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Keisuke KONDO

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Research Institute for Economics and Business Administration

Kobe University

2-1 Rokkodai, Nada, Kobe 657-8501 JAPAN

Total Fertility Rates and Urban Agglomeration in Asia*

Keisuke Kondo†
RIETI & Kobe University

Abstract

This study examines the relationship between total fertility rates and urban agglomeration in Asia through a comparative descriptive analysis of subnational data from Japan, South Korea, Taiwan, Vietnam, Indonesia, and Thailand. Against the backdrop of a nationwide decline in fertility, the study asks whether low fertility is systematically associated with population density within Asian countries and region, rather than constituting a national-level demographic outcome solely. The empirical analysis is based on explanatory spatial data analysis, combining maps of population density and total fertility rates. The empirical analysis finds that, within each country examined, fertility tends to be lower in denser and more urbanized areas, particularly in major metropolitan areas such as Tokyo, Seoul, Taipei, Ho Chi Minh City, Jakarta, and Bangkok. Although the strength and dispersion of the relationship vary across national contexts, a broadly similar negative density–fertility gradient is observed throughout Asia. These findings suggest that low fertility in Asia should be understood not only as a demographic transition, but also as a spatial phenomenon closely associated with urban concentration.

JEL classification: J11, J13, R12, R23
Keywords: Total fertility rate, Population density, Urban agglomeration, Population decline

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† Corresponding author. Research Institute of Economy, Trade and Industry (RIETI). 1-3-1 Kasumigaseki, Chiyoda-ku, Tokyo, 100-8901, Japan. (e-mail: kondo-keisuke@rieti.go.jp).

1. Introduction

Low fertility has become one of the most important demographic challenges in Asia. While declining fertility was once viewed primarily as a feature of a small number of advanced economies, it has increasingly emerged as a broader regional phenomenon. As shown in Figure 1, total fertility rates, which are taken from World Bank (2026), have declined substantially across a wide range of Asian countries and region, including China, Indonesia, Japan, South Korea, Taiwan, Thailand, and Vietnam, although the timing and pace of decline differ across them. This trend has far-reaching implications for labor supply, economic growth, population aging, and the long-run sustainability of urban and regional development.

Low fertility should not be understood solely as a national demographic outcome. A growing body of economic research has examined the relationship between fertility and family behavior, as well as the structural transformation of society (Joseph Hotz et al. 1997; Doepke et al. 2023; Boydell et al. 2023; Jean Yeung and Abalos 2025), while another strand of work has emphasized the relationships among agglomeration, urbanization, housing costs, and demographic change (Sato 2007; Sato and Yamamoto 2005; Simon and Tamura 2009; Maruyama and Yamamoto 2010; Lovenheim and Mumford 2013; Dettling and Kearney 2014; de la Croix and Gobbi 2017; Morita and Yamamoto 2018; Goto and Minamimura 2019; Kondo 2019; Lee 2025). Despite the sharp decline in total fertility rates across Asia, relatively little attention has been paid to the comparative spatial pattern of fertility decline across Asia. In particular, it remains unclear to what extent low fertility is systematically associated with urban concentration within Asian countries and region, rather than simply reflecting country-level institutional or cultural differences.

This study addresses this issue by examining the relationship between total fertility rates and population density across subnational units in selected Asian countries and region. Using municipality- or province-level data for Japan, South Korea, Taiwan, Vietnam, Indonesia, and Thailand, the study provides a comparative descriptive analysis of fertility and urban agglomeration. The empirical approach is based on explanatory spatial data analysis, combining population density and fertility maps with cross-sectional scatterplots that relate total fertility rates to log population density. This design allows assessing whether a common spatial gradient is visible across countries at different levels of development and at different stages of demographic transition.

This study contributes to the literature by showing that, within each country examined here, fertility tends to be lower in denser, more urbanized areas. This negative association is especially visible in major metropolitan areas such as Tokyo, Seoul, Taipei, Ho Chi Minh City, Jakarta, and Bangkok, although its strength and dispersion vary across national contexts. Note that these findings are descriptive and, by themselves, do not establish causality. Nevertheless, they suggest that fertility decline in Asia should be

understood not only as a demographic transition, but also as a spatial process closely linked to urban agglomeration. This perspective has important policy implications. If fertility is systematically lower in dense urban environments, then responses to low fertility cannot be considered independently of urban conditions such as housing affordability, commuting burdens, and child-rearing infrastructure.

The remainder of this paper is organized as follows. Section 2 reviews the related literature. Section 3 describes the data and method. Section 4 presents the results. Section 5 concludes.

[Figure 1]

2. Literature Review

This study relates to three strands of literature: the economics of fertility, the spatial economics of fertility and agglomeration, and the role of housing and urban costs in shaping family formation. Taken together, these studies suggest that fertility is influenced not only by household preferences and income but also by the spatial organization of economic activity and the costs of living in dense urban environments.

