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# THE IMPACT OF CORRIDOR INVESTMENTS IN IRAQ: EVIDENCE FROM BIG DATA



**This brief summarizes results from an impact evaluation of road investments in two corridors in Iraq:** the rehabilitation of 317 km of Iraq's Expressway 1, near the Um Qasr Seaport, and the construction of a new 23 km corridor between Girsheen and Suheila in Iraq's north-west intended to improve access to Türkiye. Most rehabilitation work along Expressway 1 occurred from 2016 through 2020, and construction of the Girsheen - Suheila corridor was completed by early 2020. As impacts of corridor improvements can take time to materialize, this evaluation examines short-term impacts of road investments.

The evaluation leverages nighttime lights satellite imagery to track changes in local economic activity and leverages two data sources to track road use: GPS mobility data and radar satellite imagery that captures metallic reflectance of vehicles.



**We detect an increase in road users after road investments, but do not find evidence that projects led to an immediate increase in nighttime lights. The results indicate that the influence of road investments on economic activity, if any, is not yet apparent and may take more time to materialize. Overall, this work demonstrates the application of big-data sources for evaluating large transport corridors.**

## Context

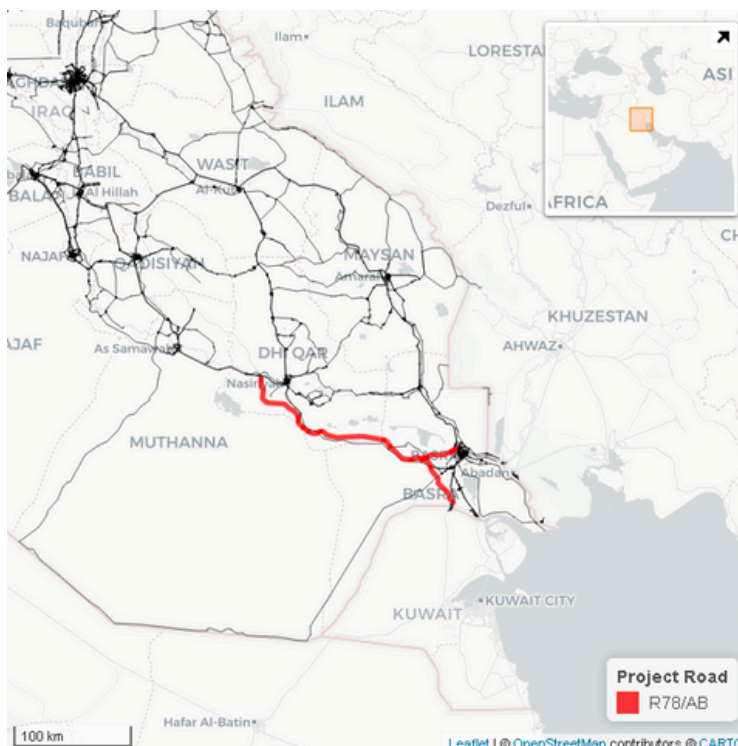
Iraq has an extensive road network of over 44,000 kilometers that is crucial for its connectivity and economic integration. The highway system provides the primary surface transportation link connecting Iraq to its neighboring countries. Iraq's integrated road network supports tourism and connects the country's population centers to essential services, while promoting domestic trade.

**In 2014, the conflict in Iraq damaged the transport infrastructure, increasing the cost of trade of goods and services, impeding international and regional mobility of goods and services, and weakening economic integration.** The poor condition of the roads significantly affected mobility, resulting in reduced access to essential services and job opportunities. At the firm level, access to labor and markets resulted in fewer job opportunities, and households experienced high mortality and decreased access to healthcare due to poor-quality roads.

## Evaluation Corridors

The National Development Plan, supported by the World Bank and other donors, prioritizes transport infrastructure. The World Bank collaborated with Iraq to rehabilitate and construct critical road segments, expected to improve regional connectivity and access to essential services. As part of a collaboration between the World Bank and the Iraqi government, two road works were supported under the Iraq Transport Corridors Project:

**1. Rehabilitation of a 317 km segment of the R7/8AB sections of Expressway 1.** Rehabilitation work included improved surfacing, enhanced guardrails, and concentration of businesses along the corridors into new lay-by (rest stop) areas. Improvements to R7 (145 km) were completed in July 2020, improvements to R8A (31 km) were completed in May 2020, and improvements to R8B (81 km) were completed by end of 2022. An additional 60 km were rehabilitated along Expressway No. 1 from Baghdad to the westerly direction.



