

Leader Biases and Growth: Evidence from Spatial Superstitions of Chinese Politicians^{*}

Justin Jihao Hong[†] Yuheng Zhao[‡]

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Abstract

We study the causal impact of leaders' idiosyncratic beliefs on economic development. To do so, we exploit enduring spatial superstitions in Chinese society, which associate people with individual-specific inauspicious orientations according to birth time and exogenous astrological rules. Using data over 20 years, we find that municipal zones that are supernaturally unfavorable to mayors experience an average 2 to 3 percent slower gross domestic product (GDP) growth. This change results from reduced industrial expansion and public good investment, and is more pronounced for mayors from more superstitious hometowns. Misallocation analysis based on 1.8 million firm-level observations suggests such biases likely impede efficiency. In the longer run, having more "treated" years can accumulate into cross-zone disparities. Notably, the role of leader beliefs depends on institutional environments: it is more pronounced when government involvement in the economy is high and subordinate autonomy is limited; however, less-institutional treatment such as ideological training of leaders and anti-corruption campaigns has no significant mitigating effects. Collectively, our results shed new light on the idiosyncratic but substantial role of leadership, and how it interacts with institutions in shaping macro outcomes.

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[†] Hong: Department of Economics, Boston University (E-mail: hjihao@bu.edu, corresponding author)

[‡] Zhao: School of Applied Economics, Renmin University of China (E-mail: zhaoyuheng@ruc.edu.cn)

1 Introduction

Leaders matter: they play a crucial role in resource allocation and development trajectories in managerial and political contexts (e.g., Jones and Olken, 2005; Bertrand and Schoar, 2003; Malmendier and Tate, 2005; Ottinger and Voigtländer, 2021; Fenizia, 2022; Bai, Jia and Yang, 2023). It is therefore central to understand their objective functions, which may, as the existing literature shows, include monetary gains, promotion, and social welfare. Yet leaders also have idiosyncratic preferences and beliefs that – by virtue of their control over resources – can potentially have real socioeconomic consequences. In this paper, we show for the first time the very substantial impact of political leaders’ supernatural beliefs on growth and allocative efficiency. By better understanding leaders’ objectives and goals, we may better understand why some leaders produce better outcomes than others, and how institutions can interact with leadership in sometimes nuanced and non-obvious ways.

A rich qualitative record suggests that leaders’ idiosyncratic beliefs – many of which lack scientific basis – can have substantial consequences. For instance, the Reagans were known to incorporate astrology in their event planning while in the White House, and there is even an anecdote that astrological beliefs played a role in shaping President Reagan’s stance toward the Soviet Union. In India, sitting chief ministers seldom visit Noida City, due to an age-old taboo that doing so may result in the inability to assume office again. In Ireland, local governments allocated additional taxpayer money to reroute a motorway away from vindictive fairy bushes.¹ More broadly, in his seminal work on European leaders, historian Frederick Adams Woods identifies a monarch’s personal beliefs – apart from their capacity and networks – as an important determinant of state performance (Woods, 1913). However, it is difficult to establish the causal impact of leader beliefs on development, due to the difficulty of separating individual-specific variation, observational equivalence, and linking belief shifts to relevant aggregate outcomes.² To make progress on these fronts, the ideal setting would feature a large

¹For details about these anecdotal accounts, see: <https://www.nytimes.com/1988/05/04/us/white-house-confirms-reagans-follow-astrology-up-to-a-point.html>, <https://www.indiatimes.com/explainers/news/assembly-elections-2022-superstitions-myths-jinxes-in-indian-politics-559729.html>, and <https://europe.stripes.com/travel/2019-09-05/the-fairy-tree.html>.

²Existing work has made important steps by using leader experience to suggest the role of their beliefs. However, genuine beliefs of leaders are seldom measurable and can be correlated with other factors (e.g., competence, skills, party affiliation, social image, etc.) (Levitt, 1996). Moreover, in high-stakes settings such as politics, policy outcomes can be chosen due to strategic calculation. For instance, officials might favor their hometowns not only due to their social preferences but also for informational advantage or favor-exchange (Hodler and Raschky, 2014; Persson and Zhuravskaya, 2016; Do, Nguyen and Tran, 2017). Similarly, legislators with daughters may support pro-female policies because of electoral concerns and social image besides their feminist sympathies (Washington, 2008); Politicians with environment-related background may promote green growth as they have comparative advantages in relevant skills (Fang et al., 2023).

sample of comparable leaders, with quasi-random, individual-specific variation generated by one set of beliefs that can be consistently measured.

In this paper, we study the consequences of idiosyncratic beliefs among prefectural leaders in China. To identify the causal effects of such beliefs, we exploit the enduring *Fengshui* superstitions – a set of ancient supernatural beliefs about space in Chinese society – to shed light on whether, to what extent, and how leaders’ idiosyncratic biases affect growth. Notably, these pseudo-scientific beliefs generate exogenous, individual-specific variation: certain orientations can be deemed inauspicious for certain individuals and should be avoided (because these orientations are considered too supreme to disturb, potentially bringing bad fortune and unexpected obstacles to lives/careers), a determination based on their birth time (sometimes birthplace as well) and ancient astrological rules. As such, certain places within a leader’s jurisdiction may be idiosyncratically regarded as unfavorable, independent of other confounding socioeconomic factors. The Chinese setting is particularly well-suited for two reasons. First, political leaders play an important role in local economic growth, and their frequent turnover generates rich within-region variation in leadership (Li and Zhou, 2005; Yao and Zhang, 2015). Second, according to official reports in 2014, 7 out of 11 top-ranked officials under investigation revealed superstitious biases that influenced their decision-making, speaking to the prevalence of supernatural forces in politics as documented in other contexts.

The leaders in our study are the prefectural leaders. An average prefecture, or city, has approximately 3 million residents and includes on average 8.5 subordinate “counties”.³ Prefectural leaders in China wield substantial authority in high-stakes local decisions, influencing the trajectory of regional growth (Yao and Zhang, 2015). While counties retain a degree of autonomy, critical policies and projects necessitate the endorsement of upper-level leaders. In most cases, the prefecture and its counties hold a joint interest in local development. However, the incorporation of leader-specific spatial superstitions may affect beliefs about the economic merits of projects proposed by counties in inauspicious orientations. These beliefs may carry more weight in marginal cases in which projects are hard to evaluate and potential outcomes are ambiguous, or they fall mostly within leaders’ discretion (e.g., public good investment). Given that prefectural leaders make numerous decisions during their terms, the revelation of such irrelevant, idiosyncratic beliefs, when accumulated, may potentially have aggregate

³A prefecture ranks below provinces and above counties as the second-level administrative division in the country. As of 2020, China is officially divided into 333 prefecture-level divisions, consisting of 2,851 county-level divisions.

economic consequences.⁴

The frequent turnover of prefectural leaders in China generates rich shocks in "inauspiciousness" among subordinate counties. These within-county shocks allow us to compare a given county's development when it is located in the unfavorable zone of the upper-level leader *versus* when it is not. To this end, we construct a new dataset that captures the spatial superstitions of all Chinese prefectural leaders between 2000 and 2018. Combining information from astrological programs with the input of expert astrologists, the dataset identifies the inauspicious zones, if any, for each leader (e.g., southwest for leaders born in July 1958; west for leaders born in September 1958). We then determine whether a county falls within leader-specific inauspicious zones during a particular year, using its orientation to the prefectural government where leaders work and live.

We begin by validating our empirical strategy. We show that the ever-treated counties and never-treated counties in our sampled period (2000 - 2018) share similar *ex-ante* geographic, demographic, and economic conditions in 1999. Moreover, a county's past socioeconomic outcomes do not systematically correlate with its treatment status under future prefectural leaders. We also observe a robust balance in characteristics between prefectural leaders with "inauspicious" counties in their jurisdiction and those without. These patterns collectively bolster the validity of our empirical design.

Our estimated results indicate that leaders' idiosyncratic beliefs can have a substantial impact on economic development. Counties located in leaders' inauspicious zones experience 2 to 3 percent relative decrease in gross domestic product (GDP) growth, compared with other counties under the same leader in the same year. To put this magnitude into perspective, it is about $\frac{1}{3}$ of the hometown favoritism effect documented in the existing literature (Hodler and Raschky, 2014). The effects are primarily driven by prefectural mayors, the officials that head the government and are in direct charge of formulating and administering socioeconomic policies.⁵ The result remains robust when using night light intensity as an alternative outcome, corroborating what we observe reflects real changes. Furthermore, using an event-study design, we show that the outcome variables exhibit parallel trends before the treatment, reinforcing a causal interpretation.

⁴As an example, the mayor of Guangzhou Prefecture approves/rejects about 114 - 340 socioeconomic proposals (featuring 7-kilogram paper documents) each week. See: http://paper.people.com.cn/rmwz/html/2013-11/01/content_1354195.htm.

⁵Each prefecture is co-governed by a Party Secretary, who maintains greater political authority to set general agendas and oversee government work, and a Mayor, who heads the government agency and is in direct charge of formulating and administering socioeconomic policies. Our findings on mayors' roles are largely in line with prior work (e.g., Cao, 2022; Fang, Li and Wu, 2022).

We then investigate the channels mayors' superstitious biases hinder the growth of treated counties. First, changes in GDP sub-components suggest that the most significant decrease is within the secondary sector (manufacturing, mining, and construction). These results are corroborated with findings based on administrative land use records, which show that industrial and mining projects are significantly lower in mayors' inauspicious counties.⁶ Second, we further observe a decline in public-good-related activities. The pattern is especially prominent for transportation infrastructure, which may involve particularly high administrative and coordinating costs. The industrial and public good channels we document – which governments can more directly influence – are in line with existing research on how local leaders affect economic development in China (Persson and Zhuravskaya, 2016; Jiang, 2018; Kahn et al., 2021). Moreover, disaggregating the impacts on land usage by approval authority (prefectures *versus* subordinate counties), we find that subordinate counties react to mayor biases by promoting more local projects under their own discretion. However, at the equilibrium, the influence of mayors predominates, highlighting the central role of top leadership in shaping regional development.

We present additional results to corroborate the role of leader beliefs. First, the impact is more pronounced when the incumbent mayor originates from more superstitious hometowns. Second, we run a robustness check by further exploiting within-leader belief shifts due to year-by-year astrological changes.

Having established the discernible aggregate impact of leaders' idiosyncratic beliefs, we next turn to evaluating their efficiency consequences. We follow the misallocation literature (Hsieh and Klenow, 2009; Brandt, Van Biesebroeck and Zhang, 2012; Brandt, Tombe and Zhu, 2013; Restuccia and Rogerson, 2017; Chen et al., 2017; Ding et al., 2018), using 1.8 million administrative firm-year-level observations to estimate the total factor productivity (TFP) dispersion of industrial enterprises at the county-year level.⁷ Across different estimation approaches, TFP dispersion is consistently higher in treated counties, suggesting a worse allocative efficiency. A back-of-the-envelope calculation indicates that removing such leader biases is associated with a 1.4% - 2.4% relative productivity gain. To put this magnitude into perspective, the hypothetical productivity gain from a counterfactual move by China to the U.S. dispersion of marginal products is about 30% - 50%, according to Hsieh and Klenow (2009).

⁶This approach takes advantage of two administrative features: (1) major socioeconomic programs – which require joint approvals of county and prefectural leaders – usually involve related land usage, and (2) governments are the exclusive providers of land in China. Therefore, changes in the area of different types of land may provide a window into fine changes in local economic activities.

⁷Conceptually, revenue productivity should be equated across firms without distortions, so the extent of misallocation is worse when there is greater TFP dispersion (Hsieh and Klenow, 2009).

The effects we document have potentially long-lasting implications. To explore the longer-term effects of leader biases, we examine current cross-county differences as a function of the cumulative treated years throughout our sample period.⁸ We find that counties experienced unfavorable treatment for a longer period have relatively lower GDP levels today, with the most pronounced impact observed in those subjected to more than 7 years of unfavorable treatment. Therefore, leaders' spatial biases, though idiosyncratic, may contribute to regional disparities within their jurisdiction when their impacts accumulate over time.

Our last set of analyses examines institutional circumstances under which leaders' personal beliefs matter. This can help us better understand how institutions and individual leadership interact, providing more general insights on *why* and *when* leaders matter. First, we provide suggestive evidence that the influence of mayor biases is related to the government's role in the local economy, which partially reflects institutional quality. We construct province-year-level measures using government business-related expenditures over GDP and marketization scores (Jia, Lan and Padró i Miquel, 2020; Wang, Fan and Hu, 2018). The effect of mayor biases is stronger in areas with more interventionist governments, and the result is robust to accounting for development levels and mayors' superstition. Relatedly, we explore the role of bottom-up autonomy, leveraging staggered "county empowerment" reforms. Mayor biases have very limited impact on counties with high independence. Finally, we also explore whether less-institutional reforms within the bureaucracy can mitigate the effects of leader biases. In contrast to the previous finding, the Party's ideological training and Xi's anti-corruption campaigns make no statistically significant changes.

Our work relates to three main strands of literature. To our knowledge, we present the first causal analysis establishing the role of leaders' idiosyncratic beliefs in development, speaking to long-standing theories of leadership by scholars and the public. Our findings thus add to the broader literature on how individual leaders impact organizations and economies more broadly (Bertrand and Schoar, 2003; Malmendier and Tate, 2005; Jones and Olken, 2005; Besley, Montalvo and Reynal-Querol, 2011; Easterly and Pennings, 2020; Dippel and Heblich, 2021; Ottinger and Voigtländer, 2021). A growing body of work documents that past experiences and identity may contribute to leader performance, and a key conceptual channel through

⁸Holding constant a prefecture, its subordinate counties have been under the leadership of the same prefectural leaders in the past, and each county may have been treated a different number of times due to leader-specific supernatural biases. This offers a plausible causal identification, allowing us to examine within-prefectural disparities in growth.

which these factors operate is their influence on leaders' personal beliefs.⁹ However, it is notoriously challenging to separate the causal role of individual beliefs in politics (Levitt, 1996; Washington, 2008), and empirical evidence has largely been limited to qualitative accounts. Our setting allows us to quantify the prevalence of such distortions in a large and important polity, spanning over a wide geographic area and a long period. Moreover, our heterogeneity analyses add to the cross-regime evidence on the interaction between leadership and institutions (Clark, Murphy and Singer, 2014; Jones and Olken, 2005; Besley and Reynal-Querol, 2017; Ottinger and Voigtländer, 2021; Martinez, 2022).