The first strand is the broader economics of fertility. Foundational contributions emphasize that fertility decisions reflect economic trade-offs within the household, including the quantity–quality trade-off for children and the allocation of time and resources across competing uses. Becker (1992) provides a classic economic framework in which fertility is shaped by parental optimization under resource constraints. Joseph Hotz et al. (1997) review the economics of fertility in developed countries and stress the importance of prices, wages, income, and family institutions in fertility behavior. More recently, Doepke et al. (2023) survey the contemporary fertility literature and show that fertility choices are shaped by a wider set of forces, including female labor-market opportunities, changing gender roles, and policy environments. These studies provide the conceptual foundation for understanding fertility as an economic outcome.

The second strand focuses more directly on the relationship between fertility and geographical space. Sato and Yamamoto (2005) examine the links among population concentration, urbanization, and demographic transition, showing that the spatial concentration of population can be closely related to fertility decline. Sato (2007) further develops this perspective by analyzing fertility and migration within an economic geography framework, highlighting the interaction between agglomeration forces and demographic behavior. Simon and Tamura (2009) empirically show that higher rents in U.S. cities discourage childbearing. At a broader scale, de la Croix and Gobbi (2017) show that population density is systematically associated with fertility differences in developing countries and link this relationship to demographic convergence. Together, these studies suggest that fertility decline may be closely tied to the spatial concentration of economic activity and population.

A related strand of research theoretically and empirically examines agglomeration and fertility in the Japanese context. Maruyama and Yamamoto (2010) analyze the relationship between variety expansion and fertility. They suggest that variety expansion arising from agglomeration economies provides an incentive to make lower-fertility decisions based on a preference for variety. Morita and Yamamoto (2018) show that a decrease in transportation costs results in lower fertility under the framework of agglomeration economies. Goto and Minamimura (2019) develop a new economic geography model with endogenous fertility and show theoretically that the fertility rate is lower in densely populated regions due to the high opportunity cost of rearing children there. Most directly related to the present study, Kondo (2019) employed household-level microdata to provide empirical evidence that urban agglomeration is associated with lower fertility rates, after controlling for confounding factors. This line of work is especially important because it shows that the fertility–agglomeration relationship is not only a cross-country regularity but also a within-country phenomenon with micro- and regional-level relevance.

The third strand emphasizes housing and local living costs as mechanisms linking urbanization to low fertility. Lovenheim and Mumford (2013) show that shocks to wealth through the housing market affect fertility choices differently betwee home owners and renters. Li (2024) provides global evidence that rising house prices discourage fertility, reinforcing the view that affordability constraints are central to fertility decline. This mechanism is particularly relevant in dense metropolitan areas, where land scarcity and housing costs tend to be most severe for young couples. In this sense, the housing literature helps explain why fertility may be systematically lower in highly urbanized places.

This study contributes to the literature in two ways. First, while prior studies have established important theoretical and empirical links between fertility and urban agglomeration, most existing work either focuses on a single country or studies fertility determinants without a comparative spatial perspective across Asia. By contrast, this study documents a common descriptive pattern across selective Asian countries and region using comparable subnational evidence on fertility and population density. Second, whereas much of the literature emphasizes causal mechanisms such as structural transformation of society or chicare support policies, this paper takes a comparative spatial perspective and asks whether low fertility is systematically concentrated in dense urban areas across different national contexts.

3. Data

This study constructs a comparative subnational dataset for selected Asian countries and region in order to examine the relationship between total fertility rates and population density. The empirical focus is on within-country spatial variation rather than cross-country regression analysis. Accordingly, the unit of observation is the subnational administrative area in each country and region, observed around 2000 or 2010, depending

on data availability. The analysis covers Japan, South Korea, Taiwan, Vietnam, Indonesia, and Thailand.

The two key variables in the study are the total fertility rate and population density. Total fertility rate is measured for each subnational unit, and the subnational total fertility rates are taken directly from national statistical publications in each country, as cited in the next paragraph. Population density is simply calculated as total population divided by the land area at the subnational level. Table 1 presents the descriptive statistics of total fertility rate and population density for each country and region.

The study harmonizes administrative units across countries to the extent possible, while acknowledging that exact equivalence is constrained by differences in national statistical systems. For Japan, the unit of observation is the municipality, yielding 1,747 observations as of 2011. The data is taken from Statistics Bureau of Japan (2026). South Korea is divided into 227 cities, counties, and districts (si-gun-gu). The data is taken from Ministry of Data and Statistics of Korea (2026). Taiwan is divided into 21 special municipalities, municipalities, and counties. The data is taken from Ministry of the Interior of Taiwan (2026). Thailand is analyzed at the provincial level with 76 provinces. The data is taken from National Statistical Office of Thailand (2026). Vietnam is divided into 58 provinces and 5 centrally governed municipalities—Hanoi, Ho Chi Minh City, Da Nang, Hai Phong, and Can Tho. The data is taken from National Statistics Office of Vietnam (2026). Indonesia is divided into 33 provinces, special regions, and the special capital district of Jakarta. The data is taken from BPS-Statistics Indonesia (2026). These administrative units form the basis for the country-specific maps in this study.

A point worth clarifying in this study is that the spatial scale differs across countries: Japan and South Korea are observed at a relatively fine subnational scale, whereas Thailand, Vietnam, and Indonesia are analyzed at broader provincial scales. This does not invalidate the descriptive comparison, but it does imply that the strength and dispersion of the observed density–fertility relationship may partly reflect differences in the level of spatial aggregation.

