Do Expiring Budgets Lead to Wasteful Year-End Spending? Evidence from Federal Procurement

Online Appendix

Jeffrey B. Liebman Neale Mahoney

May 30, 2017

B The Impact of Appropriations Timing on the Within-Year Pattern of Government Procurement Spending

It is the exception rather than the rule for Congress to pass annual appropriations bills before the beginning of the fiscal year. Between 2000 and 2009, the full annual appropriations process was never completed on time. Although defense appropriations bills were enacted before the start of the fiscal year four times, in eight of the ten years, appropriations for all or nearly all of the civilian agencies were enacted in a single consolidated appropriations act well after the start of the fiscal year.

Analysts have attributed some of the challenges facing federal acquisition to the tardiness of the appropriations process, since these delays introduce uncertainty and compress the time available to plan and implement a successful acquisition strategy (Acquisition Advisory Panel, 2007). In this subsection we analyze the relationship between the timing of the annual appropriations acts and the within-year pattern of government contract spending. For this analysis, we use the full 2000 to 2009 FPDS data, even though the data prior to 2004 are of lower quality. Apparently, in these earlier years, some contracts were all assigned dates in the middle of the month. Therefore, the within-month weekly pattern of spending is not fully available.

Appendix Figure A1 shows results from regressing measures of end-of-year spending on the timing of annual appropriations. This analysis has two data points for each year, one representing defense spending and the other representing non-defense spending. For each observation, we measure the share of annual contract spending occurring in the last quarter, month, and week of the year and the "weeks late" of the enactment of annual appropriations legislation.[1] "Weeks late" measures time relative to October 1 and takes on negative values when appropriations were enacted prior to the start of the fiscal year. For defense spending, "weeks late" measures the date that the defense appropriations bill was enacted. For non-defense spending, the date is assigned from the date of the consolidated appropriations act, or, in the case of the two years in which there was not a consolidated act, a date that is the midpoint of the individual non-defense appropriations acts.[2]

There is a clear pattern in the data in which later appropriation dates result in a greater fraction of government spending occurring at the end of the year. In the plots, we show the separate slopes of the defense and non-defense observations. Defense spending tends to be appropriated earlier and to have less end-of-year spending, but the slopes for the two types of spending are similar. The labels show the regression coefficients, including the coefficients from a pooled regression in which defense and non-defense spending have different intercepts but are constrained to have the same slope. The estimates show that a delay of ten weeks—roughly the average over this time period—raises the share of spending in the last quarter by 2 percentage points from a base of about 27 percent. A ten-week delay raises the share of spending in the last month by 1 percentage point, from a base of about 15 percent. Both coefficients are statistically significant at the 1 percent level. As we mentioned above, we do not have reliable within-month data on timing for the years prior to 2004, so we exclude the pre-2004 years for the analysis of spending during the last week of the year. The estimates indicate that a 10-week delay raises the share of spending occurring in the last week of the year by 1 percentage point on a base of 9 percent. Due to the smaller sample, the estimate is less precise, with a p-value of 0.07.[3]

C Calibrating the Welfare Gains

This section describes the procedure we use to estimate the welfare gains from rollover and discusses the results in more detail. To estimate the welfare gains, we first calibrate the model to fit the spike in spending and drop-off in quality under the status quo in which rollover is not allowed. Given the calibrated parameters, we then simulate the pattern of spending when rollover is permitted using value function iteration. A comparison of welfare under these regimes gives us the welfare gain from rollover and from alternative counterfactual policies.

[1] Enactment is defined by the date the President signs the legislation.

[2] We aggregate all non-defense spending to facilitate communication of the pattern of results while capturing nearly all of the available variation. We have also conducted analyses in which we assign each non-defense agency the date of its individual appropriations act and obtain very similar results.

[3] When appropriations bills are delayed beyond the start of a fiscal year, the government operates under a continuing resolution that typically maintains spending at the levels set for the prior fiscal year. When a new budget is passed, any changes in the budget level are prorated to account for the shorter year.

C.1. Target Moments

The calibrated infinite horizon model is characterized by a parameter that determines the curvature of the value of spending function and a parameter that determines the distribution of spending shocks. We calibrate these parameters such that simulated data from the model has the same spike in spending and drop-off in quality that we observed in the federal procurement data.

Spike in spending. We define the spike in spending as the ratio of last month spending to average monthly spending over the rest of the year. This ratio is 2.18 in the pooled 2004 to 2009 FPDS.

Drop-off in quality. We calibrate the drop-off in quality by matching the coefficient on last month from an ordered logit regression in the I.T. Dashboard data and the coefficient on last month from an analogous regression in simulated data from the model.[4]

Recall from Section 1 that the quality of spending in a given month is defined as the value of spending per dollar of expenditure: $q_m = \alpha_m v(x_m)/x_m$. The logistic regression estimates of the drop-off in quality are based on the assumption that quality is determined by the data generating process

$$q_m = \beta_q Last\_month_m + \sigma_q \epsilon_m$$

where $Last\_month$ is an indicator for the last month of the year and the error term is the product of a type-I extreme value random variable ϵ and scale factor $\sigma_q > 0$.

In the I.T. Dashboard data, we do not observe this underlying quality variable but instead observe a categorical overall rating variable, which we assume is an index of underlying quality. Because our outcome variable is categorical, we can recover an estimate of β_q/σ_q with an ordered logit regression of overall rating on the $Last\_month$ indicator and controls.[5] In the simulated data from the model we observe quality directly. We recover β_q/σ_q in these data with a straightforward logistic regression of quality on the $Last\_month$ indicator variable.

Appendix Table A11 shows odds ratios of the coefficient on last month from ordered logit regressions in the I.T. Dashboard data. In our preferred specification, which includes year, agency, and project characteristic covariates, projects that are originated in the last month of the year have 0.42 odds of having a higher quality score. We calibrate the model so that the drop-off is the same in the simulated data from the model.

C.2. Calibrating the Model

We match these two moments by calibrating the model's two parameters: σ and γ. Specifically, we assume that the uncertainty shocks, α, are drawn from a log-normal distribution, $\ln \alpha \sim N(0, \sigma)$, parameterized by a standard deviation parameter, σ, and the

[4] The approach of matching regression coefficients in actual and simulated data is sometimes referred to as indirect inference (Gourieroux, Monfort and Renault, 1993). See Voena (2015) for a recent application of this technique.

