Paying over the odds at the end of the fiscal year

Stuart Baumann     Margaryta Klymak*

Please do not distribute and cite.
Thank you.

Abstract

Heightened end of fiscal year spending has been observed in a number of countries. This is often considered a problem for policymakers due to the possibility of some of this spending being wasteful. It is also likely that suppliers will raise their prices to profit from the heightened willingness to spend. This paper uses Ukrainian government procurement data to show that this latter effect is a substantial factor at the end of the fiscal year. Suppliers to the Ukrainian government bid higher at the end of the fiscal year and the final price paid for goods is thus higher. This result is robust across several procurement mechanisms in use in Ukraine.

JEL Codes: H57, H61, L22, L24
Keywords: government spending, procurement, fiscal year distortions, Ukraine

*Klymak (corresponding author): margaryta.klymak@qeh.ox.ac.uk, Department of International Development and the Centre of Studies of African Economies, University of Oxford, 3 Mansfield Rd, Oxford OX1 3TB, United Kingdom. For useful comments we would like to thank seminar participants at the CSAE Internal Seminar (2019) and the European Economic Association Annual Conference (2019).
1 Introduction

At the end of every fiscal year many governments rush to use unspent budget allocation. This pattern of governments spending substantial amounts in the last month of fiscal year has been observed in many countries including the United Kingdom (Baumann, 2019), the United States (Liebman and Mahoney, 2017), Germany (Fitzenberger, Furdas and Sajons, 2016), and across other OECD countries (Eichenauer, 2016). This spending is often regarded as problematic by economists and policymakers as it is feared that it might be rushed and of poor value. There is some empirical evidence for this from the United States government procurement data (Liebman and Mahoney, 2017). Their evidence tends to suggest that government departments use budget on lower value projects at the end of the fiscal year.

This pattern of end of fiscal year spending also presents an opportunity for firms. If governments are more willing to spend why not increase prices? There is some anecdotal evidence from this from Hyndman, Jones and Pendlebury (2007) who conducted an extensive survey of public sector managers in the United Kingdom. These managers recognised the potential for paying over the odds at the end of the fiscal year and tried to avert increased price by negotiating long-term contracts where the department could order goods and services at a fixed price at any time. Unfortunately, however, this tactic faced the problem of firms being excessively busy at the end of the fiscal year and unable to satisfy the demand for the government department. Thus departments ended up contacting other suppliers at a heightened price anyway. There is also anecdotal evidence that firms are aware of heightened end of the fiscal year spending with a number of media articles providing tips and recommendations to firms on how to profit from this (i.e. Federal Times (2015, 2017)).

This paper examines two questions. First, we examine how the end of the fiscal year impacts the prices government departments pay in procurement. The second question investigates how much government money is wasted by higher prices at the end of the fiscal year. We use Ukrainian procurement lot level data over the period 2015 – 2018 to find that departments systematically pay more for goods and services at the end of the fiscal year. We first show this empirically and then present a model to capture suppliers pricing decisions being affected by the departments’ end of fiscal year spending decisions. We will use the dataset to calibrate the model and gain additional waste estimates from
Finally, we will use the calibrated model to estimate the effect of a variety of policy responses to the end of fiscal year spending that have been considered in the literature.

There are multiple mechanisms through which government departments can pay more for goods and services at the end of the year compared to what they would pay earlier. The first is that the increased willing to pay on the part of departments can result in higher prices when departments are negotiating prices directly with a supplier. In cases where there are multiple suppliers competing for departmental work a standard result from auction theory indicates that the price the department is willing to pay will not be relevant to price determination. In these cases however the department would expect to get fewer bidders given the larger number of auctions in the market in later months of the year. This leads to less price competition between bidders. In addition it is likely that certain bidders will be more efficient at completing certain jobs and thus with fewer bidders there is less chance of a particularly good match between department and winning bidder. The lower price competition between firms means that a firm has a better outside option if they do not win an auction - they can find another job that will also have little price competition and the likelihood of higher profits. As departments must pay at least a firm’s outside option to incentivise them to do the work this further pushes up prices.

This paper contributes to two bodies of the literature. The first is relatively new but rapidly growing literature on the end of fiscal year spending. The existing papers have focused on explaining why the heightened spikes occur. Liebman and Mahoney (2017) suggest that government departments face uncertainty and thus build up a precautionary savings fund throughout the year. If they can not save this fund into the next year they will expend it at the end of the fiscal year resulting in heightened spending. Baumann (2019) noting that spending spikes also exist in the United Kingdom where funds can be spent across fiscal years, suggested the alternate explanation that spending spikes reflect procrastination on the part of government departments. As departmental reporting is all organised on a fiscal year basis departments can delay exerting effort in spending funds until later in the fiscal year. Eichenauer (2016) suggest the more behavioural mechanism that end of fiscal year spending occurs as a result of a lack of planning capacity and bureaucratic effectiveness without impacting final year totals. While these previous papers have focused on the reasons behind excessive end of year spending, this paper focuses on
the strategic price effects of the heightened end of fiscal year spending. Secondly, we estimate the extent of waste associated with heightened prices at the end of the fiscal year.

