# Foreign Aid and Conflict: Evidence from the Chinese Belt and Road Initiative in Pakistan

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**Abstract**

This paper examines the impact of large-scale infrastructure aid on political violence, focusing on Belt and Road Initiative (BRI) projects in Pakistan. While the relationship between aid and armed conflict has been widely studied, the effects of Chinese aid to developing countries remain less understood. Using an event study design on district-level violent conflict data in Pakistan from 2010 to 2020, I find that violent incidents decreased in districts along the China-Pakistan Economic Corridor (CPEC) during the month of construction and shortly after. However, when examining patterns on an annual scale, there is increased volatility of violence in subsequent years, suggesting that the initial reduction in conflict is temporary. I explore the channels through which aid impacts conflict, showing that large-scale, government-supported transportation projects, carried out under military protection, initially reduce conflict but return to previous levels over time. These findings highlight significant short-term effects of infrastructure aid on local political violence but suggest no enduring decrease. This study also provides the first rigorous evidence on the social impacts of BRI projects, a growing but understudied form of foreign aid, specifically addressing impacts on local violence.

**Keywords:** Foreign Aid, Conflict, Infrastructure, China-Pakistan Economic Corridor, Belt & Road Initiative

**JEL Codes:** C33, F52, O18, O53

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# 1 Introduction

The relationship between aid and conflict remains a contentious topic, with studies presenting contrasting results on how aid influences conflict dynamics. Some research suggests that aid might exacerbate conflict, while others argue that it promotes peace and stability.[1] This divergence underscores the complexity of aid's impact on conflict and highlights the importance of examining the various factors involved. In particular, the total amount of Chinese financial aid, now surpassing that of other major donors, presents a unique case. The China-Pakistan Economic Corridor (CPEC), a flagship project under the Belt and Road Initiative (BRI), combines substantial financial backing, technical expertise, and security measures through large-scale infrastructure investments, creating an intriguing context for exploring the impact of such aid on conflict and violence.

This paper addresses the question: *What is the impact of transportation infrastructure aid on political violence?* Focusing on the Western Alignment project within the China-Pakistan Economic Corridor (CPEC), I leverage district proximity to constructed routes and the timing of construction phases to investigate how local violence responds.

A major challenge is establishing a detailed and accurate timeline of construction across multiple regions. To address this, I compile a novel dataset on the development of the Western Alignment, drawing on information from the CPEC authority reports, local news reports, and Google Earth satellite imagery to verify the construction timelines. This timeline, pinpointing construction stages geographically, is then matched with violence incidents from Global Terrorism Dataset (GTD), allowing for precise estimation of the project's impact on political violence.

Leveraging the temporal and geographical variation in road construction rollout, I construct a district-by-time panel dataset spanning 2010 to 2020 and implement a difference-in-differences design. I complement these results with an event study approach with three specifications that identify the causal effects of construction on violence in both short and longer term. The short-term analysis captures immediate effects using monthly data to observe how violence responds within the construction year, while the extended analysis assesses cumulative impacts using an-

[1] For instance, studies by Crost et al. (2014), Nunn and Qian (2014), Dube and Naidu (2015), Darden (2019) highlight how aid can inadvertently fuel violence by creating economic dependence, reinforcing corrupt practices and encouraging rent-seeking behavior. Conversely, studies by De Ree and Nillesen (2009), Beath et al. (2017), Crost et al. (2016) support the notion that aid can stabilize regions by addressing the underlying causes of conflict, catalyzing economic development, and contributing to the delivery of basic services for local residents, thereby fostering stability and social cohesion.

nual data, covering the same period. The first specification is a two-way fixed effects Poisson model with district- and year-month fixed effects, incorporating district-by-year fixed effect to control for district-specific annual variations, such as population, socioeconomic changes, and other time-varying district unobservables. The second specification addresses the staggered timing of construction through a two-way Mundlak using a Poisson model that also accounts for the discrete nature of my outcome of interest. The third specification uses a Synthetic Difference-in-Differences approach with population controls. For the extended analysis using annual data, I reapply these methods, with the first specification transitioning to a classical two-way fixed effects model, to assess how the impacts of road construction on violence evolve over time, providing insights into potential shifts and volatility in violence over the years after construction finishes.

The short-term results from the first specification are both economically and statistically significant. Starting from a baseline monthly average of 0.611 incidents, the number of incidents decreases by 52.44% in CPEC districts after the start of construction, by 52.46% during the CPEC construction months, and by 68.58% in the month following road construction completion. To visualize the treatment effect dynamics over a year, I examine 9 pre-construction months and 10 post-construction months, observing a 66.33% decrease in incidents during the construction month and a 64.64% decrease one month later. When excluding the district-by-year fixed effect, the event study frameworks from the classical two-way fixed effects model and two-way Mundlak regression reveal non-parallel trends, raising concerns about potential bias in the estimated effects. However, the Synthetic Difference-in-Differences design effectively accounts for this uncertainty and yields credible parallel pre-trends, showing a similar short-term reduction in violence during and immediately after construction. Compared to the month prior to construction, the number of incidents during the construction month decreased by 0.46 units and 0.53 in the subsequent month. However, these effects appear temporary, as estimates stabilize around zeros in the following months.

When examining broader patterns on an annual scale, the two-way fixed effects model with Pseudo Poisson Maximum Likelihood (PPML) estimation suggests a statistically significant 42.7% increase in violence since the construction start year. Results from alternative specifications are positive but not statistically significant, suggesting tentative evidence of an effect. Visualizing the dynamics of the treatment effects over the years reveals increased volatility in violence patterns, introducing uncertainty into the overall positive impact and renders the effect less conclusive.

These findings suggest that while infrastructure development may temporarily reduce conflict, it does not lead to sustained reductions over time. Similar results are obtained when restricting the control group to adjacent districts, and likewise when using non-adjacent districts as the control group, further reinforcing these findings. To better understand the drivers behind these results, I conduct a series of mechanism checks. I find no significant impact of population changes on observed violence trends, suggesting that other unknown district-specific factors with annual variation may be influential. Anecdotal evidence points to the presence of military forces during road construction as a likely factor for the short-term reduction in violence. However, as construction phases out and military presence diminishes, violence gradually returns to pre-construction levels.

This paper contributes to two strands of literature. First, it explores large-scale infrastructure as a unique form of development aid, offering new evidence on how aid—particularly through the China-Pakistan Economic Corridor (CPEC) and the Western Alignment road route—affects local violence. In line with research showing that development aid can reduce violence in the short term, infrastructure projects demonstrate similar effects.[2]

Second, this paper enhances the understanding of mechanisms that influence the impact of aid, including *predatory theory*, where aid resources can escalate violence if intercepted by insurgents.[3] Another mechanism, *control of territory*, suggests that aid interventions are more effective in areas under pro-government control.[4] The *hearts and mind* theory posits that reducing violence relies on gaining local support through service provision, encouraging civilians to share valuable information with government forces.[5] The impact of aid also depends on *project characteristics*, such as management performance, scale, and donor structure. Effective management correlates with reduced conflict, whereas aid fragmentation (multiple donors) can increase predatory behaviors, leading to more attacks.[6] Military aid can also escalate violence, as seen in Colombia, where U.S. military

[2]De Ree and Nillesen (2009) found that foreign aid had a stabilizing effect by reducing the continuation probability of conflict in sub-Saharan African countries. Beath et al. (2017) conducted a randomized field experiment in Afghanistan, demonstrating that community-driven development programs had a positive effect on counter-insurgency, increasing support for the government. Crost et al. (2016) found that conditional cash transfer reduced conflict-related incidents in Philippine villages.

[3]Nunn and Qian (2014) showed that U.S. food aid increased violent incidence and duration of civil conflict in recipient countries, particularly during the wheat shipping period, as rebel groups sought to divert the aid to fund operations.

[4]Sexton (2016) demonstrated that aid in pro-government areas of Afghanistan reduced insurgent violence more effectively, creating a conducive environment

[5]Berman et al. (2011) found that local service provision in insurgent areas could incentivize civilian cooperation with government by sharing intelligence.

[6]Child et al. (2021) tested the effectiveness of aid projects and investigated how public opinions may be influenced

aid led to increased paramilitary-led violence surpassing guerrilla activity (Dube and Naidu, 2015). Conversely, small-scale reconstruction projects in post-war Iraq led to fewer insurgent attacks, highlighting the value of targeted interventions (Berman et al., 2013).

CPEC led to an unprecedented scale of foreign aid, with infrastructure investments that vastly exceed previous formats in both scope and resource commitment. The Western Alignment projects, passing through government-controlled territories but influenced by local tribal groups, provide a unique context. These projects bring substantial resources in the short term, which may incentivize insurgent groups to engage in predatory behavior. However, they are also characterized by strong management performance and a single-donor structure, both of which are effective factors in reducing violence. The military protection accompanying these projects is distinct from traditional military assistance, as its primary goal is to safeguard the construction rather than to provide direct military support. This paper suggests that the project characteristics and military presence play a significant role in the short-term violence reduction—beyond what predatory theory alone would predict. However, the effects over time remain uncertain, indicating that anticipated benefits such as sustained government control and reduced insurgent activity are not yet fully evident. This uncertainty highlights the complexity of achieving long-standing stability.

The remainder of the paper is organized as follows. Section two explains the background on Chinese financial aid, China-Pakistan Economic Corridor, Western Alignment Road routes and related literature. Section three presents a conceptual framework outlining the mechanisms through which foreign aid, particularly infrastructure aid, affects violence. Section four introduces the data including information on violence, CPEC projects construction timeline, Pakistani administrative units and descriptive statistics. Section five discusses the empirical setting and regression models. Section six presents the main results and robustness checks. Finally, sections seven and eight provide a discussion and conclusion, summarizing the main points of the paper and offering insights into the future of aid projects.

in situations of aid fragmentation, finding that in contexts with multiple donors, predatory behavior from government officials or insurgents increased, leading to higher levels of attacks. Moscona (2019) studied World Bank aid projects in Africa and showed that well-managed projects correlated with lower conflict levels, emphasizing the importance of management performance in aid effectiveness.

# 2 Background: Chinese Foreign Aid and Conflict

## 2.1 Chinese Financial Aid

Over the last two decades, China has emerged as a major provider of international development assistance, inventing substantial resources in low- and middle-income countries. Between 2000 and 2021, China spent approximately $843 billion U.S. dollars across 165 countries, with its annual spending now exceeding that of other major donors and lenders together (AidData, 2021). The Belt and Road Initiative (BRI), launched in May 2013 by the Chinese government, includes a wide range of infrastructure development projects designed to promote economic integration and connectivity throughout Asia, Africa and Europe. BRI features an unique type of foreign assistance by distributing aid through large-scale infrastructure investments, including power plants, electricity grids, ports, pipelines, railways, and roads. Also, the BRI infrastructure projects are primarily financed via bilateral loans at the highly subsidized market interest rates rather than direct grants, and are implemented by Chinese firms, often employing Chinese workers and using materials imported from China. This form allows for tighter project control, not relying on local supply chains and less susceptible to local corruption. These features differentiate BRI from traditional Western aid, raising questions about whether such projects qualify as "foreign aid" in the conventional sense.

According to economic development literature (Todaro and Smith, 2015), foreign aid is typically defined by two key criteria: (1) the objective should be non-commercial from the donor's perspective, and (2) the financing should be concessional, offering more favorable terms than commercial loans. Under this definition, many BRI projects fall into a gray area. While they are often driven by China's strategic and economic interests, they also provide critical financial resources and infrastructure to recipient countries. For instance, the China-Pakistan Economic Corridor (CPEC), the largest component of BRI, involves over $54 billion in planned infrastructure investment and has delivered concessional loans, interest-free loans, and limited grants to Pakistan. Although CPEC may not fully meet the traditional definition of foreign aid, it plays a similar role by enabling infrastructure development that Pakistan could not afford independently. These investments offer long-term developmental benefits and align with the broader goals of promoting stability and prosperity in the region. As such, this study treats CPEC as a distinct and influential form of foreign aid, and conducts careful analysis of its social and political implications.

