The Market Price of Overtime Work: Evidence from Municipal Financing

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Abstract

This paper develops a novel method for measuring overtime work in the public sector using satellite-derived nighttime light data. Based on developed measures, we observe that government overtime in China exhibits seasonality, regional variation, and synchronization, with higher intensity towards the end of the year. We also find that overtime in the public sector is counter-cyclical, particularly during recessions, and is positively correlated with political turnover. Some of these characteristics differ from overtime behaviour in the private sector. Additionally, the paper examines the financial implications of overtime, demonstrating that higher overtime intensity is associated with lower municipal bond yield spreads, suggesting reduced financing costs. This effect is more pronounced for short-term debt, during recessions, and in fiscally stable municipalities. However, in cities characterised by frequent and persistent overtime, no such reduction in municipal financing costs is observed. Overall, the findings provide valuable insights into labour market regulations and government finance.

JEL Codes: J22; G12; G32; H72

Keywords: Overtime work; Municipal bonds; Financing costs; Nighttime light data; Public sector overtime

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1 Introduction

In most countries, fundamental employment standards are governed by at least two primary regulations: a minimum wage, which establishes a baseline for workers' pay, and an overtime premium, which sets a flexible upper limit on workers' hours (OECD, 2024; ILO, 2024). While the economic effects of wage and hour regulations, particularly the minimum wage, have been extensively studied (Autor et al., 2016; Harasztosi and Lindner, 2019; Cengiz et al., 2019; Dustmann et al., 2022; Berger et al., 2025), the impacts of overtime remain underexplored, despite their potential to influence workers' hours, earnings, and job prospects. From a theoretical standpoint, labour supply models suggest that workers may extend their hours in response to the overtime premium (Idson and Robins, 1991). In contrast, labour demand models predict that firms will reduce weekly hours—typically to 40 hours—and hire additional workers to compensate for the reduction, thus creating a "work-sharing" effect (Hunt and Katz, 1998; Kapteyn and Kalwij, 2004).

Empirically, overtime work presents a significant challenge in many countries, particularly those undergoing rapid economic development, where it affects both workers' well-being and the broader economy. Despite the existence of overtime regulations, research on their effects has been limited due to a lack of substantial policy changes and difficulties in obtaining accurate data to assess their impacts (Brown and Hamermesh, 2019). Much of the existing literature relies on survey-based data to examine overtime (e.g., Ehrenberg and Schumann, 1984; Cahuc and Carcillo, 2014; Goux et al., 2014; Madeira, 2014; Bick et al., 2018; Søndergaard, 2023), but these studies often suffer from small sample sizes or a lack of panel data structures, limiting their ability to accurately estimate changes in overall employment (Quach, 2022). Moreover, many studies focus on cross-sectional data, neglecting the dynamic nature of overtime work.

These challenges are particularly pronounced in public-sector labour markets, where data and research on overtime remain scarce. Public-sector employment is distinct due to differences in compensation, job security, and non-monetary benefits (Bozeman and Kingsley, 1998; Rainey, 2009). Furthermore, as reported by the World Bank and OECD, public-sector (or general government) employment accounts for approximately 20% of total employment globally (OECD, 2023).[1] The limited research on public-sector overtime, coupled with measurement constraints

[1] For data from the World Bank, please refer to the Worldwide Bureaucracy Indicators database.

and the importance of public-sector employment, motivates the need to better understand overtime practices in this sector.

This paper seeks to address these gaps by using comprehensive local government data from across China to examine overtime work in the public sector. China offers a unique and compelling context for analysing overtime practices, as it is one of the largest economies globally, employing millions of civil servants and public employees across diverse regions. These regions exhibit significant differences in local economic development, administrative practices, and labour policy enforcement (Brødsgaard and Gang, 2010). This regional heterogeneity provides a valuable perspective for studying how local overtime practices differ and their outcomes. Additionally, China consistently reports some of the longest average working hours among OECD countries (see Figure 1), raising important questions regarding the economic consequences of extensive overtime in the labour market.

To address the limitations associated with the unavailability of conventional data, this study proposes a novel methodology for measuring overtime work in local governments by utilising satellite-derived nighttime light data from the Visible Infrared Imaging Radiometer Suite (VIIRS) aboard the Suomi National Polar-orbiting Partnership (NPP) satellite. Unlike traditional survey data, high-frequency satellite data offer a scalable and objective indicator of government activity during off-hours. Conceptually, an increase in government overtime work during the night should correspond to a rise in nighttime brightness. However, it is important to note that nighttime light data are frequently used as a proxy for economic growth and activity. To enhance the robustness and accuracy of our overtime measure, we define government overtime as occurring on days when both of the following conditions are met: first, when the nighttime light in a given government area exceeds the median nighttime light within that grid (reflecting the inherent characteristics of the grid), and second, when the nighttime light in the government area surpasses the median brightness of surrounding grids (which serves as a proxy for local economic conditions). We further validate our overtime measure against survey data and demonstrate that it is reliable.

Based on the developed overtime measures, our findings reveal several key stylised facts about government overtime across different regions. First, we observe a clear seasonal pattern in overtime intensity, with notable peaks towards the end of the year, likely driven by administrative deadlines and fiscal year-end requirements. Second, overtime work varies significantly across cities, with certain regions, particularly those experiencing rapid economic growth, exhibiting

higher overtime intensity. Third, overtime patterns demonstrate a degree of synchronisation within provinces, particularly in the western region of China, suggesting that local government workloads are influenced not only by local policies but also by broader regional economic development. Moreover, similar to other labour market variables, our analysis confirms that government overtime is countercyclical, with increased overtime activity observed during periods of economic downturn. Lastly, we find that political turnover plays a significant role in shaping overtime patterns, with newly appointed party secretaries often driving increased overtime efforts as a means of demonstrating commitment to policy objectives.

In addition to documenting patterns of government overtime, this study explores its financial implications for local governments. We hypothesise that overtime may signal governance quality. On one hand, overtime driven by temporary demand surges or critical projects may reflect a responsive and diligent government, improving investor confidence and potentially reducing bond spreads. On the other hand, persistent overtime in the public sector may indicate inefficiencies, poor resource allocation, and administrative burdens. Based on municipal corporate bond (MCB) data from 2012 to 2024, our empirical analysis reveals a negative relationship between overtime intensity and MCB yield spreads, suggesting that overtime may help reduce the cost of municipal financing. This result holds after controlling for various bond-, firm-, and city-level factors, and is robust across sample selection, addressing potential confounding factors and considering outliers. We acknowledge, however, that alternative explanations could account for this negative relationship. Drawing on existing literature, we show that our results remain consistent even when accounting for factors such as fiscal deficits, political turnover, the degree of fiscal decentralisation, GDP competition, and the COVID-19 pandemic.

We further examine the heterogeneity of the negative relationship between overtime and the cost of municipal financing. Our results suggest that this negative relationship is particularly pronounced during economic recessions and in municipalities with strong fiscal health, where overtime is perceived as a sign of proactive governance rather than inefficiency. Similarly, we observe that higher overtime intensity is associated with improved ratings and increased trust in local governments. Consistent with the main findings, in cities where overtime work is frequent and persistent, the market may interpret such patterns as indicative of operational inefficiencies, leading to no reduction in financing costs. Additionally, the study reveals that the impact of overtime on financing costs is more pronounced for short-term debt instruments, emphasising the

moderating role of bond maturity in the relationship between government overtime and financial markets.

Our findings contribute to several strands of literature. First, it contributes to the economics of labour supply (Guner et al., 2012; Erosa et al., 2016; Keane and Wasi, 2016; Borella et al., 2023; Jensen and Blundell, 2024), the study of working hours (Pencavel, 2015; Bick et al., 2018; Cacciatore et al., 2020; Kolasa et al., 2021; Bick et al., 2022), and regulation of overtime and overtime premium (Trejo, 1991; Hart and Ma, 2010; Cahuc and Carcillo, 2014; Lu and Lu, 2017; Quach, 2022). Although these studies provide insights on the roles of labour supply and working hours for the economy and labour markets, almost all of them are private-sector focused, whereas this paper extends the analysis to the public sector. Closer to our inquiry, Johnson IV (2003) examines the impact of the 1985 amendments to the Fair Labor Standards Act (FLSA) on public sector labour markets, focusing on wage structures, working hours, and employment patterns. The study finds that the legislation led to wage increases for eligible workers, changes in regular work hours as employers adjusted to avoid overtime costs, and shifts in workforce composition. Different from Johnson IV's (2003) study, we propose a novel approach for measuring overtime work in local governments, utilising satellite-derived nighttime light data. Based on developed measures, we observe that government overtime patterns exhibit seasonality, peaking towards the end of the year, and increases during political turnover. Overtime levels vary across cities, with higher levels in regions undergoing economic development, and are synchronised within certain provinces. Additionally, government overtime is countercyclical, which contrasts with the procyclical nature of hours per worker observed in the private sector (Ohanian and Raffo, 2012; Burda et al., 2013; Cacciatore et al., 2025).

Second, we contribute to the growing literature on municipal financing.[2] Studies have identified factors that influence the cost of municipal financing, such as credit rating (Cornaggia et al., 2018), issuance size (Capeci, 1994), default risk and liquidity risk (Wang et al., 2008; Ang et al., 2010; Schwert, 2017), and local economic conditions (Qu et al., 2023). In addition to standard financial factors, political and government-related elements also play a crucial role. Butler et al. (2009) show that higher state corruption is associated with greater credit risk and higher bond yields. Similarly, Duyvesteyn et al. (2016) highlight that negative news concerning local governments, such as reports of corruption or poor governance, leads to increased municipal

[2] Cestau et al. (2019) provide review of the recent research on municipal bond markets.

bond issuance and elevated spreads. Gao et al. (2019a) observe that local municipal bond yields in the United States are higher for states allowing unconditional access to Chapter 9 bankruptcy than for states with proactive policies to assist distressed municipalities, while Gao et al. (2019b) show that political uncertainty is priced in the municipal bond market, as evidenced by higher municipal borrowing costs in the months leading up to U.S. gubernatorial elections. Gao et al. (2021) demonstrate that Chinese local governments are more likely to default on loans from banks with weaker political influence. By incorporating existing political and fiscal factors, we, to the best of our knowledge, are the first to show that government overtime can be priced in the municipal bond market, as evidenced by lower municipal borrowing costs following government overtime.

Thirdly, this paper contributes to the field of fiscal studies (e.g., Buettner and Wildasin, 2006; Leeper et al., 2010; Halac and Yared, 2018; Bayer et al., 2023). Municipal financing is of paramount importance in fiscal studies, as it directly affects local governments' capacity to fund essential public services, manage debt, and promote economic development through infrastructure projects. By examining the relationship between overtime work and municipal bond pricing, this study demonstrates how increased overtime can be interpreted as a signal of proactive governance, potentially leading to lower borrowing costs. Our findings suggest that temporary overtime can serve as an effective strategy to reduce financing costs. Related to political allocation theory, we show that such an effect is particularly strong during economic downturns or when fiscal health is robust. In contrast, persistent or frequent overtime is unlikely to convey a positive signal. These results have important implications for the broader fiscal studies literature, particularly regarding how local governments manage financial stress and signal fiscal stability to the market. Additionally, the study offers valuable insights into the interplay between fiscal policy and government bonds.

