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Abstract

We quantify the impact of unexpectedly assigned tasks on overtime work in the context of Japanese government officials. Data on overtime work are typically less reliable. We overcome this problem by using mobile phone location data, which enables us to precisely measure the nighttime population in the government-office district in Tokyo at an hourly frequency. Exploiting the exogenous nature of task arrivals, we estimate impacts on overtime work. We find that, in response to a newly assigned task, overtime work initially decreases and then increases persistently. Institutional changes to relax the time constraint and improve the working environment of government officials play a part in mitigating overtime work, but persistent increases in overtime work remain. We provide a simple model of optimal work allocation and show that distortion in intertemporal task allocation can account for the observed responses.

JEL Classification: C22, H11, J22
Keywords: mobile location data; overtime work; local projection; government officials

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1 Introduction

Preventing long working hours is one of the important issues in labor laws. It is because overwork results in various types of adverse outcomes, such as labor productivity, health status, safety, work-life balance, and welfare in general. Although overtime work is prevalent, less is known about the nature of overtime work. This is mainly because of the lack of high-quality data. While paid overtime work involves some premium, there is unpaid overtime work (also known as excess hours). It is likely that reported overtime hours underestimate the actual amount of overwork. This would be more so given the widespread strategic use of managerial titles for the avoidance of overtime pay.[1] Additional complications arise because overtime regulations differ from country to country, and the working environment and culture vary significantly.

To deal with these difficulties, in this paper, we utilize mobile location data and focus on the overtime work of Japanese government officials. We estimate changes in overtime work in response to exogenous increases in tasks that are assigned to government officials. There are several advantages of using mobile location data. First, the location data reflect the physical presence of individuals, regardless of whether they are managerial or nonmanagerial workers. Given the widespread ownership of mobile phones (not necessarily to be smartphones), our dataset provides us with a reliable measure of overtime work. Second, we can measure the hourly changes in the area population. This helps us illustrate the high-frequency dynamics of overtime work. Third, the obtained population data are associated with individual characteristics, such as gender and age groups. Therefore, we can measure the mobility of Japanese government officials fairly accurately. There are benefits of focusing on Japanese government officials. They have relatively homogeneous characteristics and share similar corporate cultures among different ministries. Institutional details are well documented. Almost all central administrations are located in Kasumigaseki, an approximately one-square-kilometer government district in Tokyo. Last but not least, we can observe and measure some tasks that directly affect the overtime work of government officials.

We focus on a specific task, responding to a memorandum on questions (MOQ, hereafter), and quantify its impact on the overtime work of government officials.The MOQs are written questions submitted by the policymakers at the National Diet to the Cabinet and have several unique features, which we exploit for identification. The law requires the Cabinet to respond to the MOQs within a week, which will impose a significant burden on government officials who are already working at their margins. This exogenous arrival of tasks triggers inevitable overtime work. In addition, the policymakers can submit MOQs at any time regarding any subject during the sessions of the Diet, which makes it difficult to anticipate MOQs in advance.

The key identification assumption is that MOQs are an exogenous shock to the work of government officials since the policymakers have discretion over the timing and contents of the questions. This discretion has important implications for exogeneity. First, from the viewpoint of an individual government official, it is unpredictable whether she or he will be assigned to it or not. This is related to the fact that when MOQs are submitted, negotiation among representatives from ministries determines which ministry will be responsible for the MOQs. Second, even when the submission of MOQs is anticipated, the difficulty and complexity of how to respond and how long it will take to prepare are unpredictable. Third, instead of submitting MOQs, policymakers can utilize oral questions, which have better media exposure and are associated with immediate responses. As a result, important time-sensitive issues are typically asked through oral questions, and the

[1]Firms can be exempted from overtime payment if the employee is a manager and receives a salary above the overtime exemption threshold set by the law. Cohen, Gurun, and Ozel (2023) find that there are disproportionally many uses of managerial titles around the federal regulatory threshold, suggesting firms' intention to avoid paying overtime.

contents of the MOQs become more unpredictable. We also assume that no other systematic shock occurs when MOQs are submitted to the Cabinet, which enables us to identify its impact using high-frequency data. Exploiting the statutory deadline of the MOQ, we focus on the hourly changes in the population at Kasumigaseki.

We find that, on average, an increase in the number of MOQs significantly *decreases* the overtime work of government officials one day after the MOQ shock, and *increases* it six to eight working days after the shock. The increases in overtime work are typically beyond the deadline of the MOQ, suggesting that preparing for the MOQs has a negative spillover effect on other government officials. The results also suggest that the effects of MOQs are heterogeneous across different demographic groups. The estimated gender-age-specific responses suggest that male government officials, especially those in their 30s to 50s, are more heavily affected by the MOQ shock. Institutional changes to relax the tight time constraint mitigate overtime work to some extent. However, we still observe the negative spillover effect beyond the deadline of the MOQ.

A noticeable feature of our empirical results is that the MOQ shock initially decreases the overtime work. It is seemingly puzzling, given the tight time constraint that government officials face. To understand what is happening, we present a simple model of optimal work allocation. Our analysis suggests that distortion in the intertemporal allocation of hours to work can account for the observed patterns of overtime work. With the standard preference, workers would like to optimally smooth their hours worked over time. However, the presence of irregular tasks such as MOQs distorts their intertemporal task allocations. Workers choose to go home early in the initial periods to be ready for intensified hard work in the future periods. This yields suboptimal allocation. Further, we extend our simple model to an infinite-horizon setting in order to replicate the observed pattern of overtime work quantitatively.

Longer working hours reduce labor productivity and are associated with a higher probability of errors and deterioration of workers' mental and physical health (e.g., Pencavel, 2015; Hamermesh, Kawaguchi, and Lee, 2017; Sato, Kuroda, and Owan, 2020). Although mobile location data cannot be directly connected to economic outcomes, this suggests that there are significant non-monetary costs associated with the MOQ system. While the MOQ system plays an important role in increasing the transparency of the Japanese government, policymakers should refrain from abusive use of the MOQs.

Contributions of our study are two folds. First, our study complements the literature on overtime, which usually concerns the consequences of overtime regulations on labor economic outcomes, such as compensation, employment, and welfare.[2] While our dataset is not suitable to directly address economic outcomes, we examine dynamic responses of overtime work to exogenous changes in demand for overtime work. Second, this paper contributes to the expanding literature using location data for economic analysis. A large body of the literature has focused on the impact of human mobility on the spread of COVID-19, analyzing the effects of public health measures, such as social distancing policy and lockdowns, and its relationship with risk perceptions and political attitude.[3] Recently, more papers have expanded the usage of mobile location data to tackle economic questions, and this paper is one of them.[4]

[2] Quach (2022) estimates the impact of expanding overtime coverage by using monthly administrative payroll data. He finds that the exogenous increases in the overtime exemption threshold decrease employment and increase earnings. See also Anxo and Karlsson (2019), Barkume (2010), Bell and Hart (2003), Kuroda and Yamamoto (2012), and Trejo (1991), among others.

[3] See Alexander and Karger (2021), Barrios and Hochberg (2020), Chen and Pope (2020), Couture, Dingel, Green, Handbury, and Williams (2021), for the analysis in the US, Mizuno, Ohnishi, and Watanabe (2021) and Watanabe and Yabu (2021a,b) for the analysis in Japan, and Fang, Wang, and Yang (2020) for the analysis in China.

[4] For example, Athey, Ferguson, Gentzkow, and Schmidt (2020) construct a measure of segregation using the Global Positioning System (GPS) signals, which captures individuals' exposures to different groups of people. Miyauchi, Nakajima, and Redding (2021) measure commuting and non-commuting consumption trips using the location data to build a quantitative urban model. Matsumura, Oh, Sugo, and Takahashi (2021) use GPS mobility data to measure economic activity in real-time, which significantly outperforms the prediction based on conventional datasets.

The rest of the paper is organized as follows. Section 2 explains the institutional background relevant to our study. Section 3 details our dataset. Section 4 explains our empirical model and Section 5 presents the results. Section 6 presents a simple theoretical model that can account for the observed responses. Finally, Section 7 concludes.

2 Institutional Background

This section provides some institutional background about the MOQ system in the Japanese Diet relevant to our study. There are three important things to emphasize. First, the Cabinet must respond within a week after receiving the MOQs, and government officials prepare responses to the MOQs. Second, the time constraint was extremely tight, and it was relaxed slightly. Third, there was a change from a paper-based system to a paperless system.

2.1 Spirit of MOQ

Every Diet member has a right to ask questions to the Cabinet, and there are two forms of them. One is to ask oral questions during discussions at the Diet, which are the type of questions that attract media attention for their visual appearances.[5] The other form of questions is through submitting written documents (the MOQs) during the period of the Diet being held. This is our focus.

The system of the MOQ is important to ensure fair democracy. It is so because the MOQ provides all the Diet members with equal opportunities to inquire about the Cabinet's view on political issues and address important ongoing issues in society. Unlike the system of oral questions, where time allocation depends on the share of legislative seats of political parties, Diet members are allowed to submit as many MOQs as they want. Because of this flexibility, Diet members from opposing political parties typically take advantage of this system. Despite its noble purpose of preserving minority opinions, the MOQ system can be abused by the members of opposition parties.

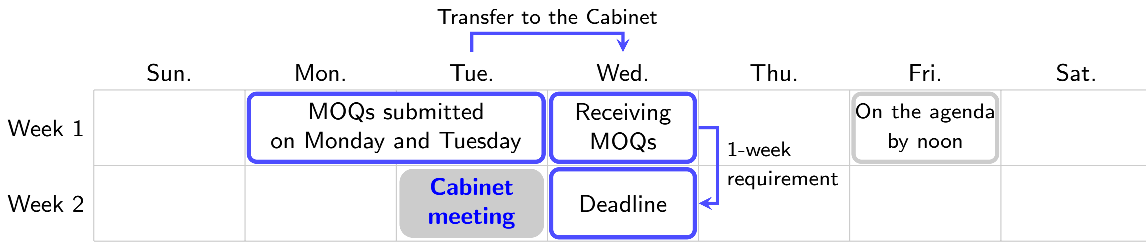
It is government officials that prepare replies to the MOQs on behalf of the Cabinet. As we will see in the next subsection, the time constraint for responding to the MOQs is tight, leading to overtime work.

2.2 Timeline of MOQ

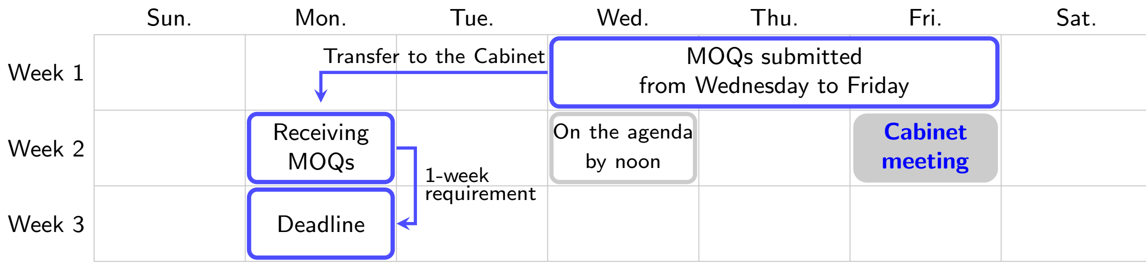
This subsection explains how the submitted MOQs are handled. This is relevant to determining the deadline and illustrates a sense of urgency for government officials. There was a change in the protocol. During 2018, the time constraint was relaxed. We will explain the previous schedule first and then how the constraint was relaxed.

