.60)	(0.60)	(0.60)
$Treat_i \times Post_t \times StartedAfterQP_i \times Competitive_i$	4.31^{***}	4.17^{***}	4.26^{***}	4.03^{***}	3.97^{***}	4.03^{***}
	(0.66)	(0.68)	(0.67)	(0.67)	(0.67)	(0.67)
Constant	6.29^{***}	16.06^{***}	13.85^{***}			
	(0.25)	(0.32)	(0.31)			
Duration, Budget, Bids	No	Yes	Yes	Yes	Yes	Yes
$Post_t \times$ (Duration, Budget, Bids)	No	Yes	Yes	Yes	Yes	Yes
Project age	No	No	Yes	Yes	Yes	Yes
Year-Quarter Fixed Effects	No	No	No	Yes	Yes	Yes
Task Fixed Effects	No	No	No	No	Yes	Yes
Industry Fixed Effects	No	No	No	No	No	Yes
Observations	287,530	263,488	263,488	263,488	263,488	263,488
R^2	0.01	0.06	0.08	0.08	0.11	0.11
Adjusted R^2	0.01	0.06	0.08	0.08	0.11	0.11

Note: *p<0.1; **p<0.05; ***p<0.01
Each observation is a project-quarter.
SEs are robust and clustered at the project level.

7 Impact of Firm's Financial Constraints

7.1 Contract Financing

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

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

Table 10: Effect of Contract Financing: Quickpay 2009-2011

	$Delay_{it}$ (in days)				
	(1)	(2)	(3)	(4)	(5)
$Treat_i$	-3.07^{***}	-2.32^{***}	-2.33^{***}	-1.91^{***}	-1.99^{***}
	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)
$Post_t$	-0.32^{**}	-1.95^{***}			
	(0.16)	(0.31)			
$Treat_i \times Post_t$	1.30^{***}	1.61^{***}	1.61^{***}	1.38^{***}	1.43^{***}
	(0.19)	(0.20)	(0.20)	(0.19)	(0.19)
CF_i	3.82^{***}	2.18^{***}	2.15^{***}	-1.04^{***}	-1.16^{***}
	(0.25)	(0.25)	(0.25)	(0.26)	(0.26)
$Post_t \times CF_i$	2.52^{***}	1.44^{***}	1.46^{***}	1.88^{***}	2.00^{***}
	(0.41)	(0.41)	(0.41)	(0.41)	(0.41)
$Post_t \times CF_i \times Treat_i$	1.13^{**}	-0.16	-0.08	-0.15	-0.39
	(0.47)	(0.45)	(0.45)	(0.45)	(0.46)
Constant	5.05^{***}	14.37^{***}			
	(0.13)	(0.23)			
Duration, Budget, Bids	No	Yes	Yes	Yes	Yes
$Post_t \times$ (Duration, Budget, Bids)	No	Yes	Yes	Yes	Yes
Project Age Tercile	No	Yes	Yes	Yes	Yes
Year-Quarter Fixed Effects	No	No	Yes	Yes	Yes
Task Fixed Effects	No	No	No	Yes	Yes
Industry Fixed Effects	No	No	No	No	Yes
Observations	287,530	263,488	263,488	263,488	263,488
R^2	0.02	0.08	0.08	0.11	0.11
Adjusted R^2	0.02	0.08	0.08	0.10	0.11

Note: *p<0.1; **p<0.05; ***p<0.01
Each observation is a project-quarter.
SEs are robust and clustered at the project level.

7.2 Receives Financial Aid

$$FinancialAid = \begin{cases} 1, & \text{if firm receives grants or is a c8A participant} \\ 0, & \text{otherwise} \end{cases}$$