[5] Coefficients in a logistic regression model are identified up to the scale factor σ_q. See Train (2003) for an in-depth discussion of this issue.

value of spending function, $v(x_m;\gamma)$, is parameterized by a curvature parameter, γ. Let $\theta \equiv \{\sigma, \gamma\}$ denote the parameters of the model. We calibrate θ and calculate welfare in the no-rollover regime in the following manner:

- Step 1. For a given θ, we calculate the value $V_m^{NR}(A,\theta)$ to the agency from having A assets in month m by backward induction, numerically integrating over the distribution of α.
- Step 2. For a given initial budget B and θ, we simulate forward a pattern of spending using the estimated $V_m^{NR}(A,\theta)$ from Step 1.
- Step 3. For each B, we find the θ that matches the spike in spending and drop-off in quality moments using a quadratic loss function. The objective is convex with a unique minimum value. Label these values $\theta(B)$.
- Step 4. We search over the domain of B and associated $\theta(B)$ to find the budget that maximizes welfare for Congress net the social cost of funds. Label this budget B^{NR}.

The parameters B^{NR} and $\theta(B^{NR})$ uniquely determine the value of spending, cost of spending, and welfare when rollover is not permitted.

C.3. Model Fit

In our baseline calibration, we specify a CRRA, $v(x) = \frac{x^{1-\gamma}}{1-\gamma}$, value of spending function with curvature parameter γ. We conduct robustness checks to examine the sensitivity of our results to a CARA functional form. We set the number of months per year to $M = 12$ and the monthly discount factor to $\beta = 0.996$.[6] We normalize the social cost of funds to $\lambda = 1$.

Panel A of Appendix Table A12 shows the target and calibrated moments. The ratio of last month to rest-of-year spending is 2.18 in the pooled 2004 to 2009 FPDS. The odds that a project started in the last month of the year has a higher quality score is 0.42 in the I.T. Dashboard data.[7] The moments calculated from the simulated data are very similar. Panel B shows the underlying parameter estimates of γ and σ from the model.[8]

Appendix Figure A2 examines how the model fits the monthly pattern of spending. Panel A plots the percent of spending each month in the pooled 2004 to 2009 FPDS and simulated data from the model with a CRRA value of spending function. Recall that the model is calibrated to the ratio of last month to rest-of-year average monthly spending but not to the shape of this increase by month. Nevertheless, the CRRA model does a good job matching the flat profile of spending over the first part of the year and the sharp

[6] This monthly discount factor implies an annual discount factor of $0.95 = 0.996^{12}$.

[7] The estimate is from an ordered logit specification of overall rating on last month and a full set of controls with the observations weighted by spending. Appendix Table A11 shows alternative specifications of this model.

[8] We are identified because we have two parameters and two moments. If we calibrated the model using only the spike in spending, we would be unable to separately identify the parameters because a large spike could arise from little curvature in the value of spending function and substantial variance in the α's or from substantial curvature in the value of spending function and little variance in the α's.

spike at year's end.[9] The simulated data from the CARA specification, shown in Panel B, also match the pattern of spending over the year. Because the CARA specification does not capture the sharp uptick in spending between August and September as well as the CRRA function form, we choose CRRA as our preferred specification.

Calibrating the model is computationally intensive. Relative to a standard stochastic, dynamic programing problem, our application is complicated by two factors. The first is that because our value function varies by calendar month, we need to estimate M value functions. The second is that our model has two optimizing agents. At the beginning of each year, Congress decides on a budget for the agency, taking agency behavior as given. At the beginning of each month, the agency chooses its level of spending, taking Congress's behavior as given. We account for this in the calibrations by estimating how the agency would behave over a grid of possible budget values $B > 0$ and then searching over this grid to find the budget B^* that maximizes Congress's objective. To speed computation, the calibrations were performed using 12 cores in parallel, running continuously for approximately one week.

C.4. Welfare with Rollover

We assess the welfare gains from rollover by comparing the non-rollover status quo to three counterfactuals. The first is the compensating variation from rollover, defined as the reduction in budget authority that allows for the same expected value of spending as in the no-rollover regime. The second is the welfare gain from rollover when Congress can re-optimize the budget it provides to the agency. The third counterfactual is the welfare gain from the first-best level of spending, defined as the level of spending in each period that equates the marginal social value of spending to the marginal social cost of funds. Compared to rollover which effectively allows agencies to save, the first-best effectively allows agencies both to save and to borrow. The welfare gains from this counterfactual are an upper bound because agencies can acquire extra resources in extenuating circumstances through mid-year supplemental appropriations from Congress.

The value to the agency $V_m^R(A)$ in the rollover regime from having assets A in month m is calculated by value function iteration. Let superscripts index iterations of the value function. The algorithm for updating the value function is

$$V_m^{j+1}(A) = \begin{cases} \max_x \alpha v(x) + \beta \mathbb{E}_\alpha \left[V_{m+1}^j(A - x) \right] & \text{if } m < M \\ \max_x \alpha v(x) + \beta \mathbb{E}_\alpha \left[V_1^j(B + A - x) \right] & \text{if } m = M \end{cases}$$

Notice that this is mathematically identical to iteration on a single composite value function

$$\tilde{V}^{j+1}(S) = \max_x \quad \alpha v(x) + \beta \mathbb{E}_\alpha \left[\tilde{V}^j \big(g(S, x) \big) \right]$$

[9]The model naturally under-predicts spending in October and March because it does not separately account for spending on items like building leases that reset on an annual or semi-annual basis.

where the month index is subsumed into the state variable $S = \{A, m\}$ and the function $g(S, x)$ governs the evolution of months and assets. As such, the existence and uniqueness of the solution follows directly from the standard conditions that $v(\cdot)$ is concave, the constraint set generated by $g(S, x)$ is convex and compact, and there is discounting $\beta < 1$ (Ljungqvist and Sargent, 2004).

