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Research Article

Equity and Efficiency in TxDOT Infrastructure Funding: A Per Capita and Spatial Investment Analysis

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ABSTRACT

The funding allocation in public works plays a pivotal role in ensuring effective and equitable delivery of transportation infrastructure services. Especially in evolving and socioeconomically diverse regions such as the state of Texas, it acts as a key driver. This study investigates the geographic and per capita allocation of construction investment in the construction projects by the Texas Department of Transportation (TxDOT) during one annual funding cycle. It focuses on district-level differences in highway project funding. The project letting schedule, along with the project cost, was derived from the TxDOT project information dashboard. The budget allocated was compared to the district level with populations and geographic land area, and the analysis was derived based on equity per capita and square mile metrics. Notable disparities in the allocation of the funding were found where urban districts like Dallas, Houston, Austin, and Bryan received higher investment on a per-area basis compared to the other districts. Also, variation in the allocation of funding was found in developing districts like Bryan and Childress, which received substantial funding compared to other districts. By combining geographic mapping with measures of investment efficiency, the research offers a diagnostic overview of where infrastructure investment is directed relative to demographic and geographic characteristics. The results offer important considerations for state-level transportation planning, specifically in terms of the balance between economic efficiency and geographic equity. The analysis offers an analytic framework for examining alternative policies that govern infrastructure investment for promoting more balanced development of various regions.

Keywords: Infrastructure funding; Spatial equity; Per capita investment; Transportation planning; Public sector investment analysis; TxDOT

INTRODUCTION

Transportation development projects play an important role in regional connectivity, economic growth, and community welfare. In large and rapidly growing states like Texas, where urban development and rural outreach are both essential when it comes to the efficient distribution of highway funds. The Texas Department of Transportation administers billions of dollars in roadway infrastructure projects over a year. However, the policymakers and administrators face a complex challenge of unbiased distribution of the TXDOT capital among the 25 districts in the state. Some of the districts in the state of Texas, like Dallas, Houston, and Austin, are more urbanized.

TxDOT investment budgets are made public through TxDOT dashboards and reports. Even though these reports are available, it is not clear if the funds are distributed in terms of equity, particularly on a per capita and spatial basis. Funding that appears adequate in absolute value can disproportionately flow to densely populated or politically influential areas, while rural or less densely populated areas are underfunded relative to size or need. This raises critical questions about the fairness and efficiency of public infrastructure investment in Texas.

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Recent research articles have indicated the necessity for data-driven approaches to quantifying spatial disparities in transportation investment. However, most of the literature continues to address either project-level or modal prioritization rather than macro-level funding equity between geographic regions. Furthermore, few studies have compared per capita and per square mile investment inequalities within a single state over a specified fiscal year using actual bid letting data.

This study aims to fill that gap by conducting a district-level analysis of TxDOT's infrastructure investments for the period from September 2024 to August 2025. Using data on total awarded project value, population, and geographic land area across all TxDOT districts, the study evaluates the extent to which funding aligns with population size and land coverage. By calculating per capita and per square mile investments, the paper offers new insights into funding fairness, efficiency, and strategic balance. Along the way, this paper assists in framing discussion about fair funding of infrastructure, presenting a policy-oriented discussion of how state transportation agencies can better match resource utilization to demographic and geographic realities. Findings are most immediately applicable to planners, public managers, and transportation economists concerned with sustainable and equitable infrastructure development in the face of contracting budgets and increased public attention.

LITERATURE REVIEW

The allocation of transportation infrastructure funding is a central concern in achieving spatial equity and regional development. Infrastructure investment plays a key role in supporting economic growth, facilitating regional integration, and improving accessibility and mobility outcomes (Banister and Berechman, 2001; Vickerman, 2007).

Federalized systems such as the Federal Highway Administration (FHWA) play an important role at the national level planning in the United States, whereas Texas “Department of Transportation (TxDOT) is responsible” for allocating resources across different districts that vary significantly in population, land area, and development needs. This has led to growing academic and policy interest in ensuring that funding allocations are both equitable and efficient.