Second, we contribute to the large and growing literature on culture and development (Guiso, Sapienza and Zingales, 2006; Nunn, 2022). Prior work has shown that collective cultural practices can affect growth (Campante and Yanagizawa-Drott, 2015; Schofield, 2020; Montero and Yang, 2022). We identify another important channel through which cultural beliefs of key individuals can generate aggregate economic impacts. The cultural factor in our study – beliefs in supernatural forces – is also of particular relevance given its ubiquity and persistence across societies (Leeson, 2012, 2013; Gershman, 2015; Leeson and Suarez, 2015; Nunn and Sanchez de la Sierra, 2017). Economists have recently begun to quantify the role of supernatural and non-standard beliefs in shaping individual and community behavior.¹⁰ We contribute by adding to the very limited work in the context of politics (Hong, 2023; Lowes et al., 2023). Our findings suggest an enduring role of culture in shaping real economic consequences, even in political contexts featuring high-stakes decision-making that affects citizen welfare.

Finally, we see our findings as contributing to the flourishing body of work on Chinese bureaucracy, and incentives and performance in public organizations more generally (Finan, Olken and Pande, 2017; Besley et al., 2022). Our results echo the findings of recent empirical work showing that a proportion of variation in state performance can be attributed to individual decisions (e.g., Fenizia, 2022; Best, Hjort and Szakonyi, 2023)

⁹See for example leader gender (Chattopadhyay and Duflo, 2004; Clots-Figueras, 2011; Ferreira and Gyourko, 2014; Brollo and Troiano, 2016; Besley et al., 2017; Dube and Harish, 2020; Lippmann, 2022), ethnicity (Hodler and Raschky, 2014; Burgess et al., 2015; Nye, Rainer and Stratmann, 2015; Beach and Jones, 2017; De Luca et al., 2018; Assouad, 2020; Logan, 2020), and religion identity (Bhalotra et al., 2014; Bhalotra, Clots-Figueras and Iyer, 2021; Wang, 2021). For leader experience, see for example: Göhlmann and Vaubel (2007), Washington (2008), Dreher et al. (2009), Diaz-Serrano and Pérez (2013), Jochimsen and Thomasius (2014), Mercier (2016), Van Effenterre (2020), Carreri and Teso (2021), Li, Wang and Zhang (2023), and Guo, Gao and Liang (2023).

¹⁰See for example: Halla, Liu and Liu (2019), Le Rossignol, Lowes and Nunn (2022), Butinda et al. (2023), and Fisman et al. (2023).

2 Background

2.1 Spatial supernatural beliefs

Fengshui is a long-standing cultural tradition in Chinese society, especially among ruling and elite classes. It posits that the surrounding environment generates supernatural forces that can affect human lives. Factors such as the location, structure, and orientation of dwellings and workplaces, along with the shapes of surrounding mountains and rivers, can all potentially affect one's fortune. In most prevalent schools of *Fengshui*, its implications are always individual-specific: the same place might induce distinct energy flows and outcomes to individuals with different birth charts, providing ideal variation for empirical studies. Historically, *Fengshui* was widely used to orient buildings and spiritually significant structures (e.g., temples and ancestral tombs). As of today, one can also see vivid examples of its incorporation in skyscrapers and business headquarters – from Shanghai to Hong Kong, and even in cities outside China such as Tokyo and New York.

In particular relevance to our empirical investigation is the notion of individual-specific “sacred/inauspicious orientations”. It serves as a fundamental component of *Fengshui* framework, generating inherent indications that help guide other fine-grained supernatural decisions. Taking one's residence or workplace as the origin, there can be eight equally divided orientations (N, NE, E, SE, S, SW, W, NW). Some of these orientations, usually one or two, can be deemed too sacred to offend and should be avoided; otherwise, they may bring bad fortune and unexpected obstacles to one's life and career. Importantly, the determination of such orientations is based on one's birth event and exogenous astrological rules. Specifically, each individual may have their own birth chart according to their birth time (year-month-date-hour), with their birthplace further shifting the internal energy balance of the birth chart. Spatial astrology then maps one's endowed internal energy to different orientations. Generally, the inauspicious orientations are the ones featuring the most powerful supernatural energy – as they are, philosophically, too powerful and extreme to be utilized and thus should be avoided. In some cases when the energy flow is relatively balanced, there may be no significant inherent inauspicious orientations. A degenerated version of such beliefs can be seen from a famous Chinese proverb that “Never disturb the ground under the sacred supernatural zone”.

In practice, by combining one's birth information with a comprehensive set of astrological rules, astrologers can identify inauspicious spatial orientations (e.g., Southeast) for an individual. This set of supernatural beliefs thus allows us to map each leader's birth event to individual-specific unfavorable orientations, which are plausibly independent of other political and economic factors when they are in office. There exist rich historical and modern accounts

showcasing the significance of spatial supernatural beliefs. For instance:

According to the “New Book of the Tang Dynasty”, a work of official history, the horse-keeper of *Emperor Dezong* (742 AD - 805 AD) avoided driving through the Southern Gate, because the sacred (inauspicious) orientation of the emperor is in that direction.

In 2005, a tragic incident occurred in a middle school in Qinyuan County. Du, the then-mayor, was supposed to arrive at the scene around 9 am. However, he deliberately took a detour to avoid the inauspicious orientation and did not arrive at the scene until noon.

As demonstrated in the investigation report of Wu, the former deputy governor of Yubei District, “[he] even studied *Fengshui* for years himself and brutally determined the construction of projects by asking the supernatural.”

As an extreme case, Fang, the then-leader of Huainan Prefecture in 2014, resorted to explosives to destroy an ongoing hotel project, asserting that the construction in that specific orientation would bring him bad fortune. This scandal led to the end of his political career.

A new documentary by China Central Television in 2024 reveals that Chen, the then-leader of Zhangzhou City, relied heavily on his *Fengshui* consultant and wasted 211 million CNY (about 29 million USD) in associated projects, despite facing opposition from grassroots bureaucrats and citizens.

Relating to our empirical design, there are two points worth mentioning.

First, when mapping local leaders’ birth events to their inauspicious zones, we seek the assistance of established *Fengshui* astrologers for cross-validation to obtain reliable measures. While there are many simplified supernatural tips in the media and on the internet, determining one’s *Fengshui* is technical and complex. The first step – producing one’s birth chart – can nowadays be done with the help of computer programs. However, the second step – determining one’s sacred orientation and other *Fengshui* characteristics – requires experts’ input: each sub-component of the birth chart can interact with each other and reshape the overall energy flow, and other external factors like birthplaces further add complexity. Therefore, an established astrologer needs years of training and practice, and many well-known experts are generally trained via the mentoring-based system. Accordingly, most believers, especially those political elites facing high-stakes decision-making and consequences, will invest heavily to consult expert astrologers periodically for private supernatural advice.

Second, although there are finer *Fengshui* practices to utilize orientations associated with different aspects (e.g., career, relationship, health, and exams), these techniques largely apply at the building level (within one's houses or workplaces). For instance, one may be advised to place an indoor plant in some special position of his bedroom to improve health, adjust their office desks to boost their career prospects, or erect a special statue in front of the government building to reduce unexpected conflicts. Accordingly, while existing, these components are less related to macro socioeconomic decisions and thus not our focus.

2.2 Prefectural leaders in China

Understanding how prefectural leaders can affect economic growth is a premise of our research. The Chinese polity structure is marked by a multi-tiered administrative hierarchy, consisting of the central, provincial, prefecture, county/district, and township-level authorities. At each level of entities, two officials share power in the administrations – the secretary of the local Communist Party committee and the head of the executive branch (e.g., the mayor at the prefectural level). A typical division of labor emerges from this structure: the party secretary oversees personnel and political duties; and the mayor assumes responsibility for the daily operation of the government, with an emphasis on promoting economic growth. In view of this labor division, consistent with the existing literature (e.g., Jia, 2017; Fang, Li and Wu, 2022; Cao, 2022), we expect a primary role of prefecture mayors in shaping socioeconomic development in subordinate counties, while also allowing for a comparison with the role of party secretaries in our analysis.

Empirical studies have underscored the influential role local leaders play in economic growth (Li and Zhou, 2005; Yao and Zhang, 2015). Prefectural leaders in China exercise considerable authority over high-stakes decisions and are responsible for policy implementations, which position them as crucial agents in shaping local socioeconomic trajectories. One of the primary channels through which prefectural leaders affect growth in subordinate counties is their decision-making power concerning major socioeconomic projects – including whether to approve, delay, or deny them, as well as the extent of their endorsement. These leaders often have to weigh the benefits and drawbacks of numerous proposals each day, and their decisions can have far-reaching aggregate implications. For instance, the mayor of Guangzhou Prefecture, on average, reviews and decides upon hundreds of local socioeconomic proposals daily, each accompanied by extensive documentation. Accordingly, leaders' personal idiosyncrasies, although sometimes seemingly moderate, can likely cumulatively impact the overall development.

An intriguing aspect of the Chinese administration system is the frequent turnover of local

leaders. This constant reshuffling is characterized by a top-down political framework, wherein two distinct features mitigate potential concerns of selection in the matching process. Typically, there are limited candidates, often only one or a few, for any given vacancy. Furthermore, these appointments are decided upon by higher-level authorities. In most cases, candidates are unlikely to refuse an appointment, as such refusal is often perceived as a direct challenge to the established leadership hierarchy. The regular movement of these leaders between localities generates useful *within-locality* shocks, allowing us to compare the same county under different prefectural leaders.

2.3 Qualitative investigations

This section presents more background information based on the authors' in-depth qualitative interviews with local officials and astrologers, which help better motivate our empirical analysis.

Why supernatural beliefs are so prevalent among leaders? Although it is notoriously hard to obtain representative statistics for politicians on such sensitive issues, there exists one exception: a 2007 internal survey conducted by the National Academy of Governance suggests more than 52.4 percent of local bureaucrats in China believe in supernatural in some form.¹¹ It is worth noting that, non-materialist ideology is nominally prohibited by the Chinese Communist Party, so the survey results can likely be conservative.

Although not the focus of this paper, there are two major reasons for the prevalence of supernatural beliefs among Chinese politicians. One, as an enduring culture, *Fengshui* can be ingrained in a person since their formative years, and politicians are no exception. While some politicians may not be more superstitious than average people, given their power and control over resources, revealing them at work may affect policy outcomes and thus be of relevance to social-economic development. Almost all officials interviewed agree that their lives and careers, in addition to their own efforts, are impacted by less-oblivious and subtle idiosyncratic factors like luck and the supernatural to a certain extent. This perspective speaks to the salience of culture in shaping behaviors (Nunn, 2012). In our empirical analysis, we explore whether the impact of leader biases hinges on the prevalence of supernatural norms in their hometown to partially explore this angle.

Two, supernatural forces can enhance leaders' sense of control over things, which can be particularly relevant as they make extremely high-stakes decisions and face uncertainty about policy outcomes and their careers (Dudley, 1999). This perspective speaks to the functional

¹¹See https://www.cas.cn/xw/zyxw/yw/200705/t20070511_1021150.shtml (in Chinese).

view of superstitions (e.g., Leeson and Suarez, 2015; Nunn and Sanchez de la Sierra, 2017).

How and when do leaders reveal their spatial biases? Upon entering a local leader's office, one will find on the wall a large, high-precise map of their jurisdiction. The map facilitates leaders' understanding of the location and scale of socioeconomic projects, serving as a preliminary tool to assist their decision-making. Naturally, this also allows for the manifestation of their spatial supernatural bias.

In theory, leaders may exacerbate the likelihood of negative states for events associated with their inauspicious zones, leading them to disproportionately disfavor projects based on their orientation or location. But to what extent and how exactly do personal biases enter decision-making and subsequently affect socioeconomic outcomes? Our conversations with two vice secretaries of their government offices (who assist leaders in documentation) provide useful insights on these fronts

"Counties have autonomy in administering many matters, such as selling a small parcel of real estate or renewing a township school. However, there are also numerous matters that require joint approval from both county and prefectural leaders, such as mining, industrial parks, and highway expansion. These large-scale county projects are crucial for driving a county's growth. In today's context, in addition to their own judgment, leaders definitely rely on opinions and input from experts and associated departments when reviewing projects. There are weekly mayor-led meetings that discuss and manage such matters. While some projects may clearly warrant approval or rejection so there is not much need for mayors to weigh in, there are instances where their personal beliefs and ideas play a significant role. For instance, in 2015, County A's proposal to expand its industrial parks received conflicting assessments from different departments. Ultimately, it was the mayor who made the final decision to support the project. So, if there exist considerations like Fengshui supernatural, of course in such cases they can likely be relevant."

"Naturally, leaders would never openly admit to denying a proposal because it does not align with their faction's interests or because their astrologers have advised against it. If a leader would like to stall something, they can find tons of nominal reasons to justify: citing high risks, concerns about sustainable development, or a tight budget. Yet, these are mere excuses – after all, even the infamous land quota restriction is de facto flexible to some extent. When leaders are genuinely inclined to promote a local project, they can always find ways to mobilize additional resources, such as policy support from the provincial government or fundraising."

"Relatedly, you may hear of citizen complaints like '[our county] was once comparable to some others in our prefecture; however, the development of our county stagnated during some particular leaders, especially [someone] who was horrible but held office for a long time. Now, it seems impossible

to catch up.”

Combining them with other qualitative accounts, we derive three key observations assisting our quantitative analysis.

First, leaders’ personal biases manifest in economic growth primarily through their control over local projects and associated resources. While counties retain certain autonomy in local administration, significant public projects typically require the endorsement of prefectural leaders. Thus, prefectural leaders’ personal beliefs may exert greater influence over areas where they have more authority to intervene. This motivates us to examine changes in development across different sectors and fields. For instance, we may anticipate a more pronounced impact on domains like public infrastructure if leaders’ supernatural biases are influential.

Second, there may be potential medium- or long-term consequences if a county experiences unfavorable treatment for an extended period, as it may induce persistent disadvantages. Relatedly, it is also of interest to understand whether there exist potential spillover/substitution effects across counties: as noted, resources that a prefecture can mobilize and manage are not fixed, but rather project-contingent; therefore, if leaders disfavor some areas, the socioeconomic costs may not necessarily be compensated by gains from other areas or periods.