Figure 1 illustrates the overall handling of the MOQs. The top two panels of Figure 1 correspond to the tight schedule before 2018. All MOQs submitted to either the House of Representatives or the House of Councillors are transferred to the Cabinet twice a week: on Monday and Wednesday. Under the tight schedule, those MOQs submitted on Monday and Tuesday are transferred to the Cabinet on the following Wednesday, which determines the deadline for responses. Upon receiving the MOQs, the Cabinet must respond to them within one week. In this case, MOQs submitted on Monday and Tuesday in Week 1 on

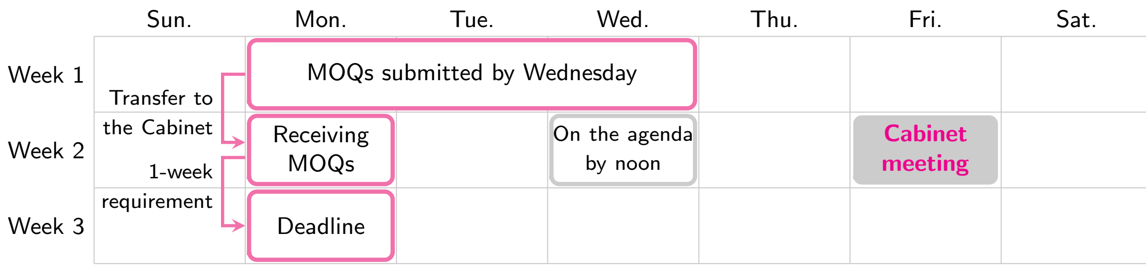
[5] It is said that preparing for oral questions is much more demanding and its time constraint is much tighter from the viewpoint of government officials. This is one of the main reasons for causing excessive overtime work for Japanese government officials. It would be interesting if we could get records for this type of question to quantify government officials' exposure to oral questions. However, as far as we are aware, such records are not publicly available.



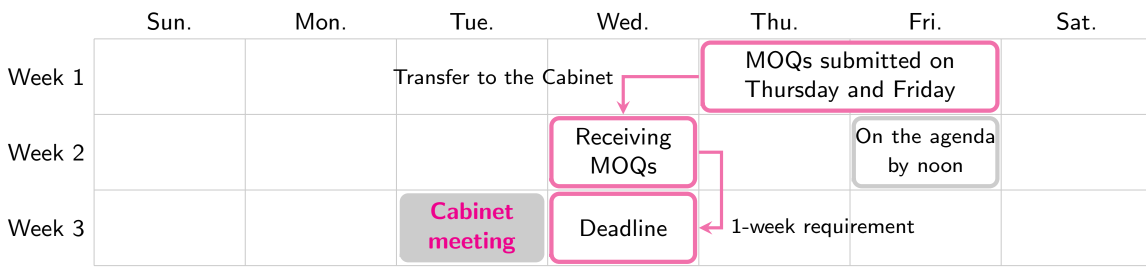
(a) Tight Schedule: MOQs submitted on Monday or Tuesday



(b) Tight Schedule: MOQs submitted from Wednesday to Friday



(c) Relaxed Schedule: MOQs Submitted by Wednesday



(d) Relaxed Schedule: MOQs Submitted on Thursday and Friday

Figure 1: Timeline of Handling MOQs: From Submission to Response

Figure 1(a) must be responded to by Wednesday of Week 2. A similar schedule applies to those submitted from Wednesday to Friday as shown in Figure 1(b).

Unlike the official deadline to respond to the submitter of the MOQ, there is a *practical* deadline from the viewpoint of government officials. Government officials prepare for replies. After going through a series of internal review processes, responses must be approved at the Cabinet meeting. To do so, the response must be listed on the agenda, which will be set in the morning two business days before the Cabinet meeting.

This requirement leaves a little time to prepare for the response. Government officials have two to four full working days (excluding the date of submission) until the *practical* deadline. For example, under the tight schedule, MOQs submitted on Tuesday or Friday are the toughest ones because they only have two full-working days until the *practical* deadline. Thus, once assigned, preparing responses has the highest priority for government officials on top of other tasks.

It is important to note that those questions submitted to the Houses become available to the government officials immediately, not after the official transfer to the Cabinet, which takes place on Wednesday or the following Monday. Upon submission of the MOQ, negotiation among representatives of ministries determines which ministry will be responsible for the MOQ. This will be done within one hour after the submission. This is when the contents of the MOQs will become available to government officials, and they initiate preparations behind the scenes.

A Diet member submits the MOQs to the Houses. The MOQs can be submitted on any business day, not like the case of oral questions where the time allocation is predetermined. This feature of MOQ submission is important for our identification strategy, and we will check the exogeneity of submission timing below.

The tight time constraint was relaxed in 2018. For the House of Representatives, from the 197th extraordinary Diet (October 14, 2018 – December 10, 2018), the timing of the transfer to the Cabinet was delayed.[6] As depicted in Figure 1(c), MOQs submitted from Monday to Wednesday are transferred to the Cabinet on the following Monday. This change was intended to mitigate the tight time constraint that government officials face. Government officials still have immediate access to the content of the MOQs upon submission. This change just extends the deadline because it is determined by the timing of being received by the Cabinet, not submission. A similar schedule applies to those submitted on Thursday and Friday, as shown in Figure 1(d). Because of this change, government officials now have four to six full-working days until the practical deadline.

Note that, unlike other days of the week, the time constraint for the MOQs submitted on Wednesday is unchanged. The Wednesday MOQs have full four working days until the *practical* deadline. We will use this fact later to evaluate the consequence of shifting from a paper-based system to a paperless system, which will be explained in the next subsection.

2.3 Shift to Paperless System

Before August 2019, the system of the MOQ had been completely paper-based. There were strict format requirements for those public documents such as font size, the number of characters in a single column (it is vertically written from top to bottom and from right to left in Japanese official documents), the number of columns, margins, and so on. To meet these formatting requirements on a hard copy, government officials had to spend additional time preparing their replies. They also had to go through an internal review process, where they prepared more than one hundred copies of documents in circulating their drafts.

Such an outdated practice finally came to an end on August 1, 2019. The House of Councillors adopted the digitalized MOQ from the 199th extraordinary Diet. Note that the shift to the paperless system and adoption of the less tight schedule happen at the same time for the House of Councillors. The House of Representatives also started using the paperless MOQs as of the 200th extraordinary Diet, which started on October 4, 2019.

[6]The House of Councillors adopted the same practice from the 199th extraordinary Diet (August 1, 2019 – August 5, 2019).

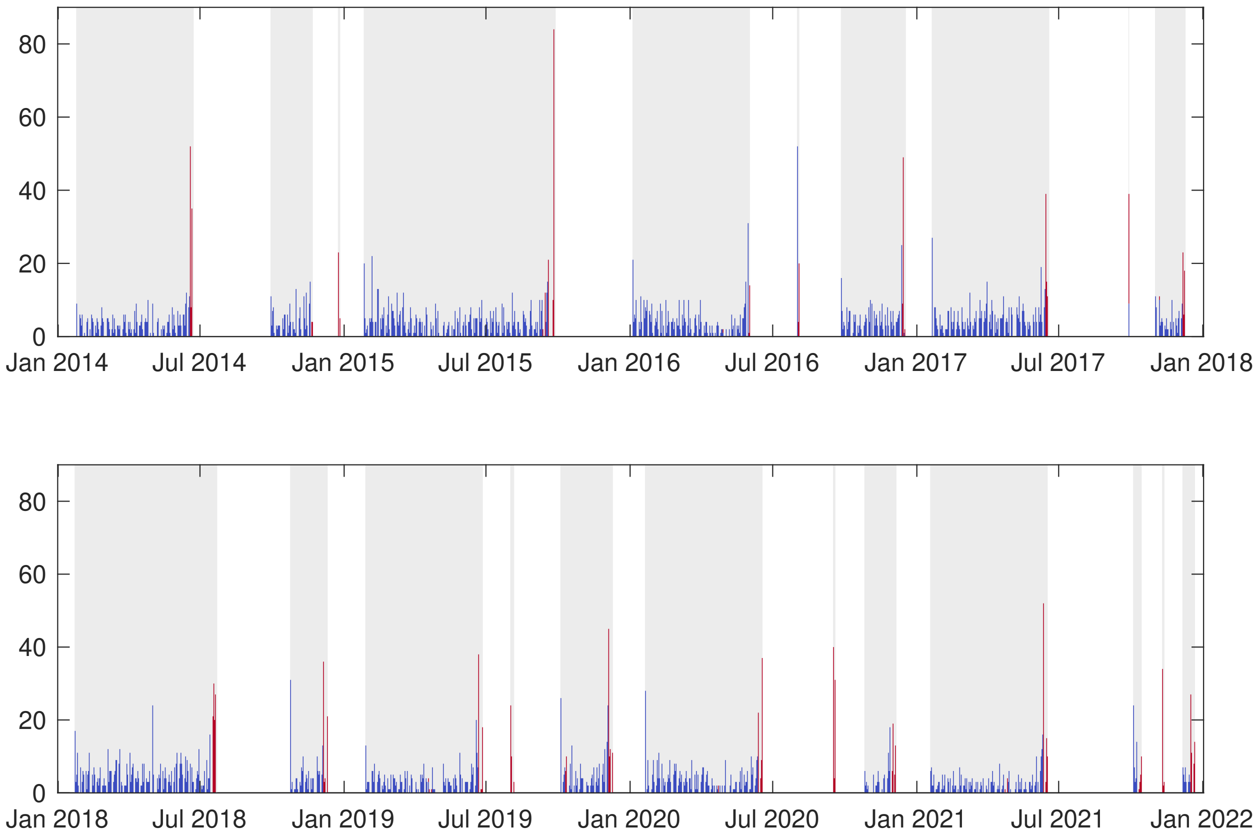


Figure 2: The Number of the Memorandum of Questions Submitted

Note: The top panel shows the number of MOQs submitted from 2014 to 2017 and the bottom panel covers from 2018 to 2021. The dark blue bars represent the number of MOQs that are responded to without any delays. The red bars indicate the number of the MOQs, responses to which are delayed. Shaded areas indicate when the Diet is held.

2.4 Salience of MOQ for Government Officials

You may wonder if government officials could save time by spending less attention and effort in preparing their replies. In this case, the MOQ would not cause serious overtime work to government officials. However, if the submitter of the MOQ is not satisfied with the response, he or she can submit another MOQ on the same topic up to three times.[7] Hence, the best interests of government officials would be that they prepare their best replies on their first try, and hence, could be a source of overtime work hours.

Finally, as we will argue later, the timing of MOQ submission is random and unpredictable. As they are unexpected and irregular work during the period of Diet, they could dampen the motivation and productivity of regular work by government officials.

3 Data

3.1 MOQ Data

Figure 2 shows the daily number of the MOQs submitted from 2014 to 2021. The shaded areas in the Figure correspond to the periods when the Diet is held. Policymakers can submit MOQs when the Diet is

[7]We can identify those re-submitted follow-up questions from the title of the MOQ.

held. As can be seen in the Figure, there are relatively large spikes in the number of the MOQs submitted at the beginning of Diet periods. These spikes reflect accumulated questions during the non-Diet period being submitted at once. We also see a large number of "last-minute" submissions of the MOQs at the end of Diet periods. These "last-minute" MOQs would stem from the fact that some voters regard the MOQ submission as an important contribution of policymakers, and that some policymakers want to make last-minute contributions. Typically, these last-minute MOQs are responded to with delays.