The shapefiles of each country and region are taken from GADM (2026), a database of global administrative boundaries. The study uses shapefiles extracted from GADM version 1.0, obtained in March 2009. These shapefiles include the boundary information of the administrative units and are used to construct the maps of population density and total fertility rates for each country and region. The Geographic Information System 0component is therefore central to this study, as it enables the visual comparison of demographic outcomes across space and the matching of statistical indicators to subnational administrative polygons.

Because the analysis is comparative and spatial, the use of a consistent geographic boundary source is an important strength. Although administrative boundaies on available shapefiles are sometimes different from those at timing of national statistical survey, this study checked boundary changes with manual reconciliation,

and all statistical units were matched one-to-one to the GIS polygons.

[Table 1]

4. Method

The study relies on explanatory spatial data analysis. In practice, this means that the empirical approach is descriptive and comparative rather than causal. The method consists of three linked components for each country. First, the paper maps population density across subnational units in order to visualize the geography of urban concentration. Second, it maps total fertility rates across the same units to show the spatial distribution of fertility outcomes. Third, it plots total fertility rate against log population density in a country-specific cross-section, using bubble size to reflect population size. Together, these visualizations are used to identify whether a negative density–fertility gradient is present and whether the largest population centers are concentrated in the high-density, low-fertility part of the distribution.

This is a reasonable strategy for the current objective, which is to document a common descriptive pattern across Asian countries and region. The main advantage of this approach is transparency: readers can directly observe both the spatial clustering of dense urban regions and the corresponding fertility distribution. It is also well-suited to a first comparative exercise, especially where harmonized microdata across countries may be difficult to obtain. At the same time, the paper should explicitly state that the method does not identify a causal effect of density on fertility. The observed association may reflect a range of underlying mechanisms, including housing costs, migration, labor-market conditions, marriage behavior, or broader regional development differences.

A key feature of the empirical design is its emphasis on within-country spatial comparison. This is important because the researchquestion is not simply based on cross-country variations. By repeating the same descriptive exercise across six countries and region, the study aims to identify whether a broadly similar urban pattern emerges despite substantial institutional and developmental differences. In this sense, the methodological contribution of the paper lies in its comparative spatial framing.

Total fertility rate is measured for each subnational unit and paired with a corresponding measure of population density, which is then log-transformed in the scatterplots. The maps display the geographic distribution of each variable separately, while the scatterplots show the relationship between total fertility rate and log population density, with circle size representing population size. This design allows us to visually assess whether denser subnational units tend to exhibit lower fertility, and whether that pattern is driven primarily by large metropolitan regions.

5. Results and Discussions

Table 2 presents the estimation results of the simple regression of total fertility rate and log populatin density for each country and region. Figures 2–7 visualizes the spatial distribution and the relationship of both variables.

Figure 2 shows a clear negative association between population density and fertility in Japan, as shown in Kondo (2019). The map of population density highlights the strong concentration of population in major metropolitan areas, especially around Tokyo, Osaka, and other large cities, while the fertility map shows relatively low fertility in these same highly urbanized areas. The scatter plot reinforces this pattern: municipalities with higher population density tend to exhibit lower total fertility rates, and the largest population centers are concentrated in the high-density, low-fertility region of the distribution. The Japanese case illustrates that very low fertility is not distributed uniformly across space. Instead, it is strongly associated with densely populated metropolitan municipalities. On the other hand, some peripheral municipalities maintain relatively higher fertility.

Figure 3 reveals a similarly pronounced negative density–fertility gradient in South Korea. The population density map shows a strong concentration of residents in and around the Seoul metropolitan area and other major urban centers, while the fertility map suggests that these dense urban locations tend to record lower fertility. The scatter plot makes this relationship particularly visible: observations at the upper end of the density distribution, including districts in the Seoul area, cluster at very low fertility levels. The Korean pattern is consistent with the Japanese one. The figure suggests that the most urbanized parts of the country are also the places where fertility has fallen most sharply. This is noteworthy because South Korea is often regarded as one of the most extreme low-fertility cases in the world as of 2024. It is suggested that there is a strong metropolitan penalty in fertility outcomes that likely interacts with housing, labor markets, educational competition, and family formation costs.

Figure 4 also suggests a negative relationship between density and fertility in Taiwan, as shown in Japan and South Korea. However, Column (3) of Table 1 shows that the coeffcient estimate is statistically insignificant. The fertility rates tend to be below 1 across counties and cities, indicating that low fertility is already widespread throughout the island. This compressed pattern is substantively informative. It suggests that, in Taiwan, the issue is not simply that large cities have low fertility while peripheral areas do not; rather, low fertility appears to be a generalized national condition, with the densest urban jurisdictions showing particularly low values within that already depressed distribution.