We calculate welfare in the regime with rollover in the following steps:

- Step 1. For a given initial budget B and $\theta(B^{NR})$ from the within-year calibrations, we estimate the value function $V_m^R(A)$ for each month $m = 1 \ldots M$ by value function iteration.

- Step 2. For this budget, the present value of spending to the agency is the beginning of year value function evaluated at this budget allocation $V_1(B)$, the net present cost of spending is the discounted sum of annual budgets B, and welfare is the difference in these values.

- Step 3. We search over the domain of B to find the value that maximizes welfare. Label this value as B^R for budget with rollover.

The parameter B^R determines the value of spending, cost of spending, and welfare with rollover

Appendix Table A13 shows the welfare gains from the three counterfactual scenarios. The first column shows the percent change in the value of spending; the second column shows the percent change in the social cost of spending (the amount of spending times λ); and the third column shows the difference between the first two columns, which gives the percent change in overall social surplus. Values are scaled by the social cost of spending under the no-rollover status quo. With the preferred CRRA specification, the compensating variation from rollover is 13 percent of the social cost of spending. That is, Congress could allow rollover, reduce the agency's budget by 13 percent, and the value of spending would be identical to the status quo.

Allowing for full Congressional re-optimization leads to slightly higher welfare gains. Spending levels (social cost) are lower than in the no rollover case. This is the result of two offsetting effects. Because agencies on average enter the year with rolled-over funds, Congress does not need to provide as much funding to ensure that the agency can take advantage of high α periods. On the other hand, Congress is more willing to provide funds given that agencies will not squander them on projects with a value below the social cost of funds. The total value of spending is slightly higher than in the no-rollover scenario.

The final scenario shows the first-best in which the agency does all spending that exceeds the social value of funds and no spending that is below. Comparing the rollover scenarios to the first-best scenario we see that rollover allows the government to capture two-thirds of the benefits of moving from no-rollover to the first-best.

C.5. Intermediate Policies

Whether these welfare gains can be achieved depends on Congress's ability to commit to future budgets. While Congress cannot completely tie its own hands, it can design policy to increase the likelihood of commitment. For example, Congress could specify that rolled over amounts are not reported in standard budget tables, increasing the cost of obtaining this information. Similarly, Congress could allow agencies to roll over funding for a time-limited grace period.[10] Such a grace period would not simply result in a spike in spending at the new deadline. Because next year's budget authority would provide a de facto rainy day fund, even a few months of rollover would allow agencies to draw down their previous year's savings over a longer time period.[11] Finally, Congress could provide more funding on a multi-year basis. While the full implications of less frequent fiscal policy are outside the scope of this paper, one benefit of multi-year budgeting is that it reduces the frequency of wasteful year-end spending. Below we first describe how we simulate the welfare gains from these intermediate policies and then present our results.

Partial commitment. Suppose that Congress can only commit to allowing rollover with commonly known probability π. Simulating welfare under this regime requires two modifications to the algorithm described above:

- The period M continuation value is replaced by $\mathbb{E}_\alpha\Big[\pi V_1(B+A-x)+(1-\pi)V_1(B)\Big]$, the average of the no-rollover and with-rollover continuation values weighted by their probabilities.
- For each B, the cost of spending is decreased by the expected level of reclaimed funds. This value is calculated by simulating forward a pattern of spending using the estimated value functions. The expected level of reclaimed funds is discounted to account for the fact that the budget authority is reclaimed a year after it is authorized.

Partial rollover. Suppose that agencies can roll over budget authority for no more than $\bar{m}$ months. Since we assume that budget authority is fungible, this policy constrains period $\bar{m}+1$ budget authority to be no greater than the annual budget B. To simulate welfare under this regime, we make the following modification to the algorithm described above:

- The continuation value is replaced with $\mathbb{E}_\alpha\Big[V_m(\min\{B+A-x, B\})\Big]$ in periods $m > \bar{m}$.

Since the agency never rolls over more than B into period $\bar{m}+1$, we do not need to account for reclaimed funds in our calculation of the cost of spending.

[10]We thank Dan Feenberg for suggesting this counterfactual.

[11]Because Congress rarely passes a budget on schedule and agencies are operating under continuing resolutions, this partial rollover period often will have expired by the time that a new budget is determined. In this case, Congress would have no incentive to take this rolled over amount into consideration.

Multiyear budgeting. Suppose that budgets are provided on a multiyear basis. There is no rollover across budget cycles, but there is full rollover across years when there is not a new budget. We simulate welfare under this policy regime with the backwards induction algorithm used to calibrate the model with one modification:

- The number of periods is increased to $k \times M$, where k is the number of years per budget cycle. The monthly discount factor β is unaltered.

Appendix Figure A3 examines the welfare gains from these intermediate policies. In each plot, the y-axis shows the welfare gain as a percent of the welfare gain from full rollover. Each point in each plot is calculated from an independent simulation of the baseline model. Panel A examines the implications of imperfect Congressional commitment. With probability π, Congress commits and agencies are able to roll over the full amount of unspent resources into the next year. With probability $1 - \pi$, Congress reneges and unspent resources are taken from the agency and valued in the welfare function at the social cost of funds. Both the agency and Congress know this probability π and optimize accordingly. The plot shows that small commitment probabilities can achieve relatively large welfare gains. For example, a 25 percent commitment probability leads to welfare gains of more than half the full rollover value, as agencies prefer to roll over their funds than engage in flat-of-the-curve spending at the end of the year.[12]

Panel B of Appendix Figure A3 examines the welfare gains from time-limited grace periods, in which agencies are allowed to roll over unused funding for $\bar{m}$ periods of the next year. Since we assume that budget authority is fungible within an agency, this policy constrains the agency's period $\bar{m} + 1$ budget to be no greater than their beginning-of-year budget allocation B. As before, a small amount of rollover can generate large welfare gains. A one-month grace period achieves 41 percent of the welfare gains from full rollover; a two-month grace period achieves 66 percent; and a four-month grace period 90 percent. Panel C shows the welfare gains from multi-year budgets. Two-year budget cycles achieve 64 percent of the gains from full rollover; three-year budget cycles achieve 90 percent.