We exclude those MOQs whose responses are delayed because the 1-week requirement is not binding. We retrieve detailed information on MOQs, which is available from the websites of the House of Representatives and the House of Councillors. It includes the name of the submitter, date of submission, date of transfer from the House to the Cabinet, date of response, and open-ended contents of the questions and the replies, together with whether responses are postponed or not. From this information, we identify the MOQs with delayed responses, which are indicated by red bars in Figure 2.

3.2 Mobility Data

Our mobile location data cover four 500-square-meter areas in Kasumigaseki, which are shown in Figure 3,[8] from January 1, 2014, to December 31, 2021. It is based on the location information of users of NTT Docomo Inc., the largest mobile phone carrier in Japan. The information in this data set is based on 80 million mobile phones. Unlike other data sets based on GPS information, the location information is based on mobile phones' communication with base stations, which provides technological merits for our analyses: when mobile phones are turned on, they keep accessing nearby base stations even when they are not used. This means that we can obtain more accurate tracking of users than the GPS-based system, which requires that the GSP needs to be enabled and applications that use the GPS must be used.

Figure 4 illustrates overall population dynamics in the Kasumigaseki area. Each line in the Figure indicates an hourly population of a particular day in thousands. Our observation at a particular time is the number of people who are staying in the area for 60 minutes. If a person stays in the area for 15 minutes, she is counted as a quarter of a person. The number for a particular time slot corresponds to the number of people in the subsequent 60 minutes.[9] Note that we define that a typical day starts from 5:00 in the morning when the first train arrives at Kasumigaseki station, and it ends at 28:00, which is 4:00 in the next morning. The beginning and end of the day correspond to when we observe the minimum population in the Kasumigaseki area. Since we are interested in the overtime work of government officials, our data are on people of age groups from the 20s to 60s. In our data set, we can observe information about gender in addition to age categories.

As can be seen in the Figure, there are predictable patterns in the population dynamics. People come to their offices by 10:00. Some of them leave the area for their lunch break. They start to leave their office around 16:00, but there are more divergent patterns in leaving their offices. Even after midnight, we observe the non-negligible size of the population. During the weekends, we also see that some people come to this area (represented by the group of lines that are clustered less than twenty thousand and are peaked around 15:00). However, the size is not so comparable to that of weekdays.

After the COVID-19 pandemic, we observe slightly different patterns. Due to the remote working that was widely encouraged during the pandemic, the area population decreased by more than 20% during weekdays.

[8]The Half Grid Square codes defined by JISX0410 for Area 1 to Area 4 are `5339-4519-2`, `5339-4610-1`, `5339-4509-4`, and `5339-4600-3`, respectively.

[9]For example, if we observe 100 people in a particular area at, say, 8:00, it could mean that 100 people stay there for one hour, or 600 people remain in the area for 10 minutes each. We cannot identify the difference between these two.

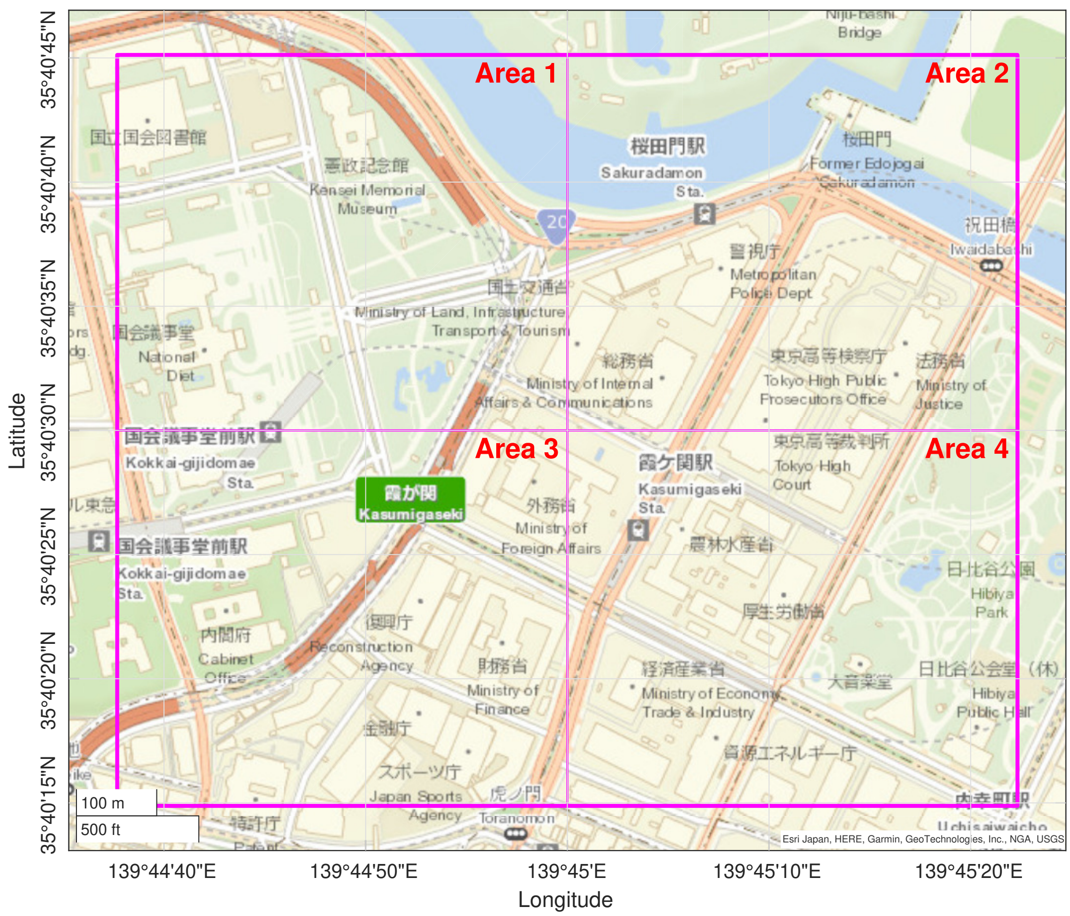


Figure 3: Kasumigaseki Area

Note: Area 1 includes a part of the Ministry of Foreign Affairs and Ministry of Land, Infrastructure, Transport and Tourism. Area 2 contains Metropolitan Police Department, Ministry of Justice, Ministry of Internal Affairs and Communications, Ministry of Land, Infrastructure, Transport and Tourism, Fire and Disaster Management Agency, Public Security Intelligence Agency, and Japan Fair Trade Commission. Area 3 includes a part of the Ministry of Foreign Affairs, Ministry of Economy, Trade and Industry, Ministry of Agriculture, Forestry and Fisheries, Ministry of Health, Labour and Welfare, Ministry of the Environment, and National Personnel Authority. Area 4 comprises the Ministry of Foreign Affairs, Ministry of Finance, National Tax Agency, Cabinet Legislation Bureau, Cabinet Office, Ministry of Education, Culture, Sports, Science and Technology, Board of Audit, Financial Services Agency, and Patent Office.

The day-to-day variations differ as well if we compare 2019 and 2021. In the transition, there are large changes in the area population in 2020.

4 Model

We are interested in what would be the impact of submitting an extra MOQ on the overtime work of government officials in the near future. In other words, for $h = 0, 1, \cdots$, our objective is to compute

$$\frac{\partial p_{HH,t+h}}{\partial q_t}, \tag{1}$$

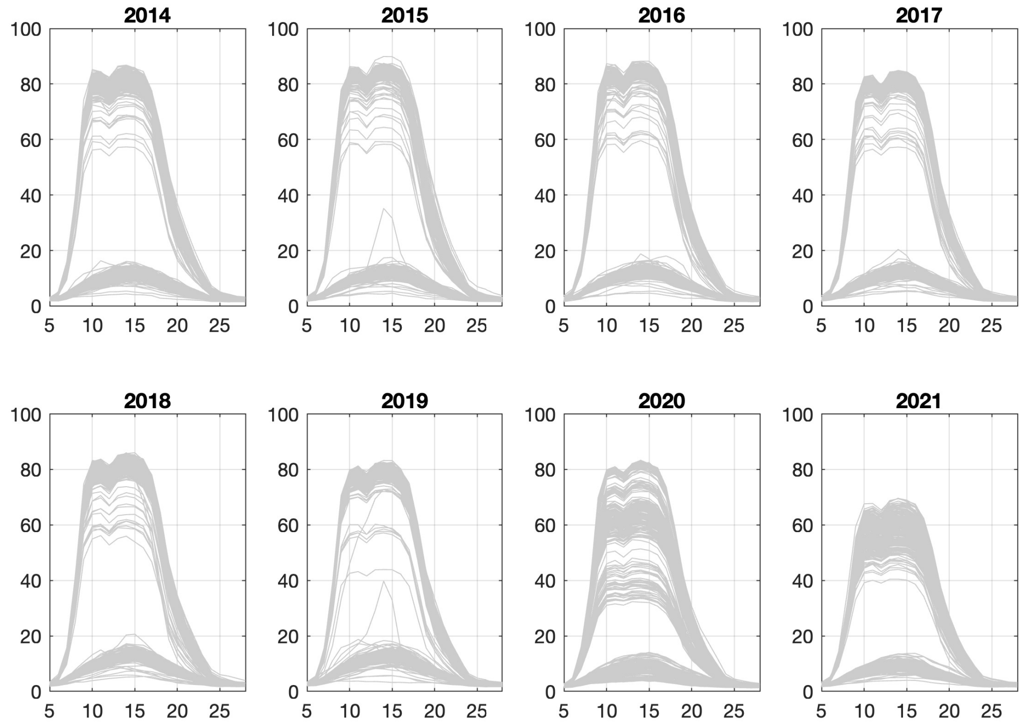


Figure 4: Mobility Patterns in the Kasumigaseki Area (thousands)

Note: Clock time is on horizontal axes. Vertical axes measure the number of people in the Kasumigaseki area in thousands.

where $p_{HH,t}$ represents the log hourly population at *HH* o'clock on a weekday t and q_t corresponds to the number of MOQs submitted at date t.[10]

Using the local projection method proposed by Jordá (2005),[11] we can estimate (1) from the following single regression

$$p_{HH,t+h} = \alpha + \theta_{HH,h} q_t + \boldsymbol{\phi}'_{HH,h} \boldsymbol{x}_t + e_{HH,t+h}, \tag{2}$$

where α is a constant term, $\boldsymbol{x}_t$ represents a vector of control variables, $\boldsymbol{\phi}_{HH,h}$ corresponds to the associated vector of coefficients, and $e_{HH,t+h}$ is an error term. Our interest is on $\theta_{HH,h}$. It measures how the area population at *HH* o'clock changes h days after an MOQ is submitted at date t. The control variables include past log population, a measure of media coverage, and a set of dummy variables. The past log population consists of the early-time population of the same date and the lagged population on earlier dates. It is given by

$$\underbrace{\sum_{i=1}^{p} \beta_i p_{HH-i,t}}_{\text{early-time population}} + \underbrace{\sum_{j=1}^{d} \gamma_j p_{HH,t-j}}_{\text{lagged population}} . \tag{3}$$

We include a measure of media coverage that is relevant for the government ministries.[12] This measure is

[10]We focus on weekday observations. The inclusion of weekend observations does not affect our result, but it complicates the interpretation of the estimation results.

[11]For a more recent discussion, see Montiel Olea and Plagborg-Møller (2021) and Plagborg-Møller and Wolf (2021).