The second body of literature is on competition in government procurement (McAfee and McMillan, 1989; Vagstad, 1995; Bajari and Tadelis, 2001; Spagnolo, 2012). Coviello and Mariniello (2014) used Italian procurement auctions data where auctions above a particular value threshold must be publicised. They found that higher publicity induced entry of a larger number of bidders and led to winning rebates. Bandiera, Prat and Valletti (2009) considers an Italian procurement system that arranges for suppliers to commit to an attractive price in return for being a preferred government supplier. Lewis-Faupel et al. (2016) used data from India and Indonesia to investigate whether an increase in transparency of public procurement (through electronic purchases) improved procurement outcomes. They did not find any change in prices however Lewis-Faupel et al. (2016) found that this type of procurement leads to improvements in quality (through reduced delays and measure of construction quality). Previous studies showed that the effectiveness of public procurement also largely depends on the type and quality of purchased goods. Bajari and Tadelis (2001) showed that cost-plus contracts are preferred over the fixed-price contracts in case of complex projects. Banerjee and Duflo (2000) used the data from the Indian software industry and found that reputation is an important determinant of contractual outcomes. Coviello, Guglielmo and Spagnolo (2017) used Italian procurement data and found that discretion increases the likelihood of winning for the same firm. They also found that this does not deteriorate the outcomes of procurement. Our paper contributes to the literature by showing that at the end of the fiscal year the inefficient outcomes are possible in electronic auctions with multiple bidders.

The paper proceeds as follows. Section 2 provides details on the Ukrainian government procurement system and the dataset. The empirical approach and results are presented in section 3, section 4 describes and solves the model, before section 5 concludes.

2 Data

After the Ukrainian revolution of 2014, the Ministry of Economic Development and Trade, civil society and the private sector collaborated on the development of a procurement plat-
form, which aimed to change the rules of public procurement and make it more transparent. The development of this platform started in February 2014 and it was first launched a year after. Given the historic corruption issues in Ukraine, the system was intended to make information about public procurement widely accessible. After launch, the platform gained a lot of support from the public, received funding for further development and scaled up quickly. The procurement platform also attracted international support winning a major international award, the World Procurement Award in the Public Sector (World Procurement Awards, 2016). After the adoption of the new public procurement law in December 2015, procurement through the system became mandatory for central government authorities and government monopolies starting from 1 April 2016. Starting from 1 August 2016, the procurement platform became mandatory for all other government bodies.

Government authorities are required to use the online procurement system only if the expected value of a purchase exceeds certain purchasing amounts. If procurement is expected to cost between 50,000 UAH but below 200,000 UAH, the government doesn’t have to use online tender process, however, is required to submit a report about that purchase. Above 200,000 UAH threshold procurements must be conducted through an online tender process. Online tender procedure consists of several stages. First, a government department announces what it would like to purchase with all technical characteristics, then the firms submit their offers including an indicative price. Once this stage is completed, the system automatically creates the day and time for an auction. The auction is in three rounds. In the first round, sequentially and starting with the firm with the highest indicative price, each firm can choose to reduce their price or remain it unchanged. A similar format is used for the second and third rounds where the prices in the previous round determine the order in which firms submit prices. The prices in the final round are the final prices bid by each firm. Depending on the winner selection criteria, which is often a price, a firm with the best offer from the final round wins the auction. The government department could also choose a different firm if nonprice aspects of the firm’s offer are compelling.

This paper uses 2,108,363 successfully procured lots over the period February 2, 2015 until December 31, 2018 inclusive. We use all online auction information as well as the reports submitted by the government. The Ukrainian fiscal year ends in December. We
use both the reports submitted to the platform as well as tenders that were procured through the system. All values used in the analysis we deflated with the monthly price indices.

The data indicates that heightened end of fiscal year spending occurs to a great extent in Ukraine. Table 1 presents basic descriptive statistics which suggests that much more tenders listed at the end of the fiscal year than in previous months. In particular, the number of tenders in December was 45% more than in January and 17% more compared to November. The number of bidders also declined substantially in the last month which may reflect crowding out of suppliers. The expected price is the price that government agency reveals when it post the job on the platform and winning price is the price of the firm that won an auction. Both are substantially higher in the final month of the year compared to other months. We can get a rough indication of the competitiveness of the winning price by how close it is to the expected price. The ratio of the winning price to the expected price, which we will refer to the price ratio through this paper, is highest in December which tends to suggest the price that departments get a less attractive price at the end of the fiscal year.

A big part of the worse price at the end of fiscal year is likely to be driven by a smaller number of bidders on these jobs. This can be seen in the bottom panel of figure 1 which shows that there are about 16% fewer bidders per job in December as compared to January. This is likely driven by about 80% more jobs being advertised in December as can be seen in the top panel.