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

Table 11: Effect of Grants or C8A Participant: Quickpay 2009-2011

	$Delay_{it}$ (in days)				
	(1)	(2)	(3)	(4)	(5)
$Treat_i$	-3.62^{***}	-3.00^{***}	-2.97^{***}	-2.20^{***}	-2.26^{***}
	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)
$Post_t$	1.20^{***}	-0.77^{**}			
	(0.15)	(0.31)			
$Treat_i \times Post_t$	1.06^{***}	1.45^{***}	1.42^{***}	1.27^{***}	1.33^{***}
	(0.19)	(0.20)	(0.20)	(0.20)	(0.20)
$FinancialAid$	7.39^{***}	6.20^{***}	6.00^{***}	2.55^{***}	2.37^{***}
	(0.33)	(0.32)	(0.32)	(0.33)	(0.33)
$Post_t \times FinancialAid$	-3.31^{***}	-2.38^{***}	-2.26^{***}	-0.45	-0.23
	(0.51)	(0.51)	(0.51)	(0.52)	(0.52)
$Post_t \times FinancialAid \times Treat_i$	2.94^{***}	1.96^{***}	2.11^{***}	0.61	0.37
	(0.53)	(0.53)	(0.53)	(0.54)	(0.54)
Constant	7.84^{***}	16.42^{***}			
	(0.12)	(0.24)			
Duration, Budget, Bids	No	Yes	Yes	Yes	Yes
$Post_t \times$ (Duration, Budget, Bids)	No	Yes	Yes	Yes	Yes
Year-Quarter Fixed Effects	No	No	Yes	Yes	Yes
Task Fixed Effects	No	No	No	Yes	Yes
Industry Fixed Effects	No	No	No	No	Yes
Observations	287,530	263,488	263,488	263,488	263,488
R^2	0.01	0.05	0.06	0.09	0.10
Adjusted R^2	0.01	0.05	0.06	0.09	0.09

Note: *p<0.1; **p<0.05; ***p<0.01
Each observation is a project-quarter.
SEs are robust and clustered at the project level.

7.3 Receives Contracts and Financial Aid

$$
CFA = \begin{cases} 1, \text{ if firm receives "contracts and grants"} \\ \text{or grants or is a c8A participant} \\ 0, \text{ otherwise} \end{cases}
$$

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

Table 12: Effect of Contracts, Grants, or C8A Participant: Quickpay 2009-2011

	$Delay_{it}$ (in days)				
	(1)	(2)	(3)	(4)	(5)
$Treat_i$	-3.28^{***}	-2.68^{***}	-2.67^{***}	-2.03^{***}	-2.11^{***}
	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)
$Post_t$	1.12^{***}	-0.94^{***}			
	(0.16)	(0.31)			
$Treat_i \times Post_t$	1.26^{***}	1.65^{***}	1.62^{***}	1.47^{***}	1.56^{***}
	(0.20)	(0.20)	(0.20)	(0.20)	(0.20)
CFA	5.37^{***}	4.34^{***}	4.14^{***}	1.99^{***}	1.94^{***}
	(0.24)	(0.23)	(0.23)	(0.23)	(0.22)
$Post_t \times CFA$	-1.26^{***}	-0.71^{**}	-0.57^{*}	0.09	0.28
	(0.35)	(0.34)	(0.34)	(0.34)	(0.34)
$Post_t \times CFA \times Treat_i$	0.53	0.03	0.13	-0.59	-0.86^{**}
	(0.37)	(0.37)	(0.37)	(0.38)	(0.38)
Constant	7.44^{***}	16.00^{***}			
	(0.12)	(0.24)			
Duration, Budget, Bids	No	Yes	Yes	Yes	Yes
$Post_t\times$ (Duration, Budget, Bids)	No	Yes	Yes	Yes	Yes
Year-Quarter Fixed Effects	No	No	Yes	Yes	Yes
Task Fixed Effects	No	No	No	Yes	Yes
Industry Fixed Effects	No	No	No	No	Yes
Observations	287,530	263,488	263,488	263,488	263,488
R^2	0.01	0.05	0.06	0.09	0.10
Adjusted R^2	0.01	0.05	0.06	0.09	0.09

Note: *p<0.1; **p<0.05; ***p<0.01
Each observation is a project-quarter.
SEs are robust and clustered at the project level.

8 Firm's rank order

- Consider a project i of firm f in quarter t.
- Let $\Pi_{f,2010}$ denote all projects of firm f in Fiscal Year 2010.
- Define $\rho_f = \sum_{i \in \Pi_{f,2010}} (Treat_i \times FAO_{if}) / Sales_{f,2010}$.
- ρ_f is the fraction of revenue a firm earned from small government projects in Fiscal Year 2010.
- Let $Rank_f = r(\rho_f)/N$ where $r(\rho_f)$ is the rank statistic of ρ_f and $N =$ number of firms. For example, $r(\rho_f) = 1$ if $\rho_f = \min(\rho_1, \rho_2, \ldots, \rho_N)$.
- Put simply, $Rank_f$ is a firm's rank order based on the fraction of revenue it earned from small government projects in FY 2010.

