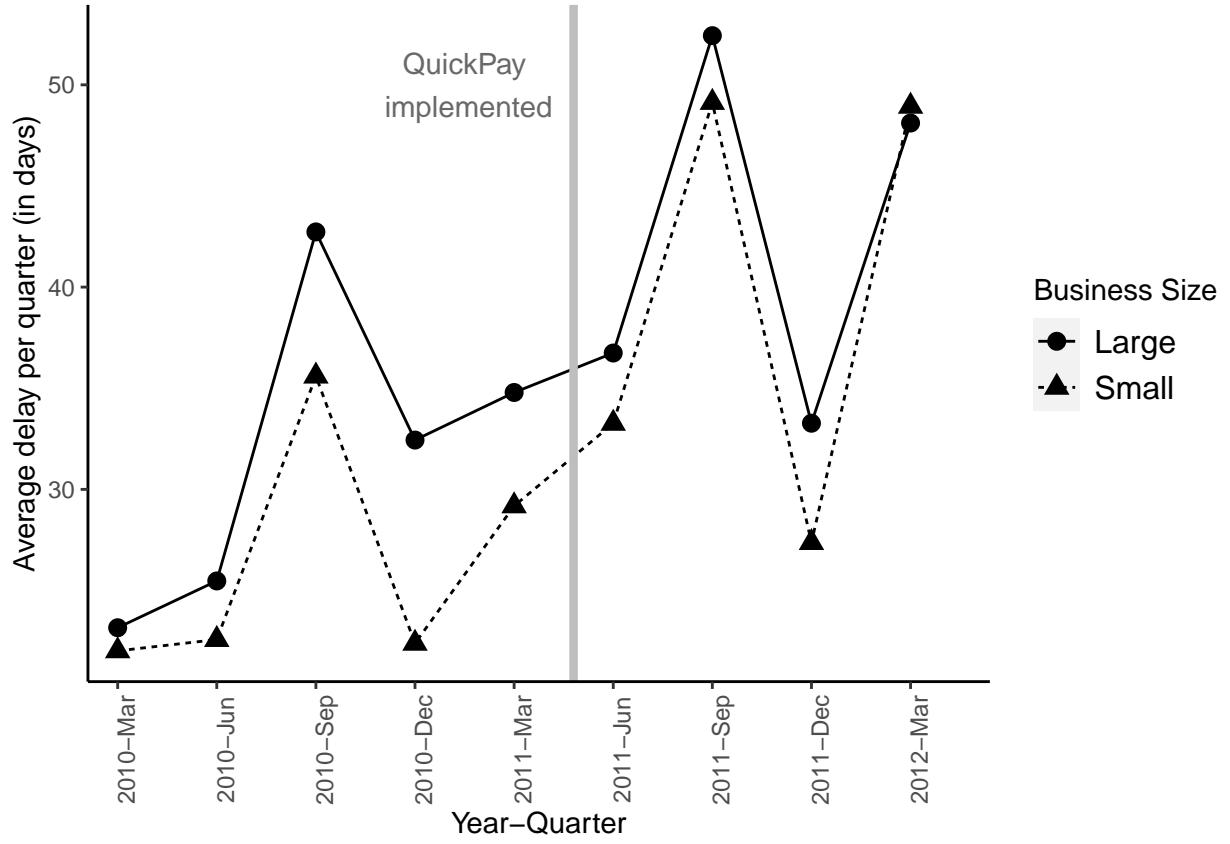


First Implementation of QuickPay (2009-2012)

Mar 29, 2021

1 Delays over Time



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 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

<i>Dependent variable:</i>	
<i>Delay_{it}</i> (in days)	
<i>Treat_i</i>	−1.10 (2.98)
<i>Treat_i × Time</i>	−0.01 (0.49)
Fixed effects	Firm, Task, and Year-Quarter
Controls	Budget, Duration, Bids
Observations	74,677
R ²	0.14
Adjusted R ²	0.03
<i>Note:</i> *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.	