In summary, the results indicate that allowing for rollover can lead to economically meaningful gains in welfare. If Congress can fully commit, the welfare gains from rollover are over 10 percent of the social cost of funds. Even if Congress can commit with a modest probability or provide a short grace period, welfare gains of more than 5 percent could be achieved.

[12] The plot is S-shaped because the value of spending is convex in the commitment probability while the amount of reclaimed funds is concave. It is the sum of a convex and concave function which gives the plot its shape.

References

Acquisition Advisory Panel. 2007. "Report of the Acquisition Advisory Panel to the Office of Federal Procurement Policy and the United States Congress."

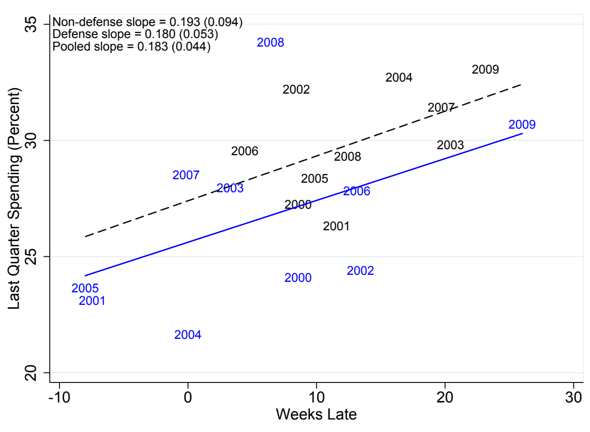
Gourieroux, Christian, Alain Monfort, and Eric Renault. 1993. "Indirect Inference." *Journal of Applied Econometrics*, 8: 85–118.

Ljungqvist, Lars, and Thomas J. Sargent. 2004. *Recursive Macroeconomic Theory.* The MIT Press.

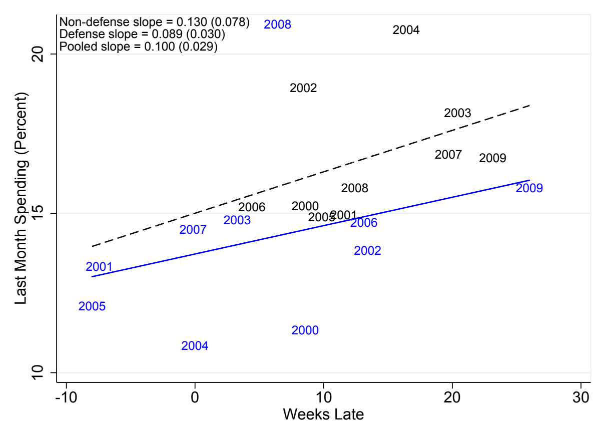
Train, Kenneth. 2003. *Discrete Choice Methods With Simulation.* Cambridge University Press.

Voena, Alessandra. 2015. "Yours, Mine and Ours: Do Divorce Laws Affect the Intertemporal Behavior of Married Couples." *American Economic Review*, 105(8): 2295–2332.

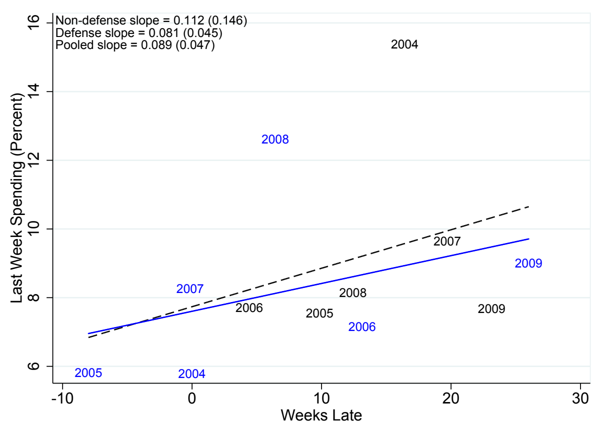
Figure A1: Year-End Spending by Appropriations Date