The fewer number of bidders per job is insufficient to explain the whole change in the price ratio achieved by the department. This can be seen in figure 2 which presents the ratio of winning over expected value at the end of fiscal year and all other months by the number of bidders. There are two observations that can be made here. The first is that the price ratio decreases in a convex manner with the number of bidders. This is in line with normal auction theory and is a good indication that the price ratio does contain meaningful information about the attractiveness of the price achieved by the firm. The second observation is that after conditioning on the number of bidders, prices are on average higher at the end of the fiscal year relative to other months. For the case of one bidder, this may be a result of the department being willing to pay more. In competitive cases with at least two bidders, this may be a result of firms having a better outside option.
<table>
<thead>
<tr>
<th>Month</th>
<th>Number of Tenders</th>
<th>Winning Bid Value</th>
<th>Number of Bidders</th>
<th>Sum Expected Value</th>
<th>Sum Winning Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>159,875</td>
<td>0.948</td>
<td>1.459</td>
<td>94,373,024,913</td>
<td>88,227,894,036</td>
</tr>
<tr>
<td>February</td>
<td>168,768</td>
<td>0.937</td>
<td>1.558</td>
<td>110,800,855,925</td>
<td>102,633,271,036</td>
</tr>
<tr>
<td>March</td>
<td>158,157</td>
<td>0.930</td>
<td>1.625</td>
<td>96,280,396,756</td>
<td>91,036,475,553</td>
</tr>
<tr>
<td>April</td>
<td>134,396</td>
<td>0.933</td>
<td>1.562</td>
<td>83,485,685,182</td>
<td>78,010,203,590</td>
</tr>
<tr>
<td>May</td>
<td>147,854</td>
<td>0.936</td>
<td>1.534</td>
<td>87,236,213,448</td>
<td>82,268,500,591</td>
</tr>
<tr>
<td>June</td>
<td>145,193</td>
<td>0.940</td>
<td>1.493</td>
<td>105,209,493,566</td>
<td>98,610,270,729</td>
</tr>
<tr>
<td>July</td>
<td>140,484</td>
<td>0.941</td>
<td>1.512</td>
<td>103,498,337,017</td>
<td>96,200,722,207</td>
</tr>
<tr>
<td>August</td>
<td>153,160</td>
<td>0.942</td>
<td>1.511</td>
<td>94,508,211,463</td>
<td>88,987,361,360</td>
</tr>
<tr>
<td>September</td>
<td>169,631</td>
<td>0.942</td>
<td>1.498</td>
<td>92,600,961,277</td>
<td>88,252,477,500</td>
</tr>
<tr>
<td>October</td>
<td>190,892</td>
<td>0.945</td>
<td>1.496</td>
<td>114,782,587,788</td>
<td>106,754,947,469</td>
</tr>
<tr>
<td>November</td>
<td>244,342</td>
<td>0.947</td>
<td>1.452</td>
<td>122,102,468,825</td>
<td>115,002,881,412</td>
</tr>
<tr>
<td>December</td>
<td><strong>293,965</strong></td>
<td><strong>0.970</strong></td>
<td><strong>1.222</strong></td>
<td><strong>130,685,089,549</strong></td>
<td><strong>125,064,480,784</strong></td>
</tr>
</tbody>
</table>

All values are in UAH.
if they do not win the auction.

As observed in table 1, the total expected price of all tenders increases throughout the year. This comes as a result of more jobs and not a greater average expected price per job. Government departments seem to be manipulating their expected price in order for it to fall beneath the threshold allowing them to avoid a full action procedure. This is more pronounced at the end of the fiscal year. They might be motivated to do this as they have a large part of the budget unspent and posting an expensive auction might be risky at the end of the fiscal year for two reasons. The first is that auction above 200,000 UAH threshold usually take longer as there are timeframes that must be followed in order to run a valid auction. The second reason is that department might only find one firm willing to bid on the job. While it is permitted to bargain when the expected price is beneath the threshold, in an auction format this is not permitted and the procurement would fail automatically, which will leave departments with an unspent budget which they cannot rollover. We plot expected values for different months and we explore the possibility of bunching at the threshold at the end of the fiscal year in graph 3. The graphs show that the expected values increase throughout the year with being the highest in December. There is a substantial level of tenders just below threshold in December.