4 Baseline Regressions

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

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

Table 2: Quickpay 2009-2011

	<i>Delay_{it}</i> (in days)		
	(1)	(2)	(3)
<i>Treat_i</i>	-6.19*** (0.50)	-3.58** (1.55)	-3.09* (1.59)
<i>Post_t</i>	13.04*** (0.52)		
<i>Treat_i × Post_t</i>	3.35*** (0.73)	6.88*** (0.91)	6.83*** (0.92)
Constant	33.00*** (0.36)		
Year-Quarter Fixed Effects	No	Yes	Yes
Firm Fixed Effects	No	Yes	Yes
Task Fixed Effects	No	No	Yes
Duration, Budget, Bids	No	Yes	Yes
<i>Post_t × (Duration, Budget, Bids)</i>	No	Yes	Yes
Observations	173,900	155,638	155,638
R ²	0.01	0.11	0.12
Adjusted R ²	0.01	0.05	0.05

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.

5 Competition

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

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

Hypothesis: QuickPay made small projects more attractive. * Number of bids received for competitively awarded small projects increased. * These new projects experienced greater delays.

5.1 Impact on bids

For competitively awarded projects, we run the following:

$$\begin{aligned} NumberOfBids_{it} = & \beta_0 + \beta_1 Treat_i + \beta_2 Post_t + \beta_3 (Treat_i \times Post_t) \\ & + X_i + (Post_t \times X_i) + \mu_t + \lambda_{task} + \epsilon_{it} \end{aligned}$$

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

	<i>NumberOfBids_{it}</i>			
	(1)	(2)	(3)	(4)
<i>Treat_i</i>	0.11 (0.11)	0.28*** (0.09)	0.28*** (0.09)	0.58*** (0.07)
<i>Post_t</i>	0.004 (0.07)	-0.43*** (0.12)		
<i>Treat_i × Post_t</i>	0.25** (0.12)	0.41*** (0.12)	0.41*** (0.13)	0.22** (0.09)
Constant	5.43*** (0.10)	4.57*** (0.10)		
Duration, Budget	No	Yes	Yes	Yes
<i>Post_t × (Duration, Budget)</i>	No	Yes	Yes	Yes
Year-Quarter Fixed Effects	No	No	Yes	Yes
Task Fixed Effects	No	No	No	Yes
Observations	371,290	348,912	348,912	348,912
R ²	0.0001	0.002	0.002	0.37
Adjusted R ²	0.0001	0.002	0.002	0.36

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.

5.2 Impact on delays

For competitively awarded projects, we run the following:

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

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

	<i>Delay_{it}</i> (in days)				
	(1)	(2)	(3)	(4)	(5)
<i>Treat_i</i>	-6.31*** (0.50)	-4.21*** (0.51)	-3.95*** (0.51)	-1.21** (0.53)	-2.06 (1.80)
<i>NewProject_t</i>	-8.19*** (0.71)	-21.51*** (0.77)	-41.89*** (0.95)	-37.24*** (0.95)	-37.51*** (1.04)
<i>Treat_i × NewProject_t</i>	6.02*** (0.98)	3.61*** (1.00)	3.64*** (1.01)	2.04** (1.01)	5.21*** (1.17)
Constant	41.21*** (0.35)	59.33*** (0.56)			
Duration, Budget, Bids	No	Yes	Yes	Yes	Yes
<i>Post_t</i> × (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
Firm Fixed Effects	No	No	No	No	Yes
Observations	144,011	128,428	128,428	128,428	128,428
R ²	0.002	0.02	0.05	0.07	0.13
Adjusted R ²	0.002	0.02	0.05	0.06	0.06

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.