Spatial equity in infrastructure finance is the impartial distribution of road investment across territorial areas. It is often in proportion to the size of the population, socioeconomic need, or land area coverage (Martens, 2017). Traditional models of allocation have been faulted for always favoring urban centers or politically influential areas. It overlooks rural or peripheral communities (Forkenbrock and Sheeley, 2004). Besides, differences in funding can keep perpetuating inequities within the system through restrictions in economic opportunities, health care provision, and education for poor regions (Sanchez and Wolf, 2007). More current studies have insisted on a more evidence-based, open planning process of infrastructure involving such indicators as per capita investment, geographic reach, and accessibility indices (Karner and Niemeier, 2013; Mouter et al., 2021).

Texas is one of the biggest states in the United States of America. Due to its large size and diversity, it presents unique challenges. TxDOT has 25 operational districts. All the Texas districts have different degrees of urbanization, population density, and transportation demands.

Despite formalized allocation formulas often founded on factors like vehicle miles travelled (VMT), lane mileage, and safety features the extent to which these are population-based and fair remains questionable (Texas Transportation Commission, 2020). Investigations like those of Zhang and Levinson (2017) have mapped the geographic inequality in accessibility and connectivity across Texas but with little analysis of how these are related to funding.

Moreover, although per capita investment is a common measure for assessing equity, it may overlook the spatial burden felt by larger geographic districts, particularly in rural areas where the cost of maintaining infrastructure can be higher due to low population density and longer road networks (Handy, 2008). As such, a two-metric approach using population and geographic size, e.g., per capita and per square mile investment, gives a more understandable view of equity and efficiency of

infrastructure distribution.

Scholarly research has also highlighted the necessity of disaggregated data and sub-regional analysis in interpreting infrastructure outcomes. The work of Golub et al. (2021) and Manaugh and El-Geneidy (2012) has, for example, shown how spatial mismatches between the availability of infrastructure and population needs can reinforce transport disadvantages. These findings echo the call for analysis at the regional level that accounts for geographic variations alongside demographic profiles.

This paper contributes to the literature by conducting a spatial analysis of TxDOT appropriations by districts, according to data made public, to examine funding by both geographic and population considerations. This method provides insight into whether current patterns of investment play a role in balanced regional development and service delivery. Beyond identifying potential gaps, the analysis identifies areas that are potentially over- or under-funded relative to demographic and spatial factors.

Whereas most of the previous literature are centered on national or metro-level equity (Martens et al., 2012; Lucas, 2012), this study puts the lens at the state level within a federal system. By doing so, it fills a gap in the literature on intra-state infrastructure equity and offers a replicable model for measuring funding allocation in other large, decentralized governments.

Finally, this study aims to bridge empirical investment evidence with normative ideals of equity and efficiency. This aligns with rising policy concern over performance-based transport infrastructure investment and contributes to the overall debate of transport justice, where transport access investment and source funding is unevenly allocated.

DATA AND METHODOLOGY

3.1 Data Sources

The study utilizes project letting information data from the Texas Department of Transportation (TxDOT) website for the fiscal year from September 2024 to August 2025. Data comprises of all the projects that are bidding in the fiscal year 2024-25 in various districts. This data provides the total dollar value of awarded highway construction projects for TxDOT districts, which were retrieved from the TxDOT Letting and Award Dashboard. Two additional variables were incorporated to capture equity and efficiency: population and land area by TxDOT district. Population figures and measurements of land area (square miles) were taken from the district and county statistics (DISCOS)

All 25 TxDOT districts were studied, a mix of urban, suburban, and rural areas sampled. The districts vary significantly in development stage, population size, and geographic size, so they are well-suited for comparative equity and efficiency analysis.

3.2 Variable Definitions and Metrics

To identify infrastructure funding efficiency and equity, three basic indicators were computed per district:

Total Investment ($) – Cumulative sum of all awarded project amounts in any district.

Per Capita Investment ($/capita) – Total investment divided by population in the district.

Spatial Investment Density ($/sq. mi) – Total investment ÷ Land area in square miles.

These measures allow vertical comparison (e.g., large and small districts) as well as horizontal comparison (e.g., investment to population or land). They give a double emphasis on equity and efficiency.