---

1 Palguta and Pertold (2017) showed bunching of government purchases just below the thresholds. They argued that government department manipulate the procurement amount in order to avoid open competition.
2 Governments are required to have the job online longer than auctions below threshold.
<table>
<thead>
<tr>
<th>Industry</th>
<th>Number of Tenders</th>
<th>Ratio of Tenders in Last Month</th>
<th>Winning Amount</th>
<th>Ratio of Winning Amount in Last Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office and computer equipment</td>
<td>112,520</td>
<td>2.49</td>
<td>167,118</td>
<td>1.85</td>
</tr>
<tr>
<td>Furniture, furniture-decorative products</td>
<td>105,936</td>
<td>2.25</td>
<td>100,631</td>
<td>1.52</td>
</tr>
<tr>
<td>Petroleum products, fuel, electricity and other energy sources</td>
<td>196,079</td>
<td>2.19</td>
<td>2,335,275</td>
<td>2.51</td>
</tr>
<tr>
<td>Printed and related products</td>
<td>35,937</td>
<td>2.16</td>
<td>36,453</td>
<td>1.43</td>
</tr>
<tr>
<td>Electrical equipment</td>
<td>52,364</td>
<td>2.09</td>
<td>226,881</td>
<td>1.84</td>
</tr>
<tr>
<td>Industrial equipment</td>
<td>36,956</td>
<td>1.96</td>
<td>278,216</td>
<td>1.22</td>
</tr>
<tr>
<td>Other</td>
<td>313,361</td>
<td>1.84</td>
<td>1,759,108</td>
<td>2.12</td>
</tr>
<tr>
<td>Clothing, footwear, bags and accessories</td>
<td>31,485</td>
<td>1.82</td>
<td>96,225</td>
<td>0.63</td>
</tr>
<tr>
<td>Transport equipment</td>
<td>57,910</td>
<td>1.76</td>
<td>634,811</td>
<td>0.99</td>
</tr>
<tr>
<td>Medical equipment, pharmaceuticals</td>
<td>149,195</td>
<td>1.75</td>
<td>327,316</td>
<td>1.39</td>
</tr>
<tr>
<td>Constructions and construction materials</td>
<td>130,774</td>
<td>1.72</td>
<td>478,462</td>
<td>0.81</td>
</tr>
<tr>
<td>Architectural &amp; construction services</td>
<td>85,388</td>
<td>1.71</td>
<td>160,959</td>
<td>1.71</td>
</tr>
<tr>
<td>Repair and maintenance services</td>
<td>98,417</td>
<td>1.70</td>
<td>251,007</td>
<td>1.41</td>
</tr>
<tr>
<td>Construction work and ongoing repairs</td>
<td>304,946</td>
<td>1.65</td>
<td>4,077,639</td>
<td>1.10</td>
</tr>
<tr>
<td>Business services</td>
<td>34,339</td>
<td>1.62</td>
<td>129,173</td>
<td>2.23</td>
</tr>
<tr>
<td>Wastewater and waste management</td>
<td>32,925</td>
<td>1.53</td>
<td>111,833</td>
<td>2.43</td>
</tr>
<tr>
<td>Food, beverages, tobacco</td>
<td>219,809</td>
<td>1.43</td>
<td>302,680</td>
<td>2.17</td>
</tr>
<tr>
<td>Chemical products</td>
<td>42,306</td>
<td>1.42</td>
<td>135,162</td>
<td>1.46</td>
</tr>
<tr>
<td>Agriculture, fishery and forestry</td>
<td>67,716</td>
<td>1.18</td>
<td>78,919</td>
<td>1.38</td>
</tr>
</tbody>
</table>
Finally, we also explore whether the end of fiscal year spending differed depending on the industry. The summary statistics by industries is presented in table 2. We can see that heightened end of the fiscal year is robust across all industries. The second column is the ratio of tenders in December to average number of tenders held in other months. The fourth column is the ratio of winning amount for tenders in December to average amount of tenders held in other months. Government agencies held 2.5 times as many tenders of office and computer equipment in December than in any other month. They spent almost twice as much on office and computer equipment than in average month. Although we cannot completely rule out that government departments buy more expensive goods within these industries. However, given that the number of tenders increased across all industries and winning amount was higher in the last month for the majority of industries suggest that more expensive purchases cannot drive the whole spending spike in December.
Figure (3) Bunching at the threshold
3  Empirical Strategy

As a starting point we would to identify empirically whether governments pay over the odds at the end of fiscal year. We use firm, government department, sector and time fixed effects along with a set of controls. The following specification is used:

\[
\text{Price Ratio}_i = \beta_0 + \beta_1 \text{Last Month}_i + \phi_a + \eta_s + \omega_i + \psi_y + \gamma \Lambda + \epsilon_i
\]  

(1)

where the dependant variable Price Ratio$_i$ is a ratio of a winning bid offered by a firm $i$ for a lot $l$ in 4 digit sector $s$ over the expected value offered by government buying agency $a$. It is defined as:

\[
\text{Price Ratio}_i = \left[ \frac{\text{Bids Value}_i}{\text{Expected Value}_i} \right] 
\]  

(2)

The regressor of interest Last Month$_i$ is a dummy variable equals one if the purchase was made in December and zero otherwise. We also control for government buying agency fixed effect $\psi_a$, firms-tender participants $\omega_i$, sector fixed effect $\eta_s$ and year $\psi_y$. $\epsilon_i$ is the statistical error term. We also control for the procurement type and whether the lot was a good, job or a service, $\Lambda$.

A natural concern can be raised that government agencies overestimate the expected value at the end of fiscal year in order to purchase goods faster before their budget expire. While that is forbidden by the procurement law, there is no monitoring of this. This possibility acts against finding the results, the evidence found is likely to be underestimate of the impact of paying over the odds.

The results of specification 1 are available in table 3. We use data for tenders that appeared at the procurement platform, which includes online auctions and government reports. The results are consistent throughout the specifications suggesting that governments save less in the last month of fiscal year as compared to other months. The last column in the table uses all controls and fixed effects and shows that government overpays around 1.6% more in the end of fiscal year. In Panel B we also control for the number of tender participants. The results suggest that for a given number of firm participants there is a higher price at the end of fiscal year.
For the results that appear in table 5, we use dataset of tenders that went through the online auctions only. Thus we disregard the reporting procedure tenders, which might have been reported with errors as they are submitted manually ex post. The results are consistent throughout the specifications suggesting that governments save less in the last month of fiscal year as compared to other months. The last column in the table uses all controls and fixed effects and shows that government overpays 1.3% more in the end of fiscal year.