Figure 5 shows that the negative association between density and fertility is also present in Vietnam. The density map highlights the concentration of population in the Red River Delta, around Hanoi, and in the

southern urban-industrial region around Ho Chi Minh City. The fertility map, however, exhibits more substantial regional variation than in the East Asian cases. In the scatter plot, the highest-density metropolitan areas are associated with lower fertility, while many less dense provinces continue to display substantially higher fertility rates. The figure confirms the same broad spatial regularity found elsewhere: major urban centers tend to have lower fertility.

Figure 6 points to a strong negative relationship between population density and fertility in Indonesia, with especially notable metropolitan outliers. The densest provinces, most prominently DKI Jakarta, are located at the very low end of the fertility distribution, while many lower-density provinces exhibit substantially higher fertility. The scatterplot indicates that the Indonesian case is characterized by a wide national range, with dense urban provinces clearly separated from sparsely populated regions in Eastern Indonesia and elsewhere.

Figure 7 shows a negative density–fertility association in Thailand as well, again with Bangkok standing out as a prominent metropolitan outlier. The population density map indicates strong concentration in the Bangkok metropolitan region, while the fertility map suggests lower fertility in this urban core relative to many other provinces. In the scatter plot, Bangkok and nearby provinces are located toward the high-density, low-fertility corner, whereas many provinces with moderate or low density display higher fertility levels.

Taken together, Figures 2–7 suggest two broad conclusions. First, low fertility differ in the timing and speed of transition across Asian countries and regions. Second, within countries and regions, fertility tends to be systematically lower in denser and more urbanized places. This negative density–fertility relationship is visible in all country and region cases examined here, although its strength and dispersion vary according to national context.

[Table 1; Figure 7]

6. Conclusion

This paper examined the relationship between total fertility rates and urban agglomeration in Asia using a comparative descriptive analysis of subnational data from Japan, South Korea, Taiwan, Vietnam, Indonesia, and Thailand. Combining maps of fertility and population density with cross-sectional scatter plots, the study documented two broad patterns. First, fertility decline is a shared regional phenomenon across Asia. Second, within each country examined here, fertility tends to be lower in denser and more urbanized places. This negative association is especially visible in major metropolitan areas such as Tokyo, Seoul, Taipei, Ho Chi Minh City, Jakarta, and Bangkok, although the strength and dispersion of the relationship vary across national contexts. These findings suggest that low fertility in Asia should be understood not only as a demographic

transition, but also as a spatial phenomenon closely linked to urban concentration. The comparative evidence indicates that dense urban environments are repeatedly associated with lower fertility outcomes, even though the spatial expression of this pattern differs by country.

The study has some limitations. The results should be interpreted with caution. The analysis does not identify a causal effect of population density on fertility, and the observed association may reflect a range of underlying mechanisms, including housing affordability, migration, labor-market conditions, delayed marriage, and childrearing costs in metropolitan areas. Therefore, these limitations point to several directions for future research, including further investigation of the mechanisms through which urban living may discourage family formation.

From a policy perspective, the findings imply that responses to low fertility cannot be considered independently of urban policy. If fertility is systematically lower in dense metropolitan environments, then housing conditions, commuting burdens, childcare provision, and the overall compatibility of city life with family formation are likely to be central policy concerns. More generally, the results suggest that the future of fertility in Asia will depend not only on family-related institutions, but also on whether rapidly urbanizing societies can create environments in which raising children is compatible with urban economic life.

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CRediT Authorship Contribution Statement

Keisuke Kondo: Conceptualization, Methodology, Formal analysis, Investigation, Data Curation, Writing - Original Draft, Writing - Review & Editing, Visualization, Funding acquisition, Project administration.

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Declaration of Competing Interest

The author has no competing interests to declare.

Data Availability

Codes and data are available upon request.

Generative AI Usage Disclosure

During the preparation of this work, the author used ChatGPT 5.4 Thinking (https://chatgpt.com/) in order to reorganize the content and to enhance clarity and readability. After using this service, the author reviewed and edited the content as needed and took full responsibility for the content of the publication.

Table 1. Descriptive Statistics

Variable	Obs.	Mean	S.D.	Min	P25	Median	P75	Max
				Indonesia				
Total Fertility Rate	33	2.669	0.456	1.818	2.427	2.563	2.908	3.816
Log(Population Density)	33	4.825	1.585	2.059	4.072	4.526	5.392	9.580
				Japan				
Total Fertility Rate	1,747	1.487	0.203	0.810	1.350	1.480	1.600	2.810
Log(Population Density)	1,747	6.366	1.301	2.451	5.598	6.264	7.138	9.993
				South Korea				
Total Fertility Rate	227	1.342	0.273	0.780	1.173	1.324	1.480	2.410
Log(Population Density)	227	6.363	2.205	2.795	4.449	6.029	8.523	10.610
				Taiwan				
Total Fertility Rate	21	0.895	0.109	0.735	0.815	0.875	0.950	1.180
Log(Population Density)	21	6.738	1.583	4.062	5.925	6.440	7.528	10.012
				Thailand				
Total Fertility Rate	76	1.885	0.272	1.300	1.695	1.885	2.055	2.540
Log(Population Density)	76	4.829	0.839	2.809	4.317	4.783	5.070	8.307
				Vietnam				
Total Fertility Rate	63	2.121	0.347	1.300	1.860	2.070	2.310	3.250
Log(Population Density)	63	5.645	0.999	3.760	4.849	5.590	6.423	8.183

Note: The unit of observation is the subnational administrative area in each country and region, observed around 2000 or 2010, depending on data availability.