Third, holding a leader’s superstitiousness constant, their biases may have a greater impact when their discretion is higher. This could be attributed to either the ambiguous prospects for the project (e.g., an innovative venture or a complex energy supply expansion without consensus) or institutional environments (constraints on individual power). While the former is challenging to directly pinpoint, the latter can be more straightforwardly probed by exploring regional differences in institutional constraints.

3 Data

3.1 Data and sources

Measuring leaders’ inauspicious orientations. Our measure of leaders’ inauspicious orientations builds on three steps. First, we collect the birth year and month, as well as the birthplace of each prefectural leader. The information, as well as other leader characteristics used in this paper, are extracted from official biographies from prefectural yearbooks.

Second, based on leaders’ birth event information, three expert astrologers help derive each leader’s supernaturally unfavorable orientations separately. While obtaining an accurate birth chart requires one’s birth date and hour, an advantage is that *Fengshui* (and Chinese astrology more broadly) assign disproportionately high weights to one’s birth year and month, which

enables experienced astrologers to infer necessary supernatural factors. From the econometric angle, this may induce some standard measurement errors that likely yield more conservative estimates and thus not a threat.

Third, we cross-validate astrologers' outputs and request them to re-check observations from which they draw different conclusions, and we iterate this process until all astrologers reach a consensus regarding the inauspicious orientations of all leaders. The first-round rate of overlapping is 86%, suggesting the underlying astrological rules, though complex, can largely yield consistent predictions.

Determining county location and treatment status. With leaders' supernaturally unfavorable orientations identified, we determine whether a county falls within these orientations of a particular leader. Following *Fengshui* traditions, the reference point (i.e., origin) is set to be one's residence or office. In our context, this corresponds to the location of the prefectural government where leaders work and reside.¹² In relation to the origin point, we can equally divide a prefecture into eight orientations: N ($337.5^\circ - 22.5^\circ$), NE ($22.5^\circ - 67.5^\circ$), E ($67.5^\circ - 112.5^\circ$), SE ($112.5^\circ - 157.5^\circ$), S ($157.5^\circ - 202.5^\circ$), SW ($202.5^\circ - 247.5^\circ$), W ($247.5^\circ - 292.5^\circ$), NW ($292.5^\circ - 337.5^\circ$).

In our baseline analysis, we directly refer to official descriptions from local gazetteers to ascertain the orientation of each county in a prefecture. This approach capitalizes on the common practice in local gazetteers, where the geographical location of each county relative to the prefectural government is explicitly detailed. For instance, in the gazetteer of *Meizhou* prefecture, it states that "Da-bu County is located in the eastern area of *Meizhou* prefecture." These descriptions are typically determined by spatial planning authorities, making them reliable and relevant. Later, for robustness checks, we also manually construct county locations using the Geographic Information System (GIS), computing the geometric centers of counties and deriving their Azimuth angles in relation to the prefectural government.

Finally, we construct our key explanatory variable at the county-year level, which is a dummy that is 1 if the county falls within the then-leader's supernaturally unfavorable orientation. As an example, if a county is in the southeast of the prefectural government, and the mayor's inauspicious orientation is to the southeast, then the county is viewed as treated.

Data on economic outcomes. Data on economic outcomes come from a variety of sources.

(1) *County-year-level data.* Our primary data on economic outcomes derive from the *China County-level Statistical Yearbook* from 2000 to 2018, which offers a detailed overview

¹²In the Chinese setting, local leaders are to reside in designated housing areas near local governments.

of socioeconomic development through our sample period. The main variables encompass county-year level GDP, GDP sub-components (outputs from the Primary, Secondary, and Tertiary sectors), the number of large-scale enterprises,¹³ outputs of large-scale enterprises, fiscal expenditure, and fiscal revenue.

For robustness checks, we supplement the Yearbook data with nighttime luminosity data obtained from the Defense Meteorological Satellite Program (DMSP) operated by the National Oceanic and Atmospheric Administration (NOAA). This additional dataset offers a consistent measure of nighttime light intensity extending from 1992 to 2013. Although the nighttime light measure can be relatively unstable at the county level (Gibson et al., 2021), it serves as a useful proxy to corroborate what we observe reflect real changes.

(2) *Land transaction data.* Our analysis also incorporates the administrative land transaction data from 2007 to 2018. Within this sample period, the total number of transactions per year escalates from 143,490 to 215,062. Governments are the exclusive providers of land in China. The supply of land quantity and designated usage hinges on both the central government's land utilization quota and the preferences of local authorities. While the former is stringently regulated, the latter aspect is more malleable and can be influenced by the discretion of local leaders. Accordingly, alterations in the utilization of specific land types may indicate shifts in related economic activities and leader preferences, which help us uncover the channels underlying the aggregate impact of leaders' spatial biases.

In the raw dataset, land usage is categorized into 41 distinct types. For analytical clarity, we have consolidated these into seven broad categories: Mining, manufacturing, and energy; public goods and services; transportation infrastructure; agriculture, fisheries, and forestry; commerce and services; real estate; and other lands. We then aggregate each of them to the county-year level for our regression analysis.

(3) *Firm-level data.* We utilize firm-level data between 2000 and 2007 from the Annual Surveys of Industrial Production (ASIP) to assess resource allocation efficiency. The ASIP data dataset encompasses all non-state-owned enterprises generating revenue exceeding 5 million RMB, as well as all state-owned enterprises, wherein we focus on manufacturing firms.

Adopting the methodology of Brandt, Van Biesebroeck and Zhang (2012), we track firms over time using their unique numerical identifiers and calculate the capital stock and investment employing the perpetual inventory method. To address the dynamics of restructuring, mergers,

¹³"Large-scale enterprises" are defined as industrial enterprises with annual revenue exceeding the size threshold established by the Chinese government, which was 5 million RMB before 2011 and 20 million RMB after 2011. The original data sources are managed vertically by the National Bureau of Statistics.

and acquisitions, we additionally match firms using information on their names, industry classifications, addresses, and other relevant details, as a supplement to their IDs. In alignment with Hsieh and Klenow (2009), we trim the 1% tails of output, capital distortions, and total factor productivity in each year to ensure our findings are robust to potential outliers. Our refined sample comprises approximately 1.8 million observations across 29 two-digit industries within the manufacturing sector. This sample includes data from 117,386 firms in 1998, expanding to 284,447 firms by 2007, and provides comprehensive information on value-added, employment, capital, ownership, and more.

3.2 Descriptive statistics

Table 1 presents descriptive statistics for our primary variables spanning from 2000 to 2018. Panel A details the economic outcomes at the county-year level, measured in 2014 CNY, along with the status of being located in local leaders' supernaturally unfavorable zones. On average, counties in our sample have a GDP of 11.6 trillion CNY and host 97 large-scale enterprises. The term "*Inauspicious zone*" represents the explanatory variable of interest, which is a dummy that is 1 if the county is located in the then-leader's inauspicious orientations according to *Fengshui* superstitions. At the county-year level, approximately 5.4% of counties are located in the inauspicious zone of its prefectural party secretary, and 5.8% fall within the inauspicious zone of its prefectural mayor. It is noteworthy that these two inauspicious zones largely do not overlap: the probability of a county being located in an inauspicious zone of either the party secretary or the mayor is 10.8%, allowing us to separate the effects attributable to the mayor from those of the party secretary.

Panel B of Table 1 shows the demographic characteristics of prefectural leaders throughout our sample period. The majority of party secretaries and mayors are males, and they exhibit similar levels of tertiary education (inclusive of on-the-job education experience). Compared with party secretaries, mayors tend to be younger both at the inception and conclusion of their tenure in office, and they demonstrate a moderately higher propensity to serve in their native provinces.

4 Leader Biases and Regional Growth

4.1 Empirical strategy

To investigate how leaders' idiosyncratic spatial biases shape local development, we hold constant a county and exploit the variation induced by the turnover of upper-level prefectural leaders. This design provides both *within-locality* variation (comparing the same county under

different prefectural leaders) and *cross-locality* variation (comparing different counties within the jurisdiction of the same leader). For county c in prefecture p in year t , we estimate:

$$y_{ct} = \beta \times \text{Inauspicious Zone}_{ct} + \lambda_c + \mu_{pt} + \varepsilon_{ct} \quad (1)$$

The unit of observation is at the county-year level. *Inauspicious Zone*_{ct} is a dummy that is one if county c is located in supernaturally inauspicious orientations of its prefectural leader in year t . λ_c refers to county fixed effects that hold the locality constant and remove time-invariant or slow-moving differences across counties. μ_{pt} represents the prefecture-year fixed effects, which absorb all prefectural and leader-specific temporal shocks. Accordingly, β , the key coefficient of interest, captures the average impact on treated counties relative to other counties within the same prefecture in the same year. We later also use “outside” counties (from never-treated prefectures) as pure controls to examine whether there exist significant within-prefecture spillovers. Finally, we allow the error term, ε_{hc} , to be correlated at the prefectural level to obtain a more conservative inference. [Figure A1](#) provides a visual illustration of our empirical strategy.

The main identification assumption is that, conditioned on the above fixed effects, the outcomes of treated and untreated counties should evolve similarly in the absence of the *Fengshui* treatment. As noted, a leader’s inauspicious zones are determined by their birth event with exogenous astrological rules and thus quasi-random. Therefore, the remaining concern is whether the appointment of leaders is simultaneously correlated with their astrological characteristics and the differential evolvement of outcomes in potentially treated *versus* untreated counties – which is conceptually far-fetched. An advantage of the Chinese setting is that the appointment of prefectural leaders is top-down and mandated: chosen individuals, who are usually promoted, may not alter assignment decisions unless they would like to end their political careers. Quantitatively, we will use event-study specifications to corroborate the lack of differential trends in economic development between treated and untreated counties.

To further buttress the validity of our empirical strategy, we present three sets of quantitative checks. First, we compare the *ex-ante* characteristics of ever-treated counties to those of non-treated counties during our sample period (2000 - 2018). [Table B1](#) shows that the average geographical, demographic, and economic characteristics of ever-treated counties are highly comparable to those of non-treated counties in 1999.

Second, we move beyond by investigating whether a county’s past socioeconomic conditions can predict the astrological features of its prefectural leader (and thus its treatment status). Specifically, we regress a county’s future treatment status (under the next leader’s term) on its current socioeconomic characteristics. The estimates in [Table B2](#) suggest no significant

predictors, providing additional support for our identification assumptions.

Lastly, we turn to leader-level characteristics. Notably, there is a group of prefectural leaders that do not have cross-county variation in their jurisdiction. Two reasons may explain this: (1) there may not be a salient inauspicious orientation, determined by exogenous astrological rules, or (2) no counties are located in their inauspicious orientations due to the location of the prefectural government and the prefecture's shape.¹⁴ If the turnover of leaders is not predominantly associated with astrological considerations, we should expect no salient difference between prefectural leaders with inauspicious counties in their jurisdiction and those without. Consistent with this notion, Table B3 finds a strong balance in terms of leaders' gender, tenure length, age, and educational background.

4.2 Impacts on economic development

Table 2 presents the baseline results. The outcome variable is the (log) county-year level GDP.¹⁵ As each prefecture is co-governed by a Party Secretary and a Mayor, we investigate the impact of each leadership in different columns.

Based on Column 1, pooling either leader's supernaturally inauspicious orientations, treated counties is associated with a relative reduction in annual GDP by about 1.5 %. Next, Columns 2 to 4 further disaggregate the roles of party secretaries and mayors. We find the *Fengshui* effects are largely driven by prefectural mayors, and the impact of party secretaries is close to zero. This pattern is consistent with most studies of the Chinese economy, in which mayors are in more direct charge of implementing socioeconomic policies and administering local projects. Accordingly, our later analysis will primarily focus on prefectural mayors. On average, counties located in mayors' inauspicious zones experience a 2 to 3 percent decrease in their GDP, compared to other counties in the same prefecture. To put this magnitude into perspective, the effect is about 1/3 of the hometown favoritism (i.e., a new leader's hometown gains excess economic growth due to favor-exchange, informational advantage or social preferences) documented in the existing literature (Hodler and Raschky, 2014). This translates to approximately 39 USD million in annual GDP or about 135 USD per capita (deflated to 2014).

It is worth noting that each county has its own government, and as with any other layers of Chinese bureaucracies, county governors tend to maximize their economic performance for promotion. Therefore, at the equilibrium, what we observe can likely be lower-bound effects of

¹⁴For instance, a mayor's inauspicious zone is the southwest, while the prefectural government is also located in the southwest of the prefecture. In this case, there will be no treated counties.

¹⁵In the spirit of Easterly and Pennings (2020), we use the level of GDP rather than its growth rate to partially assuage the volatility issues associated with growth rate measures.

prefectural leaders' personal biases, since there may exist potentially antagonistic forces from below to counterweigh their influence. We substantiate this notion later in the paper.

Robustness checks. Our baseline estimation uses pre-packaged official descriptions to determine the orientation of a county. [Table B4](#) defines county orientations based on Azimuth angles relative to the prefectural government calculated by the GIS. The results remain similar.

To corroborate that what we observe reflects real changes, [Table B5](#) replicates the exercise using the nighttime light intensity as the dependent variable. The mayor's *Fengshui* effects remain highly robust. Conceptually, the issue of data reporting is also not particularly problematic in our context: as county-level economic statistics are gathered and reported by county-level governments from the outset, if any, treated counties may have greater incentives to compensate for their growth loss via exaggeration, which may drive our estimates toward zero.¹⁶ We later also use industrial outputs collected independently by the National Bureau of Statistics to further validate.

Within-prefecture spillovers. Our baseline estimates present the relative changes in GDP, compared to other non-treated counties under the same top leader. This setup is consistent with prior work on patronage and distributive politics (e.g., [Iyer and Mani, 2012](#); [Golden and Min, 2013](#); [Hodler and Raschky, 2014](#); [Jia, 2017](#); [Xu, 2018](#)). An advantage of our setting is that we can further examine whether there exist within-prefecture substitution/spillover effects. These effects can potentially affect interpretations of magnitudes when bench-marking against an alternative counterfactual in which leaders have no supernatural biases at all.¹⁷

Specifically, we take advantage that some prefectures have none of their subordinate counties treated during our sample period. Using these counties as "clean controls", we separately re-estimate the impact of mayors' spatial biases on directly treated counties (as defined in our baseline specification) and indirectly treated counties (those in the same prefecture as the treated counties but not in mayors' inauspicious orientations). [Figure A2](#) visualizes the results. We find that the changes are concentrated in directly treated counties, with virtually similar magnitudes (2.5% reduction). On average, there are no salient spillovers to other non-treated counties under the same leader. In light of this, we continue to use our parsimonious baseline

¹⁶As shown by [Gibson et al. \(2021\)](#), when down to county and more local level, the indication of nighttime light luminosity can be ambiguous and unstable; we therefore only use it for robustness checks. Moreover, we do not find a difference in nightlight-GDP elasticity between treated and untreated counties, suggesting data falsification is not a chief factor in our setting.