[12]Our measure is based on the Nikkei Newspaper articles. We search for the number of Nikkei articles that contain a list of

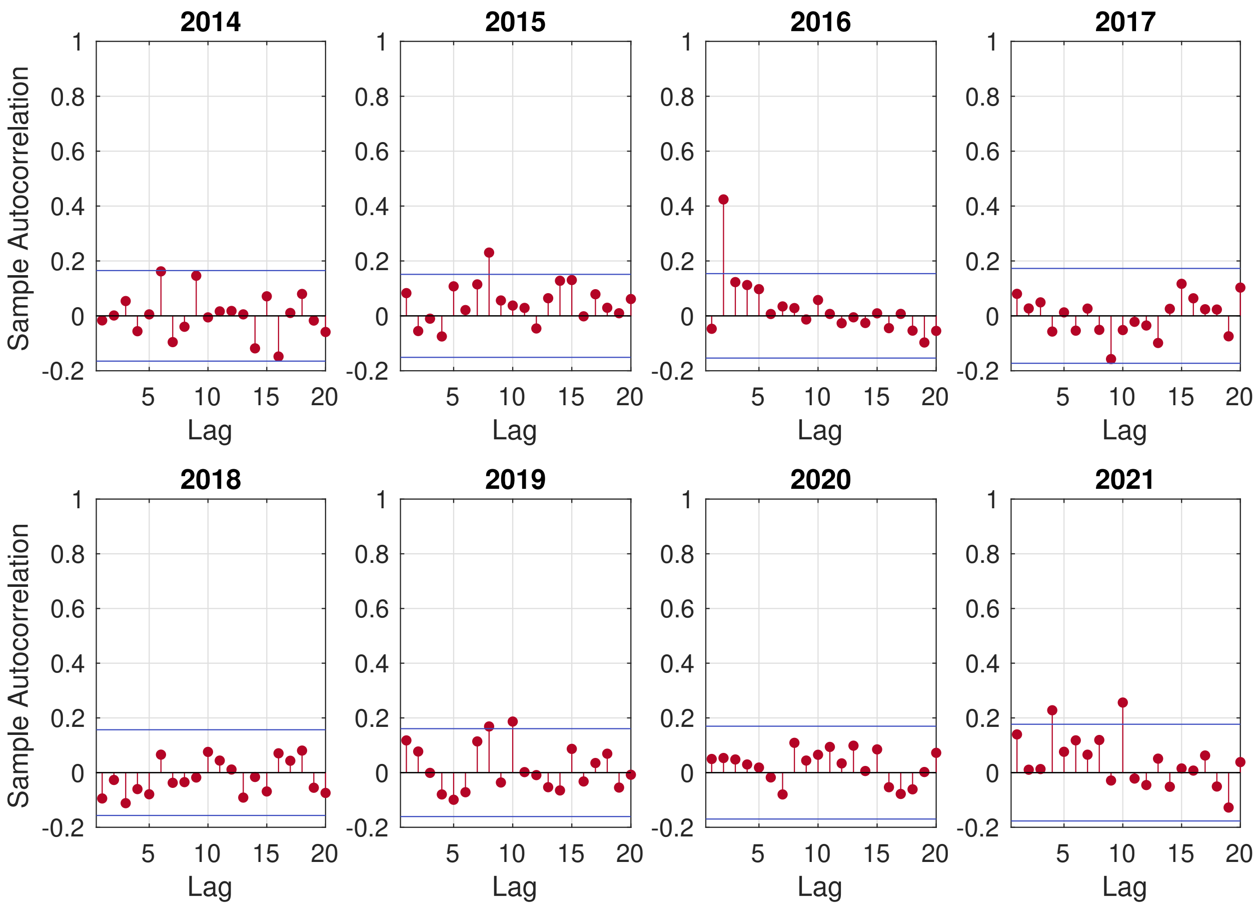


Figure 5: Sample Autocorrelation of the MOQ by Year

Note: Each plot shows sample autocorrelation of the non-delayed MOQs. The blue lines indicate ±2 standard-error confidence bounds based on the assumption that it is white noise.

intended to capture the effect of ongoing policy debates and government-related scandals that could affect the overtime work of government officials. A set of dummy variables contains (i) the Diet period dummy, (ii) year dummies, (iii) day-of-week dummies, (iv) national holiday dummies (including observed ones), and (v) state of emergency dummies (when they are relevant).[13]

A critical presumption is that the number of MOQs and the timing of the submission are exogenous so that changes in q_t are "shocks" to government officials. One way to justify this assumption is to check autocorrelation in q_t. Figure 5 presents sample autocorrelation functions of q_t by year. Overall, we do not need to worry about serial correlation in q_t. The only exception may be the MOQs submitted in 2016. Results of the Ljung-Box tests are in line with the visual impression from Figure 5. We fail to reject the null hypothesis that there is no autocorrelation, except for 2016.

The exogenous nature of submitting MOQs can be supported from a different angle. Tanaka (2008), who documents the detailed procedures for preparing the response to the MOQs from the perspectives of public administration, provides supportive evidence for the exogeneity of MOQs. Tanaka (2008) argues that

ministries. We count the total characters of the relevant articles. We exclude articles that report promotions of government officials and conferring decorations and special reports on official land prices.

[13]During the COVID-19 pandemic, Tokyo experienced a state of emergency four times. The first one was from April 7, 2020, to May 25, 2020, the second one was from January 8, 2021, to March 21, 2021, the third one was from April 25, 2021, to June 20, 2021, and the fourth one was June 12, 2021, to September 30, 2021.

government officials cannot anticipate the submission of the MOQs. He also emphasizes the abruptness of the MOQs because policymakers can ask questions about anything and anytime (during the Diet period) whenever they think it is necessary and force to receive replies within a week. Of course, there are some predictable MOQs by skimming through the list of MOQs. For example, when the Diet starts, we almost always observe a set of questions submitted by particular policymakers on certain matters. When there are scandals for ministries and government agencies, we can easily predict that the related MOQs will be submitted. Given the nature that a single Diet member can submit the MOQs anytime, we cannot anticipate exactly when they will be submitted. We provide some robustness checks to address this issue.

Even when the submission of the MOQs was anticipated, the impact on the overtime population would be accurately measured. First, the difficulty and complexity of how to respond and how long it will take to prepare are unpredictable. Second, from the viewpoint of an individual government official, it is unpredictable whether she or he will be assigned to it or not. This is related to the fact that when the MOQs are submitted, negotiation among representatives from ministries determines which ministry will be responsible for the MOQs. Third, government officials are already working at their margins. The anticipation affects our results greatly when there is room for government officials to smooth their workloads. However, it is a well-known fact that the working environment for government officials is extremely tight and that overtime work is quite common. It does not make sense to prepare for something that has not been submitted yet when they are already overloaded and working on the intensive margin.

It may be the case that the mobility dynamics in the Kasumigaseki area are affected by something other than our control variables. One possibility would be the flow from neighboring areas. It might be relevant, especially during the daytime. However, we do not know the mesh-to-mesh flow of people. To the extent that such flow is unrelated to the number of MOQs, the estimated impact of the MOQ shock will be unaffected. Moreover, there are no other high-frequency data available to account for determinants of the area population. One potential candidate would be to include weather-related variables, such as temperature and rainfall. However, the area we are interested in is a business district. Unlike recreational or tourist places, it seems that the area population in the business district is less likely to be affected by changes in weather. Even when it is the case, the lagged population in the area can account for such an effect. It may be important to include forward-looking variables, such as heavy rain/snow warnings, however. These warnings may induce people to go home earlier. Again, to the extent that these warnings are unrelated to the MOQ submission, the estimated impact of the MOQ will be unrelated.

5 Results

This section examines the estimated impact of the MOQs on the overtime population

$$\frac{\partial p_{HH,t+h}}{\partial q_t} = \hat{\theta}_{HH,h}, \tag{4}$$

for $HH = 17, \cdots, 28$. For each HH, we estimate this for $h = 0, 1, \cdots, 14$, that is for two weeks ahead. We set $p = 3$ and $d = 1$ for the past population in (3). To the extent that we include a sufficient number of lags for the past population, the estimated results are robust to different choices of p and/or d. Typically, it is a common practice to use the Newey-West standard errors because it is typically argued that the error term will be serially correlated. As discussed in Montiel Olea and Plagborg-Møller (2021), however, our specification includes the lagged population in the controls and, thus we use the standard heteroscedasticityrobust standard errors for constructing error bands. Note that it is well-known that the error bands tend to be wide with local projection (c.f., Ramey, 2016; Barnichon and Brownlees, 2019). So, our results can be viewed as conservative estimates for the impact of the MOQs on overtime work in the Kasumigaseki area.

We begin by looking at the unconditional responses of overtime work to the MOQ shock, which is an exogenous increase in the number of MOQs submitted at date t. After providing a validity check for exogeneity, we will decompose the unconditional responses. Further, we will explore the consequences of submitting the MOQ under different circumstances.

5.1 Unconditional Responses

Interestingly, the MOQ shock initially reduces the area population and then increases the overtime work persistently. Figure 6 shows percentage changes in the area population in response to the MOQ shock. Each panel in Figure 6 displays responses in each clock time, HH. That is, it plots $\hat{\theta}_{HH,t+h} \times 100$ as a function of the number of working days after the MOQ shock, h, which is on the horizontal axis of each panel. Thick lines represent point estimates, and thin lines correspond to $\pm$2-standard-error bands. Dots indicate significant responses. There are no significant responses observed on the impact day ($h = 0$). Interestingly, one day after receiving the MOQ shock, we observe large drops in the Kasumigaseki population from 17:00 to 25:00 (and also at 27:00). On average, it takes time for the MOQ shock to increase overtime work significantly. Four days after the shock, the early-evening population starts to increase significantly. Even six or eight days after the shock, the MOQ shock significantly increases the late-night population (from 21:00 to 23:00).[14]

There are significant effects observed even 12 days after the MOQ shock. Because of the 1-week requirement, we do not expect to see changes in the overtime population beyond the deadline of the MOQ. However, it is possible that the MOQ shock can have persistent impacts on overtime work if the additional tasks created by the MOQ shock crowd out the ordinary routines. In fact, this may be the case. We do observe significant increases in the overtime population 12 days later. This can happen if there are rippled effects of preparing for the reply to the MOQ on regular tasks. We call this indirect impact beyond the MOQ deadline a congestion effect. On average, we observe congestion effects for early-evening periods. The magnitude is comparable to the direct impact we observed earlier. This congestion effect is an important side effect arising from policymakers submitting the MOQ.

Figure 7 summarizes the responses for selected dates. The responses of the overtime work one day after receiving the MOQ shock are on the left panel and those eight days later are on the right. One day after receiving the MOQ shock, the overtime work significantly decreases from 17:00. It peaks at 20:00 and gradually returns to zero. At 20:00, the area population is reduced by more than 0.4%. Unlike the initial decreases, we observe increases in the area population even eight days after the shock. The overtime work increases at 17:00 by more than 0.2% and it shows hump-shaped responses and remains significant until 23:00. It becomes insignificant after 24:00. This result suggests that upon receiving the MOQ shock, government officials work overtime by midnight.

Is the impact negligible? We argue that it is not. Typically, a single MOQ is assigned to one person. If his/her overtime work is affected, it might be acceptable because preparing the reply in a timely manner is necessary to guarantee healthy discussion among policymakers and transparency of the Cabinet. However, if more than one government officials are involved, submitting the MOQ creates a negative spillover effect. Table 1 summarizes the back-of-envelope calculation based on the average weekday population in each time slot during the Diet period. For example, one day later, a single MOQ would decrease the area population

[14] A significant increase at 23:00 means the area population from 23:00 to 23:59 is increased significantly in a statistical sense.