8.1 Portfolio Effects: Discrete

- See Jie's notes for details.
- Assumption: Parallel trends between small projects of firms in different terciles wtih pooled sample large projects. May not hold. Need to include firm specific control or at least plot the trends.

- Let $Rank_f^{(k)}$ be an indicator for firm being in the k-th tercile of $Rank$. Define:
  - $Medium_i = Treat_i * Rank_f^{(2)}$
  - $High_i = Treat_i * Rank_f^{(3)}$

$$Delay_{it} = \beta_0 + \beta_1 Treat_i + \beta_2 Medium_i + \beta_3 High_i + \beta_4 Post_t + \beta_5(Treat_i \times Post_t) + \beta_6(Medium_i \times Post_t) + \beta_7(High_i \times Post_t) + \epsilon_{it}$$

Table 13: Discrete Portfolio Effects: Quickpay 2009-2011

	$Delay_{it}$ (in days)				
	(1)	(2)	(3)	(4)	(5)
$Treat_i$	-2.50^{***}	-1.51^{***}	-1.37^{***}	-0.07	-0.25
	(0.32)	(0.34)	(0.34)	(0.35)	(0.35)
$Medium_i$	-0.05	-1.35^{***}	-1.40^{***}	-0.88^{***}	-0.79^{***}
	(0.26)	(0.29)	(0.29)	(0.28)	(0.28)
$High_i$	3.22^{***}	1.39^{***}	1.31^{***}	-0.20	-0.15
	(0.28)	(0.31)	(0.31)	(0.31)	(0.31)
$Post_t$	3.09^{***}	0.48			
	(0.30)	(0.52)			
$Treat_i \times Post_t$	-1.40^{***}	0.12	-0.10	-0.50	-0.50
	(0.42)	(0.46)	(0.46)	(0.46)	(0.46)
$Treat_i \times Post_t \times Medium_i$	0.45	0.65	0.73^{*}	0.82^{**}	0.75^{*}
	(0.35)	(0.40)	(0.40)	(0.39)	(0.39)
$Treat_i \times Post_t \times High_i$	1.82^{***}	0.93^{**}	1.09^{**}	1.11^{***}	1.11^{***}
	(0.38)	(0.43)	(0.43)	(0.43)	(0.43)
Constant	6.07^{***}	13.07^{***}			
	(0.24)	(0.38)			
Duration, Budget, Bids	No	Yes	Yes	Yes	Yes
$Post_t\times$ (Duration, Budget, Bids)	No	Yes	Yes	Yes	Yes
Year-Quarter Fixed Effects	No	No	Yes	Yes	Yes
Task Fixed Effects	No	No	No	Yes	Yes
Industry Fixed Effects	No	No	No	No	Yes
Observations	122,544	110,261	110,261	110,261	110,261
R^2	0.01	0.05	0.06	0.09	0.09
Adjusted R^2	0.01	0.05	0.06	0.08	0.08

Note: *p<0.1; **p<0.05; ***p<0.01
Each observation is a project-quarter.
SEs are robust and clustered at the project level.

8.2 Portfolio Effects: Continuous

- See Jie's notes for details.
- Define $\theta_i = Treat_i * Rank_f$

$$Delay_{it} = \beta_0 + \beta_1 Treat_i + \beta_2 \theta_i + \beta_3 \theta_i^2 + \beta_4 Post_t + \beta_5 (Treat_i \times Post_t) + \beta_6 (\theta_i \times Post_t) + \beta_7 (\theta_i^2 \times Post_t) + \epsilon_{it}$$