Existing research on aid and conflict has largely focused on traditional donors such as the U.S., Nordic countries, Western Europe, OECD countries and projects implemented by international organizations such as the World Bank and the Japan Development Assistance Committee. In contrast, Chinese aid has received limited attention, particularly regarding its impact on conflict. While recent studies examine the recipient countries' economic outcomes of implementing infrastructure projects (Dreher et al., 2021), other critique China using foreign assistance to achieve its geopolitical and diplomatic goals from political aspects (Blair et al., 2022). And Lin and Xu (2023) investigates the impacts of Chinese infrastructure projects in Africa on nightlight intensity, employment, and protest activity, but does not examine political violence directly. By exploring the link between Chinese aid projects and conflict in Pakistan, this study aims to contribute to the existing literature on Chinese aid's impact from a conflict perspective.

## 2.2 China-Pakistan Economic Corridor

China-Pakistan Economic Corridor (CPEC) is a pivotal component of the Belt and Road Initiative, with infrastructure projects valued at $54 billion U.S. dollars, making it the largest project under BRI. The CPEC Authority, part of Pakistan's Ministry of Planning, Development & Special Initiatives, categorizes these projects into sectors such as energy, transport infrastructure, Gwadar port, industrial cooperation and social sector development (CPE, Accessed on 29 March 2023). Strategically, CPEC transport infrastructure projects aim to connect China's Western Xinjiang region with Pakistan's Gwadar port via a network of highways and railways, offering China more direct access to the Arabian Sea and the Middle East, while simultaneously bolstering Pakistan's economic and infrastructure development.

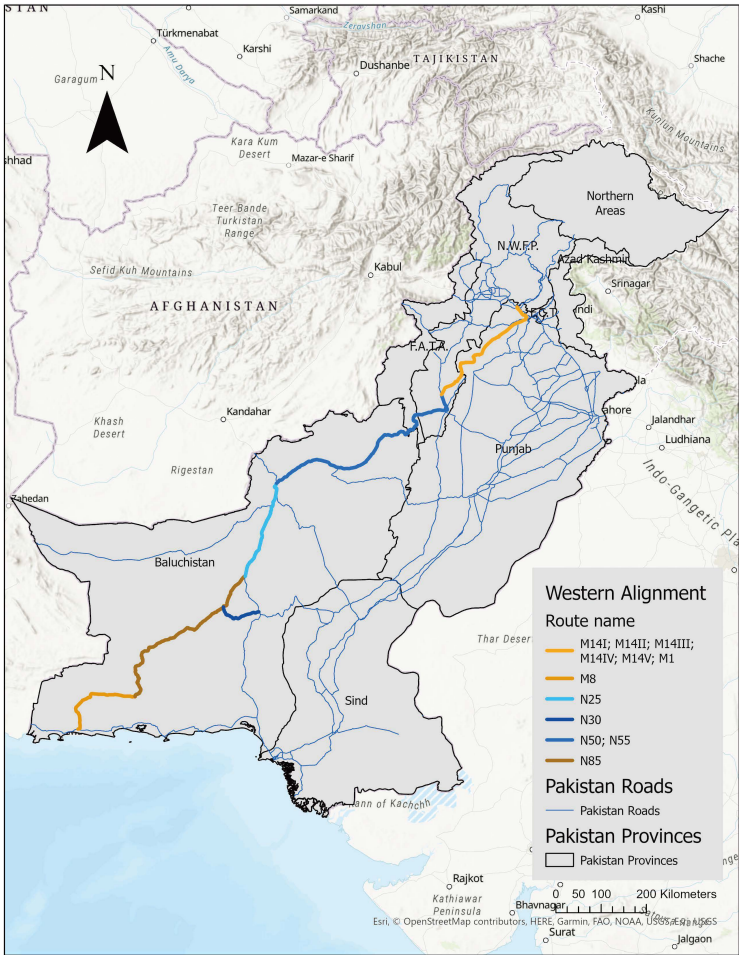
However, the implementation of CPEC has faced significant security threats due to construction extending into volatile regions. For instance, in November 2018, an attack on the Chinese consulate in Karachi resulted in multiple deaths. In April 2022, a suicide bombing near Karachi University's Confucius Institute killed three Chinese tutors and a Pakistani driver. More recently, in March 2024, a suicide bombing in Bisham killed several Chinese workers involved in a power project, and in the same month another attack happened in Gwadar port, killing two Pakistani security officers. Shortly after, militants targeted a major Pakistani air base, opposing perceived resource exploitation by Chinese investments (New York Times, 2024). In October 2024, a bombing near

Karachi's airport killed two Chinese nationals and injured at least ten others (BBC News, 2024).

These incidents underscore the persistent security challenges CPEC projects face in unstable regions, despite the deployment of Pakistani troops to protect construction sites and personnel. Security threats remain significant. Financially, CPEC projects are largely funded through loans provided by Chinese financial institutions, at reduced interest rates. This form of aid, while beneficial in terms of lower borrowing costs, still places a financial burden on Pakistan, leading to substantial debt obligations and influencing economic stability and sovereignty.

There is a notable lack of economics-focused literature examining CPEC projects, while Khan and Liu (2019) addressed conflict as a barrier to construction construction, their work presents preliminary assessments of the associated prospects and drawbacks for Pakistan. Mohmand et al. (2021) analyzed causal impact of CPEC transportation projects but focused on economic growth and transport emissions. This gap suggests a need for further study on how CPEC influences regional conflict dynamics and broader social impacts. This recurrence of violence and security risks surrounding CPEC creates a compelling context for examining the relationship between aid and conflict. Analyzing CPEC's unique aid structure could reveal valuable insights into how such large-scale infrastructure projects affect stability and violence in host regions.

Figure 1: Road Segments on the Western Alignment




*Notes:* This figure shows the twelve road segments of the Western Alignment in Pakistan, spanning a total of 1,880 kilometers, aimed at increasing traffic capacity and supporting bilateral trade.

## 2.3 Western Alignment Road Route

This paper examines the transport infrastructure component of aid in Pakistan, specifically focusing on the construction of the Western Alignment roadway network. The Western Alignment route (see Figure 1) connects China's Western border city of Kashgar in Xinjiang region, through Gilgit Baltista—part of Kashmir region which is disputed by India and Pakistan, and extends through Islamabad-the capital city of Pakistan, Lahore—the second most populous city, Karachi—the largest and most populous city in Pakistan and in the end to the south Gwadar port. This route is regarded as a crucial link between the land-based road belt and the maritime road, which conforms to the meaning of the Belt and Road Initiative.

The Western Alignment passes violence-prone provinces, including northwestern Punjab, Khyber Pakhtunkhwa, and Baluchistan, which border Afghanistan and Iran. Construction of these segments has taken place over several years, with some sections now operational. A significant challenge throughout the building phase has been the prevalence of violence along these routes, fueled by a range of social, environmental, and geopolitical issues (Ahmad and Mi, 2017).

First, land acquisition for the road has sparked protests and local resentment. Especially, western areas are farther away from governmental centers in Pakistan with less control from Pakistani government but under influence of local tribal leaders, In some cases, local communities were forced to give up their land without proper compensation. Second, environmental impact of the project is another source of conflict. The construction of road has led to deforestation, soil erosion, and water pollution, which have affected local communities and ecosystems. Additionally, the strategic implications of the CPEC projects has led to tensions with neighboring countries such as Afghanistan, which views CPEC as a potential threat to its national security. This tension is especially pronounced along the Western Alignment, which crosses Pakistan's borders with Afghanistan and Iran, regions with a high incidence of violence due to separatists and terrorist activities.

To ensure construction progress and safety, Pakistani army has been deployed at various stages of the project, providing security, assisting in construction, and managing logistics to ensure the safe and timely delivery of materials and equipment to construction sites. These security efforts, combined with the high-risk environment, present a compelling setting for studying how the construction process along the road routes may influence regional violence dynamics. As of December 2022, most segments of the Western Alignment have been completed and are open for traffic.

## 3 Conceptual Framework

The CPEC infrastructure projects, especially the Western Alignment road, introduce significant resources into regions marked by complex political and security dynamics. While these projects offer potential economic benefits and increased government presence, they also interact with various mechanisms that could impact local violence levels. The insights below outline how each mechanism applies within the specific context of CPEC:

**Predatory Theory** Since CPEC projects bring substantial resources into conflict-prone areas,

Table 1: Potential Mechanisms and Predicted Effects

| Mechanism | Key words | Predicted impact |
|---|---|---|
| Predatory Theory | Resource diversion, sabotage | Increase |
| Cost of Producing Violence | Improved connections, accessibility | Increase |
| Hearts and Minds | Economic Opportunity, local support | Decrease |
| Single Donor | Reduced predation, coherence | Decrease |
| Management Performance | Effective delivery, stability | Decrease |
| Military Presence | Insurgent attraction vs. Protection | Uncertain |
| Territory Control | Government power vs. tribal influence | Uncertain |

insurgent groups may attempt to sabotage these projects to undermine government influence and seize valuable resources. The anti-government sentiment among local populations could intensity if insurgent groups successfully disrupt the projects, potentially increasing short-term violence.

**Cost of Producing Violence** Improved infrastructure, such as new road networks, lowers the cost of producing violence by enhancing accessibility for all actors, including insurgent groups. While increased road connectivity brings convenience to civilians by improving transportation and access to markets and services, it also provides easier mobility for insurgents, potentially leading to more attacks.

**Hearts and Minds Theory** Improving people's livelihoods is essential for reducing support for insurgent activity. If the local population anticipates the successful completion of CPEC projects and experiences the tangible benefits—such as improved economic conditions, increase employment opportunities and better infrastructure—they may shift their support towards the government, thereby diminishing the influence and appeal of insurgents groups.

**Single-donor and well-managed projects** Unlike aid fragmentation often seen in multi-donor initiatives, the CPEC projects are funded by a single donor (China). This structure reduces fragmentation and minimize the likelihood of predation by insurgents or local actors, thereby increasing accountability and stabilizing project areas. Effective project management, facilitated by collaboration between Chinese and Pakistani experts, ensures that local needs are met, and project outcomes align with community priorities. This combination of coherent funding and strong management likely contributes to reduced conflict intensity by addressing community grievances and fostering stability.

**Territory Control** The Western Alignment route passes through government-controlled areas,

but local tribal leaders still hold significant influence due to their historical authority and deep-rooted community loyalties. These tribal groups could either facilitate cooperation and stability or generate resistance, depending on their perception of the infrastructure projects and the complex dynamics of territory control.

**Military Presence** Protecting CPEC projects requires a significant military presence, especially in areas susceptible to insurgent attacks. While this presence helps safeguard the infrastructure, it can also draw insurgent attention, creating a scenario where military protection reduces direct threats but may occasionally increase targeted violence in specific locations.

The impact of infrastructure construction projects within the China Pakistan Economic Corridor (CPEC) on local violence is complex and warrants thorough exploration. It is anticipated that violent attacks along the Western Alignment will decrease following the commencement of road construction, as improved infrastructure brings economic opportunities, government presence, and other stabilizing effects. However, the interplay of various mechanisms, including predatory behaviors, management performance, and lowered costs of producing violence, makes the overall impact far from straightforward. Understanding these mechanisms will provide valuable insights into how large-scale infrastructure projects influence conflict dynamics.

# 4 Data

## 4.1 Aid-CPEC Western Alignment

This study assesses aid through the development timeline of road segments on the Western Alignment. The construction start and end dates serve as key identifiers, matched with time- and location-specific data on violent incidents. The primary construction timeline is sourced from the CPEC Authority website (CPE, Accessed on 29 March 2023), which provides information on all CPEC projects. The site records details on 24 transport infrastructure projects under CPEC, including six completed, eleven projects under construction, eight still in the planning pipeline and five long-term projects. For each project, it documents location, length, commenced time and inauguration dates, as well as social and economic factors such as estimated costs, the executing company, financing loan type, supervising agency, and the total number of local jobs created. For certain segments, local news report and satellite imagery from Google Earth Pro were used to verify

construction progress.