¹⁷In the presence of strong agglomeration effects, non-treated counties (but in the same prefecture as the treated counties) might be affected negatively due to a slower growth of neighboring treated counties. Conversely, if barriers between counties are low, some investments might be attracted to non-treated counties and thus benefit them. These forces collectively can result in an ambiguous overall impact.

specification that exploits within-prefecture comparisons in our subsequent analyses. In [Figure A3](#), we show further suggestive evidence on underlying changes associated with allocative efficiency.

Event studies. A key assumption for our empirical design is that treated and untreated counties should be otherwise identical in terms of development trends in the absence of leaders' supernatural biases. While this assumption is not directly testable, we can provide supporting evidence by adopting an event-study framework.

Panel A of [Figure 1](#) presents visual evidence for the year-by-year differences in GDP for counties entering the treatment status (compared to non-treated counties), by allowing β in Equation 1 to vary by each relative year. For comparability, we restrict the analysis to status transition observed over at least an 8-year window (4 years before/after the change). The differences beyond 4 years before the treatment are omitted as the benchmark. The estimated coefficients show that, ahead of locating in mayors' inauspicious zones due to leader turnovers, there is little differential growth trend. After entering the treatment status, we observe a gradual and significant reduction in GDP relative to other non-treated counties.

Additionally, **Panel B** of [Figure 1](#) investigates the effect of exiting the treatment status. The differences beyond 4 years after the treatment ends are omitted as the benchmark. The relative GDP gap does not immediately disappear once a new leader assumes office but steadily declines over time. Notably, the coefficients here are relative to the ≥ 4 benchmark: treated and untreated counties end up evolving in similar trends again after exiting the inauspicious status; however, this does not tell us about the absolute cross-county gap in the medium/long term. We explore more about cross-county gaps in the next section.

Collectively, the roughly opposite and symmetric patterns of transitions into and out of the treatment status together reinforce a causal interpretation of our main results.

4.3 Channels

Having established the significant and robust effects of mayors' supernatural beliefs, we now turn to probe through which sectors and aspects their idiosyncratic biases hinder local growth.

We start with the disaggregate analysis of GDP sub-components. This may help us establish a broad sense of which aspects of the local economy drive the observed aggregate changes. The data allow us to break down based on the three-sector decomposition: the primary sector (agriculture, forestry, animal husbandry, and fishery), the secondary sector (manufacturing, mining, and construction), and the tertiary sector (services, commerce, and others). We then

estimate Equation 1 using each sector-specific output as the dependent variable.

Table 3 presents the results. While economic activities across all sectors are affected, the reduction in growth is predominantly concentrated in the secondary sector. This is not surprising, as the secondary sector has long been the main driver of the local economy and was thus heavily affected by government intervention and local policies. To further substantiate this finding, Columns 4 and 5 use industrial output statistics gathered directly by the National Bureau of Statistics as dependent variables. The results are similar both in terms of statistical significance and magnitudes.

One caveat of the sub-component analysis is that we do not have finer sector entries. This prevents us from identifying important aspects through which leaders can influence local socioeconomic development, such as public good investment (which can be associated with both secondary and tertiary sectors). In awareness of this issue, we complement by investigating more detailed changes in economic activities based on land usage records. This approach takes advantage of two administrative features in China: (1) major socioeconomic programs of a county – which require joint approvals of county and prefectural leaders – usually involve related land usage, and (2) governments are the exclusive providers of land. Accordingly, changes in the area of different types of land may serve as a proxy for changes in associated economic activities. Moreover, the entity of approval can be observed: for projects which subordinate counties can have more discretion, the approval authority will generally be local county governments; for projects which require support and supervision from prefectural mayors, the approval authority will generally be prefecture government. These features enable us to better separate changes in mayors' behavior and the reactions of treated counties. To this end, we use 1.9 million administrative land transaction records. The sample period starts from 2007, when nationwide administrative records are available and reliable.¹⁸ We then categorize these records by type of land usage according to official classifications and collapse them to county-year level. For each category, we normalize its land transaction area by the total county area and use this share as the dependent variable.

Figure 2 visualizes the estimated coefficients for the seven categories. To ensure comparability, we standardize each coefficient by the sample average of its corresponding dependent variable. We then rank categories based on the magnitudes of changes. Panel A presents the overall effects, pooling projects approved by prefectural and county governments. In line with the by-sector finding, economic activities associated with industrial and mining projects are significantly lower in mayors' inauspicious counties, featuring about a 25% overall decrease

¹⁸The primary land market was established in 2004, but before 2007 there existed significant missing and incomplete data entries.

compared to its average level (Row 1). This pattern speaks to the decreased industrial firm entry documented in Column 5 of Table 3. As noted, mayors may disproportionately assign more subjective weight to bad states about risky and uncertain ventures in their inauspicious zones, which can in turn lead to a lower endorsement for industrial expansion in leaders' supernaturally unfavorable counties.

Row 2 of Panel A in Figure 2 uncovers another important dimension – a significant decline in public-good-related activities, such as large-scale expansion/updates of hydraulic structures, power grids, or piping systems. Relatedly, Row 3 looks at changes in transport infrastructure, which is categorized separately in official classification guidelines due to its high-stakes nature. The infrastructure projects are relatively large-scale, associated with demanding administrative processes and coordinating costs; therefore, they can likely trigger leaders' supernatural concerns and also leave large room for them to intervene. For other entries in Rows 4 to 7, we obtain generally negative but insignificant coefficients. Though suggestive, it can be seen that the estimated magnitudes are positively associated with the scale of related projects and the extent of prefectural governments' involvement.

Panel B of Figure 2 further decomposes the outcome variables into two categories: land usage associated with projects approved by prefectural governments *versus* county governments. Two important patterns emerge. First, consistent with mayors' *Fengshui* beliefs, projects approved by prefectural governments decrease significantly across almost all categories, with the industrial and public investment domains exhibiting the most prominent changes. Second and notably, treated counties tend to promote more projects under their discretion in response, such as industrial, commercial programs, and real estate projects. This result suggests subordinate county governments exert more effort to attenuate the impact of upper-level leaders' biases. However, the overall negative impacts highlight the dominant role of mayors, speaking to the importance of leadership in shaping local development.

Although changes in land usage may only partially capture local economic development, these channels are largely consistent with the large body of studies on local leaders and growth in China. Collectively, the economic impact of mayor biases can be mostly attributed to shifts in industrial development and public good investment in treated counties, through which prefectural governments can more directly intervene in local socioeconomic trajectories. Despite the endogenous effort made by subordinate counties, mayors' biases dominate.

4.4 Further results on leader beliefs

We close our first set of analyses by presenting additional results corroborating the role of leader beliefs. First, motivated by the cultural economic literature, we exploit the heterogeneity by the prevalence of *Fengshui* norms in mayors' hometown provinces. Second, we exploit within-leader belief shifts generated by finer astrological practices and show empirical patterns consistent with these shifts.

Table 4 reports these results. Column 1 presents the baseline estimate. In Column 2, we allow the impact of locating in mayors' supernaturally unfavorable zones to vary by the extent of their superstitiousness. To this end, we use the China Family Panel Studies (2018), a nearly representative survey of Chinese individuals, which contains a question about whether one believes in *Fengshui*.¹⁹ We calculate province-specific shares of *Fengshui* believers as a proxy for the strength of related norms, and link this measure to each leader based on their hometown province. The rationale is that individuals may generally hold their cultural identity and beliefs shaped during their formative young ages in later life, even in a new environment. Consistent with this notion, the interaction term in Column 2 shows that the impact of supernatural biases is more pronounced among mayors who originate from provinces with a more entrenched *Fengshui* culture.

Column 3 provides an additional check by leveraging within-leader belief shifts. In the detailed *Fengshui* framework, year-by-year astrological changes can alter supernatural forces associated with different orientations. Although accurately determining the year-by-year *Fengshui* change for an individual generally requires more detailed information on birth events (including date and hour), workplace, and family members, we use the coarse but most transparent "Flying-Star" framework to identify these individual-specific years. In this framework, one's inauspicious zones can be particularly significant in certain years, determined by the yearly-changed star atlas. For example, during our sample period, a leader with an inauspicious zone in the Southwest should be particularly cautious in 2001 and 2010, while a leader with an inauspicious zone in the Southeast should be particularly cautious in 2003 and 2012 – since the energy of their inauspicious zones is reinforced during those years. In line with our hypothesis, the estimated coefficient is more negative during those calendar years when leaders should be particularly concerned about their inauspicious orientations.

¹⁹As culture tends to remain relatively stable in the short run, utilizing measures from 2018 may not pose a significant endogenous threat.

5 Misallocation and Cumulative Effects

Our second set of analyses moves to probe changes in misallocation and mid-term/long-term implications. Our objective is to demonstrate that the discernible aggregate impact of leaders' idiosyncratic beliefs likely induces a "leader-driven deadweight loss", a cost to society caused by individual biases. Previously, in Section 4, we presented evidence indicating the absence of substantial within-prefecture spillover effects across counties. A pertinent inquiry at this juncture is the potential for temporal substitution effects. If the projects pended in mayors inauspicious zones got resumed afterward, then the short-run impacts can be mitigated or even fully recovered in the long run. This examination is crucial for understanding the full scope of the consequences stemming from the superstition-driven decisions of local leaders, and whether these impacts are transient or result in relatively persistent inefficiencies.

5.1 Misallocation

If local development is affected by leader beliefs that have little relevance to socioeconomic basis and citizen preferences, it is conceptually plausible that revealing such beliefs may distort allocative efficiency and thus aggravate growth decline.

Align with the literature, we estimate the revenue total factor productivity (TFPR) of industrial enterprises within each county between 2000 and 2007, positing that greater TFPR dispersion is indicative of higher resource misallocation and suggests a larger scope for improvement (Ding et al., 2018). The underlying rationale is that resource allocation among firms depends on both levels of firm-specific TFP and the distortions they encounter. In an efficient resource allocation, the marginal revenue products of capital and labor are equalized across firms. Accordingly, the extent of misallocation is worse when there is greater TFP dispersion, and higher marginal revenue products signal the presence of disincentives impacting firm performance.

Table 5 probes the impacts of being in leaders' inauspicious zones on a county's allocation efficiency. In an efficient market, a firm is expected to produce until its average TFPR equals the marginal cost. **Panel A** reveals that, across different estimation approaches, the average TFPR level is consistently higher in counties identified as inauspicious ones, signaling higher barriers and costs encountered by firms. Similarly, the positive coefficients in **Panel B** suggest that such spatial biases would decrease the allocation efficiency within a county, featuring an increase in the TFPR dispersion.

To contextualize the magnitude of mayors' supernatural biases, we conduct a back-of-the-envelope calculation based on Hsieh-Klenow's framework as follows: Firstly, we multiply the

coefficient of *Inauspicious Zones (Mayor)* on TFPR dispersion by the proportion of counties treated (located in inauspicious zones of mayors) in our sample. Subsequently, we divide this product by the disparity in TFPR dispersion between China and the United States as of 2001. Finally, we multiply this quotient by the potential TFP gain that could be realized from a hypothetical shift of China to the U.S. level of dispersion in TFPR.

The calculation indicates that removing such supernatural biases could contribute to a TFP gain of approximately 1.4% to 2.4%. Compared to the potential gains in China's TFP from a marketization shift, which range between 30% and 50% as documented by [Hsieh and Klenow \(2009\)](#) under an assumption of hypothetically efficient reallocation of capital and labor, the effect of spatial biases induced by leaders' supernatural beliefs appears modest yet consequential. This comparison underscores the relevance and substantial nature of leader-driven biases in the context of overall economic efficiency.

5.2 Longer-run effects

Having established the fact that being located in mayors' supernaturally unfavorable zones would cause an efficiency loss and shift the public goods investment, which can likely generate lasting disadvantages, we now turn to its longer-term implications.

To probe this question, we note that holding constant a prefecture, its subordinate counties have been under the leadership of the same prefectural leaders and other broader shocks in the past. Meanwhile, each county may have been treated a different number of times due to exogenous, leader-specific supernatural biases that are orthogonal to other factors. Thus, when focusing on cross-county comparisons within a prefecture, we can isolate a plausibly causal mid/long-term effects. Formally, given a prefecture, we investigate the current cross-county GDP differences as a function of the cumulative treated years throughout our sample period. The outcome variable is the logarithm of a county's average GDP in 2017 and 2018.²⁰ For county c in prefecture p , we estimate:

$$y_c = \Sigma \beta_K \times \mathbf{1}[Past\ treated\ years = K]_c + \mu_p + \Gamma x'_c + \varepsilon_c \quad (2)$$

The unit of observation is at the county level. β_K , the coefficient of interest, captures the average GDP disparity in 2017 and 2018 between counties that have been located in mayors' inauspicious zones for K years during 2000 - 2016, relative to other counties that have not been treated within the same prefecture during 2000 - 2016.

²⁰We average the outcomes of two years to reduce the volatility in local growth. The results remain similar when averaging the outcomes of three years (2015-2018).

Importantly, μ_p represents the prefecture fixed effects that hold the comparisons within a prefecture and remove time-invariant or slow-moving differences across prefectures, which enables a plausibly causal interpretation of our estimates. x'_c are county-level geographic and socioeconomic controls in 1999. Geographic controls comprise the logarithm of county's area, longitude, latitude, the logarithm of the distance to the nearest coast, and the number of subordinate districts/townships in 1999. Socioeconomic controls comprise the logarithm of the population, the share of rural workers, the logarithm of total GDP, the shares of primary/secondary/tertiary-sector GDP, the logarithm of fiscal expenditure, and the logarithm of fiscal revenue in 1999. For comparability, we also hold constant the latest treated year cohort. Finally, we allow the error term, ϵ_c , to be correlated at the prefecture level.