Table 5 uses specification 1 for various procurement types. Government departments pay on average more for all types of procurements. The results for online auctions below and above the threshold are 1.8% and 1% respectively. Government agencies that purchased below the threshold and didn’t go through online tender submitted their reports. The result of running specification 1 on this data is in the last column. It suggests that the government pays about 0.2% over the odds. As the expected value is endogenous, these results are likely to be biased and act against us finding the result. These magnitudes should be treated as the lower bound estimate.

Table (3) Price Ratio and the End of Year Spending for Online Procured Tenders

<table>
<thead>
<tr>
<th>Dependent variable:</th>
<th>Price Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panel A: Tender Winners</td>
<td></td>
</tr>
<tr>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Last Month</td>
<td>0.020***</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
</tr>
<tr>
<td>Observations</td>
<td>2,103,580</td>
</tr>
<tr>
<td>R²</td>
<td>0.241</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Panel B: Tender Winners controlling for N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last Month</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Observations</td>
</tr>
<tr>
<td>R²</td>
</tr>
<tr>
<td>Year FE</td>
</tr>
<tr>
<td>Buyer FE</td>
</tr>
<tr>
<td>Firm FE</td>
</tr>
</tbody>
</table>

Note: *p<0.1; **p<0.05; ***p<0.01
Table (4) Price Ratio and the End of Year Spending for Online Procured Tenders

<table>
<thead>
<tr>
<th></th>
<th>Panel A: Tender Winners</th>
<th>Panel B: Tender Winners controlling for N</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Last Month</td>
<td>0.028***</td>
<td>0.013***</td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>Observations</td>
<td>873,849</td>
<td>873,062</td>
</tr>
<tr>
<td>R²</td>
<td>0.142</td>
<td>0.400</td>
</tr>
</tbody>
</table>

|                  |                         |                                         |                                         |
| Last Month       | 0.013***                | 0.007***                                | 0.007***                                |
|                  | (0.002)                 | (0.001)                                  | (0.001)                                  |
| Observations     | 873,849                 | 873,062                                  | 873,028                                  |
| R²               | 0.395                   | 0.537                                    | 0.563                                    |

|                  |                         |                                         |                                         |
| Year FE          | Yes                     | Yes                                     | Yes                                     |
| Buyer FE         | Yes                     | No                                      | Yes                                     |
| Firm FE          | No                      | Yes                                     | Yes                                     |

Note: *p<0.1; **p<0.05; ***p<0.01

Table (5) Procurement by type

<table>
<thead>
<tr>
<th></th>
<th>(1) Online auction below threshold</th>
<th>(2) Online auction above threshold</th>
<th>(3) Online auction international</th>
<th>Negotiation procedure (4)</th>
<th>Reporting procedure (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last Month</td>
<td>0.018*** (0.001)</td>
<td>0.010** (0.005)</td>
<td>0.004 (0.005)</td>
<td>0.002* (0.001)</td>
<td>0.002*** (0.0003)</td>
</tr>
<tr>
<td>Year FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Agency FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Seller FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Observations</td>
<td>533,329</td>
<td>193,261</td>
<td>16,566</td>
<td>129,872</td>
<td>1,225,300</td>
</tr>
<tr>
<td>R²</td>
<td>0.411</td>
<td>0.511</td>
<td>0.653</td>
<td>0.487</td>
<td>0.503</td>
</tr>
</tbody>
</table>

Note: *p<0.1; **p<0.05; ***p<0.01
4 The Model

We develop a general equilibrium model consisting of government departments and firms that trade together through auctions and bargaining.

4.1 Firms

Firms choose how many jobs, \( J_m \), they will bid on in a given month. They are matched to \( J \) different jobs which may be auctions or bargaining situations depending on how many other firms find the same jobs. Some of the jobs matched may also immediately fail if it is a bargaining situation with an expected value that is too high for bargaining to be permitted.

Firms face two kinds of cost. The first is a scaled cost that takes into account all of the jobs that a firm wins in a given month. We use \( J^* \) to denote the number of jobs that a firm wins, the total expected value of the work is \( \sum_{j=1}^{J^*} x_{E,j} \). The total scaled cost of is:

\[
\text{Scaled Cost} = \exp \left( d \sum_{j=1}^{J^*} x_{E,j} \right) - 1
\]  

(3)

The second cost is the idiosyncratic cost. This is drawn individually for each job from a uniform distribution with limits \((a, a + (b - a) \times x_E)\). For a given job each firm will realise a different idiosyncratic cost drawn from the same distribution.