(a) Last Quarter Spending



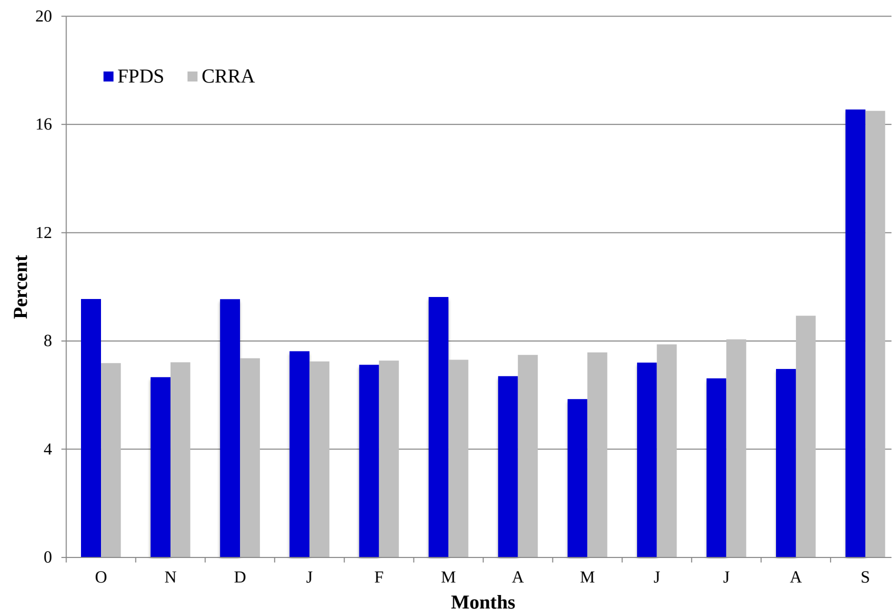
(b) Last Month Spending



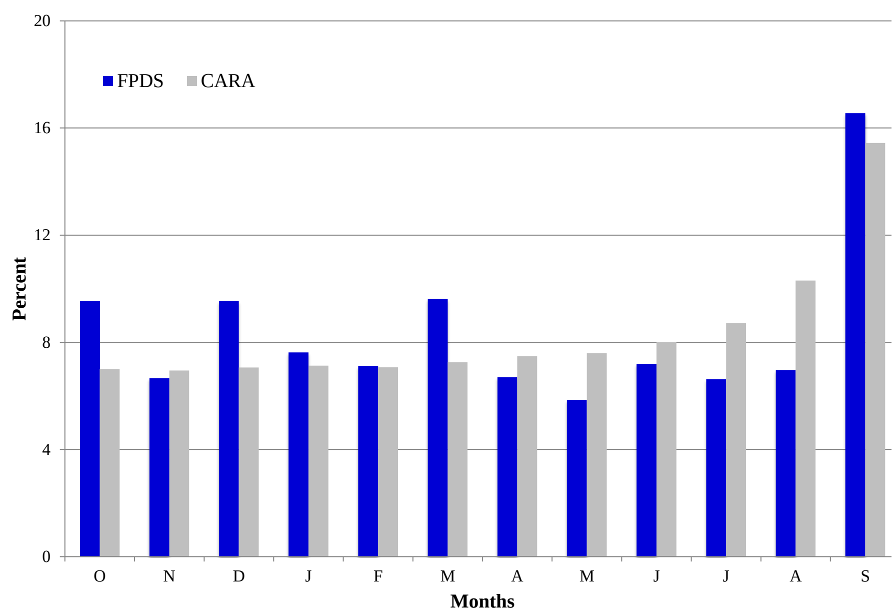
(c) Last Week Spending

Source: Federal Procurement Data System, accessed October, 2010 via www.usaspending.gov and Library of Congress.
Note: Vertical axes show the percent of annual spending occurring in the last quarter, month, and week of the fiscal year. Horizontal axes show the passage dates for the non-defense and defense appropriation bills, relative to the first day of the fiscal year in weeks. For defense spending, weeks late measures the date that the defense appropriations bill was enacted. For non-defense spending, the date is assigned from the date of the consolidated appropriations act, or, in the case of the two years in which there was not a consolidated act, a date that is the midpoint of the individual non-defense appropriations acts. Plots show fitted lines and slope coefficients from bivariate regressions on defense and non-defense spending. Pooled coefficients from a regression in which defense and non-defense spending have different intercepts but are constrained to have the same slope. Robust standard errors in parentheses.

Figure A2: Model Fit



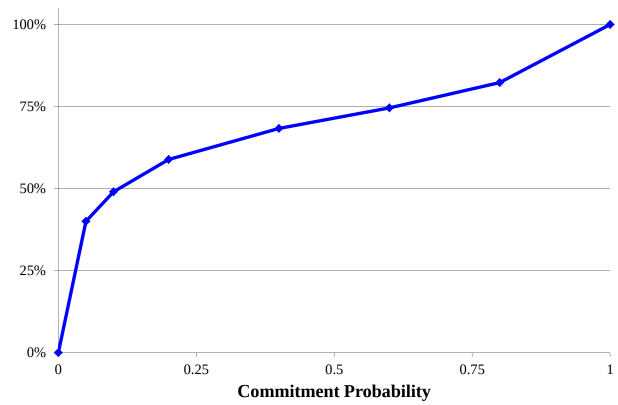
(a) CRRA Value of Spending



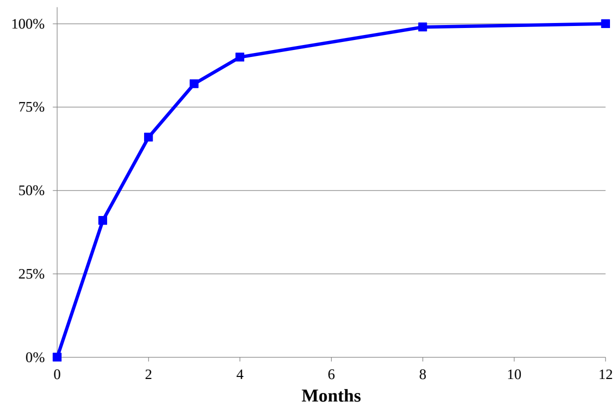
(b) CARA Value of Spending

Source: Federal Procurement Data System, accessed October, 2010 via www.usaspending.gov. *Note:* Dark bars show percent of spending each month in the pooled 2004 to 2009 FPDS. Light bars show predicted spending by month from the calibrated model parameterized with a CRRA value of spending function (Panel A) and CARA value of spending function (Panel B). The FPDS spending values are inflation-adjusted to 2009 dollars using the CPI-U.

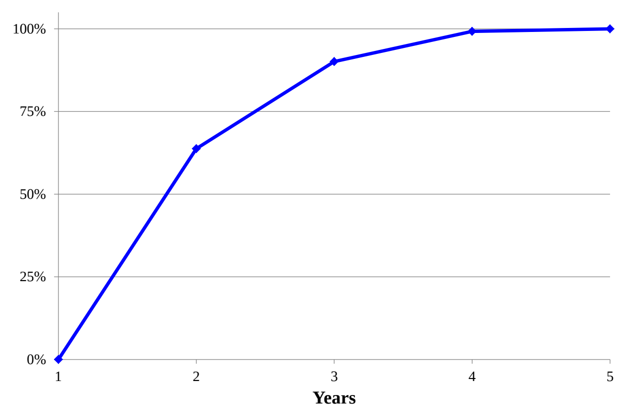
Figure A3: Percent of Full Rollover Welfare Gain



(a) Partial Commitment



(b) Grace Period



(c) Multi-Year Budgeting

Note: In all panels, the y-axis shows the welfare gain as a percent of the full rollover welfare gain. In Panel A, the x-axis is the probability that Congress can commit to allowing rollover. In Panel B, the x-axis is the number of months an agency has to use unspent funding from the previous year. In Panel C, the x-axis shows the number of years per budget cycle. Each point in each plot is calculated from an independent simulation of the baseline CARA specification from Table A13. See Appendix C for details.

Table A1: First Week Contract Spending for Selected Product or Service Codes, Pooled 2004 to 2009 FPDS

	Spending (billions)	First Week (percent)
Leases		
Lease or rental of facilities	$29.2	26.2
Lease or rental of equipment	$5.4	13.1
Service contracts		
Utilities and housekeeping services	$73.7	11.1
Medical services	$68.8	11.3
Transportation, travel and relocation services	$39.3	15.5
Social services	$5.5	9.3
Other	$2,378.1	3.1
Total	$2,600.0	4.0

Source: Federal Procurement Data System, accessed October, 2010 via www.usaspending.gov.
Note: Contract spending in the first week of the fiscal year by selected 2-digit product or service code, inflation-adjusted to 2009 dollars using the CPI-U. Categories account for 8.5 percent of overall spending but 29.7 percent of spending in the first week of the year.