Table 14: Continuous Portfolio Effects: Quickpay 2009-2011

	$Delay_{it}$ (in days)				
	(1)	(2)	(3)	(4)	(5)
$Treat_i$	1.94**	6.59***	6.69***	1.86	1.15
	(0.95)	(1.23)	(1.24)	(1.27)	(1.28)
θ_i	−20.45***	−31.10***	−30.91***	−6.70*	−4.93
	(2.88)	(3.69)	(3.71)	(3.85)	(3.87)
θ_i^2	20.38***	25.48***	25.21***	4.52	3.27
	(2.18)	(2.71)	(2.72)	(2.83)	(2.84)
$Post_t$	3.09***	0.55			
	(0.30)	(0.52)			
$Treat_i \times Post_t$	−0.39	−2.52*	−2.68*	−1.25	−0.89
	(1.14)	(1.51)	(1.51)	(1.51)	(1.51)
$\theta_i \times Post_t$	−7.11**	6.54	6.14	1.12	−0.11
	(3.52)	(4.57)	(4.59)	(4.58)	(4.58)
$\theta_i^2 \times Post_t$	8.66***	−2.85	−2.28	1.10	1.98
	(2.73)	(3.42)	(3.43)	(3.42)	(3.42)
Constant	6.07***	13.11***			
	(0.24)	(0.39)			
Duration, Budget, Bids	No	Yes	Yes	Yes	Yes
$Post_t \times$ (Duration, Budget, Bids)	No	Yes	Yes	Yes	Yes
Year-Quarter Fixed Effects	No	No	Yes	Yes	Yes
Task Fixed Effects	No	No	No	Yes	Yes
Industry Fixed Effects	No	No	No	No	Yes
Observations	122,544	110,261	110,261	110,261	110,261
R^2	0.01	0.05	0.06	0.09	0.09
Adjusted R^2	0.01	0.05	0.06	0.08	0.08

Note: *p<0.1; **p<0.05; ***p<0.01
Each observation is a project-quarter.
SEs are robust and clustered at the project level.

9 Firm's rank order : Alternate model

9.1 Continuous model

- We have $\theta_{if} = Treat_i * Rank_f$

$$Delay_{ift} = \beta_0 + \beta_1 \theta_{if} + \beta_2 (\theta_{if} \times Post_t) + \beta_3 Post_t + \beta_4 Rank_f + \epsilon_{ift}$$

- Consider a firm with $Rank_f = k$. Then, we have

- Large + Before = $\beta_0 + \beta_4 k$
- Large + After = $\beta_0 + \beta_3 + \beta_4 k$
- Small + Before = $\beta_0 + \beta_1 k + \beta_4 k$
- Small + After = $\beta_0 + \beta_1 k + \beta_2 k + \beta_3 + \beta_4 k$
- Treatment effect: $\beta_2 k$

Interpretation:

- Treatment effect is $\beta_2 k$ for a firm that received a proportion k of its revenue from small projects.
- In other words, for a firm earning k proportion of revenue from small projects, Quickpay increased delays on small projects by $\beta_3 k$ days.

Assumption: Parallel trends between large and small projects of the same firm.

Table 15: Continuous Portfolio Effects: Quickpay 2009-2011

	$Delay_{it}$ (in days)				
	(1)	(2)	(3)	(4)	(5)
θ_{if}	−0.97	-1.90^{***}	-1.76^{***}	−0.52	-0.66^{**}
	(0.59)	(0.59)	(0.59)	(0.58)	(0.31)
$Rank_f$	1.86^{***}	1.56^{**}	1.45^{**}	−0.07	
	(0.68)	(0.67)	(0.67)	(0.67)	
$Post_t$	2.52^{***}	0.35			
	(0.27)	(0.48)			
$\theta_{if} \times Post_t$	0.46	1.22^{***}	1.19^{***}	0.83^{**}	0.80^{*}
	(0.40)	(0.41)	(0.41)	(0.41)	(0.41)
Constant	4.58^{***}	11.72^{***}			
	(0.25)	(0.37)			
Duration, Budget, Bids	No	Yes	Yes	Yes	Yes
$Post_t \times$ (Duration, Budget, Bids)	No	Yes	Yes	Yes	Yes
Year-Quarter Fixed Effects	No	No	Yes	Yes	Yes
Task Fixed Effects	No	No	No	Yes	Yes
Industry Fixed Effects	No	No	No	No	Yes
Observations	122,544	110,261	110,261	110,261	110,261
R^2	0.004	0.05	0.05	0.09	0.09
Adjusted R^2	0.004	0.05	0.05	0.08	0.08

Note: *p<0.1; **p<0.05; ***p<0.01
Each observation is a project-quarter.
SEs are robust and clustered at the project level.