Table 2. Estimation Results

	Dependent Variable: Total Fertility Rates					
	Indonesia	Japan	South Korea	Taiwan	Vietnam	Thailand
Variables	(1)	(2)	(3)	(4)	(5)	(6)
log(Population Density)	−0.1853***	−0.0901***	−0.0819***	−0.0155	−0.1195***	−0.2167***
	(0.0343)	(0.0058)	(0.0062)	(0.0113)	(0.0130)	(0.0553)
Constant Term	3.5483***	2.0979***	1.8930***	0.9946***	2.4923***	3.3473***
	(0.1979)	(0.0415)	(0.0497)	(0.0956)	(0.0795)	(0.3108)
Number of Observations	33	1,747	227	21	76	63
Adjusted R^2	0.4703	0.3179	0.4616	0.0016	0.2662	0.4716

Note: Heteroskedasticity-robust standard errors are in parentheses. * denotes statistical significance at the 10 % level, ** at the 5 % level, and *** at the 1 % level.

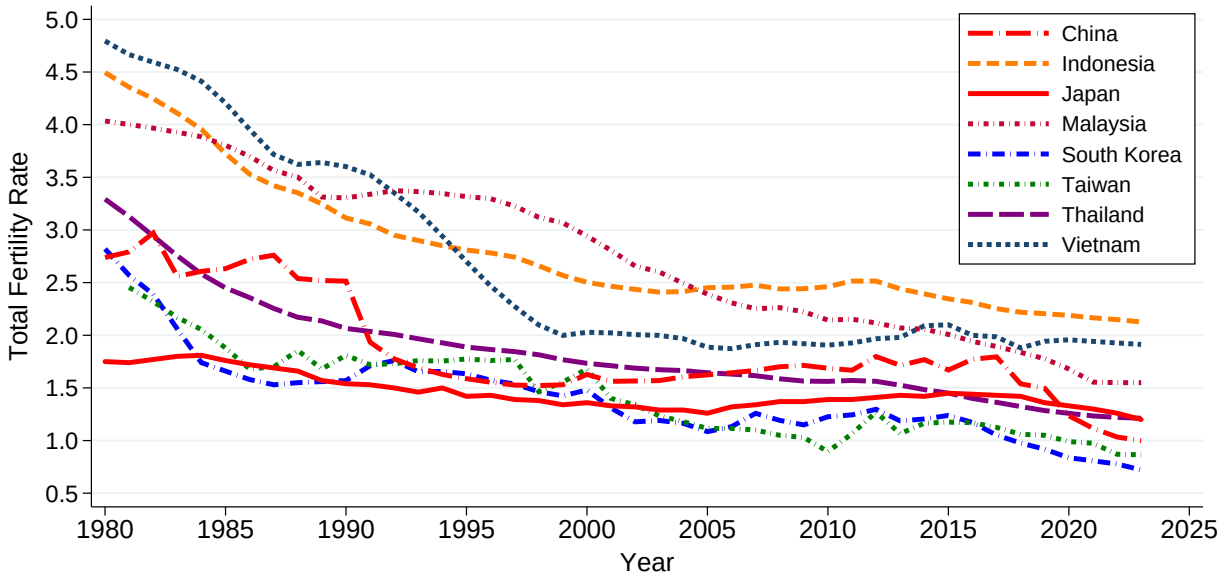
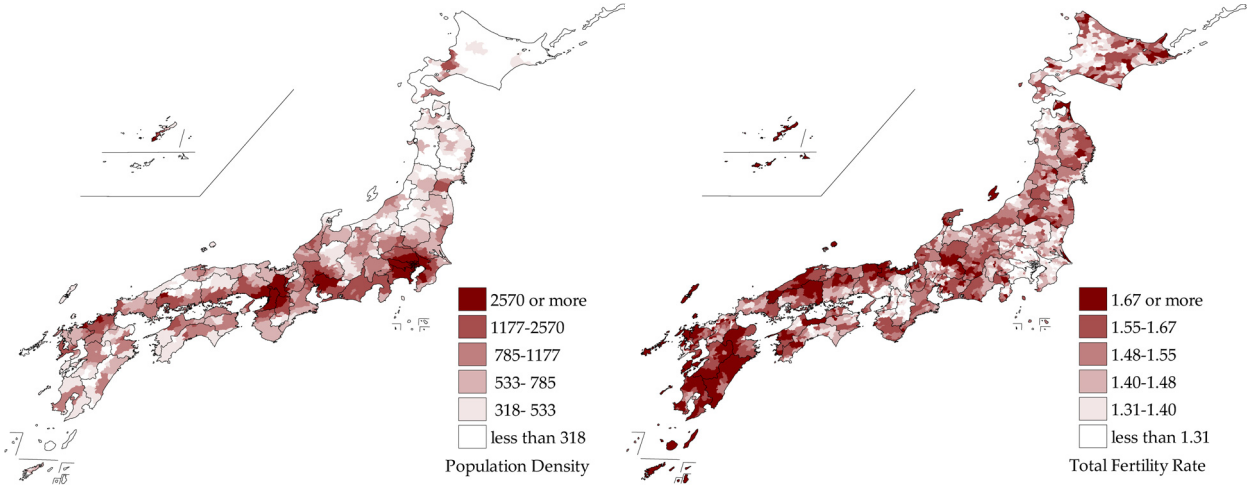


Figure 1. Total Fertility Rate for Selective Asian Countries and Regions

Note: Health Nutrition and Population Statistics, World Bank (2026).