**Figure 1. Map of R7/8AB Sections Along Expressway 1, Iraq**

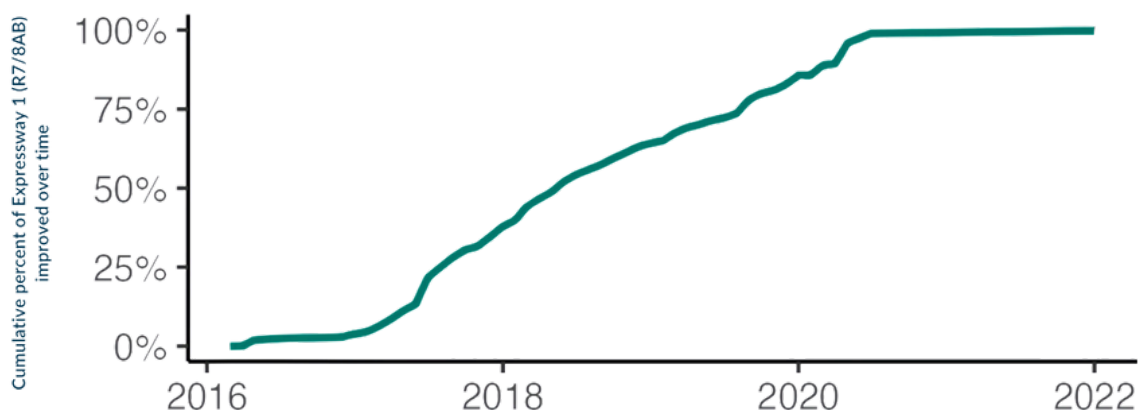
**2. Construction of a new 23 km corridor near the Turkish border (the Girsheen - Suheila corridor).** Construction was completed in March 2020. The new corridor was intended to improve connectivity to the Turkish border. Before the Girsheen-Suheila corridor, the primary trade link was a two-lane, winding, poorly cambered, and highly dangerous road, which was originally not designed to accommodate the heavy road usage that included a significant number of large freight trucks. At project appraisal, 3,000 heavy freight trucks entered Kurdistan/Iraq daily at the Ibrahim al Khalil border crossing with Türkiye, transporting goods to Iraq and cargo to the Gulf region. Recently, the number of trucks entering Iraq at the Ibrahim al Khalil border crossing has reached 5,000.



**Figure 2. Map of Girsheen - Suheila Corridor, Iraq**

## Tracking progress of improvements to Expressway 1, R7/8AB

Improvements along Expressway 1 occurred over time, where road users could travel on the expressway as rehabilitation occurred. Consequently, benefits resulting from improved roads could materialize before all improvements were completed. We track progress in road improvements over time based on monthly progress reports provided by the World Bank project team. **Figure 3** shows progress in road improvements over time. Improvements started in about 2016, with most improvements occurring through 2020.



**Figure 3. Progress of road improvements over time for Expressway 1, R7/8AB, Iraq**



## Measuring Economic Activity and Road Use

We evaluate the impact of road improvements on local economic activity and road use. Nighttime lights data is used to proxy economic activity, and two data sources are used to track road use: **GPS mobility data, and radar satellite imagery that captures metallic reflectance of vehicles.** These data sources have the advantage of being available over a wide geographic area, across time, and can be linked to other sources of geo-referenced data. Moreover, these data sources are cheap and accessible—important in a fragile context like Iraq, where on-the-ground surveys may be cost-prohibitive.

**1. Nighttime Lights:** Nighttime lights have become a widely used proxy for local economic activity (Henderson et al., 2012), and a growing body of research has evaluated the impact of road improvements on nighttime lights (Alder et al., 2016; Alder et al., 2022; Jedwab and Storeygard, 2022; Khanna, 2016). Nighttime lights data from NASA Black Marble is used for analysis; Black Marble employs advanced techniques to isolate artificial lights—or lights generated from human activities (Román, 2018). **Figure 4** shows nighttime lights around project roads.