Figure 3 visualizes the estimated coefficients across four categories: counties located in mayors' inauspicious zones for 1 - 3 years, 4 - 6 years, 7 - 9 years, and over 10 years, spanning the period from 2000 to 2016. The estimated coefficients show that counties that experienced unfavorable treatment for a longer period exhibit relatively lower GDP levels today. The relationship is not linear, indicating a compounding pattern in growth disadvantages. For counties experiencing 1 - 3 cumulative years of such treatment, the impact on current GDP (2017 - 2018) is negligible; for those subjected to 4 - 6 years of treatment, there is a discernible but insignificant decrease in GDP by 7 percentage points. This effect intensifies for counties that have experienced more than 7 years of adverse treatment, with the impact escalating to approximately 20 percentage points.

Taken together, these findings are in line with the qualitative evidence presented earlier: leaders' spatial biases, albeit idiosyncratic, can lead to growing regional disparities within their jurisdiction when these impacts accumulate over time.

5.3 Further results on prefectural-level growth

While our central focus is on county-level outcomes (corresponding to the level of treatment), we present some suggestive evidence to further characterize how mayor biases shape the aggregate development of a prefecture.

Conceptually, if prefectural leaders' biases drive down the growth of their unfavorable subordinate zones and potentially worsen the allocative efficiency across the whole prefecture, we expect that such biases may have a detrimental impact on prefecture-level growth. To isolate plausibly causal effects, we leverage the different scope of treatment – measured by the share of population or area affected – attributable to the heterogeneity in prefecture shapes. As an illustration of our identification strategy, consider two hypothetical prefectures: Prefecture A,

where 50% of its population resides in southern zones, and Prefecture B, which has only 10% of its population situated in southern zones. Should both prefectures be administered by mayors who disfavor the south, Prefecture A would experience a more pronounced effect of such leader biases. This variation in treatment intensity stems from pre-existing differences in urban shapes and is, therefore, presumed to be orthogonal to other potential confounding variables.²¹ In this way, we can estimate the impact of leader biases on prefectural-level outcomes.

Table B6 presents the results. In Columns 1 - 4, estimated impacts on prefecture-level GDP and nighttime light intensity both suggest lower aggregate growth when prefectures are more affected by leaders' supernatural biases. In light of the importance of promoting growth in mayors' promotion in China ([Li and Zhou, 2005](#); [Yao and Zhang, 2015](#)), Columns 5 and 6 further examine the relationship between treatment intensity and promotion probability. While not precisely estimated, the coefficients are consistently negative. Taking these patterns together, we speculate that leaders' strongly-held idiosyncratic beliefs may distort their objective functions and sacrifice their promotion prospects in practice – which is particularly striking in the Chinese context, where career incentives play a primary role in motivating good performance.

6 Interaction with Institutional Factors

The analyses thus far have shown leaders' supernatural beliefs can have causative impacts on local growth. However, to what extent the idiosyncratic biases matter can well be a function of institutional contexts. Motivated by the cross-country evidence (e.g., [Jones and Olken, 2005](#); [Ottinger and Voigtländer, 2021](#)), our last section extends focus to how institutional factors interact with individual leadership. The Chinese setting features rich cross-region differences in institutional quality and policy shocks, allowing us to gain potentially deeper insights about when and why leaders matter. We first exploit prominent measures of institutional quality, and then examine less-institutional shocks that aim to remove superstitious ideology or politicians' malfeasance.

6.1 Government intervention in local economy

While Chinese governments generally play highly active roles in economic development, there still exist discernible cross-province differences in political intervention (i.e., marketization). In an emerging economy, the extent of marketization can be a potentially useful measure that captures, at least partially, institutional quality and thus the constraint on political

²¹To mitigate the endogeneity, we utilize population and area at the end of the previous leader' term to construct the independent variable.

powers.²² We hypothesize that in places with heavy political intervention and thus more room for local leaders to sway socioeconomic trajectories, idiosyncratic leadership may matter more.

To empirically investigate this idea, we take advantage of two province-year level measures: one is the share of government business-related expenditures over GDP by Jia, Lan and Padró i Miquel (2020), and the other is the pre-packaged marketization score by the National Economic Research Institute (NERI) (Wang, Fan and Hu, 2018).²³ As shown by Jia, Lan and Padró i Miquel (2020), these two measures serve as useful proxies for the extent of political intervention in the local economy. Leveraging provincial-level variation can help attenuate concerns about endogenous institutions at the prefectural level, as a province acts as the first-level administrative division and ranks above its prefectures.

Table 6 presents the results. For comparability, we demean each mediator by its sample mean and divide by its standard deviation, so the interaction coefficient can be interpreted as the growth reduction associated with increasing the mediator by one standard deviation at its mean value. Column 2 uses the expenditure proxy (provincial government expenditure related to the private economy over GDP) and shows a statistically significant interacting effect. The effect is also economically significant: an increase in government intervention in the local economy by a standard deviation is associated with an additional -2.2% change in treated counties' GDP, while the mean treatment effect is -3.1%. To evaluate the confounding factors such as development levels and leaders' superstitiousness, Column 3 further controls provincial GDP per capita and the mayor hometown's superstitious norms. Two patterns emerge: (1) the interaction term for government intervention remains virtually unchanged; (2) GDP per capita has no significant mediating effect. Finally, Column 4 uses the pre-packaged marketization index as an alternative indicator, and the empirical pattern remains robust.

Together, Table 6 suggests that in regions with lower marketization (and thus likely lower institutional quality), the idiosyncratic biases of individual leaders can have a greater impact on economic development. Moreover, the null mediating effects of GDP per capita also suggest that institutional issues and power abuse may not necessarily decrease with increased prosperity.

²²For instance, the provincial marketization indexes constructed by Wang, Fan and Hu (2018) are widely-used as local institutional indicators.

²³The NERI index quantitatively assesses marketization progress based on five dimensions: the interplay between the government and market, the growth of the private sector, the development of product markets, the development of factor markets, and the development of market intermediaries. Conceptually, a higher marketization index score indicates that the market plays a more fundamental role in resource allocation.

6.2 Local autonomy: county empowerment reforms

There have been several rounds of policy experiments aimed at empowering counties with more administrative authority (Cai and Huang, 2010; Zheng, Wang and Zhao, 2011; Jia, Zhang and Guo, 2013; Liu, Qiao and Zhou, 2014; Chen and Lu, 2014; Li, Lu and Wang, 2016). Specifically, this empowerment allows county governments to (1) administer major socioeconomic policies and projects without further intervention from prefectural and provincial governments, and (2) bypass prefecture leaders to directly interact with provincial governments for local fiscal matters. Consequently, these decentralization shocks can potentially limit the centralized power held by prefectural leaders, providing another perspective on the role of institutional constraints on mayors' power.

Column 2 of Table 7 explores this perspective. To do so, we construct a county-year-specific dummy, which takes the value of 1 if the county is empowered with high governance independence. The timing of empowerment is derived from associated official documents. In line with the conceptual notion, we find that the impact is concentrated on counties with low autonomy that rely more on prefectural leaders.

6.3 Ideological training and anti-corruption campaigns

The past decade has seen intensive top-down efforts within Chinese bureaucracies to curb leaders' misbehavior and superstitious biases. The associated shocks provide interesting opportunities for us to examine whether such less-institutional designs can be effective against individual biases induced by deep-rooted cultural beliefs.

Columns 3 and 4 of Table 7 investigate the two most prominent shocks. Column 3 looks at the Chinese Communist Party's ideological training of prefectural leaders. The ideological training of Party members gains particular emphasis in Xi's agenda, aiming at reinforcing the Marxist and socialist ideology (including materialism and anti-supernatural) and promoting the "serve-the-people" mission. For prefectural leaders, the most common approach is that the provincial government initiates a short-term and intense campaign, gathering leaders and cadres for seminar-style training and requiring each prefecture to subsequently promote the training. Based on provincial yearbooks, we construct a province-year-specific dummy for whether a province conducts ideological training of its local leaders. The estimated coefficient for the interaction term in Column 3 is relatively smaller without statistical significance, suggesting that such treatment has no salient impact in curbing leaders' idiosyncratic biases.

Column 4 turns to the anti-corruption campaign that has been widely explored. The most prominent feature of this top-down campaign is that the central government dispatches

inspection teams to conduct intense audits and ferret out corrupt officials. Between 2013 and 2018, 14 waves of inspections took place, with each wave targeting 4 to 10 provinces and lasting for approximately two to three months. Following [Chen and Kung \(2019\)](#), we construct a province-year-specific dummy with an assigned value of 1 if a central inspection takes place in a particular province in a particular year. This variable is constructed based on the Central Commission for Discipline Inspection’s reports of its inspection activities. The estimate suggests no significant differences between mayors who face anti-corruption deterrence and those who do not. It is worth noting that the underlying explanation here can be complicated, as anti-corruption inspections may yield multi-faceted changes. On the one hand, it may deter power abuse and the revelation of individual biases. On the other hand, it may induce career uncertainty that increases leaders’ demand for the supernatural ([Dudley, 1999](#)). Alternatively, leaders might not read their supernatural beliefs as sensitive issues, or that these cultural beliefs can be particularly deep-rooted, so they will be difficult to change in the short term. At any rate, Columns 3 and 4 give rise to the speculation that campaign-style treatment may not be particularly effective in removing embedded personal biases.

Taken together, the analyses throughout this section speak to the notion of [Clark, Murphy and Singer \(2014\)](#) that “leaders matter most when ownership and governance structures correspond with a weak or ambiguous institutional logic.” Compared to the existing literature, our results move by showing that even in an overall weak institutional regime, an increment in institutional quality can likely play useful roles.

7 Conclusion

As demonstrated by Frederick Adams Woods’s landmark work on individual leaders and history, leaders may influence socioeconomic trajectories thanks to their own capacity, relationships, and personal beliefs ([Woods, 1913](#)). While a growing body of studies have examined the impact of leader ability and networks (e.g., [Ottinger and Voigtländer, 2021](#); [Besley, Montalvo and Reynal-Querol, 2011](#); [Dube and Harish, 2020](#); [Bai, Jia and Yang, 2023](#)), few studies have established the role of leaders’ personal beliefs in shaping development ([Krcmaric, Nelson and Roberts, 2020](#)).

Our paper is the first to provide systematic causal evidence that individual leaders’ idiosyncratic beliefs affect economic growth. We study this question in China, which features the largest polity and a sizeable number of local leaders. Our empirical strategy leverages the enduring Chinese spatial superstitions – a set of beliefs defining individuals’ unfavorable geographical orientations, based on one’s birth time and exogenous astrological rules. We

show that counties that are supernaturally unfavorable to upper-level mayors have significantly slower economic growth. Underpinning the changes are reduced industrial expansion and public good investment, accompanied by aggravated misallocation as indicated by an increase in TFP dispersion. Over time, such biases have the potential to accumulate and exacerbate regional disparities. We also show that while marketization and institutional constraints can mitigate the impact of mayors' supernatural biases, less-institutional treatment appears to be ineffective.

Overall, we see our findings as a novel contribution to the literature on individual leaders. We extend this agenda by uncovering the importance of strongly-held, idiosyncratic beliefs in shaping development. Moreover, we complement national-level evidence on how leadership and institutional contexts interact, which similarly documents more substantial impacts when there are weaker institutional constraints. Supernatural beliefs present one prominent and topical example of leaders' personal beliefs that exist around the world. Other examples may include broader religious beliefs, Protestant work ethics (work vs. luck), zero-sum thinking, communism, and environmentalism, which, despite being difficult to separate and measure in the context of politics, have been shown to have a profound impact on individual decision-making and group behavior. While our analysis leverages specifically the superstitions of politicians – which enables a clear causal identification – our findings highlight more general insights that existing descriptions of idiosyncratic beliefs and values could be important for better understanding differences across contexts in leadership and subsequent socioeconomic outcomes.

Additionally, by exploring beliefs in supernatural forces – a ubiquitous cultural phenomenon across societies – we also bridge the large literature on cultural beliefs with that on political leadership. As we show, even in high-stakes settings such as modern politics, deep-rooted cultural beliefs can influence decision-making and macro outcomes. We, therefore, bolster the plethora of qualitative accounts of politicians' engagement in supernatural and other idiosyncratic biases, which can likely affect societal welfare and thus be of real socioeconomic relevance.