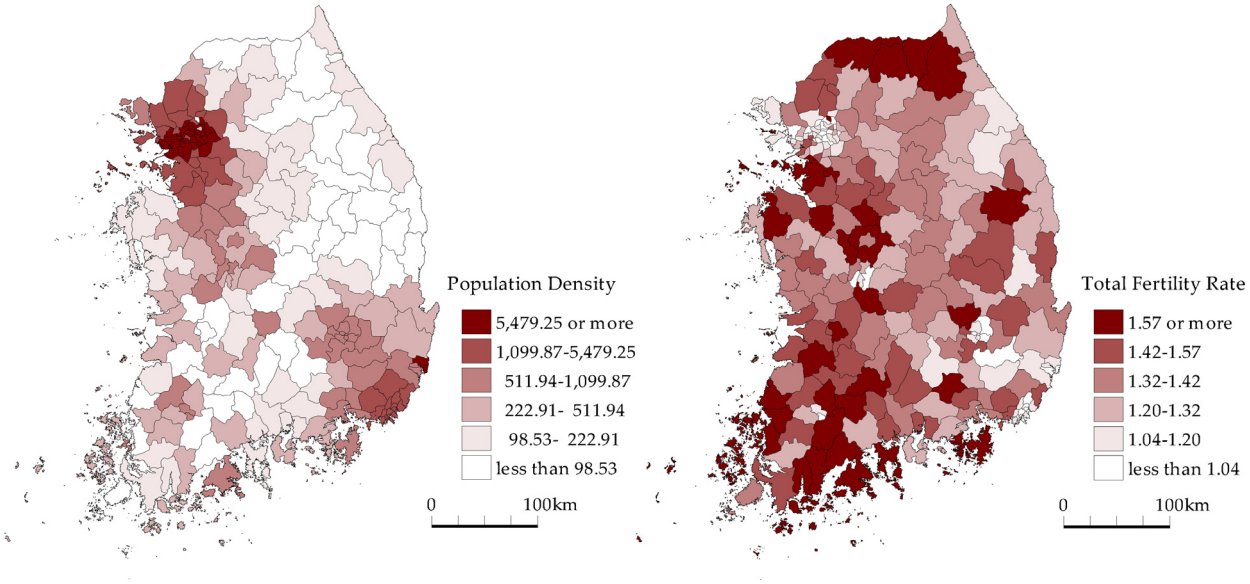
(a) Population Density

(b) Total Fertility Rate

(c) Total Fertility Rate and Population Density

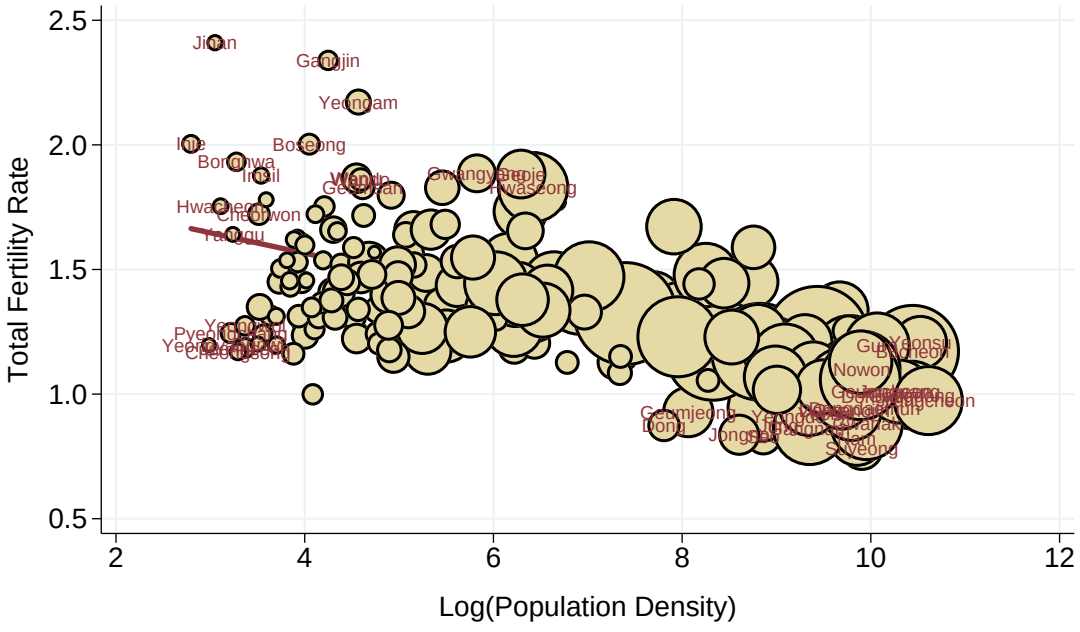
Figure 2. Total Fertility Rate and Population Density in Japan, 2010

Note: Author's creation using the data taken from Statistics Bureau of Japan (2026). Circle size in Panel (c) represents population size.