Lastly, this study makes a contribution to the growing body of literature that utilises remote sensing techniques to measure and analyse economic phenomena (Chen and Nordhaus, 2011; Henderson et al., 2012; Lessmann and Seidel, 2017; Gibson et al., 2020, 2021; Bluhm and Krause, 2022; Kim, 2022; Bilicka and Seidel, 2022; Behrens, 2024), as well as other applications (Zhao et al., 2019; Levin et al., 2020). By employing satellite nightlight data with specific filtering conditions, we demonstrate that this data can also be used to measure overtime work in local governments, extending its use beyond its common role as a proxy for economic growth. This

application is particularly important given the limited evidence on how such data performs at small spatial units.[3]

2 Measuring Overtime Work

A significant obstacle in analysing overtime work empirically lies in the difficulty of constructing appropriate indicators within large-scale analyses. Existing research largely relies on worker surveys to measure overtime work (Brown and Levin, 1974; Ehrenberg and Schumann, 1984; Cahuc and Carcillo, 2014; Goux et al., 2014; Madeira, 2014; Bick et al., 2018; Søndergaard, 2023). However, these survey-based measures are often susceptible to bias stemming from respondents' cognitive limitations, motivations, or misreporting (Bertrand and Mullainathan, 2001; Stephens-Davidowitz, 2014).[4] Moreover, most surveys are cross-sectional, making it challenging to construct longitudinal data or track employees over time. The limited coverage of firms in such studies also constrains the scope of analysis. Crucially, this challenge becomes even more pronounced for public sector overtime, as the vast majority of existing surveys focus on private firms, leaving the public sector understudied. Consequently, developing an objective and scalable measure of working hours is essential for rigorous empirical research on overtime work across both private and public sectors.

Unlike other studies, this study constructs a novel overtime indicator utilizing NASA-calibrated daily nighttime light observations from the Visible Infrared Imaging Radiometer Suite (VIIRS) aboard the Suomi National Polar-orbiting Partnership (NPP) satellite, specifically employing the Black Marble data product. The adoption of satellite-derived nocturnal illumination data offers three principal advantages: First, unlike questionnaire-based methods, this objective data source minimizes interference from subjective cognition and response biases. Second, the longitudinal nature and extensive spatial coverage of satellite data enable large-scale empirical investigations with enhanced temporal depth. Finally, the open-source characteristics of this dataset significantly improve research reproducibility and scientific rigor, addressing critical limitations in current methodological paradigms.

[3] One notable exception is Bilicka and Seidel (2022), who focus on small spatial units, using satellite nightlight data to track the global operations of car manufacturing firms.

[4] Søndergaard (2023) identifies several difficulties in using the labour input method to estimate the extent of undeclared work based on aggregated datasets. These challenges encompass handling missing data, measuring overtime, addressing extreme values, and correcting errors in administrative survey records.

2.1 Satellite Nighttime Light Data

Nighttime light data collected via remote sensing are widely recognised as a reliable proxy for human activity, capturing various light sources such as building illumination, fires, and vehicle traffic (Mellander et al, 2015; Gibson et al., 2021). In recent years, a growing body of literature in economics has employed data from the Defence Meteorological Satellite Program's (DMSP) Operational Linescan System (OLS) to study a range of economic phenomena[5] (Chen and Nordhaus, 2011; Henderson et al., 2012; Weidmann and Theunissen, 2021; Hu and Yao, 2022; Das et al., 2024). Despite the valuable insights these data provide, the DMSP/OLS dataset presents several limitations that hinder its ability to measure micro-level activity over time.

First, DMSP/OLS data are available only at monthly or annual intervals, which limits their temporal precision and makes them unsuitable for capturing daily fluctuations in human activity. Second, the dataset is prone to saturation of brightness values, as it exhibits an upper limit on brightness levels. This saturation results in the loss of information in highly illuminated areas, thus restricting the dataset's ability to accurately capture variations in light intensity in urban and densely populated regions. Finally, the spatial resolution of the DMSP/OLS data is 3,000 meters, while the corresponding nighttime light product has a resolution of 1,000 meters. This relatively low spatial resolution introduces significant noise when analyzing activities at the firm level, further reducing the precision and reliability of the data for detailed micro-level analysis.

By contrast, the VIIRS sensor on the NPP satellite offers substantial improvements in resolution and sensitivity. It eliminates the brightness saturation issue and provides data at a daily frequency. The NPP satellite orbits the Earth approximately 14 times per day, capturing images every 6 minutes with a swath width of 3,060 kilometres and a spatial resolution of 750 metres. Recent research has increasingly employed NPP/VIIRS data to examine finer-scale human and economic behaviours (Elvidge et al., 2015; Wang et al., 2022).

Despite these advantages, raw NPP/VIIRS data are subject to noise from weather conditions, cloud cover, and stray light (Román et al., 2018). To address these issues, NASA's *Black Marble* data product applies advanced geoscientific algorithms to remove noise. Specifically, the data are resampled and geolocated, with spatial and temporal aggregation performed at 15-

[5] See a survey by Gibson et al. (2020) for this topic.

arcsecond grid units. Noise from clouds, atmospheric conditions, topography, vegetation, snow, moonlight, and stray light is filtered out to produce the VNP46A2 product, a calibrated dataset with a 500-metre resolution (Román et al., 2018). The VNP46A2 product divides the globe into 10°×10° grids and provides daily frequency data from 19 January 2012 onwards. Each grid contains 2,400×2,400 cells, with each cell covering approximately 500×500 metres. The data are stored in HDF5 format and can be downloaded directly from NASA's website. This study uses Python to automate the acquisition and extraction of HDF5 files, matching the office addresses of prefecture-level city governments (based on longitude and latitude coordinates from Baidu map) with corresponding grid cells. The nighttime brightness of the target grid cell, along with the surrounding eight cells, is then extracted for analysis.

2.2 Constructing the Overtime Indicators Using Satellite Data

The high-frequency NPP/VIIRS data solve the saturation problem found in earlier datasets, providing a robust source for measuring nighttime activity for local governments. NASA's daily, noise-corrected data offer a more accurate and objective basis for assessing overtime work. Wang et al. (2022) demonstrate the usefulness of the Black Marble data in their analysis of how the COVID-19 pandemic affected economic and social activities in Chinese cities, showing that changes in nighttime brightness reflect variations in firm-level and hospital activity. Their study preliminary tests confirm a significant positive correlation between firms' production activities and the brightness of their corresponding grid cells, with no significant correlation observed in surrounding grids. Gibson et al. (2021) also confirm that VIIRS night lights data more accurate, especially for less aggregated spatial units. These findings validate the use of NPP/VIIRS data as a good proxy for local government or firm-level activity.

We first download the calibrated VNP46A2 daily nighttime light data from NASA, parse the HDF5 format files, and obtain approximately 4TB of nighttime light data with a 500-meter resolution. We then remove anomalies caused by cloud cover, extreme events, and other factors to ensure an adequate number of reference grids and exclude records with missing observations. Lastly, we obtain all local government addresses through Baidu Maps, then match the coordinates using the Amap API and correct any address discrepancies to obtain the precise longitude and latitude data of the government locations. Based on the geographic coordinates of the government

addresses, assign them to the corresponding grid. Use the 'Extract Values to Points' tool in ArcGIS to extract nighttime light intensity data for the target grid and the surrounding eight grids.

After collecting the night lights data for local governments, we next define whether it is consider as work overtime for a government. For clarity, let $BN_{i,y,d}$ denote the nighttime brightness of grid cell *i* on day *d* in year *y*. Conceptually, increased overtime work of a government at night should raise $BN_{i,y,d}$. However, directly using $BN_{i,y,d}$ as an indicator for overtime may introduce noise from temporal and spatial dimensions. We thus apply the following two additional filters to define the overtime of the government.

1. **Temporal Dimension**: High brightness may reflect intrinsic characteristics of the grid rather than overtime activity of the government. To address this, the brightness of grid *i* on public holidays ($BN_{i,y,h}$) is used as the temporal baseline. When the night light of the government exceeds the median night light on public holidays within the same grid and year ($BN_{i,y,d} > Median\ of\ BN_{i,y,h}$), the increased brightness is more likely attributable to overtime activity.
2. **Spatial Dimension**: High brightness may reflect local economic development rather than overtime work. For instance, regional infrastructure improvements and new construction could also increase brightness levels. To ensure that our proposed measure accurately capture the level of work overtime, the median brightness of the eight surrounding grids ($BN_{n,y,d}$) serves as the spatial baseline. When $BN_{i,y,d} > Median\ of\ BN_{n,y,d}$, the increase in brightness is more likely due to government's activity rather than external spillover effects.

When the above two conditions are satisfied, a government *i* on a given day in year *y*, is identified as engaging in overtime work rather than unobservable factors, such as regional differences in economic development. The final sample for overtime work consists of 638,487 city-daily observations from 19 January 2012 to 2 November 2024.

Ensuring the accuracy of overtime measurement is a pivotal concern within the scope of this study. To enhance the reliability of our proposed metric, we investigate the relationship between our overtime measure and the number of working hours for local residents from the China Family Panel Studies (CFPS), an extensive longitudinal survey initiative inaugurated by the

Institute of Social Science Survey (ISSS) at Peking University in 2010.[6] If our measure is valid, we should observe a positive relationship between working hours and overtime intensity. Conducting regression analysis, we designate the individual-level working hours in the public sector as the dependent variable, with local government overtime intensity serving as the key independent variable. Other individual-characteristic controls include city-level and year-level fixed effects. Additionally, to account for potential heterogeneity, standard errors are clustered at the city level. Our findings, presented in Table A1 in the appendix, consistently reveal a positive correlation between overtime metrics and working hours, unaffected by variations in control variables. Such a positive relationship provides robustness to our measure.

3 Stylised Facts

In this section, we present five stylised facts based on the government overtime indicators, where we calculate the overtime intensity as the mean of overtime days over specific periods for each local government:

Fact 1: Overtime Work Demonstrates Seasonality

Similar to other labour market variables (e.g., Krane and Wascher, 1999; Shimer, 2012; Baker and Fradkin, 2017), overtime work may exhibit seasonality. Figure 2 reports the overtime intensity in local government in China, averaged by month, highlighting a distinct increase in overtime towards the end of the year. The data reveal that overtime is relatively low during the early to mid-year months, with a noticeable rise in intensity beginning in October and peaking in December. This increase is likely driven by the need to finalise annual reports, meet fiscal year-end targets, and prepare for the upcoming year's plans. Additionally, local governments may face additional pressures during this period to address year-end policy implementation and budgeting cycles. The lower overtime intensity during the middle of the year suggests a more stable workload, with fewer pressing deadlines compared to the final quarter. Overall, the data reflect the seasonal nature of

[6] It is worth to note that there seems no official working hour statistics for city-level or province-level, so we choose to perform validity test based on individual survey data from the CFPS. The CFPS serves as a pivotal resource in academic inquiry, as evidenced by its adoption in scholarly investigations (e.g., Chen et al., 2020; Fan et al., 2021; Bianchi et al., 2022), thereby substantiating the generalizability of findings derived from CFPS survey data to the wider Chinese populace (Xie and Hu, 2014).

government work, where the end of the year marks a period of heightened activity and workload in preparation for the following year.

Fact 2: Government Overtime Varies Across cities.