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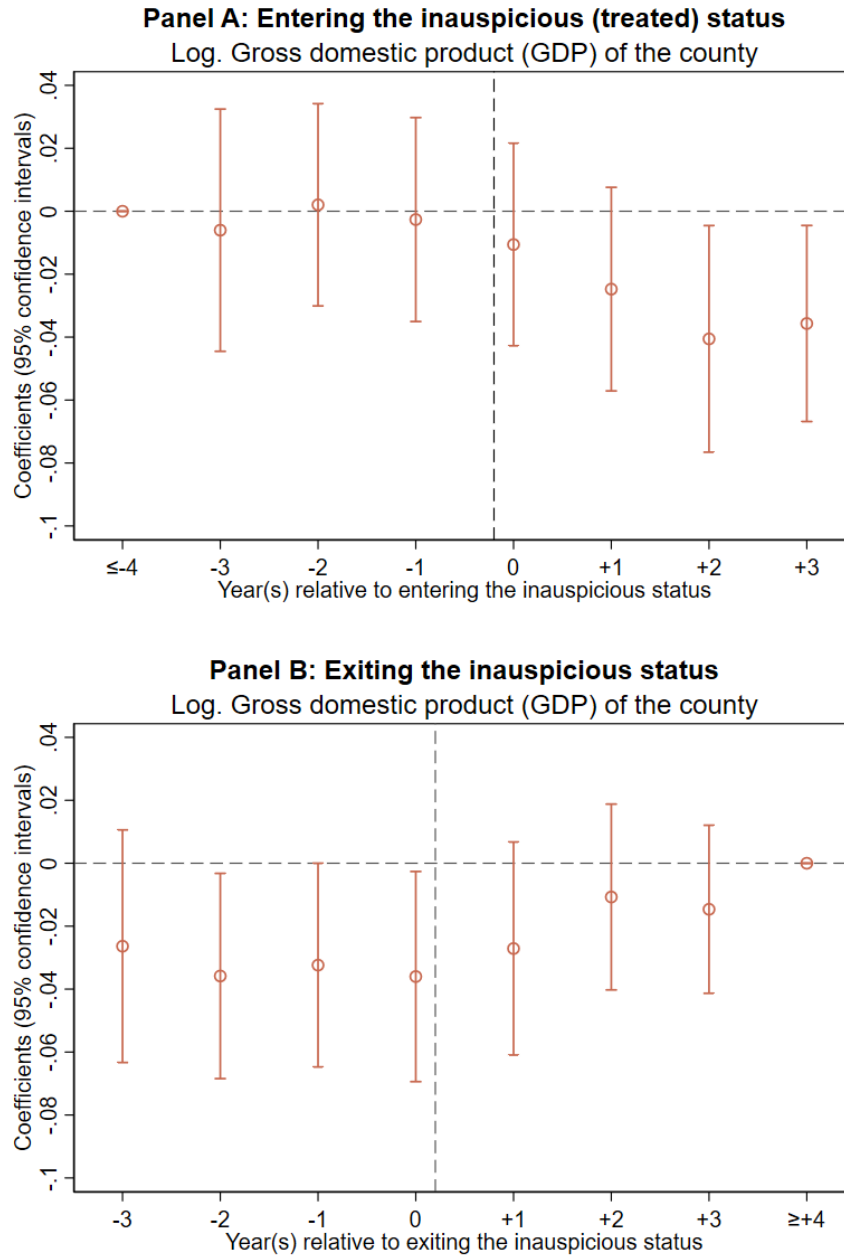
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Figures

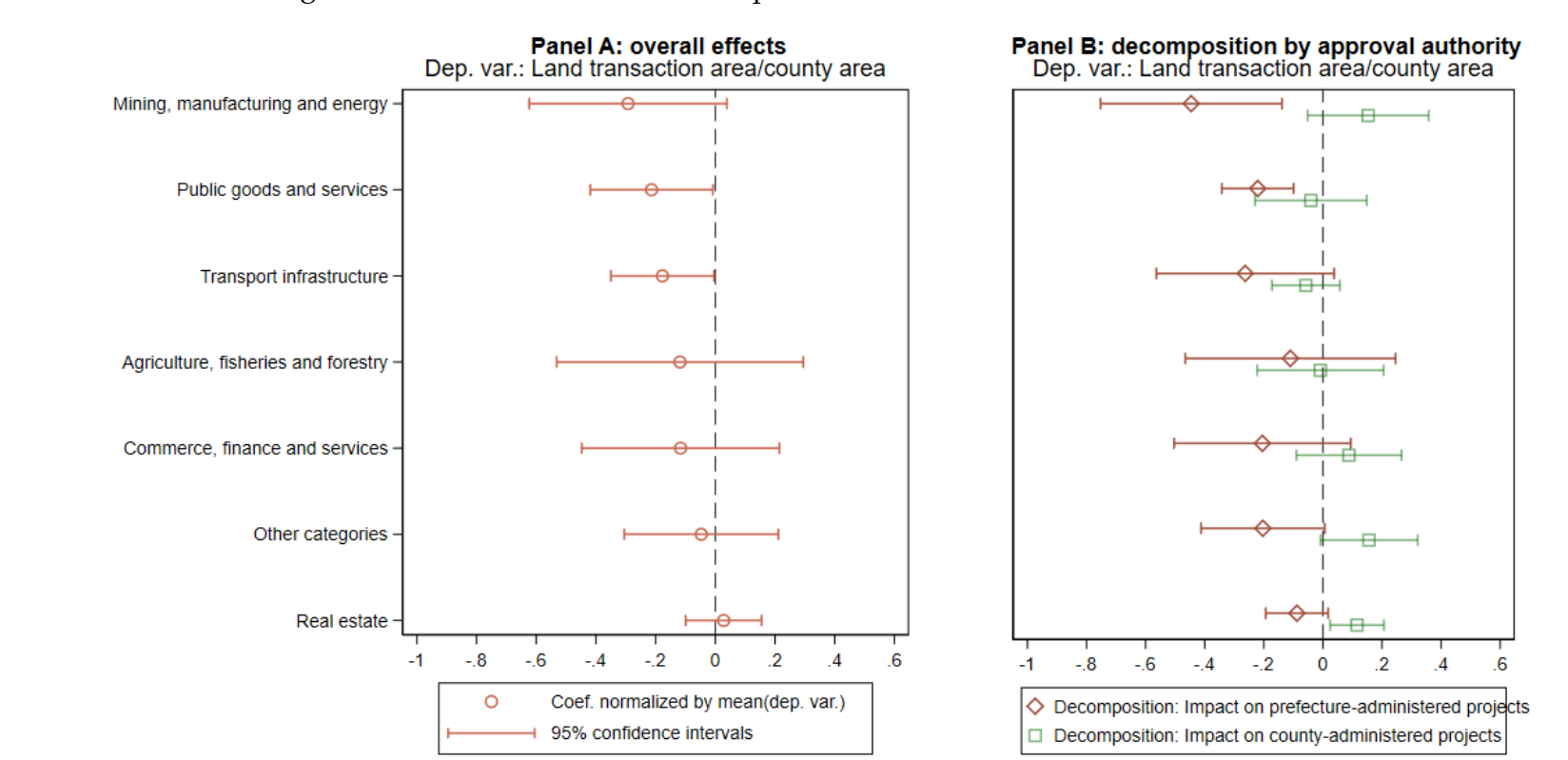
Figure 1: Event study plots – Entering and exiting the treatment status



Notes: Unit of observation: county-year. Sample period: 2000 - 2018. For comparability, we restrict the analysis to status transition observed over at least an 8-year window (4 years before/after the change). Each panel presents the estimates from one augmented event-study-type regression, with county fixed effects and prefecture-year fixed effects (same as the baseline specification). Standard errors are clustered at the prefecture level.

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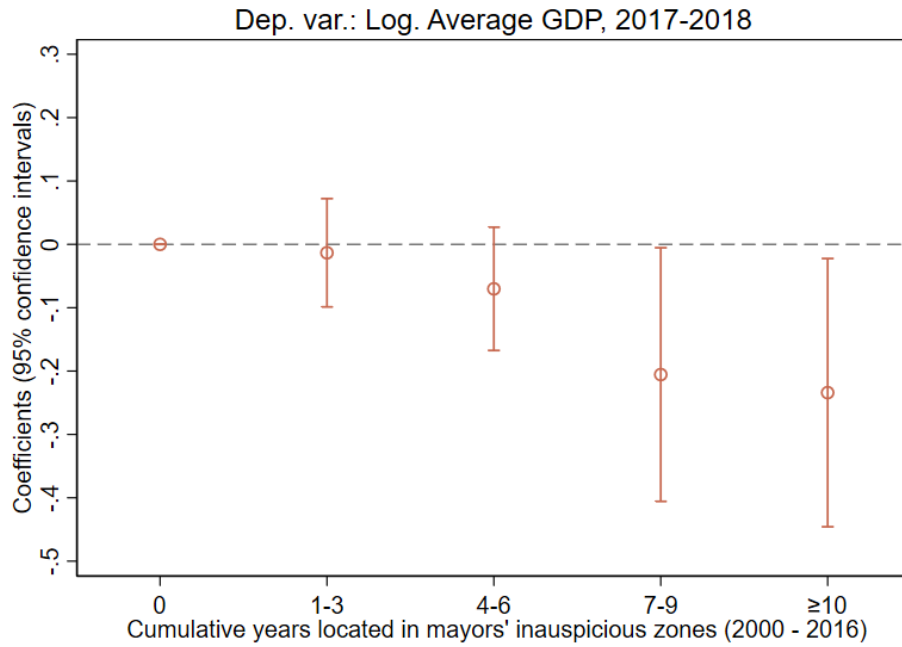
Figure 2: Channels – Leaders' inauspicious zones and local economic activities



Notes: In China, governments are the exclusive providers of land, and changes in the area of different types of land can provide a window into fine changes in local economic activities. The graph depicts the estimated impacts of being located in mayors' supernaturally unfavorable zones on land transaction area (normalized by the county's area), categorized by type. **Panel A** shows the overall effects, while **Panel B** decomposes these effects by approved authority (prefecture vs. subordinate county). Each dot presents the estimate from one regression, with county fixed effects and prefecture-year fixed effects. For comparability, each coefficient is normalized by the mean of the corresponding outcome variable. Unit of observation: county-year. Sample period: 2007 - 2018, when comprehensive land transaction records are available. Standard errors are clustered at the prefecture level.

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Figure 3: Cumulative impacts of locating in leaders' inauspicious zones



...

Notes: Unit of observation: county. Sample period for outcome average: 2017 - 2018. The figure presents the estimates from one augmented cross-sectional regression:

$$y_c = \Sigma \beta_K \times \mathbf{1}[Past\ treated\ years = K]_c + \mu_p + \Gamma x'_c + \varepsilon_c$$

where μ_p are prefecture fixed effects; x'_c are county-level geographic and socioeconomic controls in 1999. Geographic controls comprise the logarithm of county's area, longitude, latitude, the logarithm of the distance to the nearest coast, and the number of subordinate districts/townships in 1999.

Socioeconomic controls comprise the logarithm of the population, the share of rural workers, the logarithm of total GDP, the shares of primary/secondary/tertiary-sector GDP, the logarithm of fiscal expenditure, and the logarithm of fiscal revenue in 1999. For comparability, we also hold constant the latest treated year cohort. Standard errors are clustered at the prefecture level.

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Tables

Table 1: Descriptive statistics of main variables

	Mean	Standard deviation	Observations
Panel A: County-Year			
GDP (10,000 CNY in 2014)	1,161,664	1,855,852	37,436
Log. GDP	13.230	1.293	37,436
Log. Primary-sector output	11.638	1.099	37,391
Log. Secondary-sector output	12.245	1.597	37,381
Log. Tertiary-sector output	12.118	1.311	37,276
Number of large enterprises	97.004	188.311	36,389
Log. Output of large enterprises	12.622	2.138	32,495
Log. Fiscal expenditure	11.459	1.081	37,368
Log. Fiscal revenue	10.124	1.447	37,342
Inauspicious zone: Secretary	0.054	0.226	34,958
Inauspicious zone: Mayor	0.058	0.233	34,777
Inauspicious zone: either leader	0.108	0.310	33,472
Panel B: Individual leader			
Secretary: Female (binary)	0.041	0.199	1,628
Secretary: Age of taking office	50.684	3.751	1,521
Secretary: Age of leaving office/turnover	53.990	3.778	1,521
Secretary: Work in native province (binary)	0.664	0.473	1,531
Secretary: Any tertiary education	0.959	0.197	1,479
Mayor: Female (binary)	0.058	0.234	1,821
Mayor: Age of taking office	48.167	4.218	1,730
Mayor: Age of leaving office/turnover	50.215	4.214	1,730
Mayor: Work in native province (binary)	0.730	0.444	1,719
Mayor: Any tertiary education	0.948	0.223	1,628

Notes: Sample period: 2000 - 2018. In **Panel A**, all output, expenditure, and revenue related outcomes are measured in 2014 CNY. “*Large enterprises*” refer to industrial enterprises with annual revenue exceeding the size threshold established by the Chinese government, which was 5 million RMB before 2011 and 20 million RMB after 2011. Data on the annual output value of large enterprises are available for the years 2000 to 2016. “*Inauspicious zone*” is the explanatory variable of interest, which is a dummy that is 1 if the county is located in the then leader’s inauspicious orientation according to *Fengshui* superstitions. In **Panel B**, leaders’ tertiary education includes on-the-job experience.

Table 2: Leaders' inauspicious zones and economic growth

	Log. County GDP			
	(1)	(2)	(3)	(4)
Mean of dep. var	13.321	13.352	13.369	13.404
Inauspicious zone (either leader)	-0.015** (0.007)			
Inauspicious zone (Secretary)		-0.006 (0.009)		-0.005 (0.009)
Inauspicious zone (Mayor)			-0.029*** (0.009)	-0.027*** (0.010)
County FEs	Y	Y	Y	Y
Prefecture-Year FEs	Y	Y	Y	Y
Observations	35,607	34,322	34,160	32,875
Adjusted R-squared	0.985	0.985	0.985	0.985

Notes: Unit of observation: county-year. Sample period: 2000-2018. “*Inauspicious zone*” is a dummy that is 1 if the county is located in the supernaturally unfavorable orientation of the then prefectural leader(s). Each prefecture is co-governed by a Party Secretary and a Mayor. The Secretary has more bearing on the general political agenda and personnel decisions; the Mayor heads the government agency responsible for formulating and implementing socioeconomic policies and their administration. A prefecture oversees an average of 8.5 subordinate counties in China. There can be vacancies for the positions of Secretary or Mayor in some transition years. Standard errors in parentheses are clustered at the prefecture level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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Table 3: Leaders' inauspicious zones and GDP by sector

	Log. GDP sub-components			Additional industrial outcomes	
	Primary sector	Secondary sector	Tertiary sector	Log. Number of large enterprises	Log. Output of large enterprises
	(1)	(2)	(3)	(4)	(5)
Mean of dep. var	11.552	12.226	12.060	3.750	12.603
Inauspicious zone (Mayor)	-0.017** (0.007)	-0.050*** (0.015)	-0.020* (0.010)	-0.033** (0.016)	-0.055** (0.027)
County FEs	Y	Y	Y	Y	Y
Prefecture-Year FEs	Y	Y	Y	Y	Y
Observations	34,229	34,227	34,074	33,715	29,925
Adjusted R-squared	0.984	0.969	0.975	0.954	0.947
Sample period	2000 - 2018	2000 - 2018	2000 - 2018	2000 - 2018	2000 - 2016

Notes: Unit of observation: county-year. Sample period: 2000 - 2018. “Inauspicious zone (Mayor)” is a dummy that is 1 if the county is located in the supernaturally unfavorable orientation of the then prefectural mayor, according to *Fengshui* superstitions. A prefecture oversees an average of 8.5 subordinate counties in China. “Large enterprises” in this context refer to industrial enterprises with annual revenue exceeding the size threshold established by the Chinese government, which was 5 million RMB before 2011 and 20 million RMB after 2011. Data on the annual output value of large enterprises are available for the years 2000 to 2016. Standard errors in parentheses are clustered at the prefecture level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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Table 4: Corroborating the role of leader beliefs