I located the road segments on the Western Alignment using Geographic Information Systems (GIS) software, ArcGIS Pro. Figure 1 depicts the twelve road segments that pass through the Pakistani province of Balochistan. From south to north, the Western Alignment road network consists of highways labeled M8, N85, N30, N25, N50, and M14. The road construction is a combination of new pavement and upgraded segments, with a total length of 1,880 kilometers. The road construction includes both newly paved and upgraded segments. Some segments, such as the 110-kilometer-long N30 road between Basima and Khuzdar are entirely new pavement, while others are being upgraded and expanded to accommodate increased traffic. These improvements include new bridges, tunnels, and the widening of existing road to increase the capacity and facilitate the freight trade between Pakistan and China.

The Western Alignment road network project commenced in 2013 following an agreement between Pakistan and China to develop CPEC infrastructure. The Gwadar port construction began in 2014, marking the start of M8 motorway, with ongoing work to connect Gwadar port northward via the N85 highway. In 2017, construction of M14 motorways began, with the Hakla Interchange designated as the official starting point of the Western Route. Construction on highways N50, N25, and N30 started around 2018. These segments were progressively inaugurated and opened for traffic from 2019 to 2022. A detailed timeline of the road segments, at year-month level, is shown in Table 1. Based on the road length, the expected construction duration for each segment ranges from two to three years.

Table 2: Road Segments in Western Alignment Organized from South to North

| **Road Section** | **City Start (South)** | **City Finish** | **Date of Start** | **Date of Finish** | **Length (km)** |
|---|---|---|---|---|---|
| M8 | Gwadar | Hoshab | Jan 2014* | Feb 2016 | 193 |
| N85 | Hoshab | Surab | Jan 2014* | Dec 2016 | 470 |
| N30 | Basima | Khuzdar | Oct 2019 | Dec 2021 | 110 |
| N25 | Surab | Quetta | Jan 2018* | Apr 2021* | 235 |
| N50 | Quetta (Kunchlak) | Zhob | Mar 2019 | Jan 2022* | 305 |
| N50 | Zhob | D.I.Khan | Mar 2019 | Jan 2022* | 210 |
| M14I | Yarik (D.I.Khan) | Rehmanikhel | Sep 2016 | May 2019 | 54.6 |
| M14II | Rehmanikhel | Kot Belian | July 2017 | Dec 2019 | 71.2 |
| M14III | Daud Khel/Kot Belian | Tarap | Oct 2016 | Oct 2020 | 52.5 |
| M14IV | Tarap | Pindi Gheb | Apr 2016 | June 2021 | 51.2 |
| M14V | Pindi Gheb | Hakla Interchange | Jan 2017 | June 2021 | 63 |
| M1 | Hakla Interchange | Burhan Interchange | Jan 2017 | June 2021 | 65 |

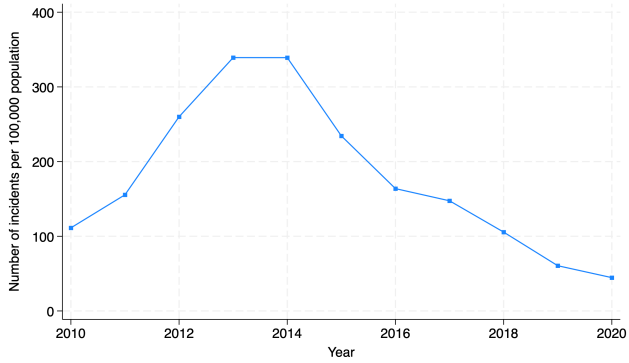
Data source: CPEC Authority Website. *indicates information sourced from news reports and verified through satellite imagery.

## 4.2 Violence

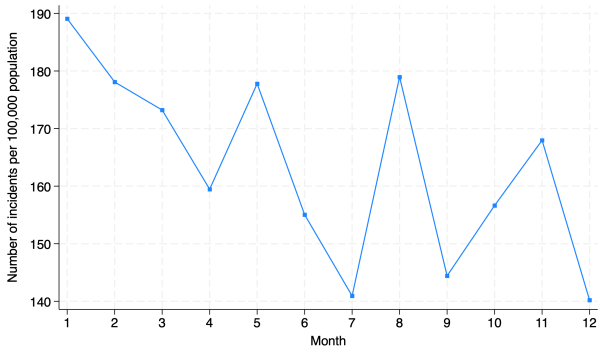
The Pakistan violence data used in this study is sourced from the Global Terrorism Database (GTD), which provides information on terrorist attacks worldwide from 1970 to 2020, including the timing, location and details of each incident. Focusing on Pakistan from 2010 to 2020, I identified a total of 11,707 incidents.

Figure 2 presents yearly and seasonal trends in violent incidents in Pakistan during this period. The left panel shows a notable increase in incidents from 2010, reaching a peak in 2013 and 2014, followed by a steady decline through 2020. This peak period can be attributed to two main factors. First, 2013 and 2014 aligned with ISIS's most active era worldwide, which intensified extremist activities in various regions, including Pakistan. Second, Pakistan's province of Balochistan has experienced a long-standing separatist insurgency, with frequent outbreaks of violence, especially in 2013 and 2014, as local insurgent movements seeking greater autonomy and independence from Pakistan. The right panel displays the seasonal trend in violence intensity, showing fluctuations with distinct peaks in specific months, particularly in the spring. These seasonal variations may be influenced by strategic timing of attacks by insurgent groups or by political events that escalate conflict temporarily.

Figure 2: Yearly-level and Seasonal Violence Trends




*Notes:* This figure shows yearly trends in violent incidents per 100,000 population.



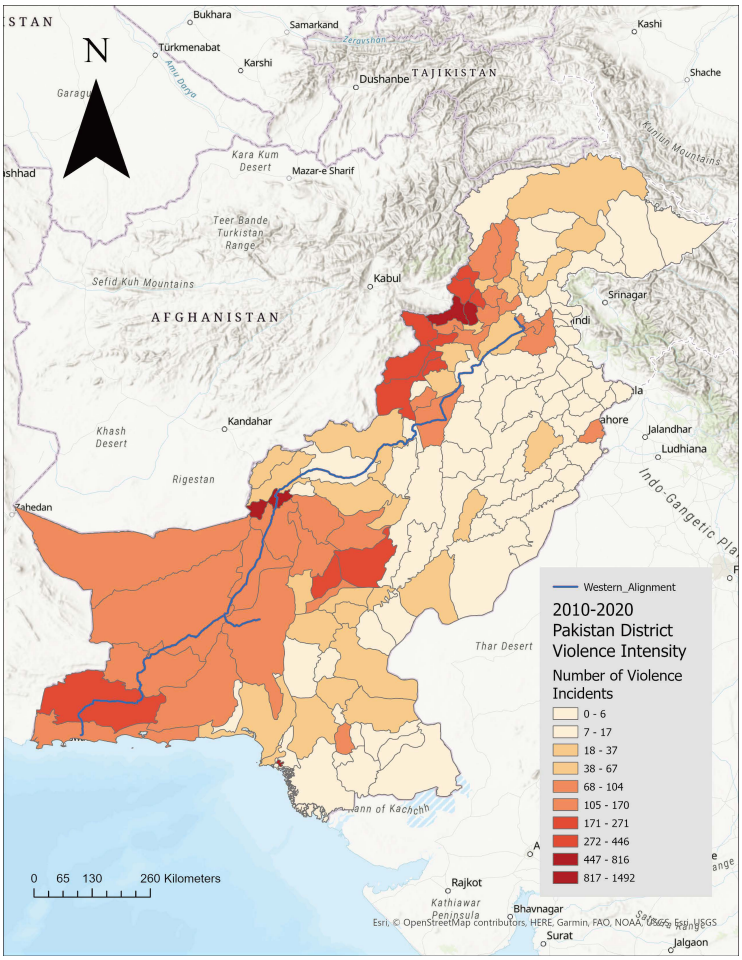

*Notes:* This figure shows the seasonal trend in violent incidents per 100,000 population.

Data source: GTD (2010-2020, Pakistan).

Next, I mapped the incidents across Pakistan using longitude and latitude information, aggregating them by district to get Figure 3, which displays violence intensity at the district level. The

western region of Pakistan, where the Western Alignment is situated, has experienced a higher concentration of violent events compared to the eastern side. This spatial distribution highlights the security challenges in areas surrounding the Western Alignment, reinforcing the relevance of studying the impact of infrastructure development on regional violence dynamics.

Figure 3: 2010-2020 Pakistan District-level Violence Intensity



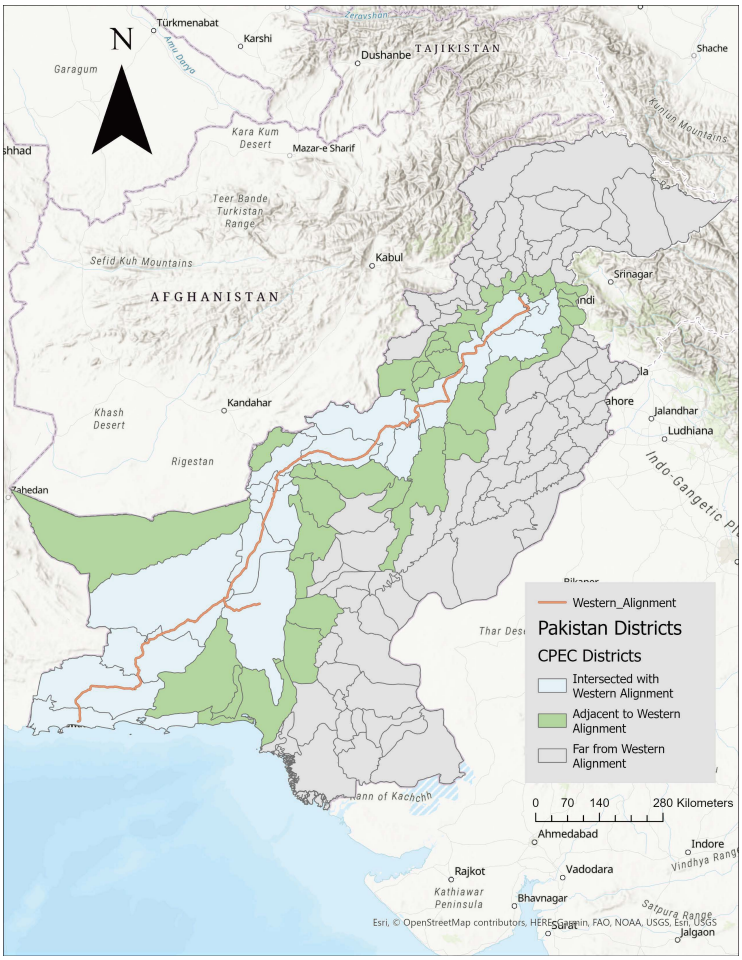

*Notes:* This figure projects the road route and violence incidents onto the map, aggregating the incidents at the district level. Data source: Global Terrorism Database (GTD), 2010-2020, Pakistan.

### 4.3 Pakistan Administrative Districts

The government of Pakistan defines 141 administrative districts as shown in Figure 4. For this study, I classify the 19 districts containing the Western Alignment (marked in light blue on the map) as the treated group. The remaining 122 districts without Western Alignment are divided in two control groups: the first control group includes all 122 districts (marked in grey and green),

while the second control group consists of the 35 adjacent districts (marked in green only). The third control group includes the 87 non-adjacent districts (marked in grey only). This classification allows for a nuanced comparison across varying levels of geographic proximity to the Western Alignment.

Figure 4: Map of Treated vs Control Groups




*Notes:* Pakistan's 141 administrative districts, with the setting of treated and control groups.