5.3 Non-competitively awarded New Projects: Impact on Delays

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

	<i>Delay_{it}</i> (in days)				
	(1)	(2)	(3)	(4)	(5)
<i>Treat_i</i>	1.39 (1.10)	3.95*** (1.14)	4.18*** (1.14)	-0.33 (1.40)	-0.95 (4.15)
<i>NewProject_t</i>	-3.58** (1.56)	-19.61*** (1.78)	-39.76*** (2.15)	-39.92*** (2.22)	-42.37*** (2.62)
<i>Treat_i × NewProject_t</i>	-2.72 (2.15)	-4.23* (2.20)	-3.97* (2.25)	-2.06 (2.33)	1.21 (2.98)
Constant	38.73*** (0.83)	54.75*** (3.48)			
Duration, Budget, Bids	No	Yes	Yes	Yes	Yes
<i>Post_t</i> × (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
Firm Fixed Effects	No	No	No	No	Yes
Observations	29,889	27,210	27,210	27,210	27,210
R ²	0.001	0.02	0.05	0.08	0.17
Adjusted R ²	0.0004	0.02	0.05	0.06	0.03

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 Impact of Firm's Financial Constraints

6.1 Contract Financing

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

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

Table 6: Effect of Contract Financing: Quickpay 2009-2011

	<i>Delay_{it}</i> (in days)				
	(1)	(2)	(3)	(4)	(5)
<i>Treat_i</i>	-6.12*** (0.50)	-4.93*** (0.53)	-5.03*** (0.53)	-2.97*** (0.56)	-2.89* (1.59)
<i>Post_t</i>	13.00*** (0.57)	6.91*** (0.95)			
<i>Treat_i × Post_t</i>	1.53** (0.78)	2.30*** (0.86)	2.30*** (0.88)	3.21*** (0.88)	5.90*** (1.01)
<i>CF_i</i>	-3.97*** (0.61)	-6.52*** (0.63)	-6.69*** (0.63)	-4.11*** (0.66)	-4.76*** (0.82)
<i>Post_t × CF_i</i>	0.72 (1.13)	-0.49 (1.15)	-0.90 (1.17)	-0.08 (1.17)	-0.37 (1.32)
<i>Post_t × CF_i × Treat_i</i>	9.24*** (1.38)	6.71*** (1.39)	7.62*** (1.41)	4.47*** (1.42)	3.70** (1.67)
Constant	33.64*** (0.38)	51.78*** (0.62)			
Duration, Budget, Bids	No	Yes	Yes	Yes	Yes
<i>Post_t × (Duration, Budget, Bids)</i>	No	Yes	Yes	Yes	Yes
Year-Quarter Fixed Effects	No	No	Yes	Yes	Yes
Task Fixed Effects	No	No	No	Yes	Yes
Firm Fixed Effects	No	No	No	No	Yes
Observations	173,900	155,638	155,638	155,638	155,638
R ²	0.01	0.02	0.03	0.05	0.12
Adjusted R ²	0.01	0.02	0.03	0.05	0.05

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.

6.2 Receives Financial Aid

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

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

Table 7: Effect of Grants or C8A Participant: Quickpay 2009-2011

	<i>Delay_{it}</i> (in days)				
	(1)	(2)	(3)	(4)	(5)
<i>Treat_i</i>	-6.96*** (0.51)	-5.71*** (0.54)	-5.80*** (0.54)	-3.41*** (0.57)	-2.63* (1.59)
<i>Post_t</i>	12.89*** (0.53)	6.36*** (0.93)			
<i>Treat_i × Post_t</i>	3.43*** (0.77)	3.19*** (0.84)	3.44*** (0.85)	3.84*** (0.86)	5.57*** (0.99)
<i>FinancialAid</i>	5.72*** (0.70)	4.01*** (0.74)	3.95*** (0.74)	2.88*** (0.77)	0.45 (1.42)
<i>Post_t × FinancialAid</i>	1.94 (1.61)	3.33** (1.69)	3.41** (1.72)	4.50*** (1.73)	3.93* (2.12)
<i>Post_t × FinancialAid × Treat_i</i>	-1.80 (1.73)	0.73 (1.79)	0.44 (1.82)	-0.99 (1.84)	2.75 (2.50)
Constant	32.42*** (0.37)	50.34*** (0.62)			
Duration, Budget, Bids	No	Yes	Yes	Yes	Yes
<i>Post_t × (Duration, Budget, Bids)</i>	No	Yes	Yes	Yes	Yes
Year-Quarter Fixed Effects	No	No	Yes	Yes	Yes
Task Fixed Effects	No	No	No	Yes	Yes
Firm Fixed Effects	No	No	No	No	Yes
Observations	173,900	155,638	155,638	155,638	155,638
R ²	0.01	0.02	0.03	0.05	0.12
Adjusted R ²	0.01	0.02	0.03	0.05	0.05

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.