	Log. County GDP		
	(1)	(2)	(3)
Mean of dep. var	13.369	13.369	13.369
Inauspicious zone (Mayor)	-0.029*** (0.009)	-0.028*** (0.010)	-0.026** (0.010)
× <i>Fengshui</i> norms of mayor hometown (centered)		-0.134** (0.062)	
× Prominent year for inauspiciousness (dummy)			-0.027** (0.011)
County FEs	Y	Y	Y
Prefecture-Year FEs	Y	Y	Y
Observations	34,160	33,742	34,160
Adjusted R-squared	0.985	0.987	0.987

Notes: Unit of observation: county-year. Sample period: 2000 - 2018. “*Inauspicious zone (Mayor)*” is a dummy that is 1 if the county is located in the supernaturally unfavorable orientation of the then prefectural mayor, according to *Fengshui* superstitions. A prefecture oversees an average of 8.5 subordinate counties in China. “*Fengshui norms of mayor hometown*” is a province-specific continuous variable, constructed by calculating the share of individuals who hold beliefs in *Fengshui* traditions; the individual *Fengshui* belief (as a binary) is obtained from the China Family Panel Studies (2018), a nearly-representative survey of Chinese individuals. “*Prominent year for inauspiciousness*” is a leader-year specific dummy, which takes the value of 1 during specific years when individuals are advised to exercise extreme caution regarding their inauspicious orientations, according to a prominent school of *Fengshui* traditions. Standard errors in parentheses are clustered at the prefecture level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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Table 5: Leaders' inauspicious zones and misallocation

Panel A: Marginal costs faced by firms	Average TFPR		
	(1)	(2)	(3)
Mean of dep. var	2.424	0.023	0.012
Inauspicious zone (Mayor)	0.150** (0.062)	0.042* (0.024)	0.040* (0.022)
Model	Hsieh-Klenow	Levinsohn-Petrin	Akerberg-Caves-Frazer
County FEs	Y	Y	Y
Prefecture-Year FEs	Y	Y	Y
Observations	9,124	9,124	9,124
Std. dev. of dep. var	1.107	0.421	0.409
Panel B: Extent of misallocation	TFPR dispersion (std. dev. of log.)		
	(1)	(2)	(3)
Mean of dep. var	1.833	0.867	0.834
Inauspicious zone (Mayor)	0.219*** (0.075)	0.038** (0.017)	0.024 (0.016)
Model	Hsieh-Klenow	Levinsohn-Petrin	Akerberg-Caves-Frazer
County FEs	Y	Y	Y
Prefecture-Year FEs	Y	Y	Y
Observations	9,124	9,124	9,124
Std. dev. of dep. var	1.129	0.220	0.218

Notes: Unit of observation: county-year. Sample period: 2000 - 2007. "Inauspicious zone (Mayor)" is a dummy that is 1 if the county is located in the supernaturally unfavorable orientation of the then prefectural mayor, according to Fengshui superstitions. We restrict to counties with more than 5 large-scale enterprises to ensure a reliable estimation of TFP dispersion. The outcome variables are constructed based on firm-level data from the Annual Surveys of Industrial Production (ASIP). The ASIP encompasses all non-state-owned enterprises generating revenue exceeding 5 million RMB, as well as all state-owned enterprises, wherein we focus on manufacturing firms. Adopting the methodology of Brandt, Van Biesebroeck and Zhang (2012), we track firms over time and calculate the capital stock and investment employing the perpetual inventory method. Our refined firm-level sample comprises approximately 1.8 million observations across 29 two-digit industries within the manufacturing sector. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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Table 6: The role of government intervention on leader biases

	Log. County GDP			
	(1)	(2)	(3)	(4)
Mean of dep. var.	13.369	13.369	13.369	13.369
Inauspicious zone (Mayor)	-0.029*** (0.011)	-0.031*** (0.011)	-0.031*** (0.011)	-0.029*** (0.011)
× Government intervention (standardized)		-0.022** (0.011)	-0.023** (0.011)	
× Alternative measure: Marketization index (standardized)				0.028** (0.011)
× Provincial GDP per capita (standardized)			-0.003 (0.008)	-0.011 (0.009)
× <i>Fengshui</i> norms of mayor hometown (standardized)			-0.028** (0.014)	-0.032*** (0.012)
County FEs	Y	Y	Y	Y
Prefecture-Year FEs	Y	Y	Y	Y
Observations	33,742	33,742	33,742	33,742
Adjusted R-squared	0.987	0.986	0.985	0.985

Notes: Unit of observation: county-year. For consistency, we keep observations for which all explanatory variables are available. “*Inauspicious zone (Mayor)*” is a dummy that is 1 if the county is located in the supernaturally unfavorable orientation of the then prefectural mayor, according to *Fengshui* superstitions. A prefecture oversees an average of 8.5 subordinate counties in China. “*Fengshui norms of mayor hometown*” is a province-specific continuous variable, constructed by calculating the share of individuals who hold beliefs in *Fengshui* traditions; the individual *Fengshui* belief (as a binary) is obtained from the China Family Panel Studies (2018), a nearly-representative survey of Chinese individuals. All other mediator variables are at the province-year level. “*Government intervention*” is the share of provincial government business-related expenditures over GDP (Jia, Lan and Padró i Miquel, 2020), and “*Marketization index*” is the pre-packaged score constructed by Wang, Fan and Hu (2018). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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Table 7: The role of institutional and less-institutional reforms

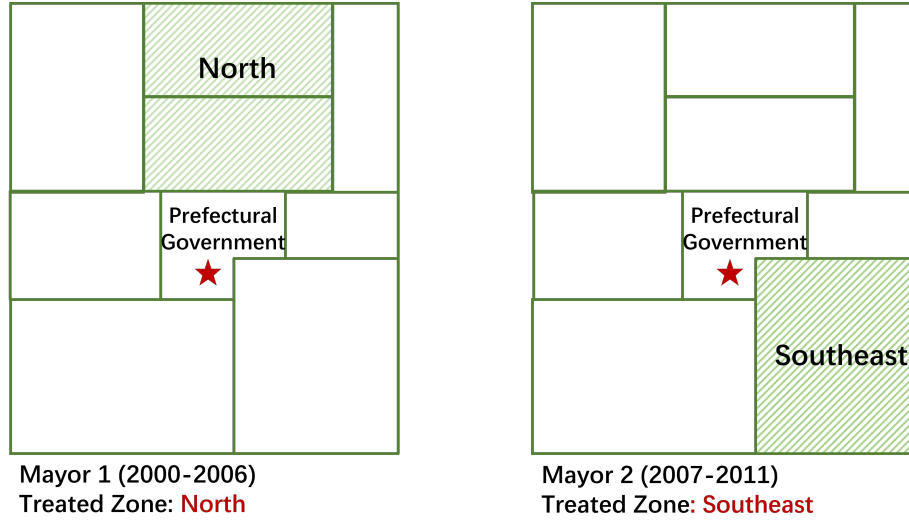
	Log. County GDP			
	(1)	(2)	(3)	(4)
Mean of dep. var.	13.369	13.369	13.369	13.369
Inauspicious zone (Mayor)	-0.029*** (0.009)	-0.034*** (0.011)	-0.035*** (0.011)	-0.035*** (0.011)
× County autonomy empowerment		0.027** (0.011)		
× Party's ideological training of leaders			0.010 (0.007)	
× Anti-corruption				0.011 (0.016)
County FEs	Y	Y	Y	Y
Prefecture-Year FEs	Y	Y	Y	Y
Observations	34,160	34,160	34,160	34,160
Adjusted R-squared	0.986	0.985	0.985	0.985

Notes: Unit of observation: county-year. “*Inauspicious zone (Mayor)*” is a dummy that is 1 if the county is located in the supernaturally unfavorable orientation of the then prefectural mayor, according to *Fengshui* superstitions. Each intermediate variable is a binary. “*County autonomy empowerment*” is a county-year specific dummy that is 1 if the county is delegated a high degree of autonomy in its local socioeconomic policies and budgets by the provincial government; this variable itself (the direct effect) is controlled in the regression since it varies by county-year. “*Party's ideological training*” is a province-year specific dummy that is 1 if the Provincial Party Committee gathers local prefectural leaders for an intensive political training and materialist ideological education. “*Anti-corruption*” is a province-year specific dummy that is 1 if the province is targeted by the central anti-corruption inspection team in the particular year. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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Appendix Figures and Tables

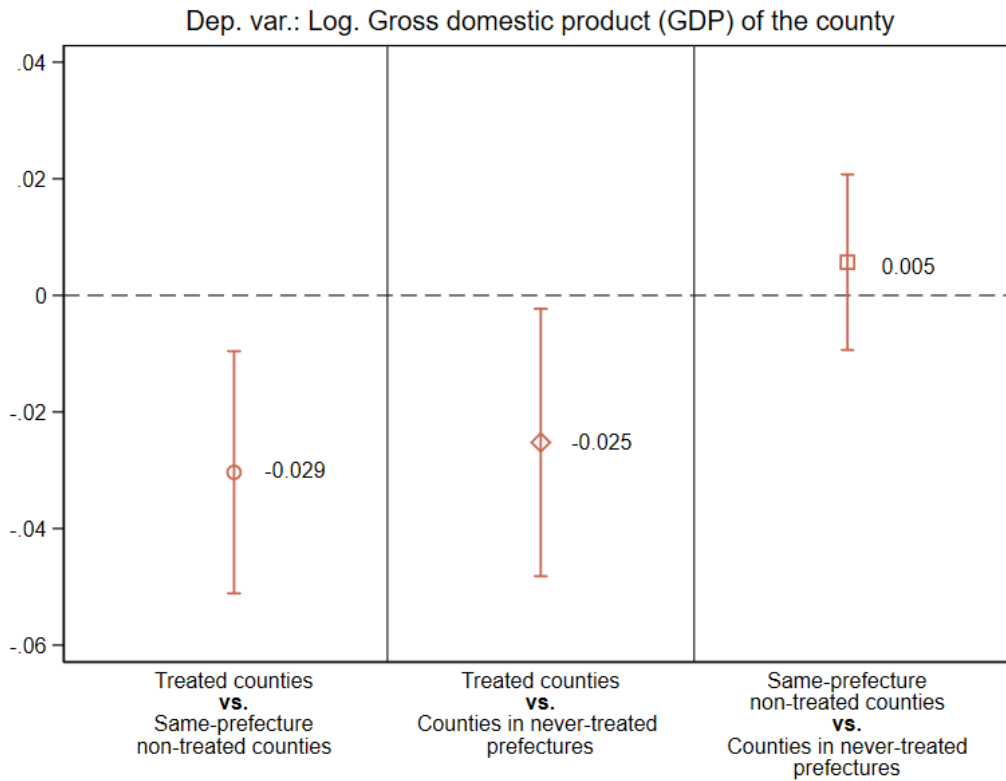
Figure A1: Illustration of the baseline identification strategy



Notes: This figure illustrates our baseline empirical strategy graphically. Each sub-block represents a county. The prefectural government is where the local leader lives and works. Given a prefecture, the left panel represents Mayor 1's governance period (whose inauspicious orientation is North), and the right panel represents Mayor 2's governance period (whose inauspicious orientation is Southeast). Shaded counties represent regions that were treated as supernaturally inauspicious to the then mayor. Each county is oriented according to its geometric center's azimuth angle to the prefectural government. There are two sources of variation. First is the *within-locality* variation – for a given county, whether it is treated or not varies by the year depending on the prefectural leader in office. Second is the *cross-locality* variation – in the same year, the treatment status varies across counties (i.e., under the jurisdiction of a leader, there are both treated and untreated counties).

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Figure A2: Accounting for within-prefecture substitution/spillovers



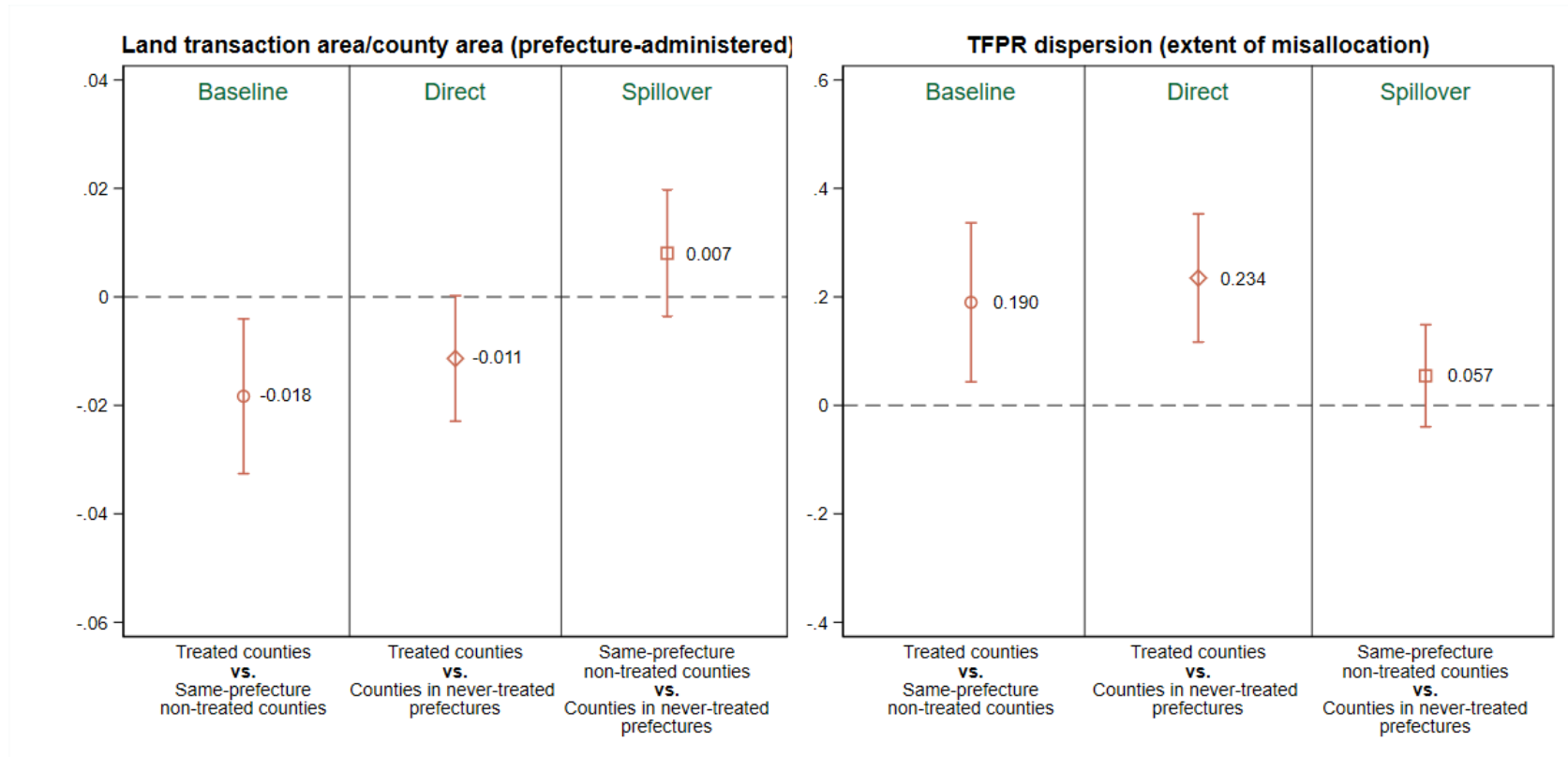
Notes: The graph depicts the estimated impacts of being located in or being neighbored by mayors' inauspicious zones, using different benchmark groups for comparison. Each point represents an estimate from one corresponding regression. A prefecture oversees an average of 8.5 subordinate counties in China. The definitions of different groups are:

- “*Treated counties*”: counties that have ever been in the inauspicious zones of prefectural mayors
- “*Same-prefecture non-treated counties*”: counties within the same prefecture as the ever-treated counties but have not directly treated
- “*Counties in never-treated prefectures*”: counties located in prefectures where none of the subordinate counties have ever been in mayors' inauspicious zones – which serve as “clean controls”

Each block presents the estimate from one corresponding regression. The dot represents the baseline coefficient comparing treated counties with other counties in the same prefecture. The diamond represents the coefficient comparing treated counties with clean controls, eliminating within-prefecture spillover/substitution effects. The square represents the coefficient comparing indirectly-affected counties with clean controls, identifying within-prefecture spillover/substitution effects. Unit of observation: county-year. Sample period: 2000 - 2018. Standard errors are clustered at the prefecture level.

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Figure A3: Within-prefecture substitution/spillovers – underlying allocative efficiency



Notes: The graph depicts the estimated impacts of being located in or being neighbored by mayors' inauspicious zones, using different benchmark groups for comparison. Each point represents an estimate from one corresponding regression. A prefecture oversees an average of 8.5 subordinate counties in China. The definitions of different groups are identical to those of Figure A2. Each block presents the estimate from one corresponding regression. Unit of observation: county-year. Sample period: 2000 - 2018. Standard errors are clustered at the prefecture level.

Table B1: Balance checks – county characteristics in 1999

Variable	Mean (standard deviation)		Mean difference: (2)–(1)	
	Non-treated counties (1)	Ever-treated counties (2)	Raw (3)	Conditional (4)
Latitude	33.421 (0.458)	32.850 (0.505)	0.571 (0.464)	-0.010 (0.021)
Longitude	110.377 (0.750)	111.252 (0.739)	-0.874 (0.795)	-0.046 (0.031)
Log. Area (km ²)	7.763 (0.062)	7.716 (0.057)	0.047 (0.060)	0.023 (0.032)
Log. Distant to coast (km)	6.058 (0.079)	5.946 (0.089)	0.112 (0.086)	-0.006 (0.020)
Number of subordinate towns	17.593 (8.745)	18.331 (8.488)	0.738 (0.477)	0.026 (0.036)
Log. Population (10 thousand)	3.422 (1.006)	3.484 (0.867)	0.062 (0.077)	-0.019 (0.032)
Primary schooler share	0.112 (0.029)	0.111 (0.034)	-0.001 (0.003)	0.003 (0.002)
Rural worker share	0.414 (0.113)	0.421 (0.099)	0.007 (0.007)	-0.001 (0.003)
Log. GDP (10 thousand)	11.669 (1.283)	11.724 (1.139)	0.055 (0.095)	-0.039 (0.037)
Primary-sector GDP share	0.355 (0.154)	0.366 (0.147)	0.011 (0.008)	-0.002 (0.006)
Secondary-sector GDP share	0.341 (0.142)	0.338 (0.142)	-0.003 (0.008)	0.002 (0.007)
Tertiary-sector GDP share	0.304 (0.088)	0.296 (0.072)	-0.008 (0.005)	-0.001 (0.004)
Log. Fiscal expenditure (10 thousand)	9.257 (0.739)	9.267 (0.623)	0.010 (0.054)	-0.022 (0.022)
Log. Fiscal revenue (10 thousand)	8.473 (1.194)	8.526 (1.025)	0.053 (0.093)	-0.031 (0.037)
Observations	1,201	783	1,984	1,984

Notes: Unit of observation: county (in 1999). “Non-treated counties” refer to counties that have not been in leaders’ inauspicious zones from 2000 to 2018. Mean differences in Column 4 are obtained by regressions with prefecture fixed effects and county orientation fixed effects (N, NE, E, SE, S, SW, W, NW). For mean differences, standard errors in parentheses are clustered at the prefecture level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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Table B2: County characteristics and future treatment status

	Treated under the next prefectural leader (binary)		
	Party Secretary (1)	Mayor (2)	Either leader (3)
Mean of dep. var	0.056	0.058	0.106
Log. Area	-0.048 (0.041)	0.011 (0.040)	-0.032 (0.066)
Log. Population	-0.018 (0.030)	-0.039 (0.033)	-0.020 (0.044)
Log. GDP	0.025 (0.030)	0.022 (0.032)	0.041 (0.046)
Log. Primary-sector output	-0.008 (0.021)	-0.035 (0.025)	-0.038 (0.033)
Log. Secondary-sector output	0.015 (0.017)	0.015 (0.018)	0.007 (0.023)
Log. Tertiary-sector output	-0.008 (0.013)	0.002 (0.013)	-0.027 (0.020)
Log. Large-scale enterprises (#)	0.003 (0.004)	0.003 (0.005)	-0.005 (0.007)
Log. Fiscal expenditure	0.009 (0.014)	-0.005 (0.015)	-0.007 (0.021)
Log. Fiscal revenue	-0.018 (0.010)	-0.005 (0.012)	0.006 (0.015)
Log. Beds per hospital (#)	0.008 (0.011)	-0.001 (0.012)	-0.008 (0.015)
Log. Social welfare institutions (#)	0.005 (0.005)	0.013 (0.007)	0.007 (0.007)
Log. Primary and middle schoolers	-0.031 (0.020)	-0.031 (0.023)	-0.025 (0.030)
Log. Total loans	-0.012 (0.008)	-0.014 (0.009)	0.000 (0.012)
Log. Household saving	0.011 (0.011)	-0.003 (0.011)	0.002 (0.015)
County FEs	Y	Y	Y
Prefecture-Year FEs	Y	Y	Y
Observations	34,322	34,160	32,875
F-test of overall significance (P value)	0.483	0.247	0.845

Notes: Unit of observation: county-year (2000 - 2018). The outcome variable is a dummy for the future treatment status, which is 1 if the county is located in its succeeding prefectural leader's supernaturally unfavorable zones. Each prefecture is co-governed by a Party Secretary and a Mayor. The Secretary has more bearing on the general political agenda and personnel decisions; the Mayor heads the government agency responsible for formulating and implementing socioeconomic policies and their administration. There can be vacancies for the positions of Secretary or Mayor in some transition years. A prefecture oversees an average of 8.5 subordinate counties in China. Standard errors in parentheses are clustered at the prefecture level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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Table B3: Balance checks – prefectural leader characteristics

	Mean (standard deviation)		Mean difference
	Within-leader variation >0 (1)	Within-leader variation = 0 (2)	Raw: (2)-(1) (3)
Panel A: Party Secretaries			
Secretary: Female (binary)	0.040 (0.005)	0.045 (0.012)	-0.004 (0.013)
Secretary: Age of taking office	50.722 (0.112)	50.651 (0.230)	0.071 (0.247)
Secretary: Age of stepping down/turnover	53.982 (0.131)	54.023 (0.235)	-0.041 (0.264)
Secretary: Work in native province (binary)	0.660 (0.016)	0.680 (0.028)	-0.020 (0.029)
Secretary: Bachelor degree (binary)	0.242 (0.012)	0.267 (0.024)	-0.025 (0.028)
Secretary: Master degree (binary)	0.550 (0.014)	0.513 (0.026)	0.037 (0.030)
Secretary: Doctorate degree (binary)	0.169 (0.011)	0.173 (0.021)	-0.004 (0.024)
Observations	1,315	313	1,628
Panel B: Mayors			
Mayor: Female (binary)	0.059 (0.006)	0.054 (0.012)	0.005 (0.014)
Mayor: Age of taking office	48.232 (0.119)	48.076 (0.218)	0.156 (0.246)
Mayor: Age of stepping down/turnover	50.252 (0.134)	49.981 (0.242)	0.271 (0.259)
Mayor: Work in native province (binary)	0.725 (0.014)	0.745 (0.024)	-0.020 (0.025)
Mayor: Bachelor degree (binary)	0.208 (0.012)	0.230 (0.022)	-0.022 (0.025)
Mayor: Master degree (binary)	0.560 (0.015)	0.581 (0.028)	-0.021 (0.031)
Mayor: Doctorate degree (binary)	0.176 (0.011)	0.151 (0.019)	0.025 (0.022)
Observations	1,451	370	1,821

Notes: Unit of observation: prefectural leader (2000 - 2018). “Within-leader variation” refers to the presence of any inauspicious zones within the prefecture governed by a leader, according to *Fengshui* spatial superstitions. For mean differences, standard errors in parentheses are clustered at the prefecture level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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Table B4: Robustness to geometric-center-defined county orientations

	Log. County GDP			
	(1)	(2)	(3)	(4)
Mean of dep. var	13.321	13.352	13.369	13.404
Inauspicious zone (either leader)	-0.020** (0.011)			
Inauspicious zone (Secretary)		-0.001 (0.013)		0.001 (0.013)
Inauspicious zone (Mayor)			-0.035*** (0.013)	-0.034*** (0.012)
County FEs	Y	Y	Y	Y
Prefecture-Year FEs	Y	Y	Y	Y
Observations	35,607	34,322	34,160	32,875
Adjusted R-squared	0.985	0.985	0.985	0.985

Notes: In this table, we define the orientation of a county (relative to its prefectural government) by its geometric center and associated Azimuth angle. Unit of observation: county-year. Sample period: 2000 - 2018. “*Inauspicious zone*” is a dummy that is 1 if the county is located in the supernaturally unfavorable orientation of the then prefectural leader(s). Each prefecture is co-governed by a Party Secretary and a Mayor. The Secretary has more bearing on the general political agenda and personnel decisions; the Mayor heads the government agency responsible for formulating and implementing socioeconomic policies and their administration. A prefecture oversees an average of 8.5 subordinate counties in China. There can be vacancies for the positions of Secretary or Mayor in some transition years. Standard errors in parentheses are clustered at the prefecture level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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Table B5: Leaders' inauspicious zones and nighttime lights

	Log. County GDP		Log. Nighttime light (mean)	Log. Nighttime light (maximum)
	(1)	(2)	(3)	(4)
Mean of dep. var	13.179	12.868	5.146	8.129
Inauspicious zone (Mayor)	-0.029*** (0.009)	-0.023** (0.010)	-0.045** (0.011)	-0.027** (0.009)
County FEs	Y	Y	Y	Y
Prefecture-Year FEs	Y	Y	Y	Y
Observations	34,160	24,548	24,353	24,353
Adjusted R-squared	0.985	0.985	0.987	0.897
Sample period	2000 - 2018	2000 - 2013	2000 - 2013	2000 - 2013
Data source	County statistical yearbooks		NOAA DMSP (1992-2013)	

Notes: Unit of observation: county-year. “Inauspicious zone (Mayor)” is a dummy that is 1 if the county is located in the supernaturally unfavored orientation of the then prefectural mayor, according to *Fengshui* superstitions. A prefecture oversees an average of 8.5 subordinate counties in China. “NOAA DMSP” refers to the nighttime luminosity data sourced from the Defense Meteorological Satellite Program (DMSP) by National Oceanic and Atmospheric Administration (NOAA), offering comparable nighttime light measures spanning from 1992 to 2013. Standard errors in parentheses are clustered at the prefecture level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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Table B6: Further results on prefecture-level outcomes

	Log. Prefecture GDP		Log. Nighttime light (mean)		Mayor promotion (binary)	
	(1)	(2)	(3)	(4)	(5)	(6)
Mean of dep. var	15.107	15.107	1.235	1.235	0.224	0.224
Share of treated area	-0.059* (0.031)		-0.069*** (0.019)		-0.077 (0.070)	
Share of treated population		-0.064** (0.030)		-0.060*** (0.018)		-0.081* (0.046)
Mean of explanatory var.	0.125	0.129	0.125	0.129	0.125	0.129
Prefecture FEs	Y	Y	Y	Y	Y	Y
Province-Year FEs	Y	Y	Y	Y	Y	Y
Mayor characteristics	Y	Y	Y	Y	Y	Y
Observations	4,309	4,309	3,355	3,355	1,591	1,591
Data source	Prefecture statistical yearbooks (2000 - 2018)		NOAA DMSP (2000 - 2013)		Yao and Zhang (2015) (2000 - 2010)	

Notes: Unit of observation: prefecture-year. A prefecture oversees an average of 8.5 subordinate counties in China. “Share of treated area” is calculated by $\frac{\text{Area of counties in mayors' supernaturally unfavorable zones}}{\text{Total area of the prefecture}}$. “Share of treated population” is calculated by $\frac{\text{Population in mayors' supernaturally unfavorable zones}}{\text{Total population of the prefecture}}$. To avoid endogeneity, we use population and area at the end of the previous leader’ term to construct each independent variable. Mayor characteristics include the full set of fixed effects for mayor tenure, age, gender, education attainment, hometown province, and inauspicious orientation(s). “NOAA DMSP” refers to the nighttime luminosity data sourced from the Defense Meteorological Satellite Program (DMSP) by National Oceanic and Atmospheric Administration (NOAA), offering comparable nighttime light measures spanning from 1992 to 2013. Standard errors in parentheses are clustered at the prefecture level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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