3.3 Analytical Approach

The study utilizes comparative and descriptive analytical methods. After the raw data had been standardized, districts per capita and square mile units of investment were ranked. This revealed

disparities in funding allocations that failed to manifest themselves in the application of absolute dollar amounts.
Districts like Dallas and Austin receive the highest funding among all 25 states; however, when the data is analyzed for per capita investment, districts like Childress and Bryan
were disproportionately given higher per capita sums
Districts were categorized and displayed in bar graphs and tables to indicate relative amounts of funding. Trends were verified for consistency with regional development priorities, population density, and geographic coverage. Outliers and anomalies were highlighted for review in the results and policy implications sections.

3.4 Assumptions and Limitations

The analysis presumes that all projects let within the fiscal year are TxDOT's final investment choices. The analysis does not reflect project duration, multi-year funding commitments, or inflationary changes over the months. The analysis also does not include qualitative factors such as project complexity or political priority, which can influence investment levels. Despite these limitations, the methodology provides a rigorous and clear means of evaluating funding equity on geographic and demographic criteria using real-world administrative data.

RESULTS

This study examines how the Texas Department of Transportation allocates its annual $10.3 billion infrastructure funds into districts all over the state. It identifies the most and least amount of money given to each district and studies the allocation with per capita and per square mile funding assessments to see whether the allocation is fair and effective.

4.1 Overview of Total District-Level Investments

For the 2024-2025 fiscal year, which ran from September 2024 to August 2025, the Texas Department of Transportation (TxDOT) expended approximately $10.33 billion in its 25 districts. The top five districts based on total funding were Dallas ($2.09B), Austin ($1.69B), Houston ($1.23B), Bryan ($1.02B), and Waco ($458M). These regions—particularly Dallas, Austin, and Houston—are high-density urban areas with ongoing mobility demands and extensive infrastructure networks.

While those types of districts were at the forefront in absolute investment amounts, such sums fail to control for population-adjusted or spatial efficiency considerations. To more validly assess equity and efficiency, per capita and per square mile spending were analyzed.

4.2 Per Capita Investment Analysis

Figure 1 illustrates the districts' per capita investment distribution. Results vary immensely. Of concern: Bryan District was the top per capita investment district with $2,021.60, followed by Childress at $1,467.33 and Paris at $850.49.
Meanwhile, large metropolitan districts such as Fort Worth with $72.68 and San Antonio with $114.03 had the bottom per capita reports.
These variations imply that population centers are not necessarily represented by investment proportionately. Large per-capita amounts in the countryside can result from large individual projects or in order to invest in minimum baseline infrastructure at lower population levels.