## 4.4 Descriptive Statistics

### 4.4.1 Monthly-level Data

I merge violent incidents from the Global Terrorism Database (GTD) with information on the Western Alignment road construction at the district and year-month level. This matching yields an 132-month balanced panel spanning 141 Pakistan districts, resulting in a total of 18,612 observations

(141 districts × 11 years × 12 months, from January 2010 through December 2020). Table 3 shows summary statistics by groups, with districts categorized based on their proximity to the Western Alignment. There are 2,508 observations from the treated districts (through which the Western Alignment passes), 16,104 observations from the first control group (districts without Western Alignment), and 4,620 observations from the second control group (districts adjacent to the treated districts). Columns (1) and (2) present the estimated means for the first and second control groups, respectively, while column (3) shows the means for the treated group.

Panel A of Table 3 summarizes district characteristics including the 2010-2020 yearly-district level population obtained from WorldPop's top-down unconstrained estimation modeling approach (WorldPop, 2020), 1998 Census population, the 2006 Night Light Development Index (NLDI) as a spatially measure of human development derived from satellite data (Elvidge et al., 2012), and Particulate Matter 2.5 from Atmospheric Composition Analysis Group (PM2, Accessed May 4, 2023). Regarding the mean characteristics, the districts through which the Western Alignment Road Route passes through tend to have, on average lower population, less development and better environmental air quality. These observed differences align with the fact that Pakistan tends to exhibit a higher concentration of political and economic activities on its eastern side in comparison to the western side.

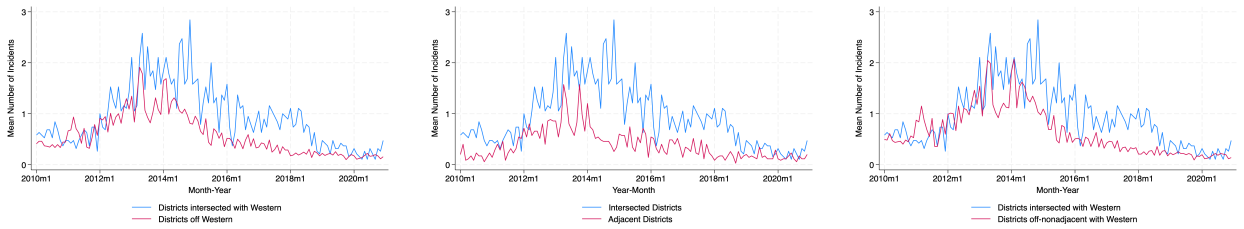
Panel B in Table 3 captures the main outcome variable (the number of violent incidents) for the treated group and control groups, along with temporal variations based on CPEC construction phases. Exposure to CPEC projects is categorized into three stages: whether i) the road construction has begun, ii) the construction process is ongoing, and iii) the construction was completed. The data shows that treated districts experience significantly higher average numbers of violent incidents compared to both control groups. Specifically, the average number of incidents in the treated districts reaches 0.812—markedly higher in the first control group (0.226), the second control group (0.151), and the third control group (0.256). Figure 5 dynamically illustrates these trends over time, showing that the treated districts exhibit higher levels of violence compared to all control groups and violence intensity peaks around 2013–2014. Panel C reports the total number of observations for districts affected by  across different construction phases, providing an overview of the temporal distribution of observations during and after construction.

Table 3: Descriptive statistics based on monthly-level panel data from 2010 to 2020.

| Variables | (1) Control 1: Districts off Western Alignment | (2) Control 2: Districts Adjacent to Western Alignment | (3) Control 3: District Off-Nonadjacent to Western Alignment | (4) Treatment: Districts Containing Western Alignment |
|---|---|---|---|---|
| *N (observations)* | 16,104 | 4,620 | 11,484 | 2,508 |
| **Panel A: District Characteristics** | | | | |
| Year 1998 Population | 1,085,398 | 531,796 | 1,283,113 | 625,460 |
| Yearly Population (2010–2020) | 1,493,432 | 785,908 | 1,778,068 | 911,772 |
| NLDI | 0.595 | 0.693 | 0.563 | 0.569 |
| PM2.5 | 54.427 | 49.558 | 56.386 | 48.841 |
| **Panel B: Number of Violent Incidents** | | | | |
| Since CPEC Construction Started | 0.226 | 0.151 | 0.256 | 0.812 |
| During CPEC Construction | 0.235 | 0.156 | 0.265 | 0.835 |
| Post CPEC Construction | 0.154 | 0.120 | 0.174 | 0.762 |
| **Panel C: Identification Variables (*N*)** | | | | |
| Exposure to CPEC Projects (a) | 4,499 | 1,267 | 3,232 | 876 |
| Exposure During CPEC Construction (b) | 4,013 | 1,092 | 2,921 | 595 |
| Exposure After CPEC Completion (c) | 486 | 175 | 311 | 281 |

*Notes:* The outcome variable is the number of violent incidents. Sample is a balanced monthly-level panel of all districts in Pakistan from 2010 to 2020. "Exposure" variables refer to district-months with non-zero project activity in each phase.
$^{***}$ $p < 0.01$; $^{**}$ $p < 0.05$; $^{*}p < 0.1$

Figure 5: Comparison of Average Violence Trends




(a) Control Group 1: All other districts

(b) Control Group 2: Adjacent districts only

(c) Control Group 3: Non-adjacent districts only

*Notes:* The outcome is the average number of violent incidents in each district per month. The left panel compares the treated districts with all other districts excluding those on the Western Alignment. The center panel compares them with adjacent districts only. The right panel compares them with non-adjacent districts that are not on the Western Alignment.

### 4.4.2 Yearly-level Data

Aggregating the data into a yearly-level balanced panel yields an eleven-year dataset covering 141 Pakistan districts, resulting in a total of 1,551 observations (141 districts $\times$ 11 years, from 2010 through 2020).

The yearly-level analysis is presented in Table 4, which provides an overview of the district characteristics and violent incident data on an annual frequency. Panel A shows the same district characteristics as in the monthly-level data, highlighting similar regional disparities. Treated districts tend to exhibit lower population density, lower development levels, and better air quality compared to the control groups. Panel B presents the yearly averages of violent incidents for the treated and control districts. The treated group experiences an average of 9.5 violent incidents per

year, significantly higher than the averages of 2.725 in the first control group, 1.822 for the second control group, and 3.076 for the third control group. This disparity emphasizes the heightened levels of violence in districts intersected by the Western Alignment road network compared to other regions.

Table 4: Descriptive statistics based on yearly-level panel data from 2010 to 2020.

| Variables | (1) Control 1: Districts off Western Alignment | (2) Control 2: Districts Adjacent to Western Alignment | (3) Control 3: District Off-Nonadjacent to Western Alignment | (4) Treatment: Districts Containing Western Alignment |
|---|---|---|---|---|
| *N (observations)* | 1,342 | 385 | 957 | 209 |
| **Panel A: District Characteristics** | | | | |
| Year 1998 Population | 1,085,398 | 531,796 | 1,283,113 | 625,460 |
| Yearly Population (2010–2020) | 1,493,432 | 785,908 | 1,778,068 | 911,772 |
| NLDI | 0.595 | 0.693 | 0.563 | 0.569 |
| PM2.5 | 54.427 | 49.558 | 56.386 | 48.841 |
| **Panel B: Number of Violent Incidents** | | | | |
| Since Year Construction Start | 2.725 | 1.822 | 3.076 | 9.500 |
| **Panel C: Identification Variables ($N$)** | | | | |
| Exposure to CPEC Projects | 422 | 118 | 304 | 76 |

*Notes:* The outcome variable is the number of violent incidents. Sample is a balanced yearly-level panel of all districts in Pakistan from 2010 to 2020.
$^{***}$ $p < 0.01$; $^{**}$ $p < 0.05$; $^{*}p < 0.1$

# 5 Empirical Strategy

I use three different models—outlined in subsection 5.1, subsection 5.2 and subsection 5.3—to ensure robust identification of the effects of road construction under the CPEC. Each model addresses considerations and strengthens the overall validity of the findings. First, I use a two-way fixed effects model estimated with Poisson Pseudo Maximum Likelihood (PPML), which is well-suited for count data and includes fixed effects to control for unobserved heterogeneity across districts and time. Second, I apply the two-way Mundlak model to account for the staggered rollout of road construction. Finally, I implement a synthetic difference-in-differences (SDID) approach to enhance the credibility of parallel trends by constructing a synthetic control group and adjusting for the staggered adoption of road construction. By employing these complementary models, I aim to mitigate potential biases and achieve a comprehensive analysis of the impact of road construction on local violence.

## 5.1 Modified Two-Way Fixed effects

### 5.1.1 Short-Term: Monthly-District Data

To test the hypothesis that CPEC construction may have a causal influence on the number of violent incidents, I use a quasi-panel structure at the district and month-year level. This structure

includes district-fixed and month-year-fixed effects, with an additional district-by-year fixed effect to account for district-specific annual variation. The baseline empirical panel data model is specified as follows:

$$incidents_{jyt} = \alpha_0 + \alpha_1 cpec_{jyt} + \theta_j + \delta_{yt} + \omega_{jy} + \epsilon_{jyt} \tag{1}$$

where $incidents_{jyt}$ indicates the number of violent incidents that happened in the district $j$, month $t$ and year $y$. $\delta_{yt}$ and $\theta_j$ represent month-year and district-fixed effects. $\omega_{jy}$ captures district-by-year fixed effects. $cpec_{jyt}$ represents whether districts $j$ at month $t$ and year $y$ has CPEC roads. In this setup, $\alpha_1$ captures the differential impact of CPEC construction on violence within a given year, isolating the effect of construction activity on the number of incidents. Given the abundance of zeros in the outcome variable, I use Psuedo Poisson Maximum Likelihood (PPML) estimation to address this distribution.

$$incidents_{jyt} = \alpha_0 + \alpha_1 cpec_during_{jyt} + \alpha_2 cpec_post_{jyt} + \theta_j + \delta_{yt} + \omega_{jy} + \epsilon_{jyt} \tag{2}$$

To analyze the temporal impact of CPEC projects, I separate $cpec_{jyt}$ into $cpec_during_{jyt}$ and $cpec_post_{jyt}$ in Equation (2). $cpec_during_{jyt}$ indicates that a district $j$ in month $t$ and year $y$ has CPEC roads under construction and $cpec_post_{jyt}$ indicates district $j$ in month $t$ and year $y$ has CPEC roads that were completed. Equation (2) yields a time-specific estimate, in which $\alpha_1$ and $\alpha_2$ represent the differential impact of CPEC during construction and post construction respectively.

### 5.1.2 Extended Analysis: Yearly-District Data

For the extended analysis, I aggregate the data to the yearly level, replacing monthly variation with yearly variation to align with the structure of the annual dataset. The classical two way fixed effects models is specified as follows:

$$incidents_{jy} = \alpha_0 + \alpha_1\, cpec_construct_{jy} + \beta\, lnpop_world_{jy} + \theta_j + \delta_y + \epsilon_{jy} \tag{3}$$

where $incidents_{jy}$ represents the number of violent incidents in district $j$ and year $y$. $cpec_construct_{jy}$ is a binary indicator of CPEC construction in district $j$ during year $y$, and $lnpop_world_{jy}$ is the natural log of the population, included as a control. $\theta_j$ represents district-fixed effects to control

for unobserved, time-invariant characteristics specific to each district, and $\delta_y$ represents year-fixed effects, accounting for time-varying factors that impact all districts. The error term $\epsilon_{jy}$ is clustered at the district level to address serial correlation within districts over time.