Firms participate in each auction simultaneously and separately from the others. This means that they will need to use an estimate of their marginal scaled cost in determining their bid. Firms must commit to all prices and jobs and cannot decide to renege on a job that they won on the basis they have won too much work in total. The relevant calculation for scaled costs is:

\[
\text{Marginal Scaled Cost}(x_E) = \exp \left( d \sum_{j=1}^{J^*} x_{E,j} + dx_E \right) - 1 - \left( \exp \left( d \sum_{j=1}^{J^*} x_{E,j} \right) - 1 \right) - \exp \left( dx_E \right)
\]  

(4)

\[
= \exp \left( d \sum_{j=1}^{J^*} x_{E,j} \right) \left[ \exp(dx_E) - 1 \right]
\]  

(5)

Where \( x_E \) is the marginal job and \( \sum_{j=1}^{J^*} x_{E,j} \) is a sum over all of the other jobs the
firm will win. This is not known by the firm but an expectation can be taken to get the expected scale cost.

\[
\text{Expected Marginal Scaled Cost}(x_E) = E[\exp(d \sum_{j=1}^{j^*} x_{E,j})] \left[ \exp(dx_E) - 1 \right]
\]

Thus the key requirement for firms to be able to determine their expected marginal scale cost is the expectation of \(\exp(d \sum_{j=1}^{j^*} x_{E,j})\). We will denote this expectation as \(\chi_m\) for each month.

We model the auction by assuming that the firm with the lowest cost always wins at a price given by the second highest price.\(^3\) As the lowest cost bidders always win the expected profit conditional on winning is given by the expected difference between the first and second order price statistic. If a firm loses the auction they go back to searching for another suitable job. If they win the auction they get a profit equal to the difference between the lowest and second lowest price. They are engaged in that work and do not go back to waiting for other jobs to appear.

Given the auction format there is an opportunity cost of accepting work - the firm cannot later bid on another job. Hence the cost a firm faces considering the opportunity cost will be denoted \(c_i^* = c_i + \Omega\), where \(\Omega\) gives the opportunity cost.

We will consider only symmetric equilibria where each firm and each government follows the same strategies and policy functions. We can note that with the standard urn-ball matching result the number of bidders per auction will be poisson distributed with the rate being equal to the number of searching firms multiplied by how many jobs each applies for divided by the number of jobs. If there is only one bidder then the auction fails under Ukrainian auction rules if the expected value of the job is greater than a certain threshold. If the expected value less than this threshold then the \(N = 1\) case is modeled as a Nash bargaining problem.

\(^3\)Thus we model it as a Vickrey auction. Note that revenue equivalence assures that the expected price will be given by the second highest price. The additional assumption is that the lowest cost bidder always wins.
4.2 Departments

A department in month \( m \) has an instantaneous utility function of:

\[
f(\alpha_m, x_{E,m}, m) = \alpha x_{E,m}^\delta [(1 - \nabla) + \nabla D(12 - m)] - \Omega x_{E,m}
\]

Where from procuring a good with an expected value of \( x_{E,m} \) is the expected price of the good and \( \alpha_m \) is a shock drawn iid from a log normal distribution. \( \delta \) and \( \Omega \) are exogenous parameters that can determine the amount of end of year spending. \( \nabla \) is a parameter describing the amount of deferred utility from spending and \( D(i) \) is discounting for \( i \) months into the future.

This functional form is similar to that used in Baumann (2019) and has been chosen as it supports that paper’s procrastination mechanism for end of financial year spending as well as the precautionary savings mechanism of Liebman and Mahoney (2017).

Government departments face different payoffs each month. We depict it in graph 4. Every period each department has a state \( B_m \) in month \( m \). The draw an i.i.d. shock \( \alpha_m \) and decide whether or not they will advertise a job. If a department decides not advertise a job, they earn a small positive amount, \( s \), into the next period.\(^4\) If it advertises the job, there might a number of firms drawn from Poisson distribution which can approach a department. If no firms approached the department or only one firm shown interest in an advertised job but the expected value of a good is above the threshold, \( T \), then the auction fails. If only one firm approached a department and the expected value is below threshold \( T \), then bilateral bargaining will take place, where two outcomes are possible. The first is that a firm and a department fail to reach an agreement and the auction fails. Alternatively, bargaining is successful. Finally, if multiple firms approached a department, firms participate in a second price auction. If the second price is too high for a department, the auction fails. If the price is acceptable to a department, it gets the good for the second price.

\(^4\) This is done instead of getting advertising firms to pay a small search costs primarily for computational reasons that are described in the computational appendix.
Department sees $\alpha_m$, decides whether to advertise or not. If they advertise they choose an expected price $x_E$.

If does not advertise

Department earns $s$ into the next period.

If advertises with $x_E$

Department gets a collection of firms drawn from a Poisson distribution, $N$.

If $N=0$ or $N=1$ & $x_E > T$

No bidders. Auction fails.

If $N=1$ & $x_e < T$

Bargaining will occur between firm and department.

If $N > 1$

There is a second price auction.

Null Bargaining Set

It fails.

Bargaining acceptable

Department gets the good for bargained price.

Second price acceptable

Department gets the good for second price.

Second price is too high

It fails.

Figure (4) Department payoffs for each month, $m$, given budget $B_m$
4.3 Solving the Model

We use the following algorithm to solve the model. First, we guess the vectors \( \chi_m \) and \( J_m \). We also guess a department value function for the first month of the year giving discounted utility as a function of budget. We use the guessed values above to do value function iteration throughout the year. We then use the converged value functions together with \( \chi_m \) and \( J_m \) to simulate jobs and spending for government departments and firms. After that, we analyse the simulated data to determine the optimal \( J_m \) in each month for a firm and the corresponding \( \chi_m \) for each month.