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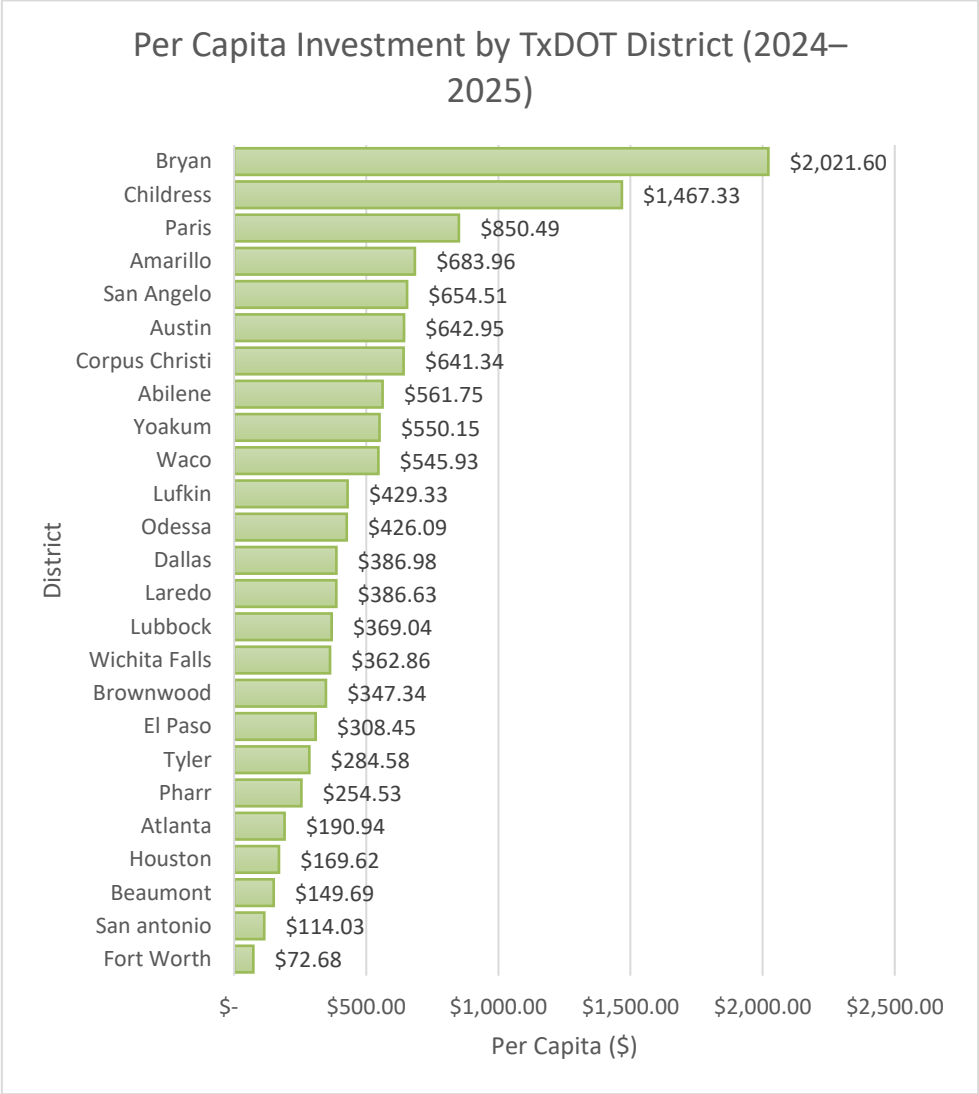

Rank	District	Investment ($)	Population	Land Area (sq. mi)	$/Capita
1	Bryan	$ 1,025,871,213.65	507,455	7,710	$ 2,021.60
2	Childress	$ 49,739,626.50	33,898	11,193	$ 1,467.33
3	Paris	$ 365,522,097.87	429,777	6,153	$ 850.49
24	San Antonio	$ 318,876,663.45	2,796,456	12,242	$ 114.03
25	Fort Worth	$ 203,864,861.53	2,805,077	6,952	$ 72.68