6.3 Receives Contracts and Financial Aid

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

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

Table 8: Effect of Contracts, Grants, or C8A Participant: Quickpay 2009-2011

	<i>Delay_{it}</i> (in days)				
	(1)	(2)	(3)	(4)	(5)
<i>Treat_i</i>	-6.68*** (0.51)	-5.45*** (0.53)	-5.53*** (0.54)	-3.15*** (0.56)	-2.71* (1.59)
<i>Post_t</i>	12.17*** (0.55)	5.56*** (0.96)			
<i>Treat_i × Post_t</i>	4.19*** (0.79)	3.63*** (0.86)	3.90*** (0.87)	4.40*** (0.87)	5.84*** (1.03)
<i>CFA</i>	4.90*** (0.62)	2.89*** (0.65)	2.65*** (0.66)	1.62** (0.68)	-5.92*** (1.80)
<i>Post_t × CFA</i>	3.91*** (1.21)	4.28*** (1.27)	4.47*** (1.29)	5.68*** (1.30)	5.83*** (1.64)
<i>Post_t × CFA × Treat_i</i>	-4.04*** (1.38)	-0.23 (1.43)	-0.56 (1.45)	-2.13 (1.48)	1.61 (2.16)
Constant	32.18*** (0.37)	50.27*** (0.63)			
Duration, Budget, Bids	No	Yes	Yes	Yes	Yes
<i>Post_t × (Duration, Budget, Bids)</i>	No	Yes	Yes	Yes	Yes
Year-Quarter Fixed Effects	No	No	Yes	Yes	Yes
Task Fixed Effects	No	No	No	Yes	Yes
Firm Fixed Effects	No	No	No	No	Yes
Observations	173,900	155,638	155,638	155,638	155,638
R ²	0.01	0.02	0.03	0.05	0.12
Adjusted R ²	0.01	0.02	0.03	0.05	0.05

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 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 $\rho_f = \min(\rho_1, \rho_2, \dots, \rho_N)$.
- 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.

7.1 Portfolio Effects: Discrete

- See Jie's notes for details.

- Assumption: Parallel trends between small projects of firms in different terciles with 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 9: Discrete Portfolio Effects: Quickpay 2009-2011

	<i>Delay_{it}</i> (in days)				
	(1)	(2)	(3)	(4)	(5)
<i>Treat_i</i>	2.85** (1.37)	−0.51 (1.54)	−0.37 (1.55)	0.38 (1.64)	−6.90 (4.47)
<i>Medium_i</i>	−2.92** (1.40)	−1.11 (1.56)	−1.32 (1.57)	−0.60 (1.63)	12.24** (6.17)
<i>High_i</i>	−3.26** (1.31)	0.09 (1.49)	−0.07 (1.50)	1.04 (1.58)	−3.11 (6.04)
<i>Post_t</i>	15.67*** (1.05)	6.87*** (1.83)			
<i>Treat_i × Post_t</i>	−2.42 (2.04)	2.15 (2.36)	1.26 (2.39)	1.32 (2.43)	7.32** (3.16)
<i>Treat_i × Post_t × Medium_i</i>	4.28** (2.09)	1.54 (2.38)	2.31 (2.41)	2.45 (2.45)	0.10 (3.22)
<i>Treat_i × Post_t × High_i</i>	6.76*** (1.97)	3.46 (2.28)	4.16* (2.31)	3.58 (2.35)	−1.27 (3.07)
Constant	27.08*** (0.71)	46.30*** (1.16)			
Duration, Budget, Bids	No	Yes	Yes	Yes	Yes
<i>Post_t × (Duration, Budget, Bids)</i>	No	Yes	Yes	Yes	Yes
Year-Quarter Fixed Effects	No	No	Yes	Yes	Yes
Task Fixed Effects	No	No	No	Yes	Yes
Firm Fixed Effects	No	No	No	No	Yes
Observations	71,753	63,216	63,216	63,216	63,216
R ²	0.01	0.02	0.03	0.06	0.12
Adjusted R ²	0.01	0.02	0.03	0.04	0.04