The above steps can be considered a mapping that updates \( J_m \) and \( \chi_m \) given initial guesses for them.\(^5\) This function is deterministic as the same random seeds are used for the simulation of the data and analysis of it (which requires random sampling from the simulated data) however it is likely to be discontinuous (as small changes in \( \chi_m \) and \( J_m \) can snap firms into advertising/not advertising). Thus we will not use an acceleration algorithm here and will instead use picard iteration until we are close to a fixedpoint where the changes in \( \chi_m \) and \( J_m \) are likely to be small.

4.4 Calibration Targets

There are a number of targets for calibration. These are (Monthly) the shape of total spending over the year; (Monthly) the number of jobs that firms apply to over the year; (Monthly) The similarity between the empirical poisson rate of applicants per job and the model implied rates\(^6\); (In terms of N) The ratio of bids to \( x_E \). The model implied idiosyncratic price distributions indicate the distribution of the bids here. The lowest bids should be close to the expected marginal scale cost plus the bottom of the uniform price distribution. The total range of bids should reflect the width of the uniform price distribution; (Monthly) the distribution of \( x_E \). In particular the bunching on the competitive threshold.

We will sum the squared differences between each model implied moment and its empirical counterpart. This sum will be used as the objective function.

We will impose discounting parameters of \( \beta = 0.996 \) which implies 5% annual dis-

\(^5\)While we input a guess departmental value function this is iterated to a fixedpoint that only depends on \( J_m \) and \( \chi_m \). The initial guess only matters for speed of convergence.

\(^6\)Alternatively we could have targeted The relative number of jobs advertised throughout the year but it would be double counting to do this, the poisson rates and the number of firm applications
counting. We will impose $a = 0$, annual budget $= 1.0$ in order to simplify our calibration.

We need to calibrate the ends of the idiosyncratic price distribution $(a,b)$, the search cost for departments $(s)$, the competitive threshold $(T)$, the scaled costs curvature $(d)$, the utility function parameters $(\delta, \Omega)$, the variance of the shock process $\sigma_{\alpha}$, the ratio of departments to firms. We get $J_m$ and $\chi_m$, $\lambda_m$, the department value functions endogenously as a result of the model estimation.

We have 8 parameters to calibrate and one scalar sum of moments to minimise. In this situation we will use reverse automatic differentiation in order to efficiently get derivatives for minimisation. We will then use gradient descent. When we are close to the optima we can gain some intuition for what model parameters affect with moments by evaluating the gradients of each moment with respect to each input.

Scale costs are given by:

$$SC(x) = e^{d \sum x_E} - E$$

(8)

We can get an expectation for this given we are bidding on a job with a value of $x$ but do not know how much our other total of other jobs $x'_{E}$ will be.

$$E[SC(x)] = \int \left[ e^{d x'_{E} + d x} - E \right] p(x'_{E}) dx'_{E}$$

(9)

(10)

Now the more useful thing for us is the expected marginal cost of doing the extra job $x$.

4.5 The Spending Frictions Mechanism

The precautionary savings and procrastination models both provide explanations of why government departments spend more at the end of fiscal years. In the former explanation departments face intra-year production shocks. They respond to this by saving up a precautionary savings fund throughout the year. At the end of the year this is expended as they cannot roll it over to the next year due to government budget rules. Noting that end

\footnote{Except when the precautionary savings model is calibrated in which case $\Omega$ is set to zero.}
of fiscal year spending also occurs in the UK despite budgetary rollover being allowed, Baumann (2019) suggests the procrastination model where government departments realise utility from spending at the end of the fiscal year when reporting is done and their work in the year can be measured. They realise disutility from the effort of spending immediately however and as a result procrastinate, deferring spending and the associate effort until later in the year.

In this paper we introduce a third mechanism which is closely related but distinct from the precautionary savings model. In this new “spending frictions” model government departments try to spend in each period which may or may not be successful. This may be due to environmental factors\(^8\) or due to an inability to find a suitable vendor in that month. The department will reallocate money that was not able to be spent earlier in the year to later months and in this way spending increases throughout the year. Note that this mechanism will not occur should money be able to be roll-over and hence this cannot explain the case of the UK. Ukraine does not allow rollover and the dataset we consider involves many failed tenders and so the spending frictions model may be appropriate for our purposes.

To more formally present the spending frictions model consider that we have a government department spending over a two period fiscal year. Government departments decide to advertise a job in each period with an approximate value \(\hat{x}_t\). There is a chance of finding an appropriate vendor that is denoted by \(p_t\) in period \(t\). In the event of finding an appropriate vendor they agree on some price \(x_t\) (which is likely to be similar to \(\hat{x}_t\)) and get utility from the purchase.\(^9\) If they cannot find an appropriate vendor then nothing is spent and no utility gained. Government departments may only advertise one job per month.\(^{10}\) The department has CRRA utility and cannot rollover funds between fiscal years. Conditional on finding an available firm in the first period the department’s problem is:

---

\(^8\)For instance in the event of rain it may be impossible to pay a contractor to paint a bridge.