Table A2: Year-End Spending by Time Zone Regressions

	Dependent Variable:			
	Last Day Spending		Last Week Excluding Last Day Spending	
	Smaller Contracts (<$100K)	Larger Contracts (≥$100K)	Smaller Contracts (<$100K)	Larger Contracts (≥$100K)
Hours west of GMT	0.0042	0.0003	-0.0013	0.0002
	(0.0028)	(0.0001)	(0.0011)	(0.0004)
Year FE	X	X	X	X
Agency FE	X	X	X	X
Product and service code FE	X	X	X	X
R-squared	0.034	0.010	0.047	0.021
N	409,687	1,541,248	409,687	1,541,248
Mean of dependent variable	0.0269	0.0154	0.0634	0.0456

Source: Federal Procurement Data System, accessed October, 2010 via www.usaspending.gov.
Note: Table shows coefficients from linear probability model regressions of year-end spending on hours west of Greenwich Mean Time (GMT) and controls. To facilitate the analysis, the data is aggregated to the level of the covariates and the regressions are weighted by inflation-adjusted spending in each cell.

Table A3: Summary Statistics: Major I.T. Projects as of March, 2010

	IT Spending		IT Projects	
	Millions	Percent	Count	Percent
Total	$129,729	100.0	686	100.0
Agency				
Agency for International Development	$265	0.2	3	0.4
Agriculture	$1,864	1.4	33	4.8
Commerce	$11,042	8.5	46	6.7
Corps of Engineers	$4,012	3.1	11	1.6
Defense	$14,889	11.5	46	6.7
Education	$1,407	1.1	25	3.6
Energy	$4,914	3.8	26	3.8
Environmental Protection Agency	$3,166	2.4	20	2.9
General Services Administration	$2,162	1.7	25	3.6
Health and Human Services	$8,990	6.9	64	9.3
Homeland Security	$13,068	10.1	70	10.2
Housing and Urban Development	$1,605	1.2	10	1.5
Interior	$4,557	3.5	39	5.7
Justice	$4,376	3.4	15	2.2
Labor	$2,434	1.9	34	5.0
National Aeronautics and Space Administration	$9,722	7.5	22	3.2
National Archives and Records Administration	$649	0.5	8	1.2
National Science Foundation	$374	0.3	6	0.9
Nuclear Regulatory Commission	$515	0.4	16	2.3
Office of Personnel Management	$497	0.4	7	1.0
Small Business Administration	$269	0.2	9	1.3
Smithsonian Institution	$58	0.0	9	1.3
Social Security Administration	$1,236	1.0	13	1.9
State	$3,705	2.9	13	1.9
Transportation	$12,514	9.6	42	6.1
Treasury	$4,921	3.8	41	6.0
Veterans Affairs	$16,521	12.7	33	4.8
Year of origination				
1981	$2,706	2.1	1	0.1
1991	$61	0.0	1	0.1
1992	$322	0.2	1	0.1
1993	$409	0.3	2	0.3
1994	$155	0.1	2	0.3
1996	$3,050	2.4	7	1.0
1997	$1,430	1.1	3	0.4
1998	$2,891	2.2	5	0.7
1999	$2,814	2.2	10	1.5
2000	$2,855	2.2	15	2.2
2001	$8,463	6.5	17	2.5
2002	$12,577	9.7	32	4.7
2003	$13,860	10.7	60	8.7
2004	$12,818	9.9	87	12.7
2005	$13,529	10.4	95	13.8
2006	$16,169	12.5	126	18.4
2007	$17,935	13.8	121	17.6
2008	$14,176	10.9	75	10.9
2009	$3,508	2.7	26	3.8

Source: I.T. Dashboard data, accessed March, 2010 via http://it.usaspending.gov.
Note: Major I.T. investments by federal agency and year of origination, inflation-adjusted to 2009 dollars using the CPI-U.

Table A4: Summary Statistics: Quality Indexes and Project Characteristics for Major I.T. Projects

	Mean	Std. Dev.	Min
Planned cost (millions)	189.11	447.06	0.10
Overall rating	7.07	2.30	0.00
Rating subindexes			
CIO evaluation	3.95	0.94	1.00
Cost rating	8.72	2.52	0.00
Cost overrun	5.25	1.49	0.00
Schedule rating	8.43	3.09	0.00
		Count	Percent
Investment phase			
Full-Acquisition		59	8.6
Mixed Life Cycle		304	44.3
Multi-Agency Collaboration		29	4.2
Operations and Maintenance		278	40.5
Planning		16	2.3
Service group			
Management of Government Resources		124	18.1
Missing		2	0.3
Service Types and Components		125	18.2
Services for Citizens		344	50.1
Support Delivery of Services to Citizens		91	13.3
Line of business			
Administrative Management		15	2.2
Controls and Oversight		12	1.7
Defense and National Security		30	4.4
Disaster Management		20	2.9
Economic Development		9	1.3
Education		16	2.3
Energy		5	0.7
Environmental Management		32	4.7
Financial Management		81	11.8
General Government [CA]		45	6.6
General Science and Innovation		22	3.2
Health		55	8.0
Homeland Security		40	5.8
Human Resource Management		24	3.5
Income Security		17	2.5
Information and Technology Management		85	12.4
International Affairs and Commerce		7	1.0
Law Enforcement		12	1.7
Natural Resources		16	2.3
Planning and Budgeting		8	1.2
Public Affairs		13	1.9
Revenue Collection		8	1.2
Supply Chain Management		25	3.6
Transportation		45	6.6
Workforce Management		5	0.7
Other		39	5.7
Total		686	100.0

Source: I.T. Dashboard data, accessed March, 2010 via http://it.usaspending.gov

Note: Planned total cost is inflation-adjusted to 2009 dollars using the CPI-U. Overall rating is a quality index that combines that CIO evaluation, cost rating, and scheduling rating subindexes (see text for details). It takes values from 0 to 10, with 10 being the best score. The CIO evaluation is the agency CIO's assessment of project quality. It takes values from 1 to 5, with 5 being the best. The cost rating is based on the absolute percent deviation between the planned and actual cost of the project. The cost overrun is a non-absolute measure that assigns over-cost projects the lowest scores. The schedule rating is based on the average tardiness of the project. The cost and schedule indices take values from 0 to 10, with 10 being the best. The line of business "other" category combines all categories with 4 or fewer projects.