Government overtime may vary across cities in China. As shown in Figure 3, the analysis of government overtime intensity from 2012, 2018, and 2024 presents a compelling picture of regional and temporal variations across the country. The 2012 map reveals a generally moderate level of overtime intensity across most regions, with a few distinct hotspots in central and southwest China. The predominance of blue and light-yellow areas indicates that overtime was relatively balanced in many local governments, with only select regions experiencing high intensity. By 2018, the intensity of government overtime shows a notable increase in both scale and regional concentration. Significant clusters of high-intensity overtime have emerged in central and coastal areas, particularly in regions undergoing rapid urbanisation and economic transformation. This intensification can be associated with growing local government responsibilities, such as implementing national development initiatives and handling increasingly complex administrative tasks. In contrast, the 2024 map exhibits a marked shift in the distribution and intensity of government overtime in certain provinces, with a visible contraction of overtime intensity. This pattern may suggest a potential policy shift from the Politburo Meeting of 2024, which emphasises avoiding the 'rat race' and overtime in labour markets.

Table 1 presents a comparative analysis of top and bottom city governments based on their overtime intensity, likely reflecting the level of overtime work within local government agencies. The cities at the top, such as Lijiang and Suizhou, exhibit higher intensity values, with over 40% of the sample periods experiencing overtime. This suggests that government employees in these areas may be working substantial overtime due to increased demand, economic activity, or operational pressures. These cities likely face greater administrative workloads or more urgent governance needs, despite having lower levels of economic development. On the other hand, the cities at the bottom, such as Daqing and Zhongshan, show much lower intensity, with less than 18% of the sample period characterised by overtime, which could indicate more stable government operations, less need for overtime, or more efficient work processes. Two cities, Heihe and Zhuhai, have zero overtime intensity, which may reflect either a well-balanced work environment or a lack of significant administrative tasks, possibly due to underdevelopment or fewer governance

challenges. This variation in overtime intensity highlights differing levels of government workload and administrative demands across regions.

Fact 3: Government Overtime is More Synchronized in Ningxia and Qinghai

Despite variations across provinces, local government overtime may exhibit synchronization or co-movement. To explore this phenomenon, we employed correlation analysis across provinces in China. We calculated the average pairwise correlation of city-level government overtime for each province, summarised in Figure 4.

The provinces in China exhibit a wide range of synchronization levels. Sichuan (0.1068) has the lowest average pairwise correlation, suggesting relatively weak alignment of government overtime patterns among its cities. Following Sichuan, Xinjiang (0.1183) and Hubei (0.1301) also display low correlations. These figures reflect varying degrees of overtime synchronization across different regions. At the other end of the spectrum, Ningxia (0.3163) exhibits the highest correlation, indicating the strongest co-movement of government overtime across cities within the province. Qinghai (0.2590) and Jilin (0.2141) also rank among the highest, with correlation values significantly above the national average. The range of values, from 0.1068 to 0.3163, highlights the substantial differences in overtime synchronization across provinces.

Fact 4: Government Overtime is Countercyclical

Similar to other labour market variables that exhibit cyclicality (e.g., Aguiar et al., 2013; Haltiwanger et al., 2018; Figueiredo, 2022), overtime work can also be cyclical, as businesses tend to expand during economic booms. Government overtime may display similar cyclicality, as the public sector typically supports the private sector, thereby reflecting the broader cyclical patterns observed in the economy. In contrast, it is generally believed that governments adopt a more proactive approach to mitigating economic hardship during recessions, which may result in an increased workload for public sector employees during these periods, making overtime potentially countercyclical. To examine the cyclicality of overtime in local government, we regressed GDP growth and unemployment rates on overtime intensity measures at the annual level, as city-level GDP and unemployment data are only available at an annual frequency.

The findings presented in Table 2 indicate that government overtime in China tends to be counter-cyclical. The coefficient in column (1) of Table 2 shows that overtime work is significantly

and negatively correlated with GDP growth at the 10% level. This finding is also observed when introducing city and year fixed effects (see column (2)). Turning to the results for unemployment, we observe a stronger countercyclicality of overtime in government. The results reported in columns (3) and (4) of Table 2 show that overtime work is positively correlated with the unemployment rate at the 1% level. One possible explanation for this is that governments tend to stabilise the economy during recessions, leading to increased work in the public sector during such periods.

Fact 5: Overtime Work is Positively Related to Political Turnover

Overtime work may vary across political turnovers. During these transition periods, civil servants are incentivised to engage in signalling behaviours to demonstrate loyalty, capability, and adaptability to new leadership priorities. Moreover, newly appointed leaders often renegotiate or breach their predecessor's contracts or promises to protect their own or their connected local firms' interests (Bremmer and Zakaria, 2006), thereby distinguishing themselves from their predecessors. If newly appointed politicians follow their predecessors' blueprints, the credit may go to the former leaders rather than themselves (Chen et al., 2005; Zhong et al., 2019). Consequently, employees often work longer hours and exert extra effort to secure favourable evaluations and meet these new expectations.

To test this, we regress political turnover in city mayors and secretaries on government overtime, using political turnover data manually collected from various public sources, including newspapers, websites, press releases, and other announcements. We consider turnover of both party and government officials, accounting for instances when a city's party secretary or governor is replaced within a given year. Consistent with previous studies (e.g., An et al., 2016), if an official changes in the first half of the year (before 1 July), it is treated as political turnover in the same year; otherwise, it is considered turnover in the following year.

As shown in Table 3, we observe that the turnover of party secretaries is positively associated with government overtime at the 5% level. When newly appointed party secretaries take office, workers are required to work overtime by at least 0.72 percentage points in that year, which is approximately a 2.3% increase, given that the mean overtime intensity is 0.3116. However, the turnover of government officials does not show a significant association with government overtime in local government.

4 Work Overtime and Financing Cost

After documenting several stylised facts about overtime in local governments, one natural question comes out: how is the consequences of overtime? Traditionally, economists focus on the labour cost of overtime or employee's compensation (Trejo, 1991; Johnson IV, 2003; Barkume, 2010; Hart and Ma, 2010; Quach, 2022).[7] However, much less is known about the consequences of work overtime outside the labour markets. In this section, we focus on testing whether work overtime could priced in the market by using municipal corporate bonds.

Municipal corporate bonds (MCBs) in China are distinctive financial instruments shaped by the country's fiscal policies, tax-sharing framework, and fiscal decentralisation. Although these bonds are issued by local government financing vehicles (LGFVs) and are legally classified as corporate bonds, they have implicit support from the corresponding local governments, offering an additional level of security akin to traditional municipal bonds (Chen et al., 2020).[8] These bonds are typically issued by municipal enterprises to finance public infrastructure projects or to refinance existing bank loans. As an important funding channel for Chinese local governments, MCBs share certain characteristics with municipal bonds in other countries.

Existing studies on the pricing of municipal bonds identify several common factors that influence cost of municipal financing, such as credit rating (Cornaggia et al., 2018), issuance size (Capeci, 1994), default risk and liquidity risk (Wang et al., 2008; Ang et al., 2010; Schwert, 2017), and local economic conditions (Qu et al., 2023). In addition to standard financial factors, political and government-related elements also play a crucial role. Butler et al. (2009) show that higher state corruption is associated with greater credit risk and higher bond yields. Duyvesteyn et al. (2016) highlight that negative news concerning local governments, such as reports of corruption or poor governance, leads to increased municipal bond issuance and elevated spreads. Gao et al. (2021) demonstrate that Chinese local governments are more likely to default on loans from banks with weaker political influence. Similarly, Ren et al. (2024) find that local government sentiment,

[7] Interested readers may refer to the review of Anxo and Karlsson (2019).

[8] Local government debt burdens are closely intertwined with the stimulus measures introduced. In late 2008, the central government effectively relaxed the 1994 budget law and urged local authorities to employ LGFVs for bank financing. This regulatory easing and explicit policy endorsement enabled local governments to undertake an unprecedented stimulus programme, primarily financed through substantial bank loans secured by LGFVs. For a more comprehensive discussion, see Chen et al. (2020) and Gao et al. (2021).

as reflected in official government work reports, have a significant impact on municipal corporate bond credit spreads.

Government overtime can also affect municipal bond spreads as it may serve as a signal of governance quality. On the one hand, overtime driven by temporary demand surges or critical projects may reflect a responsive, hard-working government, improving investor confidence and potentially reducing bond spreads.[9] On the other hand, chronic or excessive overtime may be interpreted as a warning sign of underlying inefficiencies, budget mismanagement, or resource constraints, heightening concerns about default risk. Persistent overtime can signal structural imbalances, reduced budget flexibility, and unsustainable operational practices, all of which contribute to wider municipal bond spreads.

4.1 Empirical Approach and Results

Our dataset comprises all municipal corporate bonds issued between 2012 and 2024, obtained from the Wind Database. We supplement this data with issuance firm-level data from the Wind Database and prefecture-level city indicators and daily treasury rates, which are sourced from the CSMAR database. We combine the work overtime indicator with these data. To ensure data quality, we consolidate trading records from different markets to remove duplicates and exclude observations with incomplete key variables, resulting in a final sample of 21,266 observations on 240 unique prefecture-level cities.

To test how work overtime in local governments could influence the spread of newly issued municipal corporate bonds, we employ the following regression model:

$$Spread_{\mathrm{i,j},k,\mathrm{t}} = \alpha + \beta_1 \mathrm{O}vertime_{\mathrm{k,t}} + \gamma_1 \mathrm{B}ondCts_{\mathrm{j,t}} + \gamma_2 \mathrm{Firm}Cts_{\mathrm{i,t}} + \gamma_3 \mathrm{M}acroCts_{\mathrm{k,t}} + \varphi_{\mathrm{i}} + \theta_{\mathrm{j}} + \mu_{\mathrm{j}} + year_t + industry_i + \varepsilon_{\mathrm{i},j,k,\mathrm{t}} \quad (1)$$

where *i*, *j*, *k*, and *t* represent the issuance vehicle (firm), MCB, corresponding prefecture-level city, and bond issuance date, respectively, for each sample observation. The dependent variable in this study is the yield spread at the time of local government bond (municipal corporate bond) issuance, defined as the difference between the bond issuance yield and the treasury bond yield of the same maturity. Due to substantial differences in issuance timing, scale, and geographical location

[9] Though different purposes, Anger (2008) show that a worker signals his value to the employer by supplying unpaid overtime based on signalling model.

between these two types of bonds, a direct comparison of their issuance yields is not feasible. Therefore, this study employs the yield spread as the dependent variable. $Overtime_{k,t}$ is the measure of intensity of overtime work in prefecture-level city governments. Based on the debt issuance date, we construct overtime intensity measures over four different time windows: 30 days, 60 days, 90 days, and 180 days.[10] The primary variable of interest is the coefficient β_1 of $Overtime_{k,t}$, which captures the average effect of overtime work on the yield spread. If overtime work significantly impacts bond pricing, we expect β_1 to be statistically different from zero.

Following the literature (e.g., Ma et al., 2019; Painter, 2020; Walker et al., 2021), we control for a set of bond characteristics, issuance firm characteristics, local economic variables, and fixed effects. The control variables for bond characteristics (BondCts) include bond issuance size, bond maturity, whether a guarantor is present, and whether the issuance is public or private. FirmCts include firm (financing vehicle) size, age, and leverage. Regional economic and fiscal variables (MacroCts) include GDP growth, population density, credit-to-GDP ratio, government debt-to-GDP ratio, fiscal deficits, and turnover of party secretaries and governors. We cluster the standard errors at the prefecture-level city level.