\(^9\)If the two sides cannot agree on a price then the situation is isomorphic to them not finding an appropriate venue. This spending process could alternatively be represented by the department advertising a job without any associate value and then choosing how much to spend after meeting a suitable firm. As the spending decision is always made conditional on finding a vendor there is no difference if the department chooses the amount of spending before or after finding the vendor.

\(^{10}\)This is for exposition however the same logic extends to the department advertising many jobs as long as the department does not advertise for many more jobs than they are prepared to buy from. This rules out the strategy of advertising from hundreds of firms and then only choosing one (the number of firms the department actually wants to hire).
EU|Finding period 1 firm = max \( x_1^{1-\delta} \frac{B - x_1^{1-\delta}}{1-\delta} \) (11)

Taking the FOCs we get:

\[ x_1 = \frac{B}{1 + (\beta p_2)} \] (12)

And multiplying by \( p_1 \) and \( p_2 \) we get the expected spending in each period.

\[
\text{Expected Spend}_1 = B \frac{p_1}{1 + (\beta p_2)}
\] (13)

\[
\text{Expected Spend}_2 = p_2 B \left[ 1 - \frac{p_1}{1 + (\beta p_2)} \right]
\] (14)

And we can verify for certain parameters this results in greater spending in the second period.\(^{11}\) This model is closely related to the precautionary savings model as both rely on uncertainty and the absence of rollover to produce heightened end of year spending.

There are also differences however. While in the precautionary savings model a rainy day fund is built up to be able to exploit future production shocks, in the spending frictions model a large sum of unspent funds reflects failures in being able to spend in previous months. The precautionary savings model suggests that government departments will always spend their entire unspent budget in the last month of the fiscal year. The spending frictions model does not however and thus can explain the empirical fact that some departments do not spend their entire budget even when these funds cannot be rolled over. We would argue that the inability model is more credible than the precautionary savings model which relies on high variance production shocks. These production shocks are hard to justify as there is no clear element in government procurement which is highly volatile in this way. In terms of policy responses both the spending frictions model and precautionary savings model suggest that rollover is a beneficial response to heightened end of fiscal year spending. Aside from rollover audits are the most common way in which governments have attempted to control end of year spending. While audits may be welfare improving in the precautionary savings (and procrastination) models they

\(^{11}\text{For instance this is the case when } p_1 = p_2 = 0.5, B = 1, \beta = 0.95 \text{ and } \delta = 1.5.\)
may be bad in the spending friction model. To the extend they increase the chance of a department not being able to find a suitable vendor they may exacerbate end of fiscal year spending spikes.

\[
E[\text{MSC}(x)] = \int \left[ e^{dx_E} - e^{dx_E'} \right] p(x_E') dx_E' = (e^{dx} - 1) \int e^{dx_E'} p(x_E') dx_E' \tag{15}
\]

\[
= (e^{dx} - 1) \int e^{dx_E'} p(x_E') dx_E' \tag{16}
\]

And we will define \( \chi = \int e^{dx_E'} p(x_E') dx_E' \) which we can get an unbiased estimate for from randomly sampling the \( x_E \)'s that a firm wins and then averaging their \( e^{dx_E} \).

4.6 Preview of Results

At the end of the fiscal year there are fewer bidders per auction. This has two effects: there is a greater chance of winning a less competitive auction and a higher expected profit from doing so; there is a better outside option from losing due to many auctions with few bidders being advertised. As the price must compensate a bidder for the outside option foregone this further increases prices.

The outside option for firms will be better at the end of the fiscal year as more jobs are advertised and auctions have lower competition and higher prices. At the same time the outside option for departments is worse. If they do not agree on a price with a firm then the department will run out of time to complete a job and lose unspent funds to treasury. These forces both lead to higher prices.

Higher prices in bargaining mean a greater outside option for firms which lead to higher prices in auctions. Higher prices in auctions increase the outside option which lead to higher prices in bargaining etc. It appears that at the end of the fiscal year departments try to spend more quickly and to avoid the possibility of not finding enough bidders to run a valid auction by lowering the expected value so a bargaining process can be run. If bargaining delivers a higher expected surplus to firms then the outside option for firms is further increased. In short each mechanism here that acts to increase prices seems to also act to boost other mechanisms that increase prices. There is a feedback effect.
5 Preliminary conclusion

Many governments operate under budgets that expire at the end of fiscal year and they end up spending a large part of unallocated budget in the last month of fiscal year. This rushed spending is believed to be wasteful. This paper examines two questions: How much government money is wasted by higher prices at the end of the fiscal year? How much waste is associated with suboptimal purchasing decisions by government departments at the end of the fiscal year?

Moving forward, we also hope to go further and look at policy suggestions to improve the efficiency of government spending: Does the requirement to have at least 2 bidders for an auction lead to more waste as a result of incentivising lowering of thresholds to allow for a bargaining process? Can allowing rollover increase the disagreement payoff for departments in bargaining and lead to better prices? Should the open procurement threshold vary by month?

Finally, we aim to tackle the question whether prices are driven up in the nongovernmental sector due to increased outside options of firms.
References