## 5.2 Two-Way Mundlak Regression

### 5.2.1 Short-Term: Monthly-District Data

The outcome variable in this analysis is the count of violent incidents in a given district and a given month. To identify the treatment effects of road construction in a staggered roll out, I use the Two-Way Mundlak difference-in-differences approach (Wooldridge, 2021) using Poisson Pseudo-Maximum likelihood (PPML) estimation, which accounts for the substantial number of district-month observations with zero incidents:

$$E(y_{jyt} \mid \boldsymbol{d}_j) = \exp\left[\eta + \sum_{qt=201401}^{T} \gamma_{qt} d_{jqt} + \sum_{st=201001}^{T} \theta_{st} g_{st,yt} + \sum_{rt=201401}^{T} \sum_{\substack{st=201001 \\ st \neq rt-1}}^{T} \tau_{rt,st}(d_{jrt} \cdot g_{st,yt})\right] \tag{4}$$

where $y_{jyt}$ represents the count of violent events in district $j$ during month $t$ of year $y$ . The indicators $d_{jqt}$ are equal to 1 when district $j$ first receives road construction in the month $t$ of year $q$, starting from the initial treatment month, Jan 2014. These indicators account for the staggered treatment timing, as districts received road construction at different times. $g_{st,yt}$ is a time dummy equal to 1 for the specific month $st = yt$, capturing time-specific effects, controlling for macroeconomic shocks, seasonal variations, or any temporal influences affecting all districts in a given month. The interaction term $(d_{jrt} \cdot g_{st,yt})$ captures the combined effect of treatment status and time, allowing us to estimate how the impact of road construction evolves following its initiation. The treatment effects $\tau_{rt,st}$ are estimated using a pooled regression approach, which accommodates heterogeneity in treatment timing across districts, enhancing statistical power and precision. The Two-Way Mundlak approach enables the estimation of short-term impacts of road construction on local violence, focusing on monthly effects immediately following treatment initiation.

### 5.2.2 Extended Analysis: Yearly-District Data

For estimating treatment effects over a yearly timeframe, I apply the following Two-Way Mundlak specification:

$$E(y_{jy} \mid \boldsymbol{d}_j) = \exp\left[\eta + \sum_{q=2014}^{T} \gamma_q d_{jq} + \sum_{s=2010}^{T} \theta_s g_{sy} + \sum_{r=2014}^{T} \sum_{\substack{s=2010 \\ s \neq r-1}}^{T} \tau_{rs}(d_{jr} \cdot g_{sy})\right] \tag{5}$$

where $y_{jy}$ represents the annual count of violent incidents in district $j$ during year $y$. The indicator variables $d_{jq}$ are equal to 1 if district $j$ received road construction in year $q$, starting from the initial treatment year of 2014. This setup tracks road construction by year and enables comparison between treated and untreated districts across different years. The year-specific dummy $g_{sy}$ is set to 1 when $s = y$, capturing year-fixed effects to control for macro-level shocks, such as national policies or global economic trends, which may impact violence levels across all districts in a given year. The interaction term $(d_{jr} \cdot g_{sy})$ captures the interaction between treatment and time, allowing for evaluation of how treatment effects evolve over years following the start of road construction. The treatment effects $\tau_{rs}$ capture year-over-year changes in violence following road construction, using a pooled regression approach.

## 5.3 Synthetic Difference-in-differences Design

Relying on Synthetic Difference-in-Differences (SDID) research design, I compare changes in violent incidents in CPEC districts to those in non-CPEC districts. The SDID method combines features of Synthetic Control and Difference-in-Differences, reweighting and matching pre-exposure trends to reduce reliance on parallel trends (as in SC) while remaining invariant to additive unit-level shifts and allowing valid inference for large panel (as in DID) (Arkhangelsky et al., 2021). This combination makes SDID well-suited for studying infrastructure projects like CPEC road construction, where treatment timing varies across districts and outcomes are observed across multiple time scales. Applying the SDID framework to both monthly and yearly datasets enables this study to capture a detailed view of how road construction influences local violence across different temporal scales.

The average causal effects of CPEC construction on violent incidents is estimated by:

$$(\hat{\tau}^{sdid}, \hat{\mu}, \hat{\alpha}, \hat{\beta}) = \arg\min_{\tau,\mu,\alpha,\beta} \sum_{j=1}^{N} \sum_{t=1}^{T} \left(y_{jt} - \mu - \alpha_j - \beta_t - W_{jt}\tau\right)^2 \hat{\omega}_j^{sdid} \hat{\lambda}_t^{sdid} \tag{6}$$

where $y_{jt}$ represents the outcome variable (number of violent incidents) for district $j$ at time $t$. The time index $t$ refers to month-year for the short-term analysis and year for the long-term analysis. $W_{jt}$ is the treatment variable capturing whether district $j$ received road construction at time $t$.

The weights $\hat{\omega}_i^{sdid}$ for districts and $\hat{\lambda}_t^{sdid}$ for time periods are chosen to achieve balance, reduce discrepancies and ensure comparability between treated and control units, while minimizing reliance on the parallel trends. Specifically:

- $\hat{\omega}_i^{sdid}$ is chosen to minimize the average squared difference in trends between the treatment and control groups, subject to a regularization parameter to prevent overfitting and ensure the uniqueness of weights.
- $\hat{\lambda}_t^{sdid}$ is selected to minimize the sum of squared differences between the time-weighted pre-treatment outcomes of the control units and the average of the post-treatment outcomes in the control group.

For statistical inference, I use block bootstrap methods to estimate confidence intervals, following prior research (Clarke et al., 2023). This approach provides robust standard errors, accounting for the staggered treatment implementation and temporal correlations across districts.

The SDID model balances pre-treatment characteristics between treated and control districts through synthetic weighting, making it well-suited for analyzing the staggered rollout of CPEC's Western Alignment road construction. By creating a comparable control group, the model addresses selection biases due to varying treatment timing across districts.

# 6 Analysis

## 6.1 Short-run Results: Aggregate Effects

In the modified two-way fixed effects model, I use Ordinary Least Squares (OLS) and Pseudo Poisson Maximum Likelihood (PPML) estimations to analyze the short-run effects of construction

on violence within the treatment year. Initial results indicated that OLS might not be suitable due to a high number of zero observations, as many districts did not experience incidents in certain months. To better handle these zero values, I opted for PPML, which is robust to potential overdispersion and misspecification issues, and is commonly used in conflict-related studies such as weintraub2016all.

In all estimations, standard errors are clustered at the district level. Table 5 presents results comparing the treated districts—those containing the —with the first control group, which includes all other districts in Pakistan. Columns 1 and 2 show OLS estimates, which do not indicate a statistically significant impact of CPEC construction on violence. Columns 3 and 4 display Poisson estimation results. After converting the coefficients from natural logarithmic form to percentage changes, the estimates suggest that the number of violent incidents in treated districts decreases by 52.44% $(1 - \exp(-0.7432))$ since construction began, by 52.46% $(1 - \exp(-0.7435))$ during construction, and by 68.58% $(1 - \exp(-1.1576))$ after construction. These reductions are statistically significant at the 95% confidence level, indicating that CPEC construction is associated with a substational decline in violence along the Western alignment

Table 6 shows results using a more geographically proximate comparison group, restricting the control group to districts adjacent to the treated districts. The Poisson estimates in Columns 3 and 4 reveal similarly large and significant declines in violence: a 54.57% $(1 - \exp(-0.789))$ reduction since construction began, 54.57% $(1 - \exp(-0.789))$ during construction, and 64.33% $(1 - \exp(-1.031))$ after completion.

Table 7 shows results using control group composed of the remaining nonadjacent districts—those that do not share a border with treated districts. This specification helps address potential spillover effects from CPEC projects by excluding adjacent districts that may also be indirectly affected. The corresponding estimates suggest a 51.32% $(1 - \exp(-0.720))$ reduction since construction began, a 51.37% $(1 - \exp(-0.721))$ reduction during construction, and a 68.53% $(1 - \exp(-1.156))$ decline after construction is completed.

Although point estimates vary slightly across specifications due to differences in control group composition, the patterns remain consistent: CPEC construction reduced violence in districts along the Western Alignment, both during construction and after completion, with results significant at the 95% confidence level.

Table 5: Short-run effects of CPEC construction on violence.

| **Variables** | **(1)** | **(2)** | **(3)** | **(4)** |
|---|---|---|---|---|
| CPEC (Since construction starts) | -0.189 | | -0.743** | |
| | (0.228) | | (0.373) | |
| CPEC (During construction) | | -0.190 | | -0.743** |
| | | (0.228) | | (0.372) |
| CPEC (Post) | | -0.654 | | -1.158** |
| | | (0.563) | | (0.474) |
| District FE | Yes | Yes | Yes | Yes |
| Month-Year FE | Yes | Yes | Yes | Yes |
| District-by-Year FE | Yes | Yes | Yes | Yes |
| Average Incidents (Baseline) | 0.611 | 0.611 | 0.611 | 0.611 |
| Observations | 18,612 | 18,612 | 10,596 | 10,596 |
| Unique Districts | 141 | 141 | 131 | 131 |
| R-squared | 0.765 | 0.765 | 0.543 | 0.543 |
| Model | OLS | OLS | Poisson | Poisson |

*Notes:* Dependent variable is the number of violent incidents at the district-month level. Columns (1) and (2) use an OLS model, while Columns (3) and (4) use Poisson regression. Standard errors are clustered at the district level and reported in parentheses. Coefficients are estimated from Equations (1) and (2), comparing treated districts to the rest.
*Robust standard errors in parentheses.*
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

### 6.2 Short-run Event Study: Heterogeneity

To consider dynamic treatment effects, I apply an event study methodology to estimate the impact of the specific construction start date on violent incidents over time. Given that construction start months vary from January to October in the treatment year, the model includes 9 pre-event periods and 11 post-periods.

For each district $j$ at month $t$ and year $y$, the first event-study specification in the modified two-way fixed effects framework is as follows:

$$incidents_{jyt} = \beta_0 + \sum_{g=-9}^{-2} \beta_g cpec_{jg} + \sum_{g=0}^{11} \beta_g cpec_{jg} + \theta_j + \delta_{yt} + \omega_{jy} + \epsilon_{jyt} \tag{7}$$

Using Psuedo-Poisson Maximum Likelihood (PPML) estimation, the results reveal that CPEC construction has a significant negative impact on violence, with effects becoming larger in the first and second post-month. Figure 6 shows the estimation results for the treatment group compared

Table 6: Short-run effects of CPEC construction on violence (treated vs. adjacent districts).

| **Variables** | **(1)** | **(2)** | **(3)** | **(4)** |
|---|---|---|---|---|
| CPEC (Since construction starts) | -0.201 | | -0.789** | |
| | (0.228) | | (0.481) | |
| CPEC (During construction) | | -0.204 | | -0.789** |
| | | (0.227) | | (0.480) |
| CPEC (Post) | | -0.676 | | -1.031** |
| | | (0.530) | | (0.521) |
| District FE | Yes | Yes | Yes | Yes |
| Month-Year FE | Yes | Yes | Yes | Yes |
| District-by-Year FE | Yes | Yes | Yes | Yes |
| Average Incidents (Baseline) | 0.550 | 0.550 | 0.550 | 0.550 |
| Observations | 7,128 | 7,128 | 4,848 | 4,848 |
| Unique Districts | 54 | 54 | 51 | 51 |
| R-squared | 0.655 | 0.655 | 0.405 | 0.405 |
| Model | OLS | OLS | Poisson | Poisson |

*Notes:* Dependent variable is the number of violent incidents at the district-month level. Columns (1) and (2) use OLS, while Columns (3) and (4) use Poisson regressions. Standard errors are clustered at the district level and reported in parentheses. Coefficients are estimated from Equations (1) and (2), comparing treated districts to adjacent ones.
*Robust standard errors in parentheses.*
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

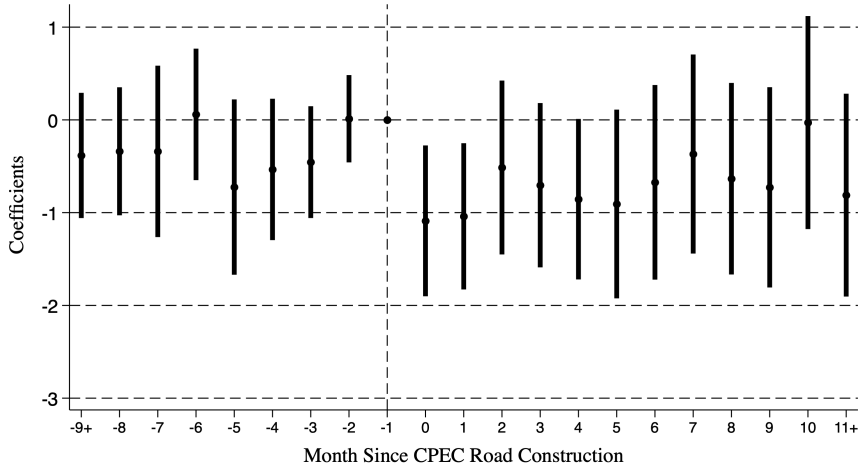
to the first control group. Relative to one month before construction starts (period -1 in Figure 6), the number of incidents decreases by 66.33% $(1 - \exp(-1.0885))$ in the month construction begins (period 0) and by 64.64% $(1 - \exp(-1.0397))$ in the following month (period 1).