It is important to note that a primary source of endogeneity in this analysis likely arises from omitted variables. To address this, we include a range of critical bond characteristics, issuance firm characteristics, and local economic variables. The use of year-month, city, industry, and credit rating fixed effects allows us to effectively neutralise the influence of diverse unobservable variables. Moreover, the two filters applied when generating the overtime intensity measure help to further mitigate endogeneity concerns. Specifically, we define overtime as occurring when the nightlight levels of the city government exceed both the general local economic activity, as reflected in the nightlight levels of the surrounding area, and the median level of nightlight during holidays, which captures the unobservable intrinsic characteristics of the grid.

Table 3 presents the baseline results, analysing the relationship between overtime work and the MCB yield spread. Across all model specifications, the findings consistently indicate that higher overtime intensity is associated with lower yield spreads. In the initial specification (Column 1), the results show that the 30-day overtime intensity measure is negatively correlated with the yield spread at the 1% significance level. The coefficient of -0.1283 suggests that a one-

[10] For example, if the issuance date is 1 July 2024, the 30-day overtime intensity measure is calculated as the average number of days with overtime work in the 30-day period preceding 1 July 2024.

percentage-point increase in overtime intensity is associated with a reduction in the yield spread by 12.83 basis points. This negative relationship remains robust when alternative time windows for measuring overtime work are considered (see Columns (2) to (4) of Table 4).

Our results suggest that overtime work in local governments sends a positive signal to the market, leading to lower financing costs. To provide further insights, we perform an analysis based on individual survey data from CFPS to investigate whether local government overtime intensity is associated with a greater level of trust in local governments and their ratings. This analysis includes a set of individual characteristics critical for trust, such as gender, age, self-rated physical health, educational attainment, marital status, employment status, whether the individual lives in an urban area, religious affiliation, membership in the Communist Party of China (CPC), and measures of mental health (CESD-20).

As shown in Table 5, the results indicate a statistically significant positive association between the intensity of overtime work in government and levels of trust. The results suggest that when local government overtime increases by one percentage point, trust in the government increases by at least 0.2669 units. Similarly, overtime work is positively associated with higher ratings for local government. These results remain robust after controlling for a set of fixed effects and individual characteristics. Based on the results summarised in Tables 4 and 5, we conclude that overtime work can send a positive signal to the market, thus reducing municipal financing costs.

4.2 Heterogeneity Analysis

Having established the systematic reduction in government financing costs associated with overtime work across the overall sample, we now explore the underlying mechanisms by examining city-level heterogeneity and temporal variations. We hypothesise that the effect of overtime work on the yield spread may differ according to the economic cycle and city-specific factors.

We first consider the roles of economic recessions and expansions. During periods of economic expansion, public-sector revenues typically increase due to higher tax receipts arising from greater economic activity. Under these conditions, overtime work may exert only a marginal impact on financing costs, as governments enjoy greater fiscal flexibility and thus have less need for cost-saving measures such as overtime. Conversely, during recessions, governments often

encounter increased expenditure on social welfare and reduced tax revenues, leading to higher borrowing requirements and rising financing costs (Auerbach and Gorodnichenko, 2012). Moreover, it is generally believed that governments adopt a more proactive stance in mitigating economic hardship during these periods. In this context, public-sector overtime work can signal proactive governance and a commitment to sustaining service delivery despite fiscal pressures, potentially lowering perceived risk and, consequently, borrowing costs. Therefore, we anticipate that the influence of overtime work on financing costs will be more pronounced and significant during recessions.

To identify recession periods, we employ the macroeconomic climate index provided by the National Bureau of Statistics of China, defining recessions as intervals between a peak and a trough. We then conduct a baseline analysis for both economic expansions and recessions. Table 6 presents the results, with Panel A reporting the findings for recessions and Panel B for expansions. As expected, the negative relationship between the yield spread and overtime work is more pronounced during recession periods. The results indicate that the coefficient for overtime work is statistically significant at the 5% level in recessions. The most conservative estimate suggests that overtime work reduces the yield spread by 13.1 basis points during these periods. However, this significance disappears, and its economic magnitude diminishes during economic expansions. In sum, overtime work appears to convey a positive signal to the market regarding government financing during recessions.

Next, we examine the role of fiscal health. Fiscal health is expected to shape both the financial and operational implications of overtime, influencing the direction and strength of its effect on financial outcomes. As discussed by Johnson IV (2003), within the framework of the political allocation model[11], fiscal constraints can determine how administrators manage overtime. In financially constrained contexts, individual decision-making may play a greater role in allocating overtime. By contrast, when constraints on working hours are minimal, managers may use overtime as an incentive to reward employees or maintain workplace morale. Additionally, managers might restrict overtime opportunities for underperforming workers as an implicit penalty. In fiscally healthy governments, overtime might therefore function as a cost-effective strategy for meeting temporary labour demands. However, in the presence of fiscal pressures, persistent

[11] These political allocation models rely fundamentally on the assumption that government administrators have discretion in assigning working hours and managing wage expenditures.

overtime could signal underlying operational burdens, indicating insufficient resources to recruit additional staff and thus alerting the market to potential inefficiencies.

To determine whether the effect of overtime on reducing financing costs depends on fiscal health, we split our sample into two groups: fiscal surplus and fiscal deficit. The fiscal surplus group comprises cases where budget revenue exceeds expenditure, whereas the fiscal deficit group includes cases where this difference is negative. The results, presented in Table 7, clearly show that overtime work yields more substantial benefits for cities with a fiscal surplus, both in economic and statistical terms. Specifically, the findings suggest that overtime can lower the yield spread by at least 41 basis points in this group. For cities with a fiscal deficit (Panel B of Table 7), the association between overtime and yield spread remains negative but is only statistically significant at the 10% level and, in some instances, loses significance. Economically, the effect is also smaller, as overtime reduces the yield spread by roughly 10 basis points in this group.

Lastly, we explore the role of persistent overtime in the workplace. Cities with varying frequencies and durations of overtime may experience divergent implications for economic efficiency and financial health. Persistent overtime could suggest structural inefficiencies or chronic resource constraints, potentially increasing long-term costs even if it alleviates immediate financing pressures. By contrast, non-persistent overtime may represent a more efficient and adaptable approach to accommodating short-term surges in demand, obviating the need to hire permanent staff and thereby reducing short-term costs without introducing long-term structural issues. Empirical research highlights the value of distinguishing between these two patterns. For instance, Ye et al. (2015) find that although occasional overtime can boost output and relieve financing pressure, persistent overtime heightens the risk of labour disputes and hidden costs linked to non-compliance with labour regulations.

To investigate the role of persistent overtime, we categorise the sample into two groups: cities characterised by persistent and frequent overtime (those whose overtime intensity is in the top 10th percentile) and cities exhibiting non-persistent overtime (the remaining cities). The findings presented in Table 8 support our hypothesis that the observed decrease in financing costs is predominantly concentrated in cities where overtime is less frequent and less persistent. Specifically, we observe a negative relationship between overtime and yield spreads in the non-persistent group. Although negative coefficients for overtime are also found in the persistent group,

these coefficients are not statistically significant. These results reinforce the notion that frequent and persistent overtime often signals operational inefficiencies.

4.3 The Role of Bond Maturity

The correlation between public-sector overtime and reduced financing costs may be neither uniform nor constant, but instead moderated by the bond maturity structure. Bond maturity influences both the risk and cost dynamics of public debt, and may either reinforce or undermine the cost-reduction benefits derived from overtime. Short-term bonds typically carry lower interest rates but involve greater refinancing risk (Harford et al., 2014), whereas long-term bonds offer relatively stable financing conditions but at higher cost due to term premiums. Wang et al. (2020) highlight that a larger proportion of short-term debt elevates credit risk and loan spreads, implying that bond maturity can introduce variation in financing costs. Moreover, the term structure of public debt affects borrowing costs and overall fiscal stability (Chadha et al., 2013; Faraglia et al., 2019). Thus, bond maturity may act as a moderator of the relationship between public-sector overtime and financing cost.

We therefore analyse the effect of overtime work on the yield spread for MCBs of varying maturities. Figure 5 summarises the results.[12] We observe that, regardless of the chosen overtime measure, the coefficients on overtime are consistently negative for yield spreads at maturities of three years or less. This negative effect appears strongest for MCBs with maturities of one to three years. For MCBs exceeding five years, the association between overtime and spreads seems sensitive to the specification and may even be insignificantly positive. These findings support the view that the reduction in financing cost attributable to overtime work is most pronounced for MCBs with maturities shorter than three years.

4.4 Robustness Checks

To confirm the reliability and robustness of our results, we conduct several additional tests that address various aspects of the analysis, including sample selection, the impact of the COVID-

[12] We note that the maturity of MCBs could extend beyond 10 years. However, in our sample, only 54 observations have a maturity longer than 10 years, which is relatively small and significantly fewer than those for other maturities. Therefore, we believe that these observations do not provide meaningful or comparable results in relation to the other maturities.

19 pandemic, potential confounding factors, and the presence of outliers. These checks further support our primary conclusion that overtime work reduces the MCB yield spread.

Although we include key variables to eliminate the possibility that the decline in the yield spread is driven by unobserved factors, other potential explanations for the reduction in local governments' financing costs may remain. We explore two such factors: GDP targets and the degree of fiscal decentralisation. First, competition among Chinese local governments with regard to GDP growth influences both local economic performance and financing costs (Chen et al., 2005; Qu et al., 2023). This competition may also affect overtime work, as officials may demand longer working hours when they set higher growth targets than the previous year. Second, the degree of fiscal decentralisation may reduce MCB yield spreads, as cities with a higher degree of fiscal decentralisation may enjoy greater flexibility regarding overtime. In extended analyses, we incorporate the degree of fiscal decentralisation—measured by the proportion of a prefecture's public budget expenditure relative to total government expenditure at all levels—and the GDP growth target, obtained from each city's Annual Government Work Report. As shown in Panel A of Table 9, the negative association between overtime work and the yield spread persists.

Second, despite controlling for key determinants and fixed effects, our results may still reflect influences of the COVID-19 pandemic. This pandemic, characterised by widespread lockdowns and significant economic disruption, may have affected financial markets in complex, time-dependent ways. Moreover, the substantial number of individuals who worked from home during the pandemic might have distorted our measurement of overtime, which relies on satellite-derived nighttime light data. To address this potential bias, we restrict our sample to the period 2012–2019, thus excluding the pandemic years. As shown in Panel B of Table 9, our findings remain robust.

Third, we consider excluding the four direct-controlled municipalities—Beijing, Shanghai, Tianjin, and Chongqing—which hold administrative status equivalent to that of provinces rather than prefectures, following the approach of Gao et al. (2021) and Zhang (2023). As reported in Panel C of Table 9, the negative association between overtime work and the yield spread endures.