(a) Population Density

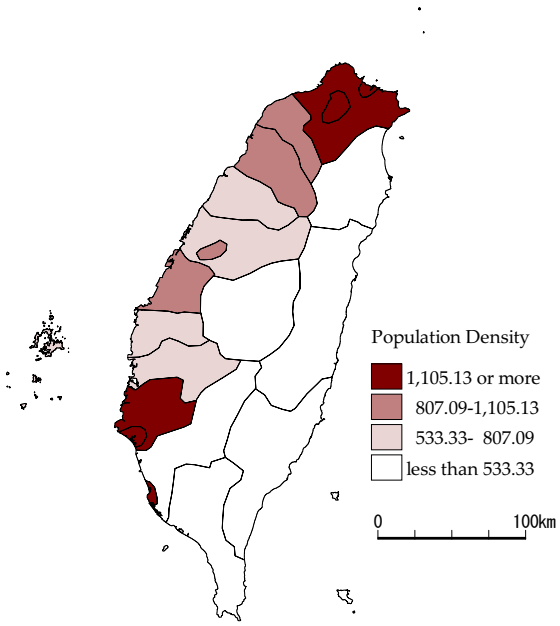
(b) Total Fertility Rate



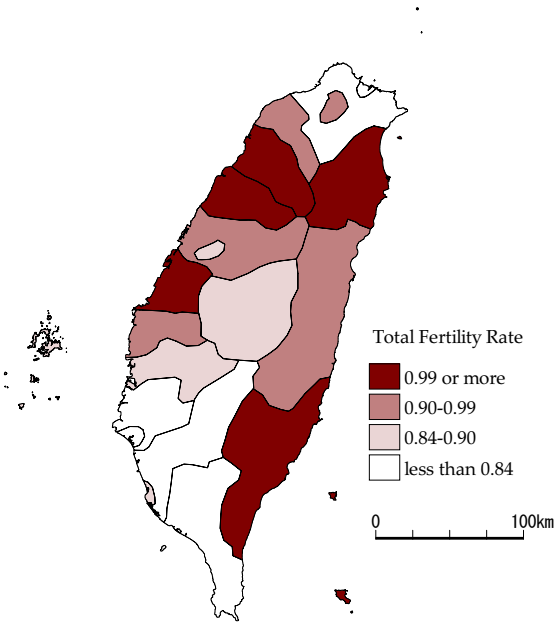
(c) Total Fertility Rate and Population Density

Figure 3. Total Fertility Rate and Population Density in South Korea, 2010

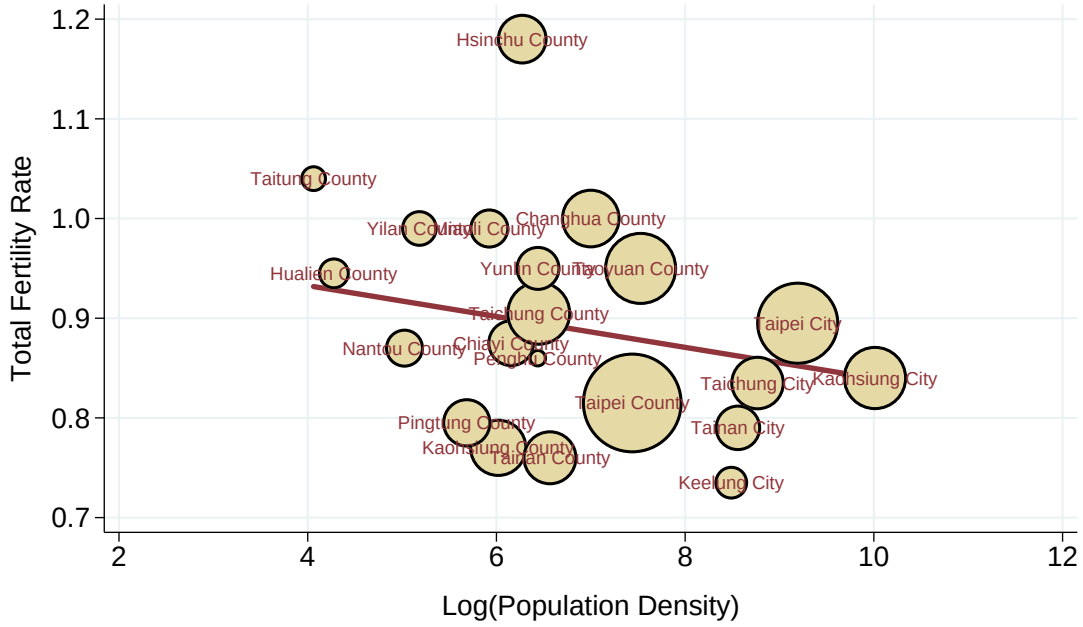
Note: Author's creation using the data taken from Ministry of Data and Statistics of Korea (2026). Circle size in Panel (c) represents population size.