9.2 Continuous Quadratic Model

- We have $\theta_{if} = Treat_i * Rank_f$

$$Delay_{ift} = \beta_0 + \beta_1 \theta_{if} + \beta_2 \theta_{if}^2 + \beta_3(\theta_{if} \times Post_t) + \beta_4(\theta_{if}^2 \times Post_t) + \beta_5 Post_t + \beta_6 Rank_f + \epsilon_{ift}$$

- Consider a firm with $Rank_f = k$. Then, we have
  - Large + Before = $\beta_0 + \beta_6 k$
  - Large + After = $\beta_0 + \beta_5 + \beta_6 k$
  - Small + Before = $\beta_0 + \beta_1 k + \beta_2 k^2 + \beta_6 k$

- Small + After = $\beta_0 + \beta_1 k + \beta_2 k^2 + \beta_3 k + \beta_4 k^2 + \beta_5 + \beta_6 k$
- Treatment effect: $\beta_3 k + \beta_4 k^2$

Interpretation: * One unit increase in rank k increases treatment effect by $\beta_3 + 2k\beta_4$.

Assumption: Parallel trends between large and small projects of the same firm.

Table 16: Continuous Portfolio Effects: Quickpay 2009-2011

	$Delay_{it}$ (in days)				
	(1)	(2)	(3)	(4)	(5)
θ_{if}	-12.87^{***}	-11.64^{***}	-11.10^{***}	-1.15	-1.69
	(1.06)	(1.15)	(1.15)	(1.19)	(1.20)
θ_{if}^2	18.94^{***}	13.95^{***}	13.55^{***}	1.41	1.04
	(1.12)	(1.23)	(1.24)	(1.31)	(1.23)
$Rank_f$	-5.51^{***}	-2.63^{***}	-2.78^{***}	-1.01	
	(0.77)	(0.76)	(0.76)	(0.75)	
$Post_t$	3.14^{***}	0.54			
	(0.29)	(0.52)			
$\theta_{if} \times Post_t$	-8.38^{***}	-0.67	-1.53	-2.43	-2.62^{*}
	(1.38)	(1.54)	(1.54)	(1.53)	(1.54)
$\theta_{if}^2 \times Post_t$	9.54^{***}	2.07	2.95^{*}	3.53^{**}	3.70^{**}
	(1.45)	(1.62)	(1.63)	(1.62)	(1.62)
Constant	7.31^{***}	13.91^{***}			
	(0.29)	(0.42)			
Duration, Budget, Bids	No	Yes	Yes	Yes	Yes
$Post_t \times$ (Duration, Budget, Bids)	No	Yes	Yes	Yes	Yes
Year-Quarter Fixed Effects	No	No	Yes	Yes	Yes
Task Fixed Effects	No	No	No	Yes	Yes
Industry Fixed Effects	No	No	No	No	Yes
Observations	122,544	110,261	110,261	110,261	110,261
R^2	0.01	0.05	0.06	0.09	0.09
Adjusted R^2	0.01	0.05	0.06	0.08	0.08

Note: *p<0.1; **p<0.05; ***p<0.01
Each observation is a project-quarter.
SEs are robust and clustered at the project level.

9.3 Discrete Model

- Let $Rank_f^{(k)}$ be an indicator for firm being in the k-th tercile of $Rank$. Define:
  - $Medium_{if} = Treat_i * Rank_f^{(2)}$ and
  - $High_{if} = Treat_i * Rank_f^{(3)}$

$$\begin{aligned} Delay_{ift} = \beta_0 + \beta_1 Low_{if} + \beta_2 Medium_{if} + \beta_3 High_{if} + \\ \beta_4 Rank_f^{(2)} + \beta_5 Rank_f^{(3)} + \beta_6 Post_t + \\ \beta_7 (Low_{if} \times Post_t) + \beta_8 (Medium_{if} \times Post_t) + \beta_9 (High_{if} \times Post_t) + \epsilon_{ift} \end{aligned}$$

- Firms in lowest tercile:
  - Large + before = β_0
  - Large + after = $\beta_0 + \beta_6$
  - Small + before = $\beta_0 + \beta_1$
  - Small + after = $\beta_0 + \beta_1 + \beta_6 + \beta_7$
  - Treatment effect = β_7
- Firms in medium tercile:
  - Large + before = $\beta_0 + \beta_4$
  - Large + after = $\beta_0 + \beta_4 + \beta_6$
  - Small + before = $\beta_0 + \beta_2 + \beta_4$
  - Small + after = $\beta_0 + \beta_2 + \beta_4 + \beta_6 + \beta_8$
  - Treatment effect = β_8
- Firms in highest tercile:
  - Large + before = $\beta_0 + \beta_5$
  - Large + after = $\beta_0 + \beta_5 + \beta_6$
  - Small + before = $\beta_0 + \beta_3 + \beta_5$
  - Small + after = $\beta_0 + \beta_3 + \beta_5 + \beta_6 + \beta_9$
  - Treatment effect = β_9

Assumption: Parallel trends between large and small projects of firms in the same tercile.

