Analysis of Economic Activity through Measurement of Traffic Flow Using the Satellite Data

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This paper develops a satellite-based approach to measuring road traffic flow as a high-frequency, spatially granular proxy for local economic activity. We exploit a motion-induced spectral displacement effect inherent to push-broom multispectral sensors. Because different spectral bands are captured at slightly different times, fast-moving vehicles appear as color-separated "rainbow" streaks in optical composites. We validate this mechanism using synchronized ground video collected during a Sentinel-2 overpass of the Jōban Expressway, confirming that the observed rainbow signatures correspond closely to truck movements recorded on the ground. Building on this validation, we construct a panel of satellite-derived traffic measures for Japan from 2016 to 2024 using Sentinel-2 imagery, complemented by higher-resolution PlanetScope observations to improve coverage and robustness. We then use these measures to examine traffic dynamics associated with major economic developments. The results show a marked increase in traffic in southern Ibaraki Prefecture—approximately 30 percent between 2016 and 2019—consistent with improved connectivity of the Jōban Expressway to Narita International Airport, while traffic in northern Ibaraki remains broadly stable. During the COVID-19 period, we find a substantial decline in traffic (about 20 percent) in southern Ibaraki, with no comparable decline in the northern area, consistent with heterogeneous exposure to disruptions in international trade and mobility. Overall, the findings demonstrate that satellite-derived traffic indicators capture economically meaningful variation linked to infrastructure changes and large shocks, offering a scalable complement to traditional proxies such as nighttime lights, especially where ground-based traffic statistics are unavailable or delayed.