Table A5: Ordered Logit Regressions of Subindices on Last Week and Controls

	Odds Ratio of Higher Subindex Value				
	Evaluation by Agency CIO		Cost Rating	Cost Overrun	Schedule Rating
	(1)	(2)	(3)	(4)	(5)
Last week of September	0.14	0.16	0.80	0.74	1.15
	(0.06)	(0.07)	(0.36)	(0.30)	(0.66)
Cost and schedule rating		X			
Agency FE	X	X	X	X	X
Year FE	X	X	X	X	X
Project characteristics	X	X	X	X	X
Weighted by spending	X	X	X	X	X
N	671	671	671	671	671

Source: Federal Procurement Data System, accessed October, 2010 via www.usaspending.gov
Note: Odds ratios from ordered logit regressions. Coefficient of 1 indicates no effect. The CIO evaluation is the agency CIO's assessment of project quality. It takes values from 1 to 5, with 5 being the best. The cost rating is based on the absolute percent deviation between the planned and actual cost of the project. The cost overrun is a non-absolute measure that assigns over-cost projects the lowest scores. The schedule rating is based on the average tardiness of the project. The cost and schedule indices take values from 0 to 10, with 10 being the best. Project characteristics are fixed effects for investment phase, service group, and line of business (see Appendix Table A4). Standard errors in parentheses.

Table A6: Year-End Contract Characteristics Regressions

	Dependent Variable:			
	Noncompetitive	One Bid	Cost-reimbursement	T&M/LH
	(1)	(2)	(3)	(4)
Last week	-0.002	0.013	-0.031	0.004
	(0.011)	(0.006)	(0.005)	(0.004)
Year FE	X	X	X	X
Agency FE	X	X	X	X
Product or service code FE	X	X	X	X
R-squared	0.41	0.20	0.52	0.21
N	6,379,381	6,379,381	6,379,381	6,379,381
Mean of dependent variable	0.284	0.199	0.298	0.055

Source: Federal Procurement Data System, accessed October, 2010 via www.usaspending.gov.
Note: Table shows coefficients from linear probability model regressions of contract type and competition type indicators on last week and controls. Noncompetitive is an indicator for noncompetitively sourced contract; one bid is an indicator for contracts that are competitively sourced but only receive one bid; cost-reimbursement is an indicator for a cost-reimbursement contract; T&M/LH is an indicator for a time and materials or labor-hours contract; the omitted category is fixed price contract. To facilitate the analysis, the data is aggregated to the level of the covariates and the regressions are weighted by inflation-adjusted spending in each cell.

Table A7: Percent of Projects in I.T. Dashboard Data

	Spending			Projects		
	All	I.T Dashboard	Percent in I.T. Dashboard	All	I.T Dashboard	Percent in I.T. Dashboard
Year of origin						
≤ 2001	$68,460	$14,538	21.2	813	48	5.9
2002	$114,668	$12,848	11.2	1,018	61	6.0
2003	$115,286	$51,004	44.2	653	113	17.3
2004	$53,151	$10,309	19.4	467	71	15.2
2005	$35,027	$16,456	47.0	250	56	22.4
2006	$13,023	$5,172	39.7	191	77	40.3
2007	$61,953	$55,665	89.8	248	183	73.8
2008	$19,864	$19,752	99.4	135	127	94.1
2009	$498	$491	98.7	16	13	81.3
2010	$285	$273	95.5	13	10	76.9
Total	$482,215	$186,509	38.7	3,804	759	20.0

Source: I.T. Dashboard data, accessed March, 2010 via http://it.usaspending.gov and 2003 to 2010 Exhibit 53 reports, available at http://www.whitehouse.gov/omb/e-gov/docs/.
Note: All spending and projects are totals from agency Exhibit 53 reports. I.T. Dashboard spending and projects are totals in the I.T. Dashboard dataset (including projects dropped from the baseline sample due to missing values). Spending values inflation-adjusted using the CPI-U.

Table A8: Alternative Mechanisms for the Effect on Overall Ratings

	Coefficients from Linear Model		Odds Ratio of Higher Overall Rating from Ordered Logit	
	Contracting Office FE Weighted	Contracting Office FE Unweighted	Longer Tenure (> 3 years)	Shorter Tenure (≤ 3 years)
	(1)	(2)	(3)	(4)
Last week	-0.66	-0.82	0.08	0.30
	(0.73)	(0.40)	(0.06)	(0.24)
Year FE	X	X	X	X
Agency FE	X	X	X	X
Project characteristics	X	X	X	X
Contracting office FE	X	X		
Weighted by spending	X		X	X
R-sq	0.889	0.696		
N	275	275	235	357

Source: I.T. Dashboard data, accessed March, 2010 via http://it.usaspending.gov and 2003 to 2010. CIO biographies, available at www.cio.gov. Federal Procurement Data System, accessed October, 2010 via www.usaspending.gov.
Note: Columns 1 and 2 show coefficients from linear regressions with contracting office fixed effects. Columns 3 and 4 show odds ratios from ordered logit regressions by CIO tenure at the agency. Coefficient of 1 indicates no effect. Overall rating is a quality index that combines that CIO evaluation, cost rating, and scheduling rating subindices (see text for details). It takes values from 0 to 10, with 10 being the best. CIO tenure is determined from CIO biographies and includes time at the agency in another position (e.g., deputy CIO). Tenure denoted as missing when tenure cannot be determined from the biographical statement. Project characteristics are fixed effects for investment phase, service group, and line of business (see Appendix Table A4). Observations weighted by inflation-adjusted spending unless otherwise mentioned. Standard errors in parentheses.