**2. GPS Mobility Data:** We use a dataset of anonymized GPS pings from mobile phones from Outlogic to track the number of users along the road.

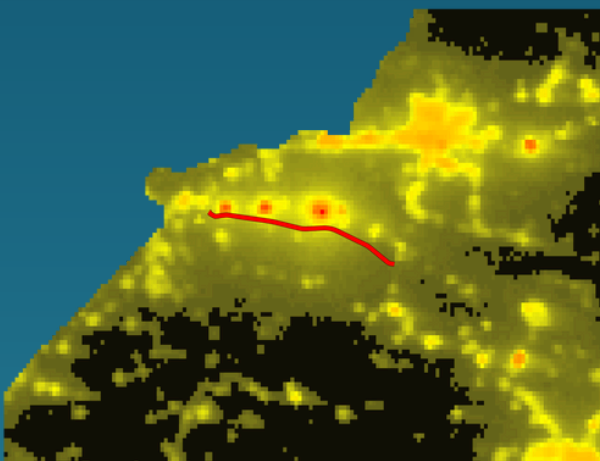


Figure 4. Nighttime lights near R7/8AB Section of Expressway 1, Iraq.

**3. Synthetic Aperture Radar Data:** As an alternate measure of road use, we leverage synthetic aperture radar (SAR) data, processed by SpaceKnow—a satellite analytics company. SAR data is retrieved from the European Space Agency Sentinel-1 satellite, and is based on transmitting waves from the satellite and measuring the strength and orientation of waves reflected back to the satellite sensor. Metallic objects such as vehicles tend to produce a strong signal; SpaceKnow has leveraged these dynamics to develop advanced algorithms that track congestion. **Figure 5** illustrates leveraging SAR data to identify clusters of vehicles.

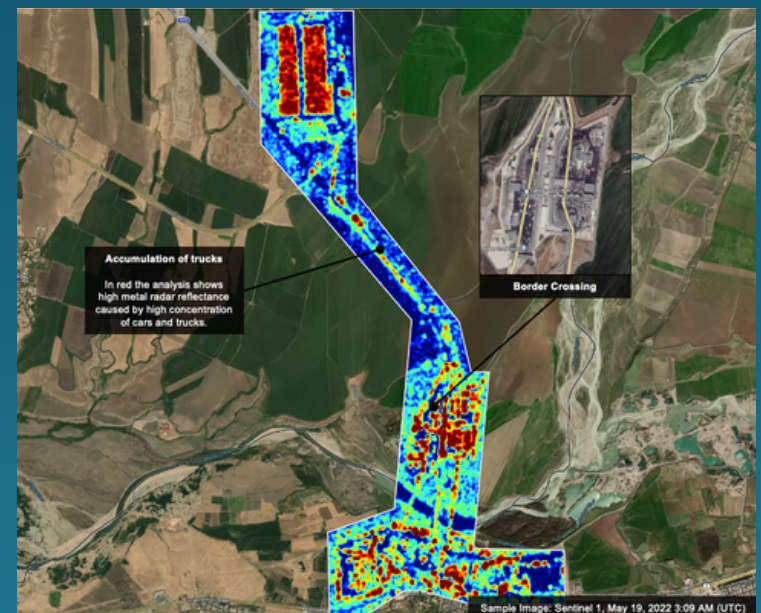


Figure 5. Metallic reflectance captured from Sentinel-1 imagery. Image provided by SpaceKnow.

## Evaluation Design and Results

An event study design is applied to measure the impact of road improvements on local economic activity and the intensity of road usage. This approach controls for both temporal trends and invariant characteristics of the units of analysis, providing a nuanced understanding of the changes post-construction. Year-fixed effects control for temporal trends throughout the study period (e.g., average nighttime lights generally increase across areas over the study area). Unit fixed effects control for time-invariant characteristics of units that might also be associated with outcomes. For the Girsheen - Suheila corridor, we examine changes after March 2020—when the road was completed. For the R7/8AB, we examine changes after January 2020—by which most improvements were made.