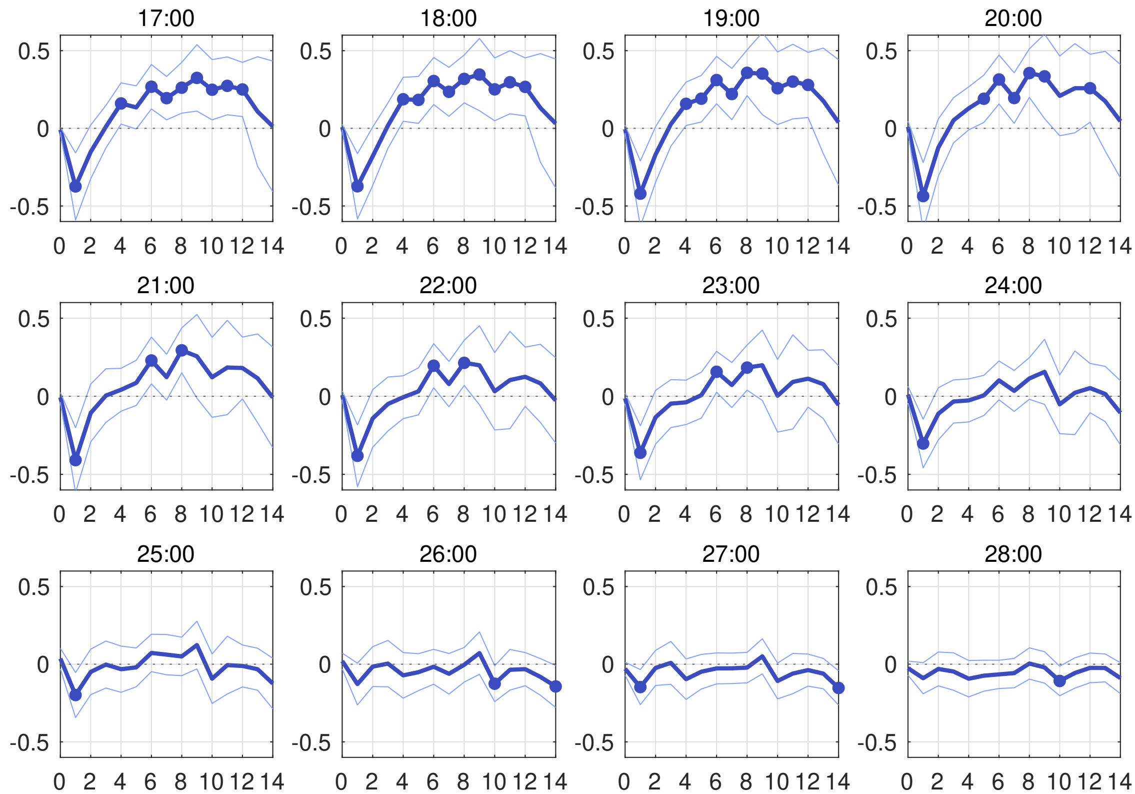
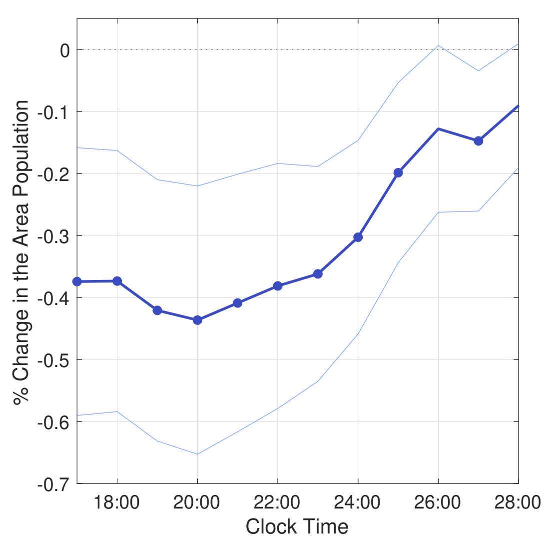
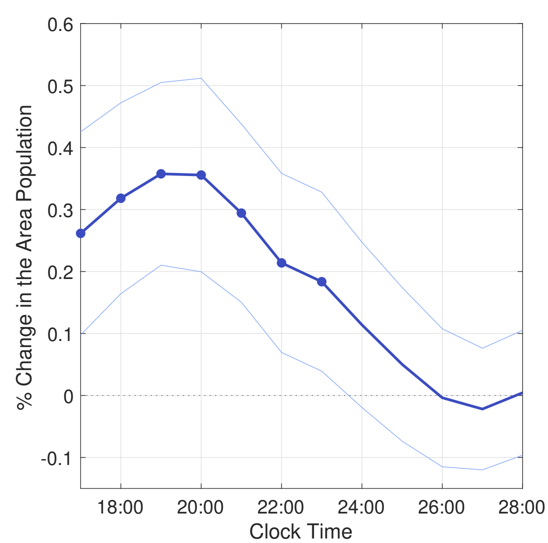


Figure 6: Impact of the MOQ Shock on the Nighttime Population in Kasumigaseki

Note: Vertical axes measure percentage changes in area population. Horizontal axes measure the number of working days after an MOQ is submitted. Thick lines are point estimates, and thin lines represent ±2-standard-error bands. Dots indicate significant responses.



(a) 1-Day-Later Responses



(b) 8-Day-Later Responses

Figure 7: Responses to the MOQ Shock for the Selected Dates

Note: Vertical axes measure percentage changes in area population. Horizontal axes represent clock time. Thick lines are point estimates, and thin lines represent ±2-standard-error bands. Dots indicate significant responses.

Table 1: Average Population during the Diet Period

		Estimated Changes	
Time	Population	1-day Later	8-day Later
17:00	66,026	-247	173
18:00	52,950	-198	169
19:00	37,463	-158	134
20:00	26,796	-117	95
21:00	19,134	-78	56
22:00	13,173	-50	28
23:00	8,399	-30	15
24:00	4,557	-14	5
25:00	3,463	-7	2

Note: The population is the average number during the weekdays in the Diet period. The estimated changes in the area population are calculated based on the point estimates for $h = 1$ and $h = 8$.

by 30 people at 23:00. Eight days later, there would be more than 15 people working overtime due to the MOQ shock. This is clearly non-negligible.

A caveat here is that the estimated results after 24:00 may be overstated. The last train from Kasumigaseki station is around 24:30. When a government official leaves the Kasumigaseki area after the last train, it is typically accompanied by a taxi driver. In this case, we count two people leaving the area together, and no way to exclude such a possibility.

5.2 Placebo Test

The validity of our estimate hinges on the fact that the submission of the MOQ is exogenous to government officials. To some extent, some of MOQs might be anticipated, especially those submitted at the beginning of the Diet period. To examine this possibility, we estimate

$$\frac{\partial p_{HH,t-k}}{\partial q_t} \tag{5}$$

for $k = 1, 2, 3$ as placebo tests. That is, we estimate changes in the population *in the past* when there is an additional increase in the MOQ *today*. Figure 8 summarizes the result of this placebo test.

It turns out that almost all responses are insignificant. The only exception is when $k = 1$ at 21:00. Although it appears to be marginally significant, the magnitude is economically quite small. This result suggests that the overtime population is not reacting to potentially anticipated changes in the number of MOQs.

In fact, this result is consistent with the working environment of Japanese government officials. They are known to be extremely busy and they are always working at extensive margins. Under such an environment, there is no incentive for them to react to something that is more or less anticipated, but not yet materialized. Even when a particular MOQ is anticipated, there is no reason to believe that she or he will be assigned to it.

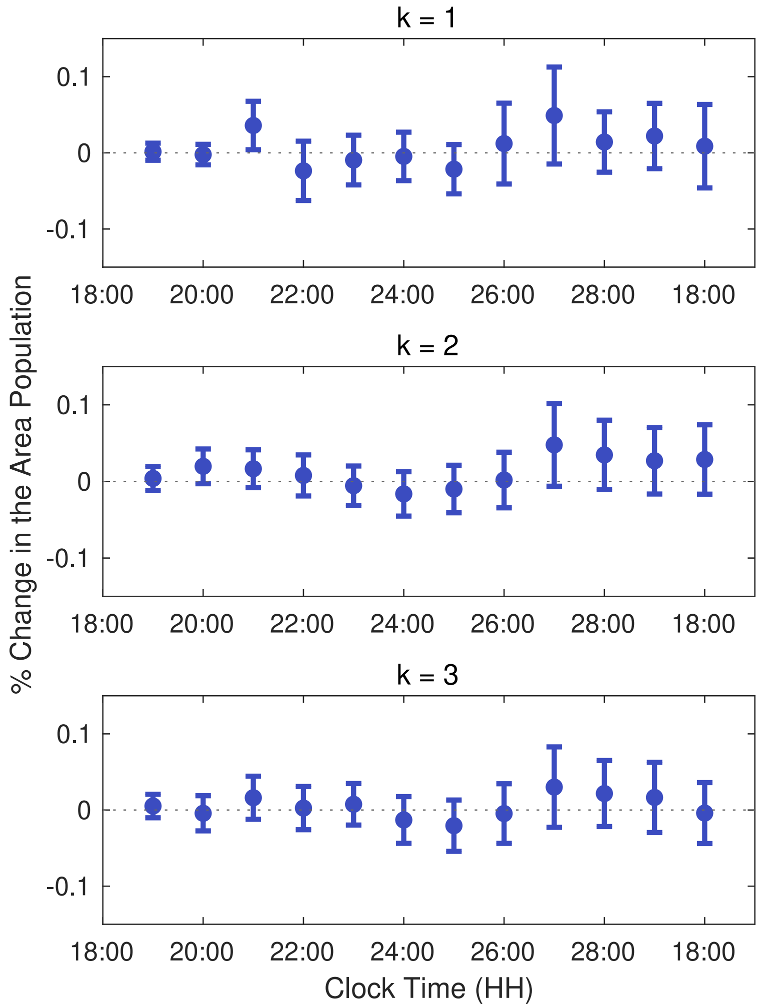


Figure 8: Placebo Test

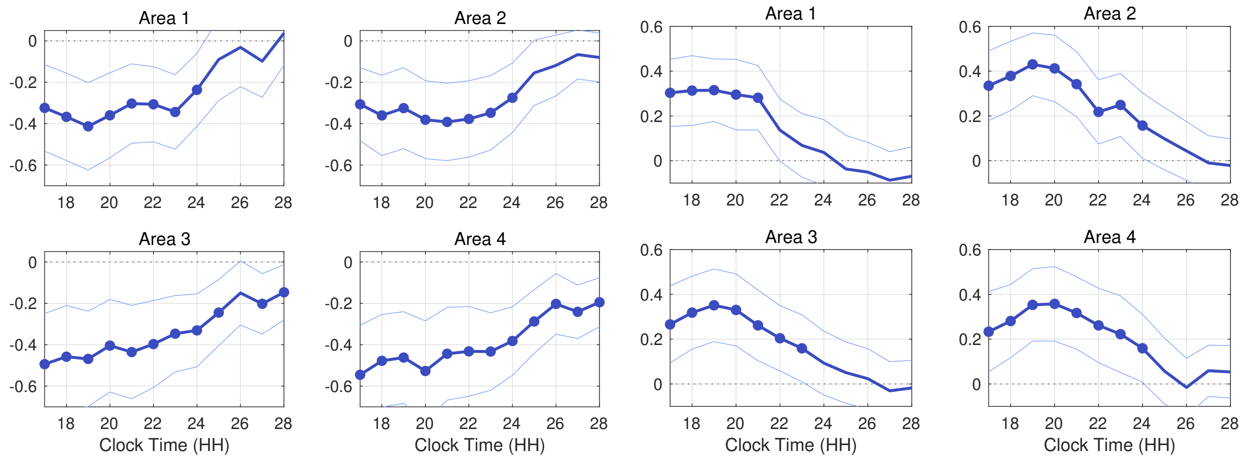
Note: The above plots show $\partial p_{HH,t-k}/\partial q_t \times 100$ for $k = 1, 2, 3$. Vertical axes measure percentage changes in area population. Horizontal axes correspond to clock time. Error bars are based on ± 2 standard error.