Finally, we consider the influence of extreme values. As noted by Qu et al. (2023), certain local governments, including those in Inner Mongolia, Guangxi, and Ningxia, have experienced much faster debt growth than others, suggesting that cities in autonomous regions may be subject to looser regulatory frameworks than other localities. This raises the possibility that our results

could be driven by extreme observations. To address this concern, we winsorise all non-binary variables at the top and bottom 1% and re-run our analysis using these winsorised variables. As shown in Panel D of Table 9, the baseline results remain robust under this procedure.

5 Conclusions

This study introduces a novel approach to measuring overtime work in local governments by leveraging satellite-derived nighttime light data from NASA's Black Marble dataset. Unlike traditional survey-based methods, which are often prone to bias and limited in scope, our approach provides an objective, scalable, and high-frequency measure of nighttime government activity. By establishing a robust empirical framework, we construct overtime indicators that account for both temporal and spatial dimensions, ensuring that observed variations in brightness are attributable to government work rather than external factors.

Building upon these overtime measures, our findings reveal several stylised facts about government overtime patterns. First, government overtime exhibits strong seasonality, with intensity peaking towards the end of the year, likely driven by administrative deadlines and fiscal year-end requirements. Second, the extent of overtime work varies substantially across cities, with higher levels observed in certain regions, particularly those undergoing economic development. Third, overtime patterns demonstrate synchronisation within provinces, suggesting that government workload is shaped not only by local policies but also by broader regional and national economic cycles. Fourth, our analysis confirms the countercyclical nature of government overtime, with local governments increasing overtime hours during economic downturns, likely as a mechanism to stabilise local economies. Finally, we find that political turnover significantly influences overtime patterns, as newly appointed officials often incentivise increased work efforts from government employees.

This study further examines the financial implications of government overtime. Our empirical results indicate that higher overtime intensity is associated with lower MCB yield spreads, suggesting that financial markets interpret increased government overtime as a signal of governance quality. This effect is particularly pronounced during economic recessions and in fiscally stable municipalities, where overtime is more likely to reflect proactive government intervention rather than structural inefficiencies. Additionally, our findings highlight that the benefits of government overtime in reducing financing costs are more substantial for short-term

debt instruments, underscoring the role of bond maturity in mediating the relationship between overtime work and financial markets. However, in cities where overtime work is frequent and persistent, it may instead serve as a warning signal of inefficiencies, leading markets to perceive higher operational risks, thereby diminishing its potential to reduce financing costs.

Overall, this study makes a significant contribution to the literature on labour economics, public administration, and municipal finance by offering a novel, data-driven approach to measuring government overtime and assessing its broader economic implications. The findings emphasise the importance of integrating innovative data sources, such as satellite imagery, into policy and governance research, while also demonstrating that financial markets respond to overtime work in the public sector. Future research could extend this framework to explore overtime patterns in other public sector domains or across different institutional settings. Additionally, further investigation is warranted to examine the long-term implications of persistent overtime on government efficiency, employee well-being, and fiscal sustainability.

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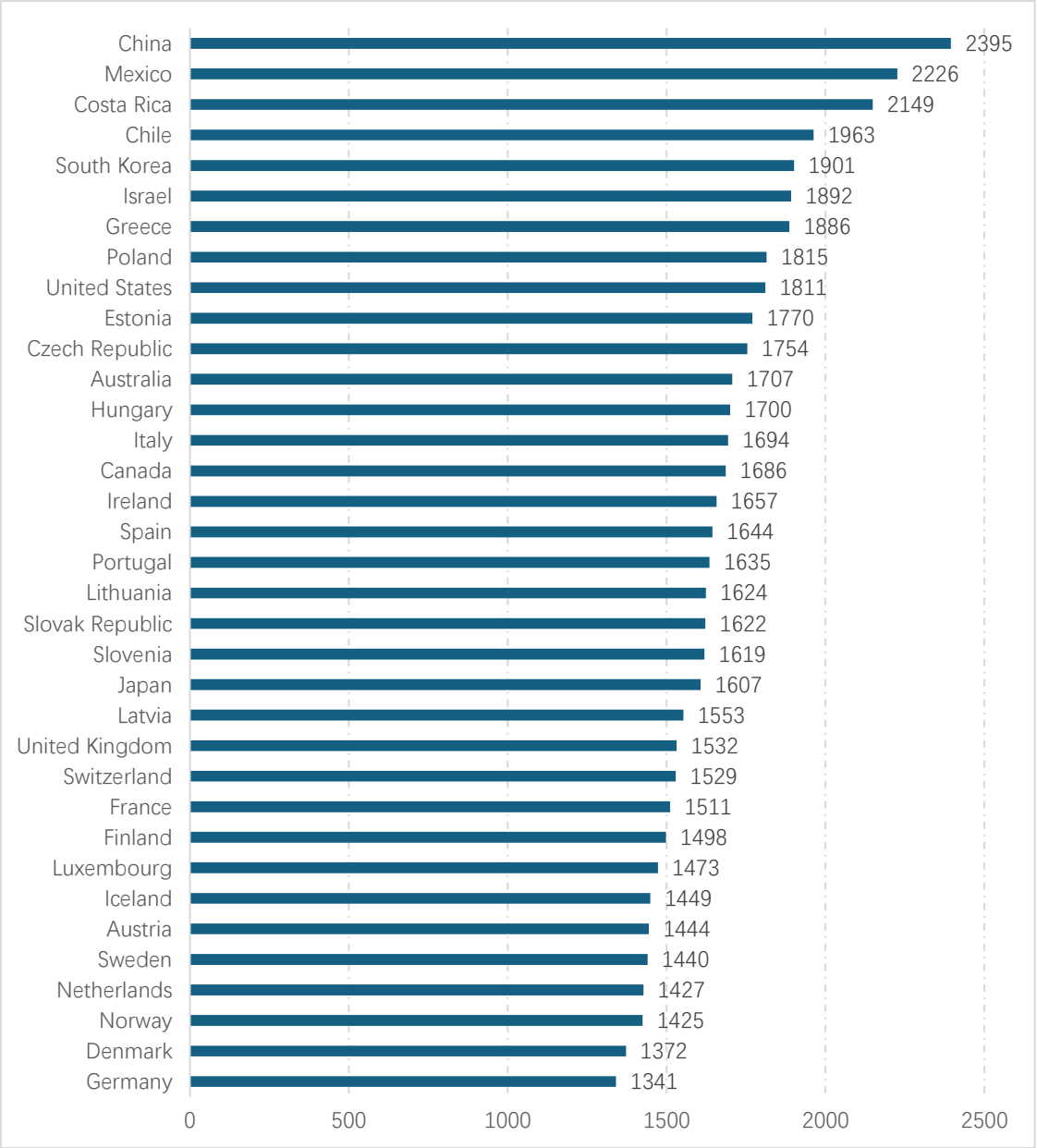


Figure 1. Average Annual Working Hours in 2022

Sources: OECD; author calculation based on China's National Bureau of Statistics

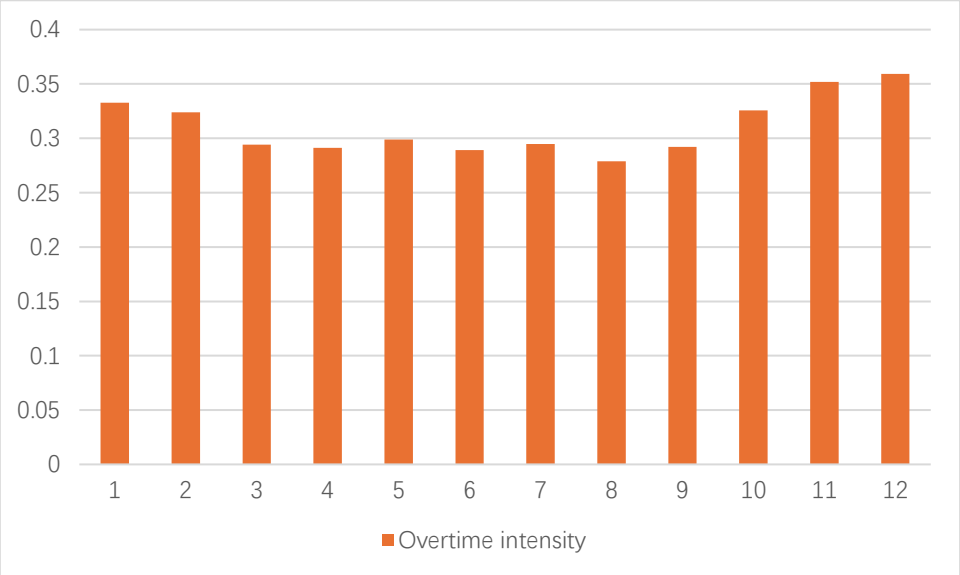
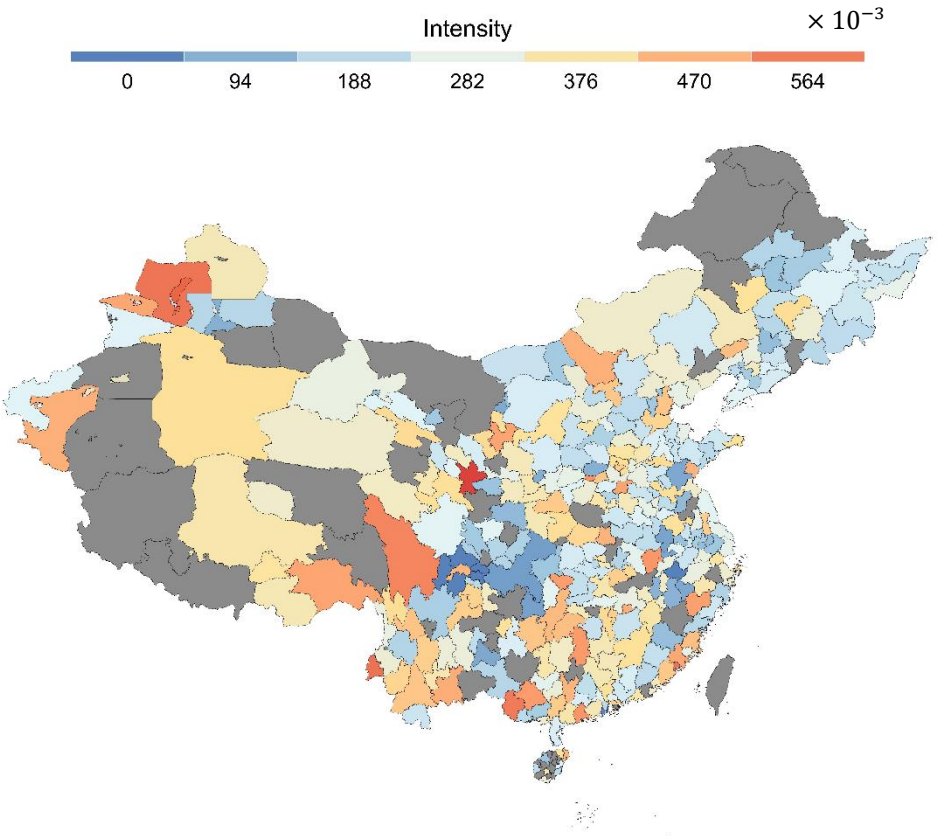