The evaluation finds the following:

- The project does not find an increase in economic activity, measured by nighttime lights, as a result of road investments. The results indicate that the influence of road investments on economic activity, if any, is not yet apparent and may take more time to materialize (see Figure 6, which shows no notable change in nighttime lights before and after investments). To this point, other work evaluating road investments on nighttime lights finds that impacts on nighttime lights can take multiple years to materialize (Alder et al., 2022). Growth in economic activity near the Girsheen -Suheila corridor has likely been limited to date as the Dohuk regional government has required the completion of a development master plan before allowing additional investments.

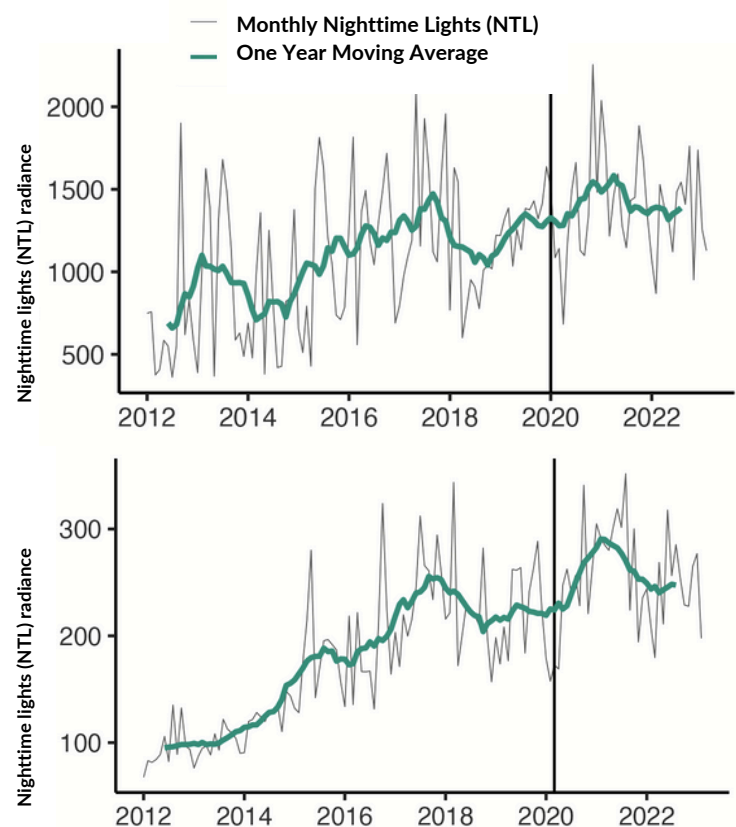


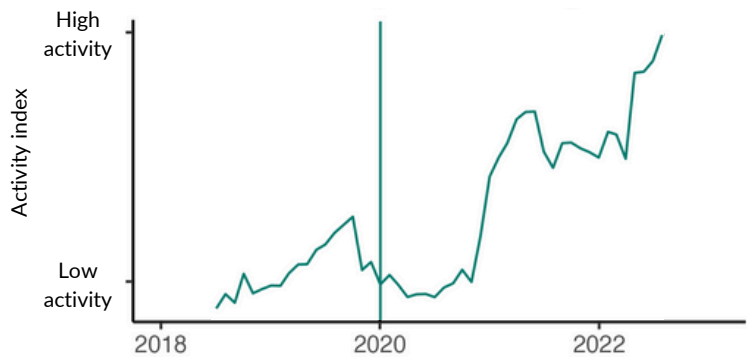
Figure 6. Average nighttime lights of cities within 20km of R7/8AB (top) and Girsheen - Suheila (bottom), Iraq



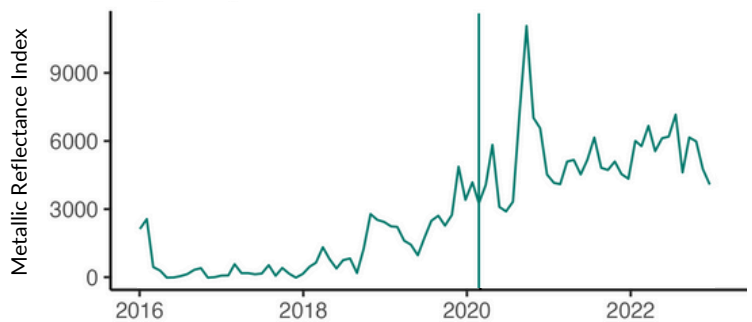
■ **Road improvements along the R7/8AB corridor led to an uptick in activity, particularly within new lay-by areas constructed along the corridor.** Figure 7 (left) shows a notable increase in activity within lay-by areas after investments. Increased use of lay-bys could result both from increased use of the corridor and from road users more likely to stop at lay-bys given the new concentration of businesses within lay-bys.