Table 1. Top and Bottom 5 Districts by Per Capita Investment

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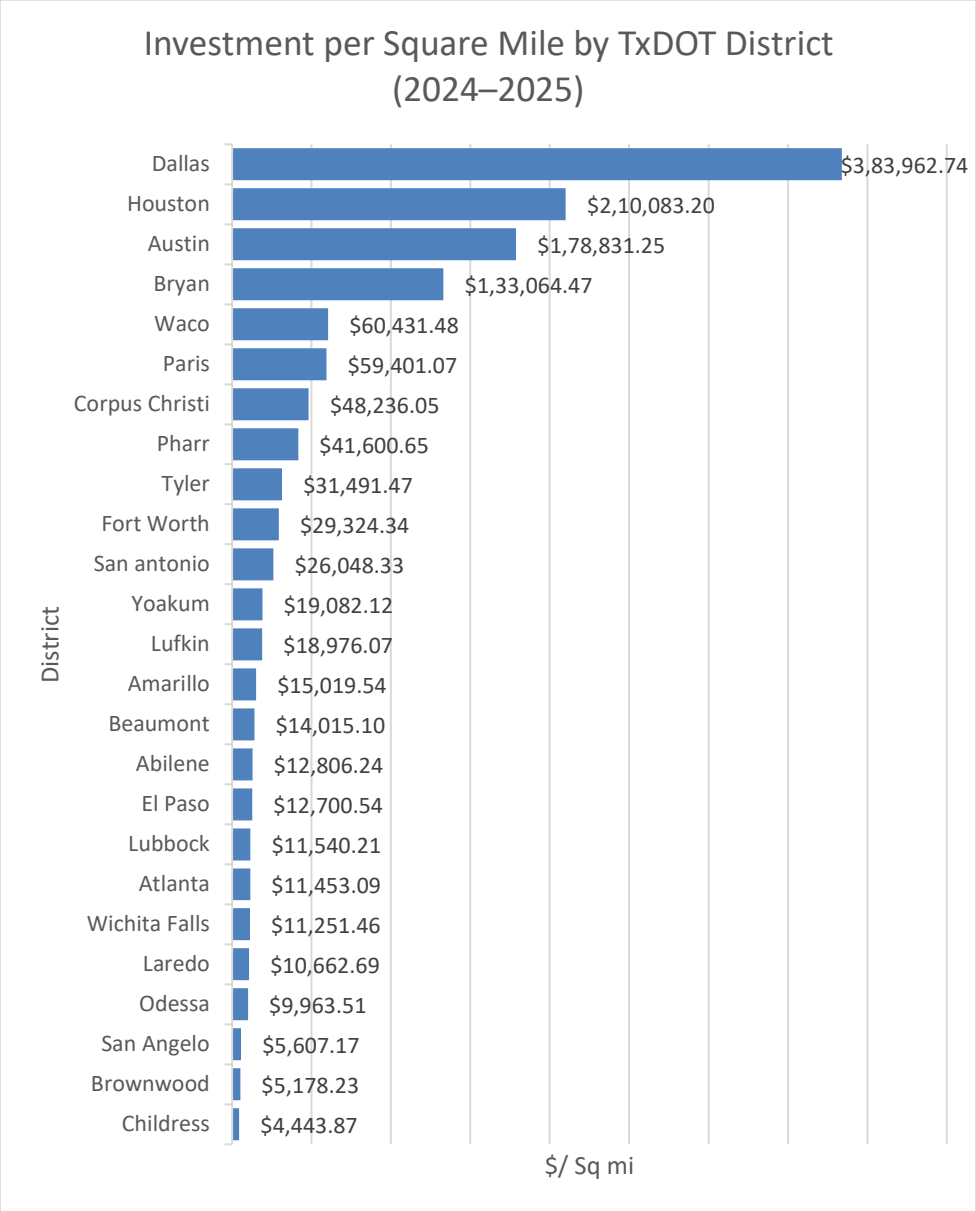
Rank	District	Investment ($)	Land Area (sq mi)	$/sq. mi
1	Dallas	$ 2,091,241,545.12	5,446	$ 383,962.74
2	Houston	$ 1,232,532,933.93	5,867	$ 210,083.20
3	Austin	$ 1,694,238,337.14	9,474	$ 178,831.25
23	Brownwood	$ 44,688,167.45	8,630	$ 5,178.23
25	Childress	$ 49,739,626.50	11,193	$ 4,443.87



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4.3 Spatial Efficiency: Investment per Square Mile

Figures 3 and 4 include:
A bar chart showing per capita funding by district (ranked)
A heat map representing funding per square mile
These visuals reveal clustering of high investment efficiency in central urban zones and a clear drop-off in rural or low-density areas.

4.4 Funding Disparity Visualization

Figures 3 and 4 are:

- Per capita district funding (ranked) in a bar chart
- A heat map of investment per square mile

These images show clustering of high efficiency of investment in the center of urban areas and a pronounced fall-off in rural or low-density zones.

4.5 Key Observations

- Equity Gap: More populated urban boroughs receive lower per capita allocations.
- Efficiency Gradient: The density of investment declines with spatial extension; rural boroughs extend over more ground but receive less money per square mile.
- Bryan and Childress are statistical outliers since they receive very high per capita allocations that may be worthy of more in-depth qualitative examination.

DISCUSSION

The results of this study highlight significant disparities in transportation infrastructure funding. The funding is distributed among all TxDOT districts. Urban districts such as Dallas, Austin, and Houston appear to dominate the funding landscape when measured by total investment. When it was compared for population size and land area, a more complex and less evident trend of funding equity and efficiency emerged.