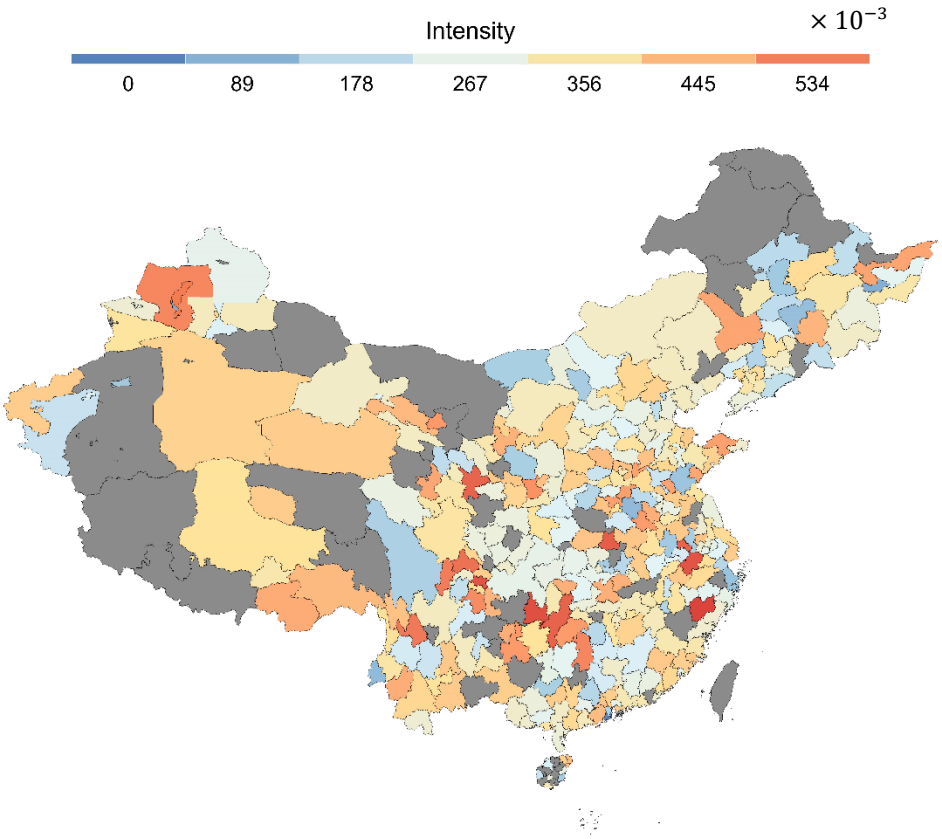
Figure 2. Seasonality of Work Overtime in Local Governments

Notes: This plot reports the overtime intensity in local government in China, averaged by month.

2012


Intensity
$\times 10^{-3}$
0
94
188
282
376
470
564

2018


Intensity
$\times 10^{-3}$
0
89
178
267
356
445
534

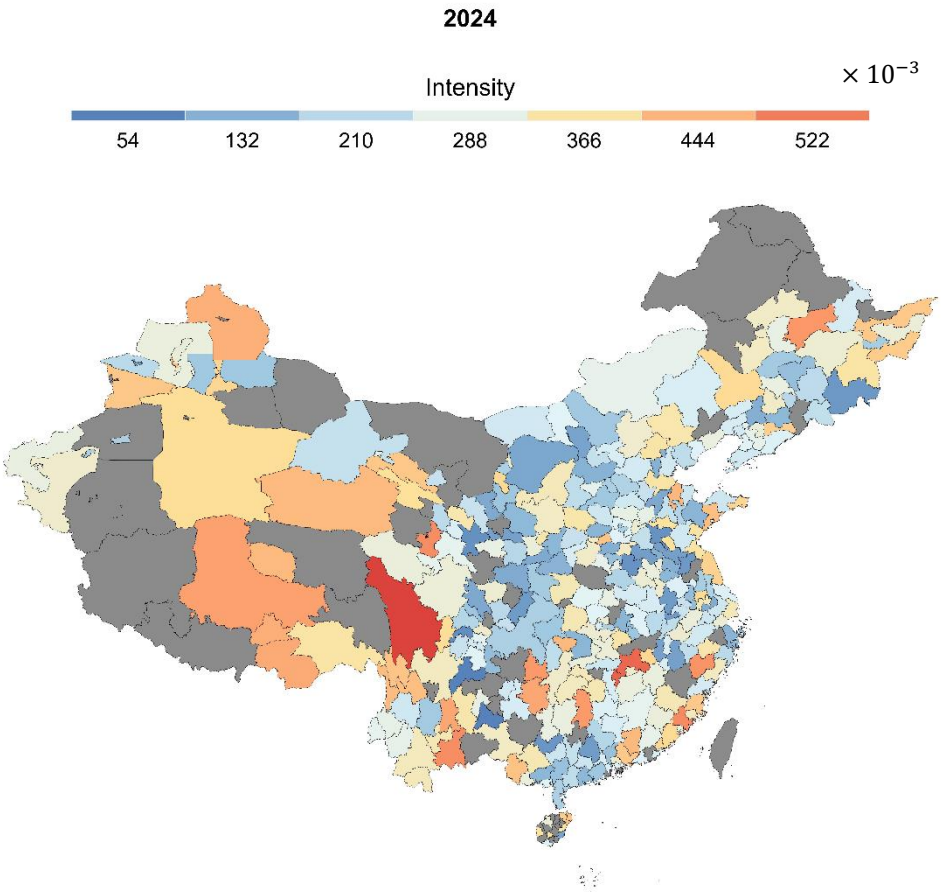


Figure 3. Prefecture-level City Government Overtime Intensity in 2012, 2018, and 2024

Notes: These plots illustrate the overtime intensity in each prefecture-level city. The grey areas represent unavailable data.

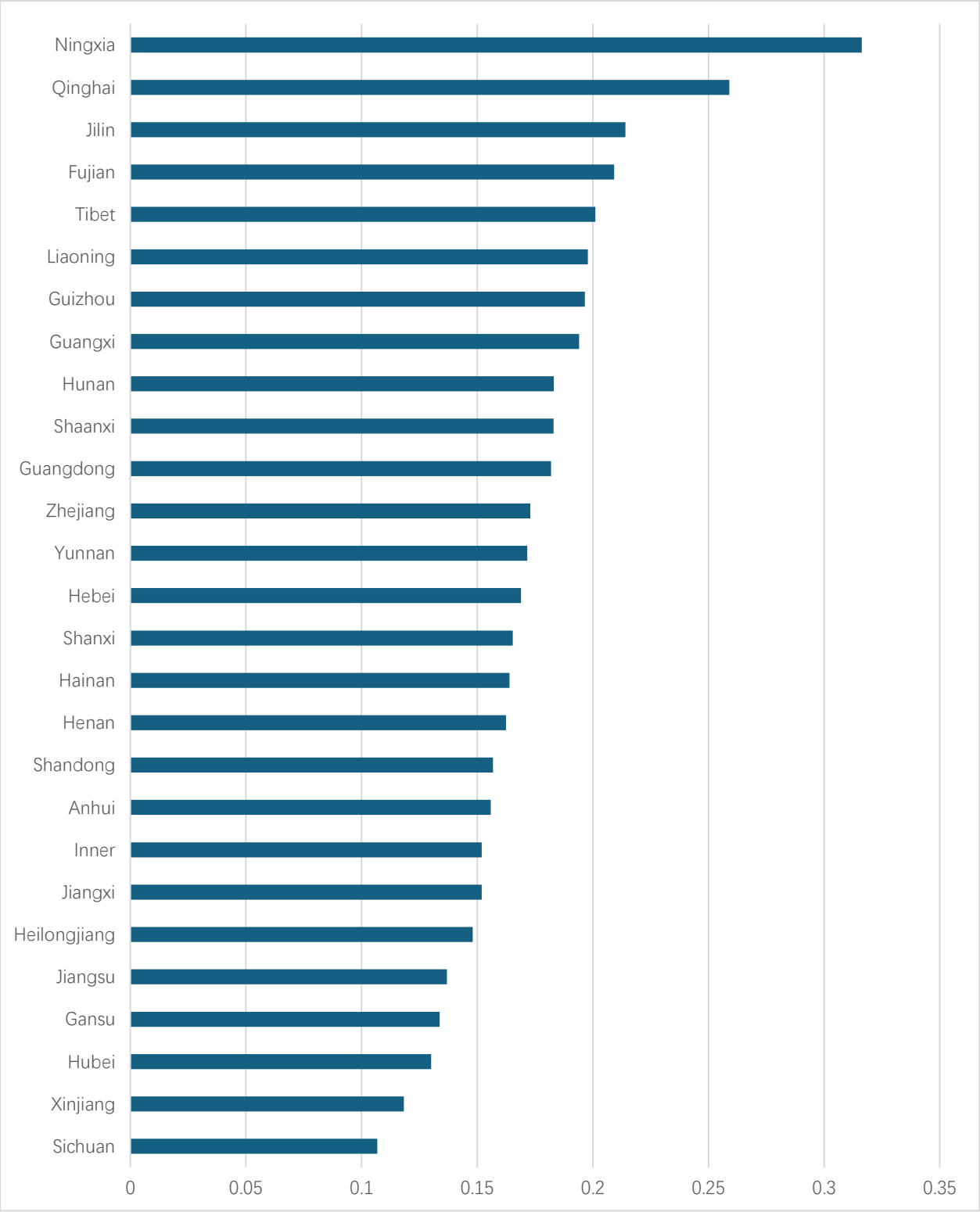


Figure 4. Co-movement of Local Government Overtime Across Provinces

Notes: We calculate the average pairwise correlation among prefecture-level cities within each province, and report the average correlation in this plot.