Table 7: Short-run effects of CPEC construction on violence (treated vs. rest-nonadjacent districts)

| **Variables** | **(1)** | **(2)** | **(3)** | **(4)** |
|---|---|---|---|---|
| CPEC (Since construction starts) | -0.176 | | -0.720* | |
| | (0.228) | | (0.387) | |
| CPEC (During construction) | | -0.177 | | -0.721* |
| | | (0.230) | | (0.387) |
| CPEC (Post) | | -0.630 | | -1.156** |
| | | (0.566) | | (0.495) |
| District FE | Yes | Yes | Yes | Yes |
| Month-Year FE | Yes | Yes | Yes | Yes |
| District-by-Year FE | Yes | Yes | Yes | Yes |
| Average Incidents (Baseline) | 0.690 | 0.690 | 0.690 | 0.690 |
| Observations | 13,992 | 13,992 | 7.752 | 7,752 |
| Unique Districts | 106 | 106 | 99 | 99 |
| R-squared | 0.754 | 0.754 | 0.578 | 0.578 |
| Model | OLS | OLS | Poisson | Poisson |

*Notes:* Dependent variable is the number of violent incidents at the district-month level. Columns (1) and (2) use OLS, while Columns (3) and (4) use Poisson regressions. Standard errors are clustered at the district level and reported in parentheses. Coefficients are estimated from Equations (1) and (2), comparing treated districts to the third control group, which is non-treated districts that are also not adjacent to treated districts ("rest-adjacent")
*Robust standard errors in parentheses.*
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Figure 6: Trends of Violence along CPEC Road



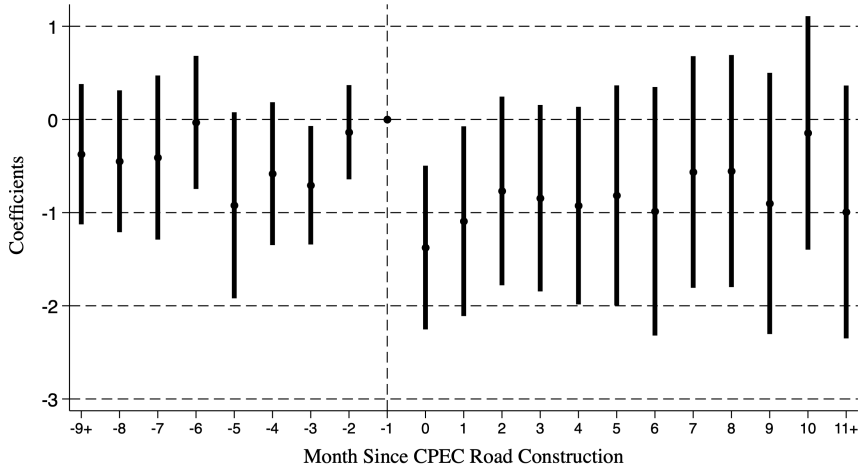

*Notes:* This figure show the coefficients of Poisson estimates and their 95% confidence intervals from equation (7). The data covers the period from 2010 to 2020 for treated and the other districts.

Figure 7 shows the effects when the control group is restricted to adjacent districts. The number of incidents decreases by 74.71% $(1-exp(-1.3749))$ in the month construction starts and by 66.44% $(1-exp(-1.0919))$ in the following month.

Figure 8 shows the effects when the control group is restricted to the rest of the district but not adjacent with the treated districts. The number of incidents decreases by 63.41% $(1-exp(-1.0056))$ in the month construction starts and by 63.09% $(1-exp(-0.9967))$ in the following month.

The pre-trends in the event-study figures support the assumption that changes in violent incidents following the start of construction are attributable to the infrastructure project. This indirect test of parallel trends strengthens the causal interpretation, linking the observed reduction in violence to the initiation of construction.

Figure 7: Trends of Violence along CPEC Road




*Notes:* Poisson coefficient estimates and their 95% confidence intervals are reported. The dependent variable is the number of incidents in district $j$ at year-month $yt$ The controls include district, time (year-month) and district by year fixed effects. The data covers the period from 2010 to 2020 for treated and adjacent districts.

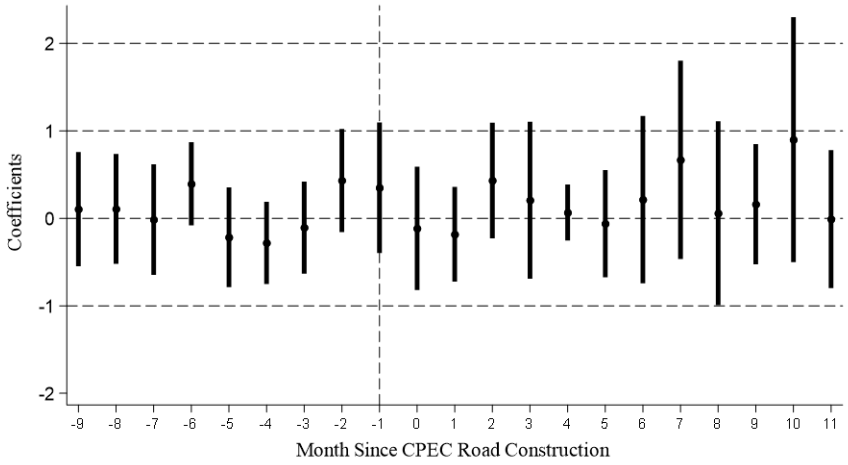
Figure 8: Trends of Violence along CPEC Road

figures/ppml_event_yearbydistrict_11month_put_rest_adja

*Notes:* Poisson coefficient estimates and their 95% confidence intervals are reported. The dependent variable is the number of incidents in district $j$ at year-month $yt$ The controls include district, time (year-month) and district by year fixed effects. The data covers the period from 2010 to 2020 for treated and rest-nonadjacent districts.

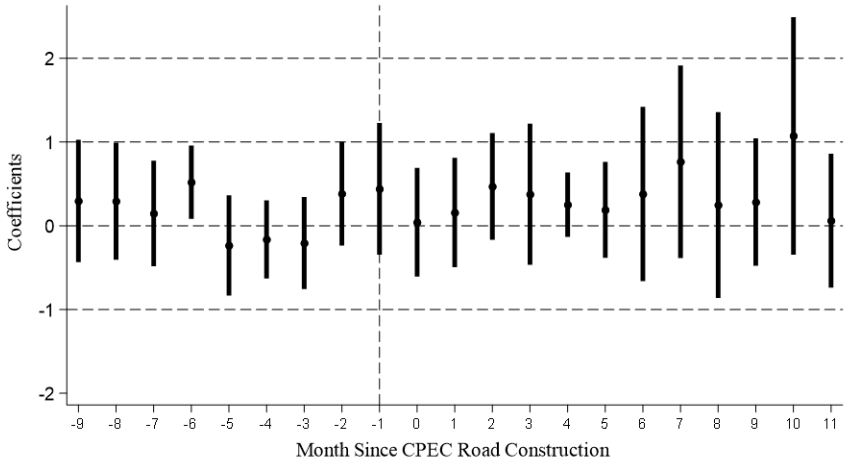
The event study plots generated using the second specification, two-way Mundlak with pre-9 and post-11 month windows, are shown in 8. This specification displays non-parallel pre-trends, whereas the third specification, using Synthetic Difference-in-Differences (SDID), achieves parallel trends, as seen in Figure 9 and Figure 10. Relative to the month before construction (effect size of 0.35), the number of incidents decreases by 0.46 units in the construction month and by 0.53 units in the following month. These effects appear temporary, as estimates stabilize around zero in subsequent months. When restricting the control group to adjacent districts, as shown in Figure 10, a similar effect is achieved, with the number of incidents decreasing by 0.4 units in the construction month and by 0.28 units in the following month, compared to the month before construction (effect size of 0.44).

Figure 9: Monthly Violence Trends over the Treated Year




*Notes:* This graph shows Synthetic Differences-in-Differences treatment effects with 95% confidence intervals from equation (6). The log of population is controlled with results bootstrapped using 1000 repetitions. The data covers from Jan 2010 to Dec 2020 for treated districts and the other districts (1st control group)

Figure 10: Monthly Violence Trends over the Treated Year




*Notes:* This graph shows Synthetic Differences-in-Differences treatment effects with 95% confidence intervals from equation (6). The log of population is controlled with results bootstrapped using 1000 repetitions. The data covers from Jan 2010 to Dec 2020 for treated districts and the adjacent districts (2nd control group)

### 6.3 Extended Results: Aggregate Effects

The results in Table 8 and Table 9 summarize the aggregate effects of construction on violence using several estimation methods: classical two-way fixed effects estimated by both OLS and PPML, two-way Mundlak (TWM) estimated by PPML, and the Synthetic Difference-in-Differences (SDID) model. The two-way fixed effects model estimated by PPML suggests a statistically significant 42.7% $((1 - exp(0.356))$ increase in violence since construction began when using the first control group and a 55.89% $((1 - exp(0.444))$ increase with the adjacent control group. Results from other specifications show positive but statistically insignificant effects, suggesting a possible yet inconclusive impact of construction on violence overall.