■ **Since the opening of the Girsheen - Suheila corridor, road use has increased as measured by metallic reflectance captured from satellite imagery.** Figure 7 (right) shows an increase in road users since the road opening in 2020; some increase in measured before, which could be due to construction activity.

**Activity index in lay-by areas along R7/8AB**



**Congestion in parking areas near Gersheein-Suheila**



**Figure 7. Trends in road users for R7/8AB (top) and Girsheen - Suheila (bottom), Iraq.**



*Note: For the R7/8AB, activity is measured within new lay-by areas constructed along the corridor. The GPS mobility data was captured with Outlogic. For Girsheen - Suheila, congestion is measured via metallic reflectance from Sentinel-1 SAR data. Sentinel-1 SAR data is able to capture clusters of vehicles; consequently, we measure activity in parking areas near the Girsheen - Suheila corridor—which comprised of parking areas on the road that connected the border to the Girsheen - Suheila corridor.*





## Conclusion

Large transport corridors are critical to fostering economic integration within and across countries; however, given endogenous placement of roads, transport corridors can be difficult to evaluate. This work illustrates the use of multiple big-data sources for evaluating two dimensions of transport corridors: road use and economic activity. The use of alternative, big-data sources can be especially important in Fragility, Conflict & Violence (FCV) affected countries like Iraq—where on-the-ground surveys can be cost prohibitive.

This work evaluates two corridor investments in Iraq: the rehabilitation of a 317 km corridor in Iraq's south-east, and the construction of a new 23 km corridor in Iraq's north-west. We evaluate corridors within about three years after completion or when most investments were made, limiting the analysis to detecting short-term impacts. We find an increase in road usage for both corridors, but find that impacts on economic activity, if any, have yet to materialize. While short-term impacts on road usage were identified, this work corroborates existing literature that shows that the impact of corridors on economic activity can take time to materialize.



## References

Alder, S., Croke, K., Duhaut, A., Marty, R., Vaisey, A. (2022). The Impact of Ethiopia's Road Investment Program on Economic Development and Land Use: Evidence from Satellite Data. *World Bank Policy Research Working Paper Series*, 10000.

Alder, S., Shao, L., and Zilibotti, F. (2016). Economic reforms and industrial policy in a panel of Chinese cities. *Journal of Economic Growth*, 21(4):305–349.

Henderson, J. V., Storeygard, A., and Weil, D. N. (2012). Measuring economic growth from outer space. *American Economic Review*, 102(2):994–1028.

Jedwab, R., Storeygard, A. (2022). The Average and Heterogeneous Effects of Transportation Investments: Evidence from Sub-Saharan Africa 1960–2010. *Journal of the European Economic Association*, 20(1):1-38.

Khanna, Gaurav, Road Oft Taken: The Route to Spatial Development (July 1, 2016). Available at SSRN: <https://ssrn.com/abstract=2426835> or <http://dx.doi.org/10.2139/ssrn.2426835>

Román, M. O., Wang, Z., Sun, Q., Kalb, V., Miller, S. D., Molthan, A., Schultz, L., Bell, J., Stokes, E. C., Pandey, B., Seto, K. C., Hall, D., Oda, T., Wolfe, R. E., Lin, G., Golpayegani, N., Devadiga, S., Davidson, C., Sarkar, S., Praderas, C., Schmaltz, J., Boller, R., Stevens, J., Ramos González, O. M., Padilla, E., Alonso, J., Detrés, Y., Armstrong, R., Miranda, I., Conte, Y., Marrero, N., MacManus, K., Esch, T., and Masuoka, E. J. (2018). Nasa's black marble nighttime lights product suite. *Remote Sensing of Environment*, 210:113–143.

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