Table 17: Discrete Portfolio Effects: Quickpay 2009-2011

	Dependent variable:				
	$Delay_{it}$ (in days)				
	(1)	(2)	(3)	(4)	(5)
Low_{if}	-2.49^{***}	-1.47^{***}	-1.34^{***}	-0.004	-0.25
	(0.32)	(0.34)	(0.34)	(0.35)	(0.35)
$Medium_{if}$	-3.26^{***}	-3.23^{***}	-3.08^{***}	-1.88^{**}	-1.04^{***}
	(0.92)	(0.85)	(0.86)	(0.77)	(0.31)
$High_{if}$	1.39^{*}	-0.79	-0.66	-0.61	-0.40
	(0.81)	(0.84)	(0.84)	(0.83)	(0.31)
$Rank_f^{(2)}$	0.72	0.41	0.34	1.00	
	(0.91)	(0.84)	(0.84)	(0.76)	
$Rank_f^{(3)}$	-0.65	0.71	0.63	0.40	
	(0.79)	(0.81)	(0.82)	(0.81)	
$Post_t$	3.10^{***}	0.48			
	(0.30)	(0.52)			
$Low_{if} \times Post_t$	-1.41^{***}	0.12	-0.09	-0.49	-0.50
	(0.42)	(0.46)	(0.46)	(0.46)	(0.46)
$Medium_{if} \times Post_t$	-0.96^{***}	0.77^{**}	0.64^{*}	0.32	0.24
	(0.36)	(0.39)	(0.39)	(0.39)	(0.39)
$High_{if} \times Post_t$	0.41	1.05^{***}	1.00^{**}	0.62	0.61
	(0.39)	(0.40)	(0.40)	(0.40)	(0.40)
Constant	6.06^{***}	13.03^{***}			
	(0.24)	(0.39)			
Duration, Budget, Bids	No	Yes	Yes	Yes	Yes
$Post_t \times$ (Duration, Budget, Bids)	No	Yes	Yes	Yes	Yes
Year-Quarter Fixed Effects	No	No	Yes	Yes	Yes
Task Fixed Effects	No	No	No	Yes	Yes
Industry Fixed Effects	No	No	No	No	Yes
Observations	122,544	110,261	110,261	110,261	110,261
R^2	0.01	0.05	0.06	0.09	0.09
Adjusted R^2	0.01	0.05	0.06	0.08	0.08

Note: *p<0.1; **p<0.05; ***p<0.01
Each observation is a project-quarter.
SEs are robust and clustered at the project level.

10 Other Proxies for Treatment intensity or Portfolio effects

10.1 Proxy 1: Revenue from small projects

- We defined ρ_f as the share of revenue a firm received from small projects in fiscal year 2010.
- The numerator of ρ_f is the sum of all federal obligations from small projects of a firm in fiscal year 2010. Because obligations can be negative, the sum can be zero or negative even if the firm held substantial

number of small projects.

- In the previous section, we ranked the values of ρ_f. But this makes interpretation somewhat tricky. The minimum rank for each firm is now 1/N and it is never zero. What does a unit increase in Rank mean?
- An alternative can be to simply scale the values of ρ_f to between 0 and 1. That is, for a firm A, we define $Share_A = (\rho_A - \min(\rho_f))/(\max(\rho_f) - \min(\rho_f))$.
  - Suppose $\rho_A = -1, \max(\rho_f) = 3, \min(\rho_f) = -2$. Then, $Share_A = (-1 - (-2))/(3 - (-2)) = 1/5$.
  - The max share will be 1 and min share will be 0.
- Setting aside measurement issues described earlier, we have:
  - $Share_f = 0$ represents a firm getting no revenue from small projects.
  - $Share_f = 1$ represents a firm getting its entire revenue from small projects.

10.2 Proxy 2: Ratio of small projects

- For firm f, define $Share_f = \frac{\text{Num of small projects in FY 2010}}{\text{Total num of projects in FY 2010}}$.
- Same analysis as before but advantages:
  - Sample size: only firms excluded are new entrants to government projects.
  - No measurement problem. $Share_f$ will be zero for firms with no small projects, and one for firms with only small projects.
  - We can control for differences across firms through fixed effects. This will be less of an issue here because we will have enough observations.