### 6.4 Extended Event Study: Heterogeneity

The extended event study of annual violence patterns visualizes the dynamics of treatment effects over time. The Synthetic Differences-in-Differences (SDID) model demonstrates credible parallel pre-treatment trends, while also revealing increased volatility in the post-treatment periods. This volatility introduces uncertainty into the aggregate positive effect, rendering it less conclusive. In

Table 8: Effect of CPEC construction on violent incidents using yearly-level data.

| **Aggregate Effects** | | | | |
|---|---|---|---|---|
| **Variables** | **(1)** | **(2)** | **(3)** | **(4)** |
| CPEC (Since construction starts) | 0.746 | 0.356* | 1.771 | 3.753 |
| | (3.451) | (0.191) | (1.201) | (2.984) |
| Converted to Increased Units | 0.75 | 3.18 | 0.57 | 3.75 |
| Average Baseline Incidents | 7.45 | 7.45 | 7.45 | 7.45 |
| Observations | 1,551 | 1,441 | 1,551 | 1,551 |
| Model | TWFE | TWFE-PPML | TWM-PPML | SDID |

*Notes:* Dependent variable is the number of violent incidents at the district-year level. Estimates are from Equations (3), (4), and (6). The natural log of district-by-year population is controlled for in all models. In the TWM-PPML model, population per thousand is also controlled. The comparison is between treated districts and those off the Western Alignment.
*Robust standard errors in parentheses.*
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

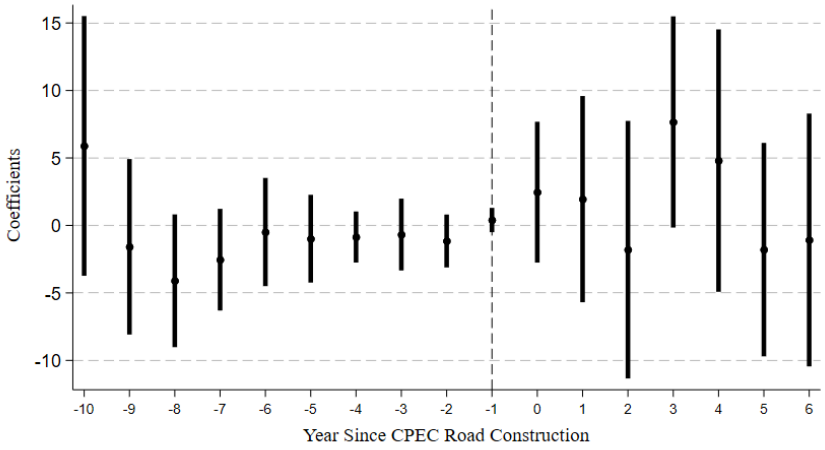
Table 9: Effect of CPEC construction on violent incidents using yearly-level data (restricted sample).

| **Aggregate Effects** | | | | |
|---|---|---|---|---|
| **Variables** | **(1)** | **(2)** | **(3)** | **(4)** |
| CPEC (Since construction starts) | 0.051 | 0.444** | 2.720* | 1.243 |
| | (3.193) | (0.149) | (1.650) | (2.212) |
| Converted to Increased Units | 0.05 | 3.90 | 1.00 | 1.24 |
| Average Baseline Incidents | 6.98 | 6.98 | 6.98 | 6.98 |
| Observations | 594 | 561 | 594 | 594 |
| Model | TWFE | TWFE-PPML | TWM-PPML | SDID |

*Notes:* Dependent variable is the number of violent incidents at the district-year level. Estimates are based on Equations (3), (4), and (6). All specifications control for the natural log of district-by-year population. The TWM-PPML model also controls for population per thousand. This sample compares treated districts to those off the Western Alignment.
*Robust standard errors in parentheses.*
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

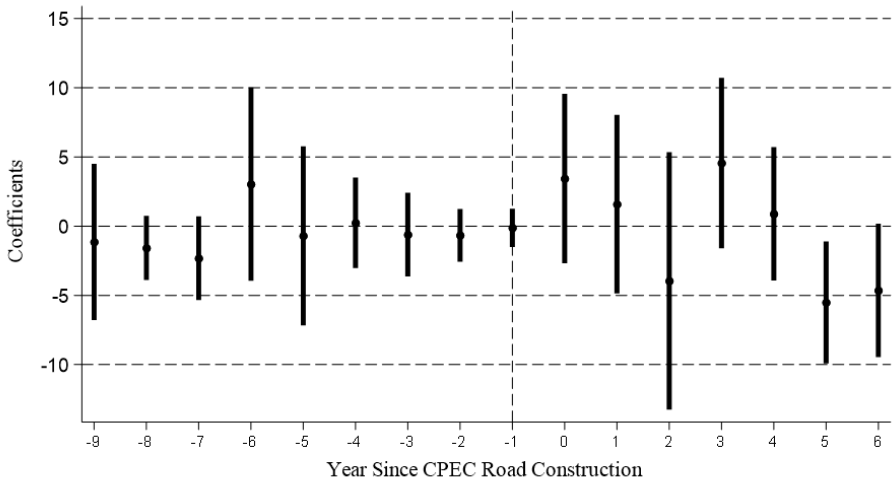
contrast, the event study plots from the two-way fixed-effects and two-way Mundlak models, shown in 8, display poor parallel trends in the pre-treatment period.

Figure 11: SDID Yearly-Level Event Study




*Notes:* This graph shows Synthetic Differences-in-Differences treatment effects with 95% confidence intervals. Covariate includes the log of population with results bootstrapped using 1,000 repetitions. The data covers 2010-2020 for treated districts and the other districts (1st control group).

Figure 12: SDID Yearly-Level Event Study




*Notes:* This graph shows Synthetic Differences-in-Differences treatment effects with 95% confidence intervals. Covariate includes the log of population with results bootstrapped using 1,000 repetitions. The data covers 2010-2020 for treated districts and the adjacent districts (2nd control group).

### 6.5 Robustness Check

There might be a treatment selection issue, such as if the road construction projects are chosen based on past violence and the road routes are selected to pass through the less violent neighborhoods. I first run regression equation (8) with *cpec* as dependent variable to see whether the historical violence affects the current road construction situation and observed the results in Table 10. The coefficients are close to zero and it is hard to interpret them as causal impact of past violence on road construction.

$$cpec_{jyt} = \alpha_0 + \alpha_1 incidents_{jyt-1} + \theta_j + \delta_{yt} + \omega_{jy} + \epsilon_{jyt} \tag{8}$$

Table 10: Dependent variable: Whether there are CPEC projects in a district and month.

| **Past Violence** | **(1)** | **(2)** | **(3)** |
|---|---|---|---|
| Violence in the previous month | -0.004 | | |
| | (0.002) | | |
| Violence in the past two months | -0.004 | 0.004 | |
| | (0.002) | (0.003) | |
| Violence in the previous year | | | 0.001 |
| | | | (0.003) |
| District FE | Yes | Yes | Yes |
| Month-Year FE | Yes | Yes | Yes |
| District-by-Year FE | Yes | Yes | Yes |
| Observations | 912 | 912 | 912 |
| Unique Districts | 19 | 19 | 19 |
| R-squared | 0.016 | 0.016 | 0.016 |
| Model | Poisson | Poisson | Poisson |

*Notes:* The dependent variable is a binary indicator for whether any CPEC construction projects were ongoing in a district in a given year-month. Models are estimated using Poisson regressions with district, month-year, and district-by-year fixed effects. Standard errors are clustered at the district level and reported in parentheses.
*Robust standard errors in parentheses.*
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

To consider possible impacts from the past violence, I attempt to add the number of incidents that are one month before into the original model as equation (9). Since the average road construction period for each segment is two to three years, I also use violence that is one year before as a control, as shown in equation (10), to measure the historical violence more accurately.

$$incidents_{jyt} = \alpha_0 + \alpha_1 cpec_{jyt} + \alpha_2 incidents_{jyt-1} + \theta_j + \delta_{yt} + \omega_{jy} + \epsilon_{jyt} \quad (9)$$

$$incidents_{jyt} = \alpha_0 + \alpha_1 cpec_{jyt} + \alpha_2 incidents_{jyt-12} + \theta_j + \delta_{yt} + \omega_{jy} + \epsilon_{jyt} \quad (10)$$

Table 11 shows the results after applying Poisson estimation and clustering in the districts level, and the significance of original coefficients of CPEC projects do not change. Columns 1 and 2 are results estimated from original regression models. Columns 3 and 4 display the coefficients while adding the number of incidents that is one month before the construction start date. Columns 5 and 6 show the coefficients after adding the number of incidents that is one year before the construction start date. The past violence does not affect the coefficients of CPEC projects and the coefficients remain significantly negative.

Table 11: Dependent variable: Number of violent incidents in a district-month (treated vs. districts off the Western Alignment).

| **Variables** | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** |
|---|---|---|---|---|---|---|
| CPEC (Since construction starts) | -0.743** | | -0.742** | | -0.743** | |
| | (0.373) | | (0.372) | | (0.373) | |
| CPEC (During construction) | | -0.743** | | -0.742** | | -0.743** |
| | | (0.372) | | (0.371) | | (0.372) |
| CPEC (Post) | | -1.158** | | -1.155** | | -1.157*** |
| | | (0.474) | | (0.473) | | (0.474) |
| Past Violence (One month before) | | | 0.001 | 0.001 | | |
| | | | (0.002) | (0.002) | | |
| Past Violence (One year before) | | | | | -0.000 | -0.000 |
| | | | | | (0.002) | (0.001) |
| District FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Month-Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| District-by-Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 10,596 | 10,596 | 10,596 | 10,596 | 10,596 | 10,596 |
| Unique Districts | 131 | 131 | 131 | 131 | 131 | 131 |
| R-squared | 0.543 | 0.543 | 0.543 | 0.543 | 0.543 | 0.543 |
| Model | Poisson | Poisson | Poisson | Poisson | Poisson | Poisson |

*Notes:* The dependent variable is the number of violent incidents at the district-month level. All models use Poisson regressions with district, month-year, and district-by-year fixed effects. Columns vary by inclusion of past violence controls. Comparison group is districts off the Western Alignment.
*Robust standard errors in parentheses.*
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Besides the empirical evidence, there is contextual evidence that CPEC road segments selection largely depends on economic factors. Many CPEC road segments on the Western Alignment route are based on existing road routes and the construction work involves upgrading and improving the

existing roads, such as widening the road, adding additional lanes and improving road surfaces rather than new alignments. Also for the new road segments, the selection was based on a careful consideration of efficiency and connectivity. The alignment was chosen to provide the shortest possible route and to improve connectivity between different regions of Pakistan, which would help to boost economic development in these areas. As a result, we may conclude that previous violence may not have an impact on road selection and development.

# 7 Discussions

Violence intensity decreased temporarily during the initial months of CPEC construction. The unique characteristics of CPEC projects—large-scale infrastructure with strong management and a single-donor structure—may contribute to this short-term reduction.

This trend contrasts with prior research by Crost et al. (2014), which showed that insurgency violence typically spikes during the early stages of development projects in Philippines, as insurgents react violently to hinder government projects and exploit resources. CPEC projects bring substantial resources in the short term, potentially incentivizing insurgent groups to sabotage or exploit these assets. However, the strong military presence likely plays a significant role in reducing violence in the short-term—beyond what predatory theory alone would predict.

In the extended analysis, while positive significant effects are observed, increased uncertainty in post-construction dynamics renders these positive effects less conclusive. Violence appears to revert to pre-construction levels after road completion, likely due to a reduction in military protection once construction is finalized. We do not observe consistent improvements in overall safety, even as government control and authority over the territory expand during construction. The volatility in violence also complicates the *hearts and minds* theory, which suggests that completed infrastructure projects deter insurgent activity by winning public support.

This study faces limitations due to the small number of road segments (twelve) in the Western Alignment, making it challenging to capture the temporal variation of construction phases in a more detailed and dynamic way. Future research will aim to address this by using grid-level analysis and satellite imagery to improve the accuracy and frequency of the construction timeline. While this model includes time and district fixed effects to account for some variations, further refinement is

needed to identify month-year level temporal characteristics that correlate with conflict but remain uncorrelated with error terms, strengthening causal inference. Future work will expand the analysis to include transportation projects across the Eastern, Central, and Northern Alignment routes as additional CPEC construction data becomes available.

Anecdotal evidence suggests that CPEC projects face both internal threat from extremism and terrorism such as East Turkestan Islamic Movement (ETIM), Tehreek-e-Taliban (TTP), Lashkar-e-Tayyiba, Lashkar-e-Jhangvi, (LeJ), Daesh (ISIS), Balochistan Liberation Front (BLF) and the militant wings of some political parties and external threats from terrorist groups in Afghanistan and Iran including Al Qaeda, the self-styled Islamic State, Tehreek-e-Taliban (TTP), the movement of Islamic Uzbekistan and the Turkmenistan Islamic party. These parties all try to stop the CPEC projects (Ahamd and Mi, 2017), which may bring violence during its construction.

The 34th Light Infantry Division, also called Special Security Division (SSD) is a newly raised division of Pakistan army with 15,000 troops tasked with providing security to the under construction CPEC and the workforce. Also, the Pakistani duty officers, civilian scientists and engineer from the Frontier Works Organization (FWO)—an administrative branch of the Pakistan Army—are heavily involved. The presence of robust military safeguards has likely acted as a deterrent against multifaceted threats that could have otherwise escalated violence in the short run.

# 8 Conclusion

This study examines the effects of infrastructure aid, specifically transportation projects under the China-Pakistan Economic Corridor (CPEC), on political violence in Pakistan, using panel data on violent incidents at the district level from 2010 to 2020. The findings indicate a decrease in violent incidents in CPEC districts, suggesting a short-term stabilizing effect of road construction. However, the annual-level analysis reveals uncertainty and volatility in violence trends, suggesting that stability is not sustained over the years.