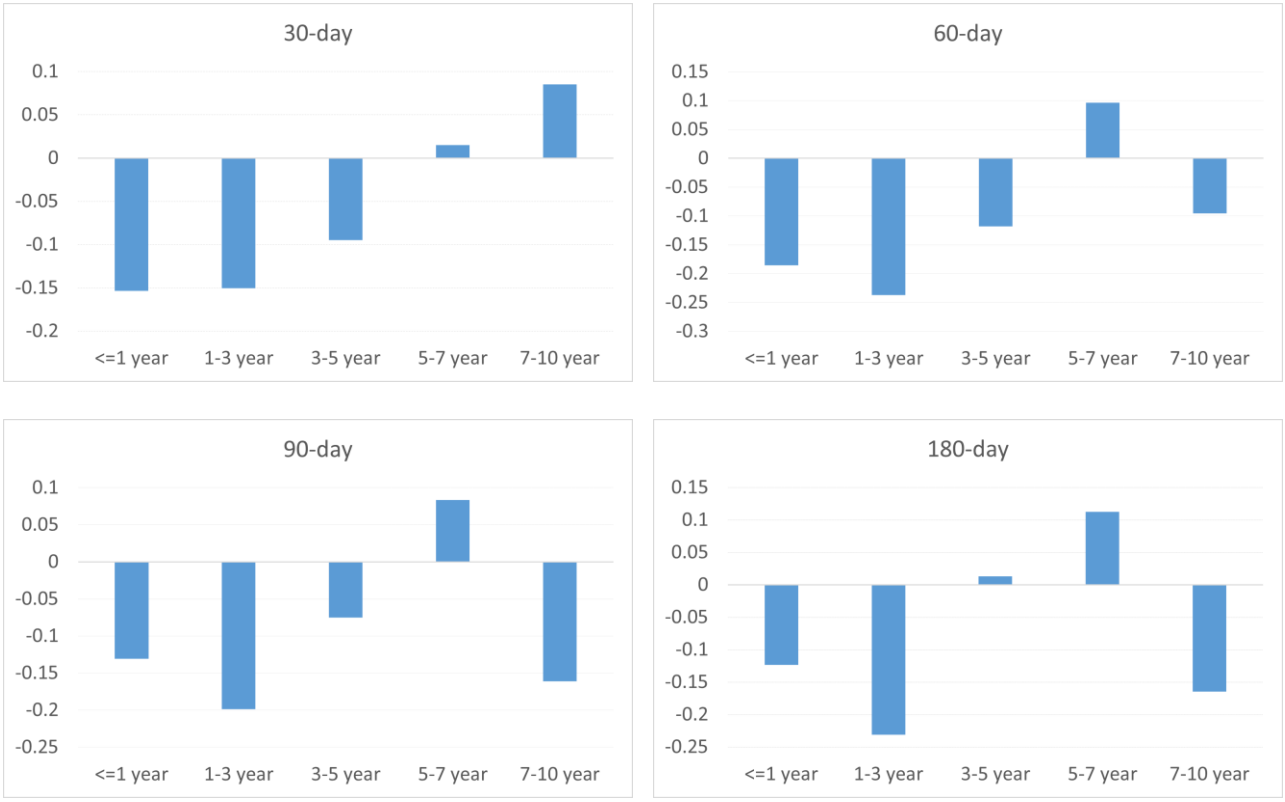


Figure 5. The Effect on Yield Spread for Different Bond Maturity

Notes: The figure shows the relationship between MCB spread and overtime intensity in terms of different bond maturity. We perform the analysis based on Equation (1) for different groups of maturity, and summarise the coefficients of overtime in the plots.

Table 1. The Top and Bottom City Governments by Overtime Intensity

Notes: The table shows the top ten and bottom ten cities in our sample of 240 cities based on their average overtime intensity from 2012 to 2024. Although there is some year-to-year variation in their relative rankings, the same group of cities generally remains at the top and bottom.

Top 10		Bottom 10	
City	Intensity	City	Intensity
Lijiang	0.4751	Daqing	0.1773
Suizhou	0.4682	Tongling	0.1755
Honghe Hani and Yi	0.4624	Changchun	0.1737
Lishui	0.4611	Langfang	0.1710
Shannan	0.4598	Zhongshan	0.1676
Diqing Tibetan	0.4579	Jincheng	0.1561
Yueyang	0.4508	Wanning	0.1443
Jiamusi	0.4456	Hefei	0.1136
Jilin	0.4368	Heihe	0.0000
Tongren	0.4354	Zhuhai	0.0000

Table 2. Government Overtime Over Business Cycle

The dependent variable is local government overtime intensity. Independent variables include GDP growth and log of unemployment numbers. We control for city and year fixed effects. The standard errors are clustered at city level, and reported in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Dependent variable: Overtime intensity				
	(1)	(2)	(3)	(4)
GDP growth	-0.0272*	-0.0139*		
	(0.0141)	(0.0085)		
Unemployment			0.0248***	0.0169***
			(0.0053)	(0.0049)
Constant	0.3173***	0.3164***	-0.0051	0.0650
	(0.0017)	(0.0015)	(0.0785)	(0.0720)
City FE	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes
Adj. R^2	0.4117	0.4192	0.4474	0.4603
Observations	3,500	3,500	2,087	2,087

Table 3. Government Overtime Around Political Turnover

The dependent variable is local government overtime intensity. Independent variables include political turnover of governor and party secretaries. We control for city-level and year fixed effects. The standard errors are clustered at city level, and reported in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Dependent variable: Overtime intensity		
	(1)	(2)
Turnover of party secretaries	0.0108**	0.0072**
	(0.0034)	(0.0036)
Turnover of Governor	0.0011	-0.0023
	(0.0035)	(0.0036)
Constant	0.3088***	0.3104***
	(0.0016)	(0.0017)
City FE	Yes	Yes
Year FE	No	Yes
Adj. R^2	0.3943	0.4100
Observations	4,080	4,080

Table 4. Baseline Results: Yield Spread and Overtime

This table presents the relationship between MCB yield spreads and overtime intensity. The analysis controls for various bond characteristics, firm characteristics, local economic variables, and fixed effects. The bond characteristics include issuance size, maturity, the presence of a guarantor, and whether the issuance is public or private. The firm characteristics include firm size, age, and leverage. The regional economic and fiscal variables encompass GDP growth, population density, the credit-to-GDP ratio, the government debt-to-GDP ratio, fiscal deficits, and turnover among party secretaries and governors. All variables are defined in Table A1. Standard errors (in parentheses) are clustered at the city level. The symbols *, **, *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	Dependent variable: Bond Yield Spreads			
	(1)	(2)	(3)	(4)
	30-day	60-day	90-day	180-day
Overtime intensity	-0.1283***	-0.1734***	-0.1707**	-0.1493*
	(0.0473)	(0.0578)	(0.0753)	(0.0698)
Amount	-0.2153***	-0.2153***	-0.2153***	-0.2156***
	(0.0216)	(0.0217)	(0.0217)	(0.0217)
Maturity	-0.1413***	-0.1412***	-0.1413***	-0.1414***
	(0.0122)	(0.0121)	(0.0121)	(0.0121)
Guarantee	-0.0965***	-0.0964***	-0.0960***	-0.0961***
	(0.0322)	(0.0322)	(0.0321)	(0.0322)
Public issuance	-0.4461***	-0.4454***	-0.4447***	-0.4453***
	(0.0476)	(0.0477)	(0.0475)	(0.0475)
Firm age	0.0004	0.0004	0.0004	0.0004
	(0.0025)	(0.0025)	(0.0025)	(0.0025)
Size	-0.1622***	-0.1622***	-0.1621***	-0.1623***
	(0.0474)	(0.0473)	(0.0473)	(0.0473)
Leverage	-0.0054***	-0.0054***	-0.0054***	-0.0054***
	(0.0020)	(0.0020)	(0.0020)	(0.0021)
GDP growth	0.0469**	0.0472**	0.0464**	0.0459**
	(0.0221)	(0.0219)	(0.0220)	(0.0220)
Population density	0.0006***	0.0006***	0.0006***	0.0006***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Credit/GDP	-0.4344	-0.4337	-0.4374	-0.4414
	(0.5238)	(0.5223)	(0.5221)	(0.5236)
Gov Debt/GDP	0.0238	0.0237	0.0232	0.0220
	(0.1190)	(0.1190)	(0.1190)	(0.1192)
Fiscal stance	-3.4211***	-3.4180***	-3.4272***	-3.4237***
	(1.2295)	(1.2278)	(1.2291)	(1.2296)
Turnover of party secretaries	0.0028	0.0029	0.0026	0.0024
	(0.0480)	(0.0479)	(0.0478)	(0.0479)
Turnover of Governor	0.0279	0.0280	0.0279	0.0279
	(0.0487)	(0.0486)	(0.0485)	(0.0485)
Constant	3.6376***	3.6510***	3.6505***	3.6468***
	(0.0964)	(0.0971)	(0.0978)	(0.0996)
Bond type FE	Yes	Yes	Yes	Yes
Credit Rating FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Adj. R^2	0.4523	0.4524	0.4524	0.4522
Observations	21,266	21,266	21,266	21,266

Table 5. Overtime Intensity and Trust and Rating in Local Governments

This table reports the relationship between overtime intensity and political trust. The dependent variable is trust in local government or rating in local government. Individual controls include gender, age, self-rated physical health, CESD-20 score, educational attainment, marital status, employment status, whether the individual lives in an urban area, religious dummy, membership in the Communist Party of China. All variables are defined in Table A1. The prefecture-level city and year fixed effects are included. The standard errors are clustered by prefecture-level city level and shown in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

	Trust in government			Rating in government		
	(1)	(2)	(3)	(4)	(5)	(6)
Overtime intensity	0.2669*	0.4055**	0.3810***	0.1322**	0.1654***	0.1614***
	(0.1574)	(0.1651)	(0.1644)	(0.0600)	(0.0594)	(0.0593)
Age		0.0223***	0.0196***		0.0073***	0.0065***
		(0.0010)	(0.0010)		(0.0004_	(0.0004)
Male		-0.1980***	-0.1525***		-0.0525***	-0.0420***
		(0.0010)	(0.0256)		(0.0089)	(0.0093)
Education		-0.0136***	-0.0084**		0.0135***	0.0123***
		(0.0033)	(0.0036)		(0.0013)	(0.0013)
Married		-0.6377***	-0.5596***		-0.1428***	-0.1350***
		(0.0327)	(0.0332)		(0.0119)	(0.0120)
Religion		0.0493	0.0516		0.0769***	0.0765***
		(0.0810)	(0.0808)		(0.0277)	(0.0277)
CPC		0.8172***	0.7116***		0.1877***	0.1537***
		(0.0638)	(0.0639)		(0.0216)	(0.0217)
Urban		-0.3583***	-0.2768***		-0.0378***	-0.0287***
		(0.0303)	(0.0309)		(0.0107)	(0.0109)
Poor health		-0.1399***	-0.1445***		-0.0434***	-0.0443***
		(0.0121)	(0.0121)		(0.0043)	(0.0043)
CESD-20		-0.0399***	-0.0386***		-0.0129***	-0.0127***
		(0.0018)	(0.0018)		(0.0007)	(0.0007)
Constant	5.1762***	6.6967***	6.6376***	3.4111***	3.6619***	3.6916***
	(0.0550)	(0.0959)	(0.0966)	(0.0196)	(0.0366)	(0.0369)
City FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry	No	No	Yes	No	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.0476	0.0857	0.0928	0.0354	0.0658	0.0659
Observations	45,718	45,718	45,718	43,197	43,197	43,197

Table 6. Heterogeneity Analysis: Recession vs Expansion

This table presents the relationship between MCB yield spreads and overtime intensity during both economic recessions and expansions. The subsample analysis controls for various bond characteristics, firm characteristics, local economic variables, and fixed effects. The bond characteristics include issuance size, maturity, the presence of a guarantor, and whether the issuance is public or private. The firm characteristics include firm size, age, and leverage. The regional economic and fiscal variables encompass GDP growth, population density, the credit-to-GDP ratio, the government debt-to-GDP ratio, fiscal deficits, and turnover among party secretaries and governors. All variables are defined in Table A1. Standard errors (in parentheses) are clustered at the city level. The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Recession				
	(1)	(2)	(3)	(4)
	30-day	60-day	90-day	180-day
Overtime intensity	-0.1310**	-0.1853***	-0.1728**	-0.1585**
	(0.0566)	(0.0666)	(0.0863)	(0.0739)
Controls	Yes	Yes	Yes	Yes
Bond type FE	Yes	Yes	Yes	Yes
Credit Rating FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Adj. R^2	0.4715	0.4716	0.4715	0.4715
Observations	17,315	17,315	17,315	17,315
Panel B: Expansion				
	(1)	(2)	(3)	(4)
	30-day	60-day	90-day	180-day
Overtime intensity	0.0134	0.0109	-0.0300	-0.0334
	(0.0765)	(0.1052)	(0.1193)	(0.1529)
Controls	Yes	Yes	Yes	Yes
Bond type FE	Yes	Yes	Yes	Yes
Credit Rating FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Adj. R^2	0.4212	0.4212	0.4212	0.4212
Observations	3,929	3,929	3,929	3,929