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 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 10: Continuous Portfolio Effects: Quickpay 2009-2011

	<i>Delay_{it}</i> (in days)				
	(1)	(2)	(3)	(4)	(5)
<i>Treat_i</i>	-1.44 (2.52)	-4.54 (2.79)	-4.12 (2.80)	-2.25 (2.88)	-19.01** (8.36)
θ_i	15.63* (8.14)	12.24 (8.85)	11.06 (8.89)	8.21 (9.06)	92.44*** (34.90)
θ_i^2	-16.17** (6.56)	-8.85 (7.11)	-8.10 (7.15)	-5.07 (7.30)	-88.48*** (31.25)
<i>Post_t</i>	15.67*** (1.05)	6.85*** (1.83)			
<i>Treat_i × Post_t</i>	-3.83 (3.74)	2.64 (4.31)	1.05 (4.38)	0.34 (4.45)	9.39 (5.79)
$\theta_i \times Post_t$	4.16 (12.19)	-3.40 (13.75)	-0.02 (13.98)	3.49 (14.13)	-4.73 (17.63)
$\theta_i^2 \times Post_t$	4.91 (9.87)	6.92 (11.09)	4.92 (11.27)	1.51 (11.38)	1.46 (13.78)
Constant	27.08*** (0.71)	46.30*** (1.16)			
Duration, Budget, Bids	No	Yes	Yes	Yes	Yes
<i>Post_t</i> × (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
Firm Fixed Effects	No	No	No	No	Yes
Observations	71,753	63,216	63,216	63,216	63,216
R ²	0.01	0.02	0.03	0.06	0.12
Adjusted R ²	0.01	0.02	0.03	0.04	0.04

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 : Alternate model

8.1 Continuous model

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

$$Delay_{ift} = \beta_0 + \beta_1\theta_{if} + \beta_2(\theta_{if} \times Post_t) + \beta_3Post_t + \beta_4Rank_f + \epsilon_{ift}$$

- Consider a firm with $Rank_f = k$. Then, we have
 - Large + Before = $\beta_0 + \beta_4k$
 - Large + After = $\beta_0 + \beta_3 + \beta_4k$
 - Small + Before = $\beta_0 + \beta_1k + \beta_4k$
 - Small + After = $\beta_0 + \beta_1k + \beta_2k + \beta_3 + \beta_4k$
 - Treatment effect: β_2k

Interpretation:

- Treatment effect is β_2k 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 β_2k days.

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

Table 11: Continuous Portfolio Effects: Quickpay 2009-2011

	Delay _{it} (in days)				
	(1)	(2)	(3)	(4)	(5)
θ_{if}	−4.81* (2.60)	−6.34** (2.63)	−5.86** (2.64)	−3.31 (2.66)	−4.43 (3.59)
$Rank_f$	4.98* (2.93)	7.22** (2.95)	6.53** (2.97)	5.66* (2.99)	
$Post_t$	14.74*** (0.96)	6.92*** (1.68)			
$\theta_{if} \times Post_t$	4.91*** (1.40)	5.66*** (1.54)	5.60*** (1.56)	5.24*** (1.58)	6.23*** (1.75)
Constant	26.88*** (0.77)	44.82*** (1.14)			
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
Firm Fixed Effects	No	No	No	No	Yes
Observations	71,753	63,216	63,216	63,216	63,216
R ²	0.01	0.02	0.03	0.06	0.12
Adjusted R ²	0.01	0.02	0.03	0.04	0.04