The unique characteristics of CPEC projects —large-scale investment, strong management performance, single-donor and military protection—appear to be key factors explaining the short-term reduction in violence, which is larger than the influence of other socio-economics changes. Military protection has played a pivotal role in mitigating violence and creating an environment conducive

to progress during the construction phase of the CPEC projects. Nevertheless, the military involvement has not yet resulted in increased government control or authority over other parties in the region.

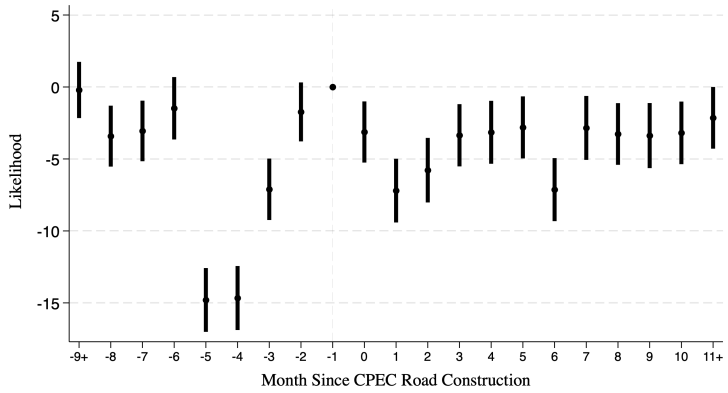
The research contributes to a deeper understanding of the complex relationship between aid and conflict by exploring the channels through which aid influences violence. The implications of this study could inform future policies and aid allocation decisions, particularly in conflict-affected regions. Recognizing the short-term stabilizing effects of infrastructure aid and understanding the channels behind them can help policymakers design targeted and effective strategies to foster peace and stability. While military protection during construction appears effective in the short term, sustaining a stable environment post-construction remains challenging. Future research into the causes of long-term volatility in violence is essential to address this issue effectively.

# Appendix A. Figures

## 8.1 Short-run results-Monthly-level data

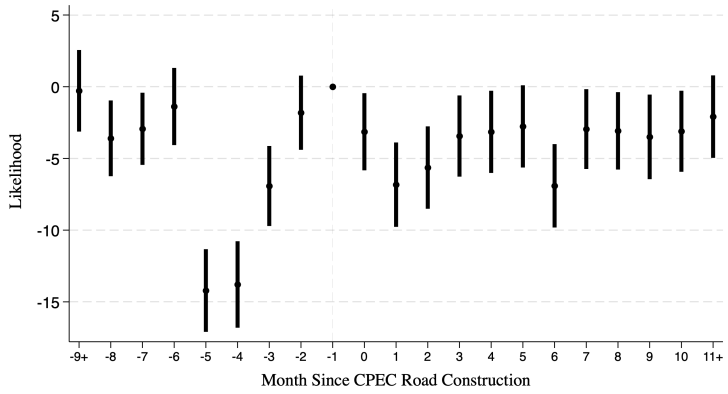
Figure 13 and Figure 14 show two-way Mundlak regression results with time periods restricted to the 9 months before and the 11 months after the treatment. When excluding the year-by-district fixed effect used in the first specification, the event study frameworks from the two-way Mundlak regression reveal non-parallel trends, raising potential concerns about bias in the estimated effects. This bias arises from not accounting for district-specific yearly changes—such as local policy adjustments, economic shifts, or external influences—which may distort the treatment effect. Despite this, the figures indicate a drop in violence during the month of treatment and the month following. While this pattern may suggest an initial impact, the absence of parallel trends warrants caution in interpretation.

Figure 13: Two-way Mundlak Monthly Violence Trends over the Treated Year




*Notes:* This figure shows the coefficients of Poisson estimates considering the Staggered roll-out of road construction and their 95% confidence intervals from equation (4). The data covers the period from 2010 to 2020 for treated and the other districts.

Figure 14: Two-way Mundlak Monthly Violence Trends over the Treated Year



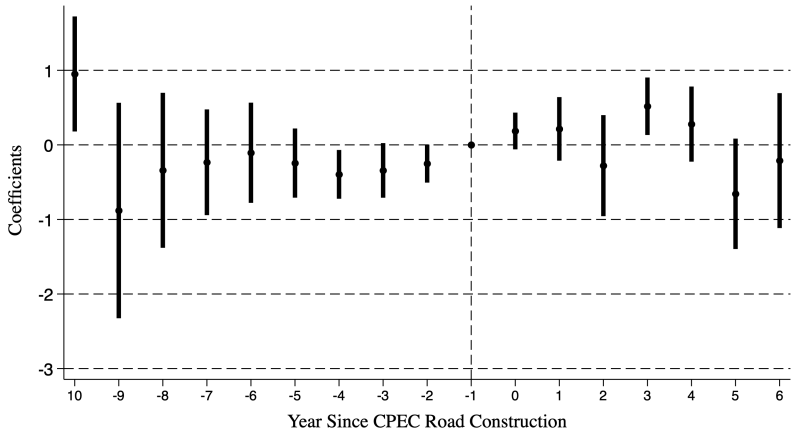

*Notes:* This figure shows the coefficients of Poisson estimates considering the Staggered roll-out of road construction and their 95% confidence intervals from equation (4). The data covers the period from 2010 to 2020 for treated and the adjacent districts.

## 8.2 Extended Results-Yearly level data

### 8.2.1 Two-way Fixed-effects Model

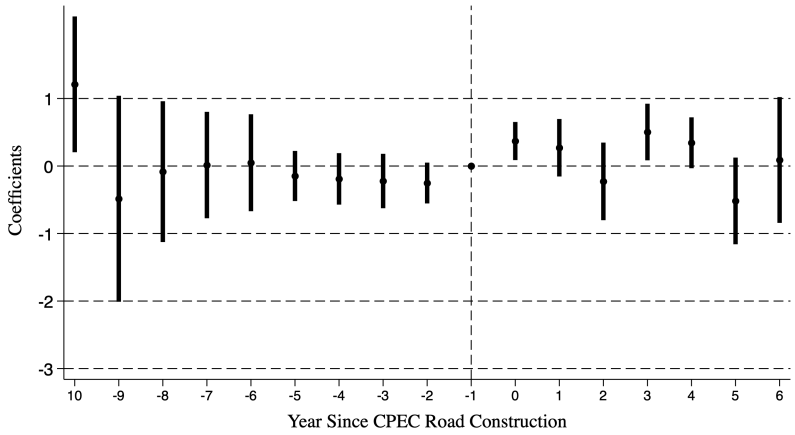
The event study plots from the two-way fixed-effects model estimated by PPML, shown in the Figure 15 and Figure 16, highlight the volatility of violence over time in the post-construction periods for both the first control group and the adjacent control group.

Figure 15: Two-way Fixed Effects Yearly Level Violence Trends




*Notes:* This graph presents Poisson Pseudo Maximum Likelihood regression with 95% confidence intervals from equation (3) controlling log of population, with standard errors clustered at the district level. The data covers 2010-2020 for treated districts and the other districts (1st control group).

Figure 16: Two-way fixed-effects Yearly Level Violence Trends

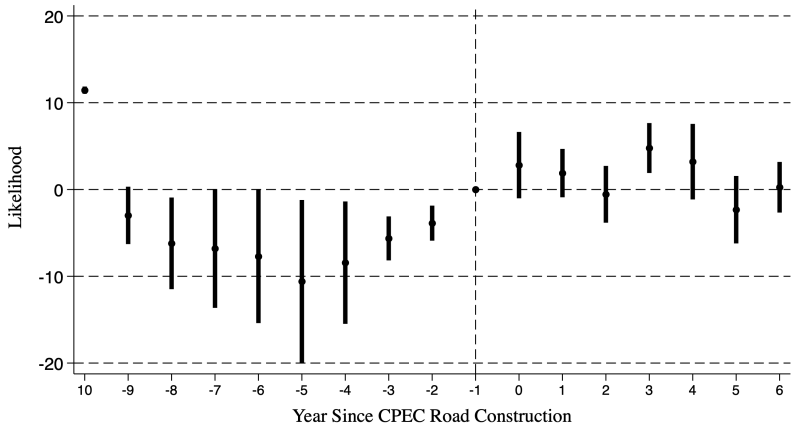



*Notes:* This graph presents Poisson Pseudo Maximum Likelihood regression with 95% confidence intervals from equation (3) controlling log of population, with standard errors clustered at the district level. The data covers 2010-2020 for treated districts and the adjacent districts (2nd control group).

### 8.2.2 Two-way Mundlak Model

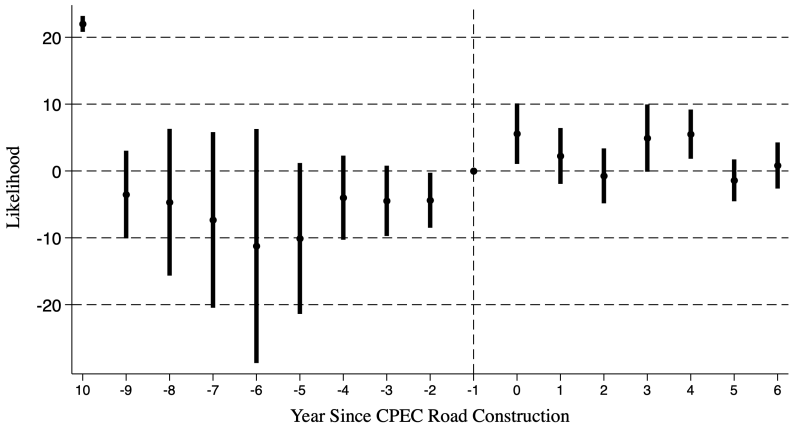
Figure 17 and Figure 18 display the event study plots from the two-way Mundlak regression estimated with the PPML models. The plots reveal poor parallel trends in the pre-treatment periods, while the post-treatment periods exhibit randomness and appear uncertain.

Figure 17: Two-way Mundlak Yearly-Level Violence Trends




*Notes.* This graph shows results from a Two-Way Mundlak regression with 95% confidence intervals estimated from equation (5). Standard errors clustered at the district level with control of population per thousand. The data covers 2010-2020 for treated districts and the other districts (1st control group)

Figure 18: Two-way Mundlak Yearly-Level Event Study




*Notes.* This graph shows results from a Two-Way Mundlak regression with 95% confidence intervals estimated from equation (5). Standard errors clustered at the district level . The data covers 2010-2020 for treated districts and the adjacent districts (2nd control group)

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The Global Terrorism Database™ (GTD) is an open-source database including information on terrorist events around the world from 1970 through 2020

## Glossary

**BRI** The Belt and Road Initiative, a global infrastructure development strategy launched by China in 2013 to improve trade routes and foster economic cooperation across Asia, Europe, and Africa through projects in transportation, energy, and communication. 0, 1, 5, 6

**CPEC** China-Pakistan Economic Corridor, a major infrastructure project under the Belt and Road Initiative aimed at enhancing connectivity and economic development between China and Pakistan, including investments in transportation, energy, and special economic zones. 1, 3–7, 9–12, 16, 18, 19, 21, 22, 27, 29, 34–36

**GTD** Global Terrorism Database is an open-source database including information on terrorist events around the world from 1970 through 2020 . 1, 13, 15

**ISIS** Islamic State of Iraq andf Syria, a militant extremist group that has claimed territories in Iraq and Syria and is recognized as a terrorist organization globally, known for its violent activities and ideology. 13

**Western Alignment** A key route within the China-Pakistan Economic Corridor that connects Gwadar Port in southwestern Pakistan to China, running through the western regions of Pakistan and intended to enhance connectivity and economic opportunities in these areas. 1, 3, 4, 8, 9, 11, 12, 14–16, 18, 22, 23, 34