5.3 Decomposing the Unconditional Responses

In this subsection, we will decompose the unconditional responses to the MOQ shock by examining the impacts on subcategories of $p_{HH,t+h}$. Our dataset allows us to decompose them into four different areas shown in Figure 3. It is also possible that we can examine different responses of the area population by gender and age groups.

Figure 9 presents area-specific responses to the MOQ shock. The left panels are 1-day-later responses and the right panels are 8-day-later responses. For initial decreases in overtime work, much action seems to come from Area 3 and Area 4. While the responses in Area 2 become insignificant after 24:00, those in Area 3 and Area 4 remain significant. However, Area 2 is relatively more dominant for eight-day-later increases in overtime work than Area 3 and Area 4. Area 1 shows somewhat muted responses compared with other areas. This is because there are not many ministries located in Area 1. The National Diet and the Diet Library mostly occupy Area 1.

In terms of gender-age-specific responses, we can observe heterogeneous patterns in different gender-age-



(a) 1-Day-Later Responses

(b) 8-Day-Later Responses

Figure 9: Area-Specific Responses to the MOQ Shock for the Selected Dates

Note: Vertical axes measure percentage changes in area population. Horizontal axes represent clock time. Thick lines are point estimates, and thin lines represent $\pm$2-standard-error bands. Dots indicate significant responses.

specific responses. Figure 10 summarizes gender-age-specific responses to the MOQ shock. The top panels are responses of male government officials of different age groups and the bottom panels respond to female counterparts. The left panels are responses one day after the MOQ shock, while the right panels correspond to those eight days after the shock.

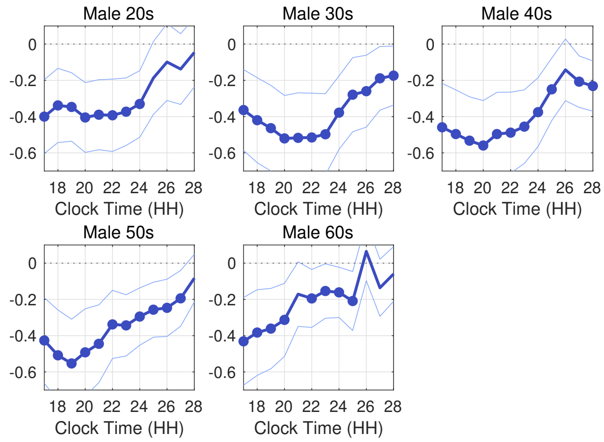
For each age category, male responses are stronger and more persistent than female counterparts. This is true regardless of increases or decreases in the area population.

Compared with other age groups, 20s are less responsive to the MOQ shock than other age groups, regardless of gender. This is interesting because it is widely believed that young government officials have to work too long and such a tough working environment causes health problems and quits of young government officials. It may be the case that government officials in their 20s are always working at their margins regardless of whether MOQs are submitted or not. In other words, there are almost no rooms at intensive margins that they can adjust. The weaker responses of the 20s may be consistent with such a situation.

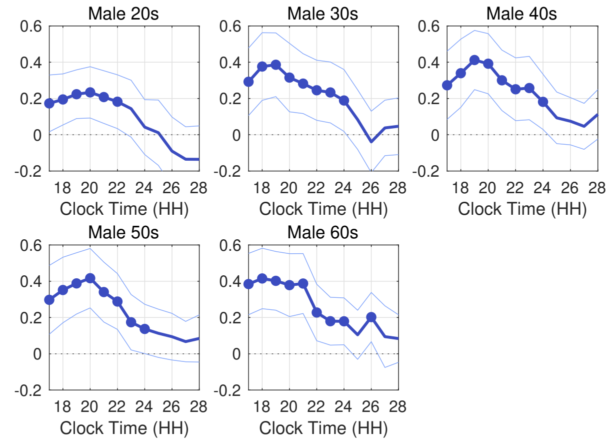
Responses of the 60s are somewhat insignificant, especially for females. An important caveat here is that most government officials retire at the age of 60. To be precise, they retire on March 31 of the fiscal year when they become 60 years old. There are some exceptions for higher-ranked officials, but, in this sense, there might not be enough 60s who are affected by the submission of the MOQ. Another concern is the effect of taxi drivers after midnight. As mentioned earlier, we cannot avoid double-counting taxi drivers if government officials leave the Kasumigaseki area by taxi. Some taxi drivers are in their 60s. For these reasons, the interpretation of the responses for the 60s requires some caution.

5.4 Consequences of Relaxing the Time Constraint

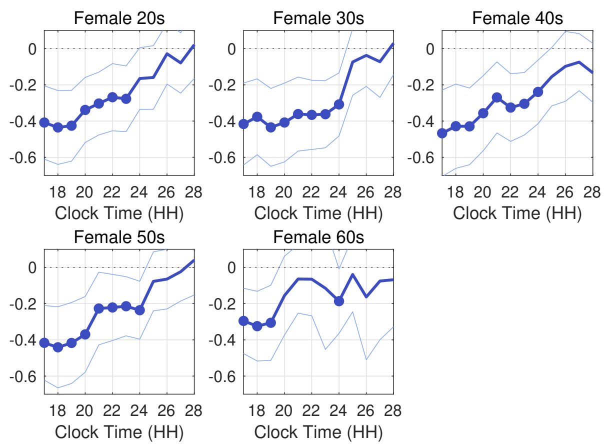
In this subsection, we will explore the effects of the MOQ shock under different time constraints. So far, we have estimated the impact of the MOQ shock on the Kasumigaseki population over the sample period as if the time constraints are the same. As explained in Section 2, the schedule was much tighter in the early days, and later it was relaxed to allow for additional time. In addition, handling of the MOQs was completely paper-based before, the paperless system was first introduced to the House of Councillors from



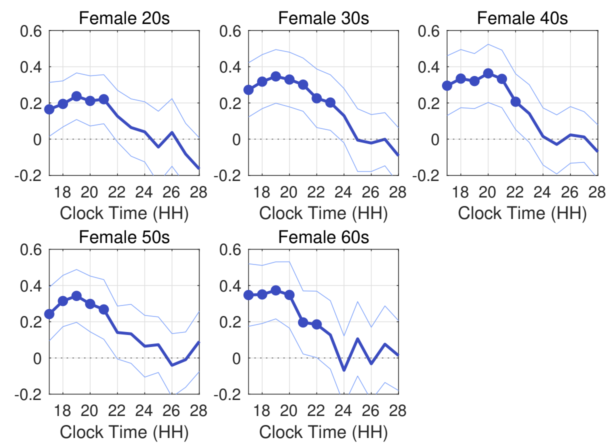
(a) Male-Age-Specific Responses One Day Later



(b) Male-Age-Specific Responses Eight Days Later



(c) Female-Age-Specific Responses One Day Later



(d) Female-Age-Specific Responses Eight Days Later

Figure 10: Gender-Age-Specific Responses to the MOQ Shock

Note: The top panels show male-age-specific responses, and the bottom panels are female counterparts. The left panels are responses one day after the MOQ shock, while the right panels correspond to those eight days after the shock. Vertical axes measure percentage changes in area population. Horizontal axes measure clock time. Thick lines are point estimates, and thin lines represent ±2-standard-error bands. Dots indicate significant responses.

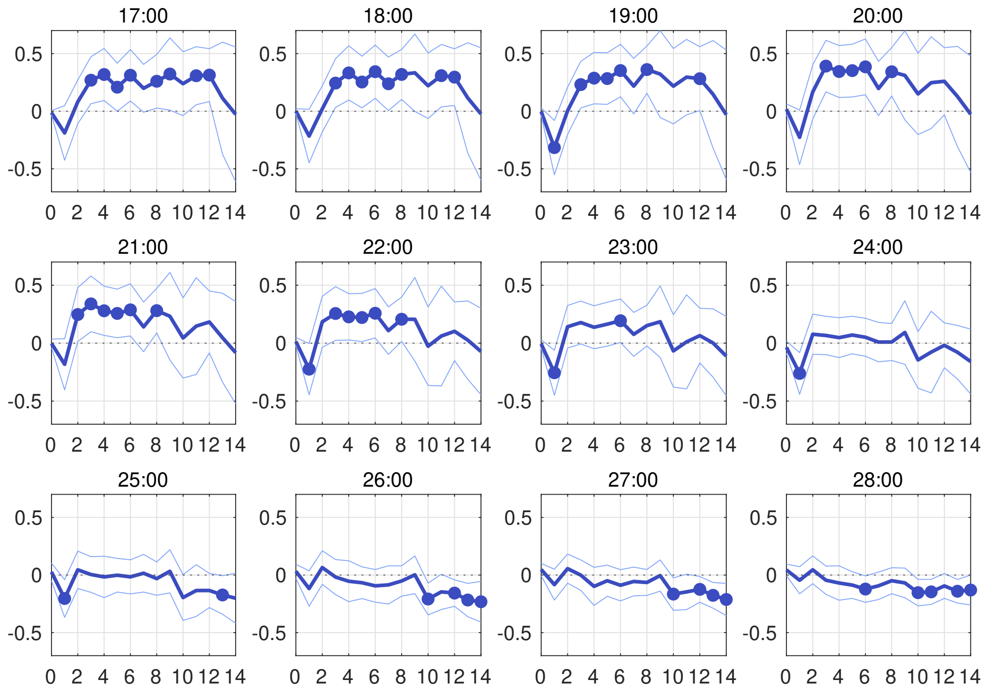
the 199th extraordinary Diet (August 1, 2019 – August 5, 2019) and then to the House of Representatives from the 200th extraordinary Diet (October 4, 2019 – December 9, 2019).

First, we will look at the effect of the MOQ shock under the tight schedule, as illustrated in Figures 1(a)–1(b). In this exercise, we just include the MOQs whose deadline is tight (from the 186th ordinary Diet to the 196th ordinary Diet for the House of Representatives, and to the 198th ordinary Diet for the House of Councillors).