Table 7. Heterogeneity Analysis: Fiscal Deficits vs Fiscal Surplus

This table examines the relationship between MCB yield spreads and overtime intensity separately for cities experiencing fiscal deficits and those with fiscal surpluses. The subsample analysis accounts for various bond characteristics, firm characteristics, local economic variables, and fixed effects. The bond characteristics include issuance size, maturity, the presence of a guarantor, and whether the issuance is public or private. The firm characteristics encompass firm size, age, and leverage. The regional economic and fiscal variables include GDP growth, population density, the credit-to-GDP ratio, the government debt-to-GDP ratio, fiscal deficits, and turnover among party secretaries and governors. All variables are defined in Table A1. Standard errors (in parentheses) are clustered at the city level. The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Fiscal Surplus				
	(1)	(2)	(3)	(4)
	30-day	60-day	90-day	180-day
Overtime intensity	-0.4168***	-0.5084**	-0.5359**	-0.5259**
	(0.1032)	(0.1945)	(0.2193)	(0.2346)
Controls	Yes	Yes	Yes	Yes
Bond type FE	Yes	Yes	Yes	Yes
Credit Rating FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Adj. R^2	0.6122	0.6120	0.6118	0.6108
Observations	1,091	1,091	1,091	1,091
Panel B: Fiscal deficit				
	(1)	(2)	(3)	(4)
	30-day	60-day	90-day	180-day
Overtime intensity	-0.1009**	-0.1348**	-0.1246*	-0.1061
	(0.0475)	(0.0572)	(0.0745)	(0.0972)
Controls	Yes	Yes	Yes	Yes
Bond type FE	Yes	Yes	Yes	Yes
Credit Rating FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Adj. R^2	0.4468	0.4469	0.4468	0.4467
Observations	20,171	20,171	20,171	20,171

Table 8. Heterogeneity Analysis: The Role of Persistent Overtime

This table investigates the relationship between MCB yield spreads and overtime intensity, distinguishing between cities with frequent and persistent overtime and those with less frequent occurrences. Cities are classified as having frequent and persistent overtime if their overtime intensity ranks in the top 10% of the sample. The subsample analysis accounts for various bond characteristics, firm characteristics, local economic variables, and fixed effects. The bond characteristics include issuance size, maturity, the presence of a guarantor, and whether the issuance is public or private. The firm characteristics encompass firm size, age, and leverage. The regional economic and fiscal variables include GDP growth, population density, the credit-to-GDP ratio, the government debt-to-GDP ratio, fiscal deficits, and turnover among party secretaries and governors. All variables are defined in Table A1. Standard errors (in parentheses) are clustered at the city level. The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Persistent and frequent overtime				
	(1)	(2)	(3)	(4)
	30-day	60-day	90-day	180-day
Overtime intensity	-0.1109	-0.0453	-0.0415	-0.1265
	(0.1358)	(0.1512)	(0.1828)	(0.2109)
Controls	Yes	Yes	Yes	Yes
Bond type FE	Yes	Yes	Yes	Yes
Credit Rating FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Adj. R^2	0.5001	0.4999	0.4999	0.5000
Observations	2,171	2,171	2,171	2,171
Panel B: Non-persistent overtime				
	(1)	(2)	(3)	(4)
	30-day	60-day	90-day	180-day
Overtime intensity	-0.1378***	-0.1965***	-0.1957**	-0.1670**
	(0.0502)	(0.0626)	(0.0829)	(0.0745)
Controls	Yes	Yes	Yes	Yes
Bond type FE	Yes	Yes	Yes	Yes
Credit Rating FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Adj. R^2	0.4478	0.4480	0.4479	0.4478
Observations	19,092	19,092	19,092	19,092

Table 9. Robustness Checks

This table presents robustness checks of the effect of overtime on yield spread. In Panel A, we address the effect from fiscal decentralisation and GDP competition. In Panel B, we consider the effect of COVID-19 by restricting our sample period for 2012 to 2019. In Panel C, we exclude four direct-controlled municipalities—Beijing, Shanghai, Tianjin, and Chongqing. In Panel D, we winsorise all non-binary variables at top and bottom 1% to reduce the concern of outliers. All other settings are similar to Equation (1). We also control for a set of fixed effects, including bond type, credit rating, industry, city, and year, in all specifications. To save space we only report the coefficients of key variables. Standard errors (in parentheses) are clustered at the city level. The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
Panel A: Addressing alternative explanations				
	30-day	60-day	90-day	180-day
Overtime intensity	-0.1577***	-0.2082***	-0.2146***	-0.1546*
	(0.0521)	(0.0689)	(0.0829)	(0.0862)
Fiscal decentralisation	-4.7146***	-4.7115***	-4.7086***	-4.7213***
	(1.1950)	(1.1924)	(1.1958)	(1.1938)
Target GDP growth	-0.0551***	-0.0553***	-0.0553***	-0.0556***
	(0.0204)	(0.0204)	(0.0204)	(0.0204)
Controls	Yes	Yes	Yes	Yes
Other FEs	Yes	Yes	Yes	Yes
Adj. R^2	0.4704	0.4704	0.4704	0.4702
Observations	13,006	13,006	13,006	13,006
Panel B: COVID-19 pandemic				
	30-day	60-day	90-day	180-day
Overtime intensity	-0.1860***	-0.2244***	-0.2530***	-0.2368**
	(0.0588)	(0.0748)	(0.0860)	(0.1084)
Controls	Yes	Yes	Yes	Yes
Other FEs	Yes	Yes	Yes	Yes
Adj. R^2	0.4654	0.4654	0.4655	0.4652
Observations	7,716	7,716	7,716	7,716
Panel C: Exclude Beijing, Shanghai, Tianjin, and Chongqing				
	30-day	60-day	90-day	180-day
Overtime intensity	-0.1623***	-0.1911***	-0.1997**	-0.1693*
	(0.0443)	(0.0605)	(0.0779)	(0.0978)
Controls	Yes	Yes	Yes	Yes
Other FEs	Yes	Yes	Yes	Yes
Adj. R^2	0.4684	0.4684	0.4683	0.4682
Observations	18,789	18,789	18,789	18,789
Panel D: Winsorized at the 1%				
	30-day	60-day	90-day	180-day
Overtime intensity	-0.1294***	-0.1689***	-0.1637**	-0.1455**
	(0.0478)	(0.0576)	(0.0742)	(0.0653)
Controls	Yes	Yes	Yes	Yes
Other FEs	Yes	Yes	Yes	Yes
Adj. R^2	0.4577	0.4578	0.4577	0.4576
Observations	21,266	21,266	21,266	21,266

Appendix A

Table A1. Overtime intensity and individual working hours

This table presents the relationship between overtime intensity and individual working hours in the public sector. The objective of this table is to demonstrate the validity of local government overtime intensity. The dependent variable is the number of working hours for each respondent, while the primary independent variable is local government overtime intensity. Control variables include gender, age, self-rated physical health, CESD-20 score, educational attainment, marital status, employment status, whether the individual resides in an urban area, religious affiliation, and membership in the Communist Party of China. All variables are defined in Table A1. Fixed effects for prefecture-level cities and years are included. Standard errors are clustered at the prefecture-level city level and are reported in parentheses. Asterisks (*, **, ***) denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	Dependent variable: Number of working hours	
	(1)	(2)
Overtime	10.6848*	13.8285**
	(6.0131)	(6.8527)
Age		-0.2793***
		(0.0837)
Male		6.6255***
		(1.1365)
Education		0.0893
		(0.2341)
Married		1.6446
		(1.7774)
Religion		-0.6423
		(4.5849)
CPC		-0.6584
		(1.5546)
Urban		0.6824
		(1.7033)
Poor health		-0.5595
		(0.5457)
CESD-20		0.2574**
		(0.1168)
Constant	37.9488***	34.9689***
	(1.8659)	(7.4321)
City FE	Yes	Yes
Year FE	Yes	Yes
Adj. R^2	0.1189	0.2126
Observations	878	791

Table A2. Variable definitions and data sources

Variable	Definition	Source
Bond Yield Spreads	The spread between the bond's coupon rate and the yield on government bonds of the same maturity	WIND; CSMAR
Overtime intensity	The level of work overtime for government in given period	Author's calculation
Amount	The size of the bond issuance (log-transformed)	WIND
Maturity	The term to maturity of the issued bond	WIND
Guarantee	A dummy variable equal to 1 if there is any form of collateral (e.g., mortgage, pledge, or both) or if a joint liability guarantee (including irrevocable joint liability) is provided; otherwise 0	WIND
Public issuance	A dummy variable equal to 1 if a bond is issued publicly, and equals to zero if it is issued privately.	WIND
Firm age	The age of issuance firm's age	WIND
Size	The log of assets for issuance firm	WIND
Leverage	The ratio of total assets to total liabilities for a firm	WIND
GDP growth	The percentage change in a city's Gross Domestic Product (GDP) from year to year.	CSMAR
Population density	The ratio of the number of people in the city to total land area (square kilometers).	CSMAR
Credit/GDP	The ratio of private credit to GDP for each city	CSMAR
Gov Debt/GDP	The ratio of local government debt to GDP for each city	CSMAR
Fiscal stance	The ratio of (total government revenue minus total government expenditure) to GDP	CSMAR
Turnover of party secretaries	A dummy variable indicates one if a city occurs the change of party secretary in year t, and zero otherwise.	Author's calculation
Turnover of Governor	A dummy variable indicates one if a city occurs the change of governor in year t, and zero otherwise.	Author's calculation
Age	The age of individual respondents	CFPS
Male	A dummy variable indicates one if the respondent is female and zero otherwise.	CFPS
Education	Respondent's educational attainment (years)	CFPS
Married	A dummy variable indicates one if the respondent is married and zero otherwise.	CFPS
Religion	A dummy variable indicates one if the respondent has religious belief and zero otherwise.	CFPS
CPC	A dummy variable indicates one if the respondent is the	CFPS

	Communist Party of China member and zero otherwise.	
Urban	A dummy variable indicates one if the respondent residents in urban area, and zero otherwise.	CFPS
Poor health	A self-reporting health rating from 1 (best) to 5 (worst) health status.	CFPS
CESD-20	The CESD-20, as constructed for the China Family Panel Studies (CFPS), involves a detailed questionnaire designed to identify the presence and severity of depressive symptoms. Each of the 20 items on the scale asks respondents to rate the frequency of symptoms they have experienced in the past week, with responses typically scored on a four-point scale ranging from 1 to 4. The overall score range from 20 (best) to 80 (worst).	CFPS
Recession	A dummy variable indicates one if a year is in economic recession	Author's calculation
Expansion	A dummy variable indicates one if a year is in economic expansion	Author's calculation
Fiscal Surplus	A dummy variable indicates one if a city has positive fiscal stance in year t, and zero otherwise.	Author's calculation
Fiscal deficit	A dummy variable indicates one if a city has negative fiscal stance in year t, and zero otherwise.	Author's calculation
Fiscal decentralisation	The ratio of a prefecture's public budget expenditure relative to total government expenditure at all levels.	CSMAR
Target GDP growtl	Growth target proposed by city government.	City's Annual Government Work Report