Table A9: Standard Deviations of Year-End and Rest-of-Year of Spending Volumes and Overall Ratings

	Percent of Spending		Quality of Spending	
	Std. Dev.	Residual Std. Dev.	Std. Dev.	Residual Std. Dev.
	(1)	(2)	(3)	(4)
Last week of September	5.92	5.55	3.82	1.86
	(0.32)	(0.30)	(0.28)	(0.14)
Rest of Year	3.78	3.39	2.31	1.40
	(0.03)	(0.03)	(0.07)	(0.04)

Source: Federal Procurement Data System, accessed October, 2010 via www.usaspending.gov and I.T. Dashboard data, accessed March, 2010 via http://it.usaspending.gov. .
Note: Columns 1 and 2 show the standard deviations of the percent of spending in the full FPDS data for contracts originated during the last week of the year and during earlier weeks in the year. Columns 3 and 4 show the standard deviations of the overall rating quality index from the I.T. Dashboard data for contracts originated during the last week of the year and during earlier weeks in the year. Columns 1 and 3 show the standard deviations in the raw data. Columns 2 and 4 show these standard deviations after partialling out fixed effects. The percent of spending statistics are calculated using observations that are the percentage of spending by agency and by week in each year. The fixed effects are for agency and year. In constructing the agency-week-year observations for the I.T. Dashboard data set, the individual project data is weighted by spending on each project so that the standard deviations can by interpreted as the variation per dollar of expenditure. The residual analysis for the I.T. Dashboard data partials out agency, year, and product characteristics fixed effects. Project characteristics are fixed effects for investment phase, service group, and line of business (see Appendix Table A4).

Table A10: Difference-in-Differences Estimates of Overall Rating on Justice and Last Week

	OLS Estimates					
	(1)	(2)	(3)	(4)	(5)	(6)
Justice X last week	3.54	2.29	2.85	2.36	2.251	2.49
	(1.58)	(1.80)	(0.66)	(0.59)	(0.57)	(0.97)
Last week	-1.91	-1.06	-0.93	-0.99	-0.81	-0.47
	(1.58)	(1.24)	(0.58)	(0.49)	(0.47)	(0.22)
Justice	0.06	-0.59	-3.33	-3.88	-4.02	-2.03
	(0.39)	(0.36)	(0.11)	(0.65)	(0.63)	(0.80)
Year FE		X	X	X	X	X
Agency FE			X	X	X	X
Project characteristics				X	X	X
Weighted by spending	X	X	X	X	Winsorized*	
R-squared	0.06	0.22	0.58	0.68	0.60	0.48
N	686	686	686	686	686	686

Source: I.T. Dashboard data, accessed March, 2010 via http://it.usaspending.gov .
Note: Coefficients from OLS regressions of overall rating on fully interacted Justice and last week indicators and controls. Overall rating is a quality index that combines the CIO evaluation, cost rating, and scheduling rating subindexes (see text for details). It takes values from 0 to 10, with 10 being the best score. Project characteristics are fixed effects for investment phase, service group, and line of business (see Appendix Table A4). Standard errors clustered by agency in parentheses.
*Spending weight Winsorized at $1 billion (96th percentile).

Table A11: Ordered Logit Regressions of Overall Rating on *Last Month* and Controls

	Odds Ratio of Higher Overall Rating			
	(1)	(2)	(3)	(4)
Last month	0.57	0.65	0.54	0.42
	(0.09)	(0.12)	(0.12)	(0.11)
Year FE		X	X	X
Agency FE			X	X
Project characteristics FE				X
N	671	671	671	671

Source: I.T. Dashboard data, accessed March, 2010 via http://it.usaspending.gov.
Note: Odds ratios from ordered logit regressions. Overall rating is a quality index that combines that CIO evaluation, cost rating, and scheduling rating subindices (see text for details). It takes values from 0 to 10, with 10 being the best. Project characteristics are fixed effects for investment phase, service group, and line of business (see Appendix Table A4). Observations weighted by inflation-adjusted spending. Standard errors in parentheses.

Table A12: Target and Calibrated Moments

		Moments in Simulated Data	
	Target Moments	CRRA Model	CARA Model
Panel A: Moments			
Spike in spending			
Ratio of last month to rest-of-year monthly	2.18	2.17	2.18
Drop-off in quality			
Odds ratio of high quality in last month	0.42	0.42	0.41
Panel B: Parameters			
Curvature of value of spending (γ)		3.02	1.86
Standard deviation of shocks (σ)		1.73	2.02

Source: I.T. Dashboard data, accessed March, 2010 via http://it.usaspending.gov. Federal Procurement Data System, accessed October, 2010 via www.usaspending.gov.
Note: Panel A shows target and calibrated moments for the spike in spending and the drop-off in quality. The target spike is calculated as the ratio of last monthly to rest-of-year average month spending in the pooled 2004 to 2009 FPDS. The target drop off is the odds ratio of a high quality score from an order logit regression of overall rating on last week and controls in the I.T. Dashboard data. The specification is also shown in column 4 of Appendix Table A11.

Table A13: Welfare Gain from Rollover

	Δ Value	Δ Social Cost	Δ Social Surplus
No Rollover	0.0%	0.0%	0.0%
CRRA			
Compensating Variation	0.4%	-13.1%	13.4%
Full Congressional Reoptimization	1.9%	-11.5%	13.4%
First Best	2.4%	-16.2%	18.6%
CARA			
Compensating Variation	0.0%	-16.0%	16.0%
Full Congressional Reoptimization	1.8%	-14.3%	16.1%
First Best	1.5%	-20.6%	22.1%

Note: Welfare gains from rollover from the calibrated model with CRRA and CARA value-of-spending functions. Compensating variation is the reduction in budget authority that could be provided to the agency with rollover to achieve the same expected value of spending as in the no-rollover regime. Full Congressional reoptimization allows Congress to adjust the budget for the agency. First best is the level of spending that equates the marginal value of spending to the marginal social cost in each sub-year period. The first column shows the percent change in the value of spending, the second column shows the percent change in the social cost of spending, and the third column shows the percent change in social surplus. All values are normalized by the social cost of spending under the no-rollover status quo. See Appendix C for details.