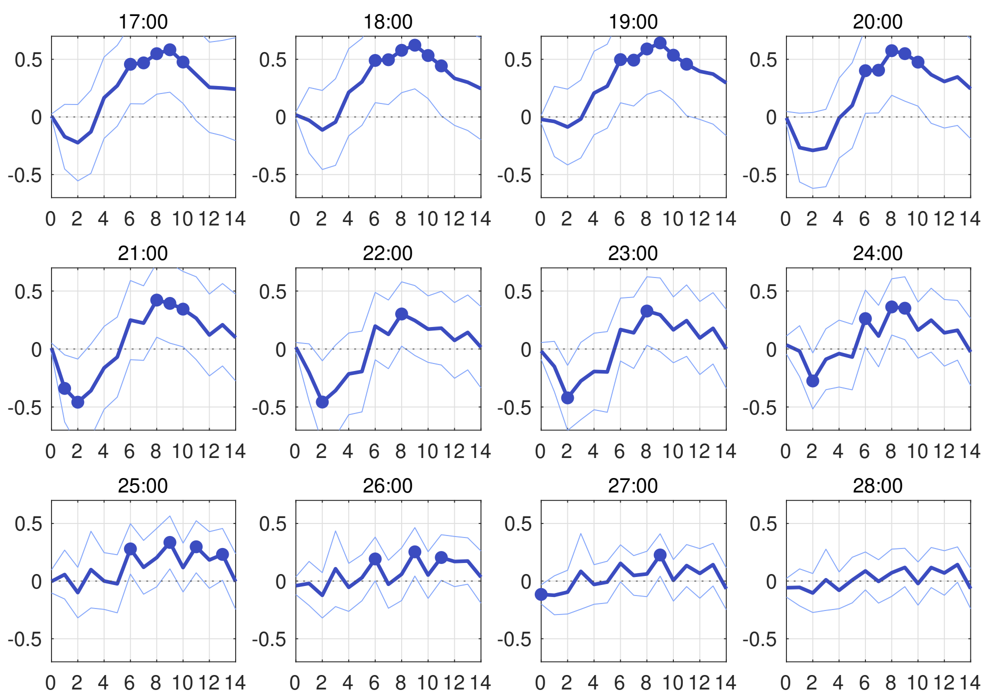
Second, we will look at a subset of the MOQs that are submitted from the 200th extraordinary Diet to the 207th extraordinary Diet. These MOQs are submitted under the relaxed schedule shown in Figures 1(c)–1(d).[15] Note that these MOQs are handled through the paperless system as well.

The top panel of Figure 11 shows the estimated responses under the tight schedule. Compared with the

[15]Note that we do not include the 199th extraordinary Diet for the House of Councillors because all the MOQs are responded with delays.



(a) Responses under the Tight Schedule



(b) Responses under the Relaxed Schedule

Figure 11: Impact of Relaxing the Time Constraint

Note: Panel (a) shows responses under the tight schedule illustrated in Figures 1(a)–1(b), while panel (b) displays those under the relaxed schedule shown in Figures 1(c)–1(d). Vertical axes measure percentage changes in population. Horizontal axes measure the number of working days after an MOQ is submitted. Thick lines are point estimates, and thin lines represent $\pm$2-standard-error bands. Dots indicate significant responses.

unconditional responses shown in Figure 6, we observe significant responses earlier than those in the whole sample. Two or three working days after the shock increases in the area population become significant. This is consistent with the tight schedule explained in Section 2. Under the tight schedule, government officials need to prepare responses at most within four full working days. The majority of estimated increases in overtime work stem from the congestion effect, rather than the direct impact of the MOQs.

The bottom panel of Figure 11 presents the estimated responses under the relaxed time constraint.. Compared with the unconditional responses in Figure 6, the estimated responses show much stronger congestion effects, especially in the early evening. It takes six working days until the congestion effect becomes apparent. Under the relaxed schedule, government officials at most have six full-working days until the practical deadline. Thus the estimated increases in overtime work are mainly due to the congestion effect.

We see the drops in the area population one or two working days after the MOQ shock, regardless of whether under the tight schedule or the relaxed schedule. The magnitude is greater for those under the relaxed schedule than for those under the tight schedule.

Overall qualitative patterns remain unchanged even when we account for different time constraints. The exact timing and magnitude differ depending on the time constraint government officials face. Upon receiving the MOQ shock, the overtime work tends to decrease initially, and then it starts to increase and persists beyond the MOQ deadline.

5.5 Responses to the Wednesday Shock

The above discussion is slightly misleading because those responses under the relaxed schedule examined above reflect two changes: relaxed schedule and paperless system. To isolate the effect of introducing the paperless system, we will take advantage of the fact that the time constraint for the MOQs submitted on Wednesday is unchanged, as mentioned in Section 2.2.

If we focus on the impact of the MOQs submitted on Wednesday and compare before and after the 200th extraordinary Diet when the paperless system was introduced, we can infer the impact of shifting from the paper-based system to the paperless system. To this end, we estimate the following specification:

$$p_{HH,t+h} = \alpha + \theta_{HH,h} q_t^w + \kappa_{HH,h} s_t q_t^w + \boldsymbol{\phi}'_{HH,h} \boldsymbol{x}_t + e_{t+h}, \tag{6}$$

where q_t^w represents the number of MOQs submitted on Wednesday and s_t is a dummy variable, which takes 1 if the date t is after October 4, 2019, when the 200th extraordinary Diet begins. The coefficient $\kappa_{HH,h}$ captures the impact of introducing the paperless system.

Figure 12 plots $\hat{\kappa}_{HH,h} \times 100$. Some point estimates suggest that there are decreases in MOQ-related overtime work under the paperless system. Most of them remain insignificant, however. This result is not conclusive, yet suggestive that the paperless system has not mitigated overtime work induced by the submission of the MOQs.

6 A Simple Model of Optimal Work Allocation

This section presents a theoretical model that can account for the observed responses following the MOQ shock. A noticeable aspect of the estimated responses may be that the overtime work *decreases* one day after the MOQ shock, and then it increases gradually. We show that this pattern arises naturally as a result

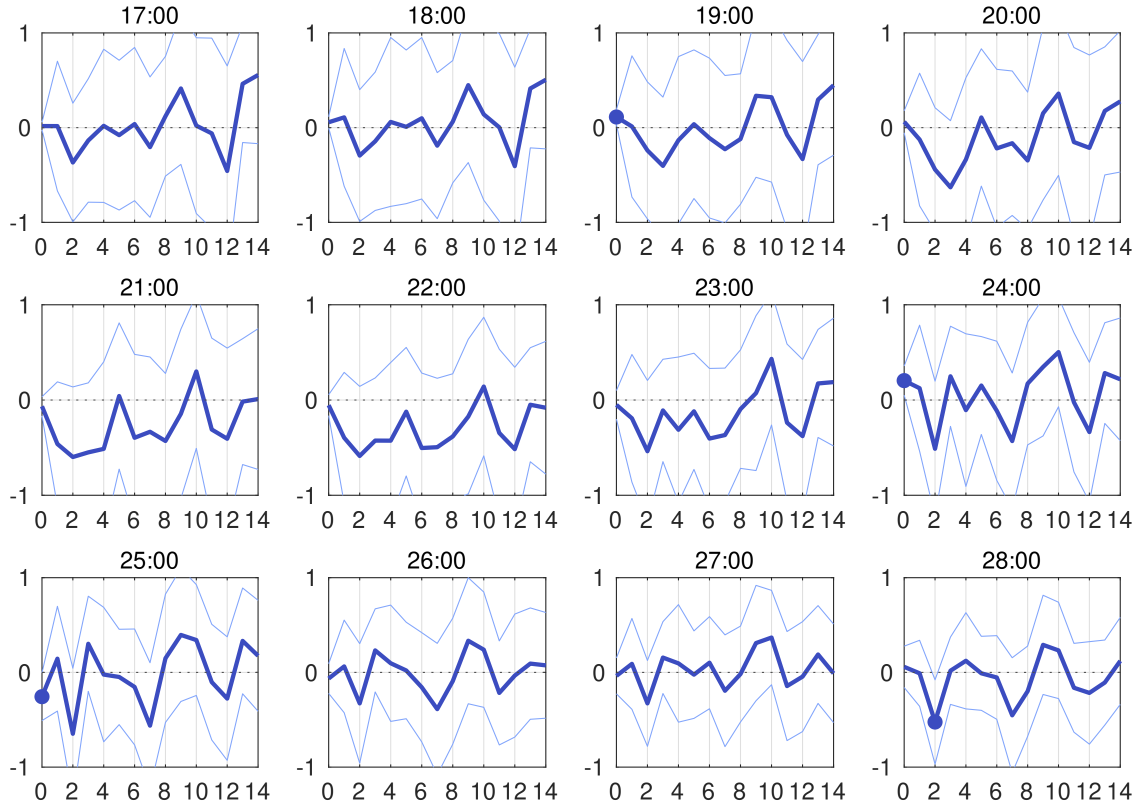


Figure 12: Impact of the Wednesday-MOQ Shock under the Paperless System

Note: Vertical axes measure percentage changes in area population. Horizontal axes measure the number of working days after an MOQ is submitted. Thick lines are point estimates, and thin lines represent ±2-standard-error bands. Dots indicate significant responses.

of the intertemporal optimization of working hours combined with an enforced task assignment in future periods.

Intuitively, upon receiving an irregular task such as MOQ, workers foresee increases in working hours in future periods. The task cannot be reallocated to the current time period because of a rigid workflow as outlined in Section 2. Nonetheless, as workers like to smooth their working hours to maximize their utility, given such an expected rise in the future task, they choose to reduce the current hours worked to be ready for the hard work in the future time periods. It turns out that it is a suboptimal allocation. In the following subsections, we formally develop the mechanism using a simple two-period model. We also extend the model to see dynamic consequences in a quantitative setting.

6.1 Irregular Task and Distorted Allocation in a Simple Two-period Model

We consider the intertemporal choice of working hours for an individual worker in a two-period deterministic model.[16] Lifetime utility of an individual worker is given by

$$u\left(L_1\right) + \beta u\left(L_2\right), \tag{7}$$

[16] Our discussion is based on Hamano and Murakami (2022), who consider a more general setup.

where L_t for $t = 1, 2$ is hours worked at time t, and $\beta \in (0, 1)$ represents the subjective discount factor. We conventionally assume that the utility function satisfies that $u' < 0$ and $u'' < 0$. Exogenously, tasks are assigned every period. There are two types of tasks: regular and irregular tasks. Regular tasks can be reallocated across time. We assume that irregular tasks have a hard deadline. They must be completed within the period that is assigned.

The salient feature of the model is that the worker can work more or less than to finish the total amount of tasks that are assigned to the worker at time t. If she works more than to complete the assigned amount of tasks, this means that she helps her colleagues. If she works less than to fulfill the assigned tasks, her colleagues help her finish her tasks. This feature is something analogous to lending and borrowing.

For each period, the worker faces the following constraint:

$$(1+\phi)V_{t-1} + T_t + F_t = (1+E_t)L_t + V_t, \tag{8}$$

where T_t and F_t are the amounts of regular and irregular tasks, respectively, E_t is the extra effort necessary to meet the deadline, and V_t represents carried-over tasks from t to $t+1$. When $V_t > 0$, there are unfinished tasks, which incur some costs $\phi > 0$ in the next period (i.e., forgetting details of the remained tasks). If $V_t < 0$, she works more than the assigned tasks at t by helping her colleagues who are facing other tasks. This would be rewarded in the next period, as they help her back. This is something analogous to lending and borrowing. Through this feature, regular tasks can be allocated across time. For simplicity, we assume $V_0 = 0$. Because all tasks need to be finished by the end of period 2, we have $V_2 = 0$.

It is important to emphasize that irregular tasks differ from regular ones, as irregular tasks cannot be reallocated across time. Without this constraint, they are fundamentally identical. To meet the hard deadline within the period, the worker needs to make extra efforts such that

$$F_t = E_t L_t. \tag{9}$$

Note that when there are no irregular tasks, there is no need to make extra efforts.