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 Continuous Quadratic Model

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

$$Delay_{ift} = \beta_0 + \beta_1\theta_{if} + \beta_2\theta_{if}^2 + \beta_3(\theta_{if} \times Post_t) + \beta_4(\theta_{if}^2 \times Post_t) + \beta_5Post_t + \beta_6Rank_f + \epsilon_{ift}$$

- 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 12: Continuous Portfolio Effects: Quickpay 2009-2011

	<i>Delay_{it}</i> (in days)				
	(1)	(2)	(3)	(4)	(5)
θ_{if}	8.16* (4.51)	−3.96 (4.98)	−3.59 (5.02)	−0.81 (5.21)	26.72 (18.44)
θ_{if}^2	−15.84*** (4.56)	−2.95 (5.11)	−2.68 (5.15)	−3.17 (5.38)	−38.43* (21.55)
$Rank_f$	7.00** (3.05)	7.62** (3.06)	6.76** (3.08)	6.19** (3.10)	
$Post_t$	15.33*** (1.01)	7.03*** (1.78)			
$\theta_{if} \times Post_t$	−6.42 (6.39)	4.03 (7.32)	2.96 (7.43)	4.50 (7.52)	20.71** (8.88)
$\theta_{if}^2 \times Post_t$	12.31* (6.73)	1.79 (7.75)	2.87 (7.87)	0.81 (7.96)	−15.74* (9.43)
Constant	25.79*** (0.84)	44.57*** (1.23)			
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
Firm Fixed Effects	No	No	No	No	Yes
Observations	71,753	63,216	63,216	63,216	63,216
R ²	0.01	0.02	0.03	0.06	0.12
Adjusted R ²	0.01	0.02	0.03	0.04	0.04

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.

8.3 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 13: Discrete Portfolio Effects: Quickpay 2009-2011

	<i>Dependent variable:</i>				
	<i>Delay_{it} (in days)</i>				
	(1)	(2)	(3)	(4)	(5)
<i>Low_{if}</i>	3.04** (1.38)	−0.17 (1.55)	−0.09 (1.56)	0.78 (1.65)	−6.90 (4.47)
<i>Medium_{if}</i>	1.87 (2.77)	−2.10 (2.87)	−1.14 (2.91)	0.26 (2.89)	5.34 (4.30)
<i>High_{if}</i>	−10.13*** (3.71)	−10.80*** (3.59)	−10.63*** (3.58)	−10.74*** (3.54)	−10.00** (4.17)
<i>Rank_f⁽²⁾</i>	−1.75 (2.69)	0.82 (2.76)	−0.27 (2.80)	−0.10 (2.80)	
<i>Rank_f⁽³⁾</i>	9.91*** (3.69)	10.71*** (3.55)	10.47*** (3.55)	12.55*** (3.50)	
<i>Post_t</i>	15.65*** (1.05)	6.85*** (1.83)			
<i>Low_{if} × Post_t</i>	−2.39 (2.04)	2.18 (2.36)	1.28 (2.39)	1.32 (2.43)	7.32** (3.16)
<i>Medium_{if} × Post_t</i>	1.89 (1.56)	3.73** (1.74)	3.59** (1.76)	3.78** (1.79)	7.42*** (2.03)
<i>High_{if} × Post_t</i>	4.36*** (1.38)	5.65*** (1.52)	5.45*** (1.54)	4.90*** (1.56)	6.05*** (1.71)
Constant	26.89*** (0.72)	45.96*** (1.17)			
Duration, Budget, Bids	No	Yes	Yes	Yes	Yes
<i>Post_t</i> × (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
Firm Fixed Effects	No	No	No	No	Yes
Observations	71,753	63,216	63,216	63,216	63,216
R ²	0.01	0.02	0.03	0.06	0.12
Adjusted R ²	0.01	0.02	0.03	0.04	0.04

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 Other Proxies for Treatment intensity or Portfolio effects

9.1 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.

9.2 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.