5.1 Spatial Efficiency: Investment per Square Mile

Per capita investment breakdown revealed stark variations between urban and rural zones. Bryan, Childress, and Paris received the highest per-resident appropriations, with San Antonio and Fort Worth among the lowest. These variations are also consistent with previous research emphasizing the disparity between population density and infrastructure investment (Hong & McArthur, 2016; Lopez et al., 2020). Every region needs basic infrastructure, even if they have less population. This is evident in the highly rural areas like Childress, whereas high per capita funding in districts like Bryan shows that these are developing districts which have key locations near already urban districts like Houston, Austin, and Dallas. So, the funding trends may also be indicative of political or administrative considerations rather than equitable or fair demand-based planning
Compared to Zhang and Xie (2017), who advocate proportional fairness in transport investment, this study suggests potential over-allocation within low-density locations and underinvestment in high-demand locations. Planning-wise, it challenges how much urban congestion and mobility pressures are being addressed by current investment strategies.

5.2 Spatial Investment Efficiency

The investment per square mile in the same context highlighted a concentration of finance in more urbanized areas such as Houston, Dallas, and Austin. The districts captured the greatest spatial efficiency, which means infrastructure investment is denser and concentrated in areas of greater transportation demand and network complexity. This is with the knowledge that urban areas attract

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greater infrastructure density to serve economic activity and multimodal connectivity, as evidenced by Gordon and Walter (2018).
On the other hand Districts with a high land coverage like San Angelo, Amarillo, and Odessa received significantly less spatial funds. This reflects two things: lower population densities and a mismatch in resource allocation.
The basic access or maintenance needs are not proportionately supported. This finding echoes the spatial equity issues discussed by Wu et al. (2021). The paper argues that geographic dispersion can mask underlying infrastructure challenges in rural regions.

5.3 Balancing Equity and Efficiency

The stark difference between Investment per capita and investment per square mile area suggests a policy dilemma between equity and efficiency. High capita funding in rural areas reflects the provision of basic infrastructure for the remote population. But it may not reflect any economic impact on the area.
In the state of Texas, urban areas have benefited more efficiently with the help of spatially concentrated funding, since these areas have a highly dense population these districts still do not tops in the per capita investment ranking even after receiving substantial amounts of funding.
Per Ferreira and Beukers (2020) a dual-metric approach that combines demographic and spatial indicators for fair infrastructure allocation is effective.
In the case of TxDOT, this financial year's approach prioritizes the extension of road networks and political coverage over mobility optimization. A priority of investment rebalancing is necessary to ensure that both rural accessibility and urban congestion are equitably addressed.

5.4 Implications for Policy and Practice

The study highlights the importance of incorporating standardized, data-driven metrics such as per capita and per square mile funding into the decision-making process of transportation agencies. TxDOT and similar agencies can benefit from enhanced transparency on project choice and prioritization, particularly resolving geographic equity issues in terms of transportation need.
Introduction of new standardized thresholds and adding guidelines for minimum and maximum investment levels per person or per area could enhance fairness and efficiency.
Additionally, a more integrated planning approach like combining funding metrics with economic impact, usage forecasts, and maintenance needs could align investment more closely with public value.

CONCLUSION

This study considered the equity and merit of funding transportation infrastructure in the 25 TxDOT districts for the fiscal year 2024–2025. By using per capita and per square mile investment indicators, the study revealed that in general, funding favors large city regions such as Dallas, Austin, and Houston, but the distribution of funds based on population and land area presents a different image of equity in the allocation.
Most notably, rural or developing counties such as Bryan and Childress were significantly higher than average on a per-capita basis in funding, which would suggest that the investment strategy of TxDOT could be mirroring baseline infrastructure needs in low-population areas. Conversely, more densely populated counties such as San Antonio and Fort Worth had significantly lower per-capita investments, which raises the issue of whether mobility needs in high-growth urban centers are being met equitably.
Spatial analysis also identified imbalances in investment concentration, where urbanized regions received more concentrated investment per square mile. Two-layered analysis helps to highlight the importance of factoring in both demographic and geographic factors when analyzing fairness and efficiency in public infrastructure disbursement.
The findings underpin advice to transport authorities to adopt more open, evidence-based planning frameworks that serve to balance demographic equity and spatial efficiency simultaneously. Per capita

and per area investment measures must be at the center of the next generation of project choice and priority planning approaches in an effort to ensure that infrastructure spending is more responsive to both population needs and spatial access

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