The worker maximizes her lifetime utility (7) subject to constraints (8) and (9). The optimality condition is given by

$$u'(L_1) = \beta(1+\phi)\frac{1+E_1}{1+E_2}u'(L_2). \tag{10}$$

It states that the current marginal utility of working is equalized with the future marginal utility. This is similar to the consumption-smoothing motive and the individual worker wants to smooth her hours to work.

In the optimality condition (10), the presence of E_1 and E_2 is a source of intertemporal distortion. To see this point, Figure 13 depicts the equilibrium allocation of hours worked in this two-period setting. The downward-sloping line is the intertemporal resource constraint, which incorporates (9). The curves concave to the origin are the indifference curves that correspond to specific levels of the lifetime utility. The level of utility is higher when the indifference curve moves closer to the origin. Suppose for simplicity that $T_1 = T_2 = T$. Without irregular tasks (i.e., $F_1 = F_2 = 0$, and thus $E_1 = E_2 = 0$), the optimal allocation takes place at point A in Figure 13 when $\beta(1+\phi) > 1$. At point A, we have $L_1^* > T > L_2^*$, meaning that the worker works more today than tomorrow, despite the same amount of regular tasks over two periods. The indifference curve is tangent to the resource constraint as the marginal rate of substitution is equal to the slope of the resource constraint such that $\frac{u'(L_1^*)}{\beta u'(L_2^*)} = 1+\phi$. This allocation is optimal providing the highest possible level of utility under the constraint.

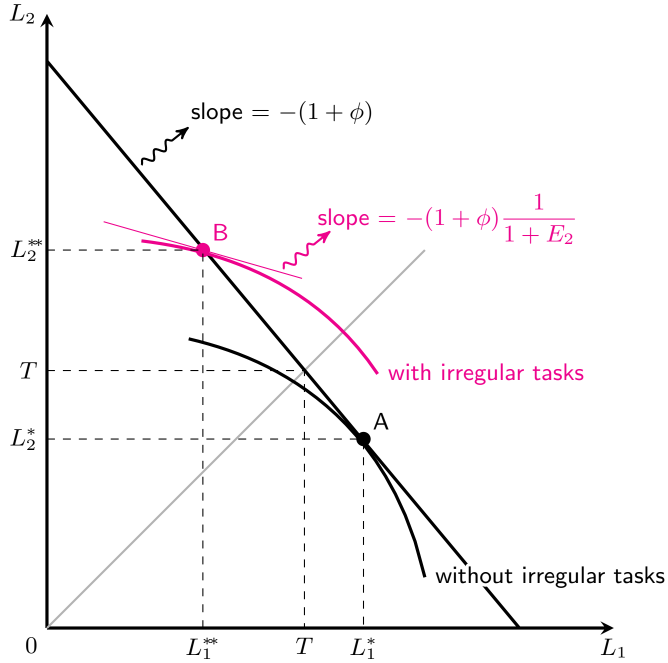


Figure 13: Equilibrium Allocation with and without Irregular Tasks

Note: The horizontal axis measures labor supply and the number of regular tasks in period 1. The vertical axis represents those in period 2.

The arrival of irregular tasks yields suboptimal allocation. This is contrary to the optimal allocation associated with regular tasks that can be allocated across time. Now suppose that irregular tasks arise in the second period (i.e., $F_1 = 0$ and $F_2 > 0$, and thus $E_1 = 0$ and $E_2 > 0$). We can find the new equilibrium allocation at point B in Figure 13, where the indifference curve intersects with the resource constraint and the slope of the indifference curve is flatter than the resource constraint, as $\frac{u'(L_1^{**})}{\beta u'(L_2^{**})} = \frac{1+\phi}{1+E_2}$. The equilibrium allocation with the irregular tasks in the second period leads to $L_1^{**} < L_1^*$ and $L_2^{**} > L_2^*$. The worker reduces her hours worked in the first period and increases them in the second period. Comparing points A and B, it is easy to see that this allocation is welfare decreasing.

It is important to emphasize that irregular tasks cannot be reallocated to the first period. In other words, the worker cannot work in advance to prepare for the irregular tasks that will arise in the near future, even when the arrival is fully anticipated. Intuitively speaking, to be ready for hard work in the future period, she is obliged to reduce her current working hours to save her energy.

6.2 Simulation in a Dynamic Setting

The basic mechanism of our model remains valid even in an infinite-horizon setup. To examine the dynamic implications of our model, we perform numerical simulations with future anticipated increases in irregular tasks.

To obtain quantitative results, we assume the following utility function:

$$u(L_t) = -\frac{L_t^{1+\frac{1}{\psi}}}{1+\frac{1}{\psi}}, \tag{11}$$

where $\psi > 0$ controls the intertemporal elasticity of substitution of labor. To guarantee the stationarity of the model, we assume that the cost parameter for carried-over tasks ϕ is time-varying and follows

$$\phi_t = \phi + \vartheta[\exp(V_t - \bar{V}) - 1], \tag{12}$$

where ϕ is the steady-state value such that $\phi = \frac{1}{\beta} - 1$, $\bar{V}$ is the steady-state level of V_t, and $\vartheta > 0$ is a parameter that governs the feedback on ϕ_t from V_t. This specification is borrowed from the idea of the debt-elastic interest rate in small-open economy models (Schmitt-Grohé and Uribe, 2003). As the individual worker owes her colleagues more than $\bar{V}$, there are higher costs that must be incurred.

The only source of uncertainty is the state of irregular tasks (i.e., constant regular tasks). Here, we consider two types of processes that characterize F_t: an anticipated rise and gradual increases in future irregular tasks. First, we assume that irregular tasks F_t follow the following AR(1) process:

$$F_t = \rho_F F_{t-1} + \varepsilon_{F,t-s}, \tag{13}$$

where $\varepsilon_{F,t-s}$ is an i.i.d. shock on irregular tasks that is learned s periods ago, and $|\rho_F| < 1$ controls the persistence of the shock. We set $s = 7$. That is, at $t = 0$ it is anticipated that the irregular task increases at $t = 7$.

Second, contrary to the one-time anticipated increase in irregular tasks, it may be the case that the amount of irregular tasks increases gradually in the future. This would be more relevant for the tasks such as MOQs. Following Barsky and Sims (2011), we assume

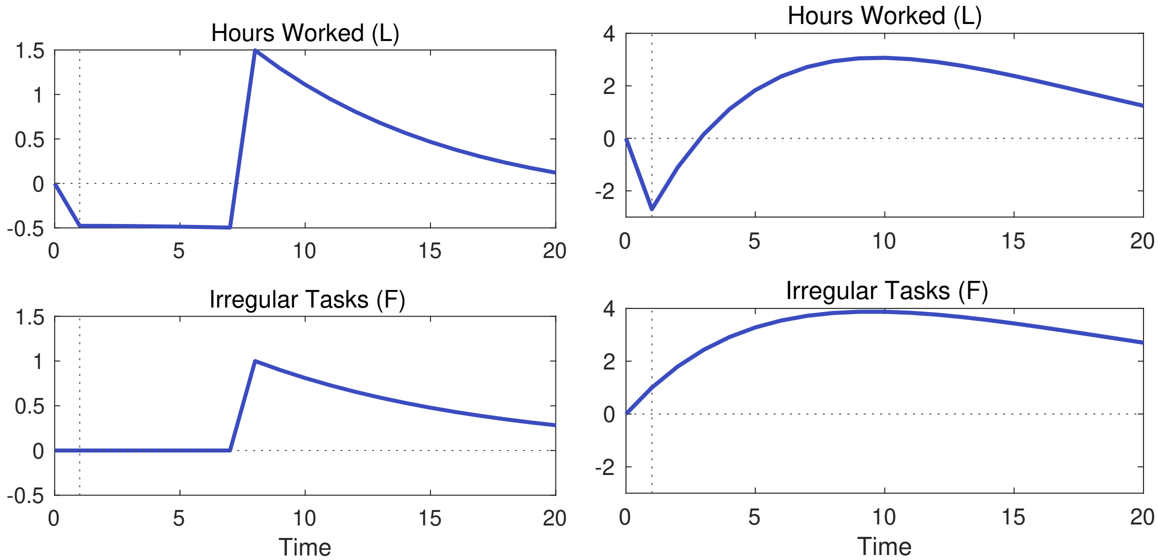
$$F_t = G_t + \rho_F F_{t-1}, \tag{14}$$

$$G_t = \rho_G G_{t-1} + \varepsilon_{G,t}, \tag{15}$$

where $\varepsilon_{G,t}$, is an i.i.d. shock and $|\rho_G| < 1$ controls persistence of G_t.

Figure 14 compares responses of hours worked with two different specifications of shocks to irregular tasks. The left panels show responses to the anticipated irregular task shock with (13). In particular, we assume that the irregular task increase by one percent at $t = 7$, which is depicted in the bottom panel in 14(a). The top panel of 14(a) displays responses to this anticipated shock. Following this expected increase in F_t (and thus E_t), the worker reduces labor supply even from $t = 0$ to $t = 6$. Help from her colleagues enables this reduction in hours worked. The right panels of Figure 14 correspond to responses to the gradual increases in the irregular tasks that are modeled in (14)–(15). At $t = 1$, the worker realizes that the irregular tasks initially increase by one percent. As the irregular tasks are expected to grow gradually, the worker chooses to reduce the labor supply initially. In fact, the hours worked are lower than the steady-state values for three periods and start to increase later on.

It is important to emphasize that the underlying mechanism of generating initial drops in hours worked is the distortion in the intertemporal allocation that is analyzed in the simple two-period model. Regardless of the type of shocks, increases in the future irregular tasks trigger temporal reductions in labor supply in order to be ready for the hard work anticipated in the near future.



(a) Anticipated Shock

(b) Gradual Increases in Irregular Tasks

Figure 14: Dynamic Responses of Hours Worked

Note: The horizontal axes represent time. The vertical axes measure percentage deviations from the steady-state values. The vertical dashed lines indicate $t = 1$ when the worker receives the shock. In this simulation exercise, we set $\psi = 2$, $\beta = 0.99$, $\phi = \frac{1}{\beta} - 1$, $\varphi = 0.0001$, and $\rho_F = \rho_G = 0.9$.

7 Conclusion

In this study, we shed light on the overtime work of government officials. Although their work is essential for the management of our civil society, working overtime can be a source of inefficiency by damaging human capital. We use mobile phone location data to estimate the impact of the MOQs on the overtime work of Japanese government officials using the local projection. Unlike conventional reported overtime working hours, the mobile location data give us a more accurate picture of the nighttime population in the Kasumigaseki area. We exploit the exogenous nature of task arrivals to quantify the impact of the MOQ shock on overtime work.

We find that, on average, an increase in the number of MOQs significantly *decreases* the overtime work of government officials one day after the MOQ shock, and *increases* it six to eight working days after the shock. The temporary decrease in overtime work is followed by persistent increases. The increases in overtime work are typically beyond the deadline of the MOQ, suggesting that preparing for the MOQs has a negative spillover effect on other government officials. The results also suggest that the effects of MOQs are heterogeneous across different demographic groups. The estimated gender-age-specific responses suggest that male government officials, especially at their 30s to 50s, are more heavily affected by the MOQ shock. The relaxed time constraint for responding to the MOQs mitigates overtime work to some extent. However, we still observe the congestion effect beyond the deadline of the MOQs. We also examine the impact of moving from the paper-based system to the paperless system. Our result suggests that it does not alleviate overtime work. We provide a simple model of optimal work allocation and show that distortion in intertemporal task allocation can account for the observed responses.

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