(a) Population Density



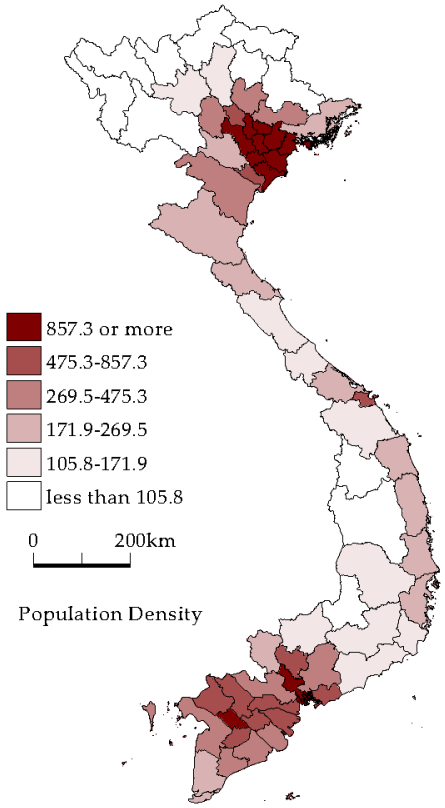
(b) Total Fertility Rate



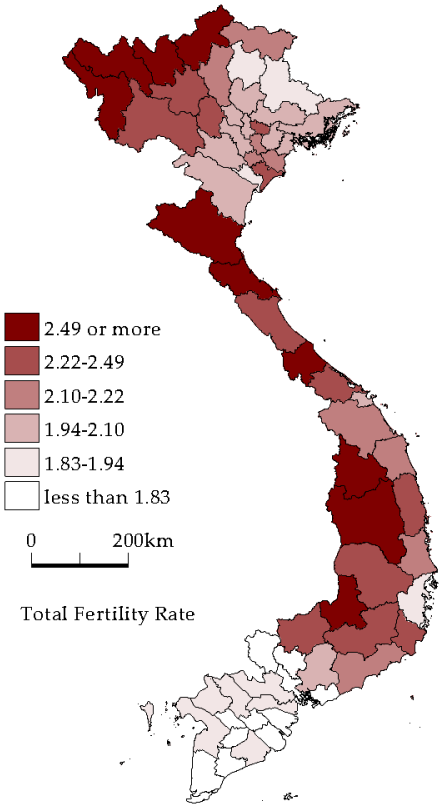
(c) Total Fertility Rate and Population Density

Figure 4. Total Fertility Rate and Population Density in Taiwan, 2010

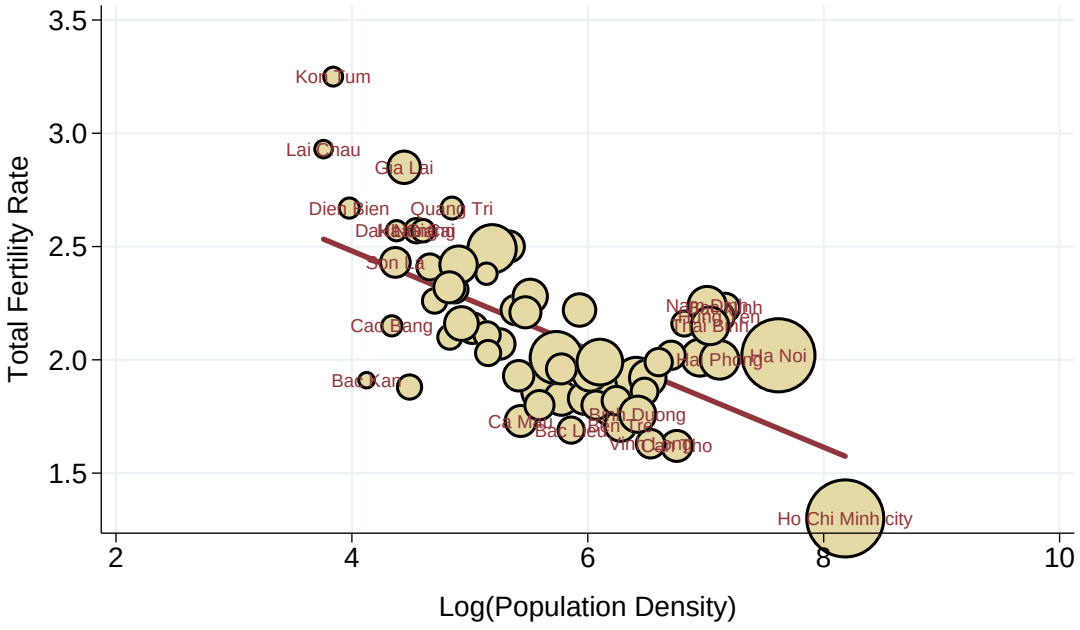
Note: Author's creation using the data taken from Ministry of the Interior of Taiwan (2026). Circle size in Panel (c) represents population size.



(a) Population Density



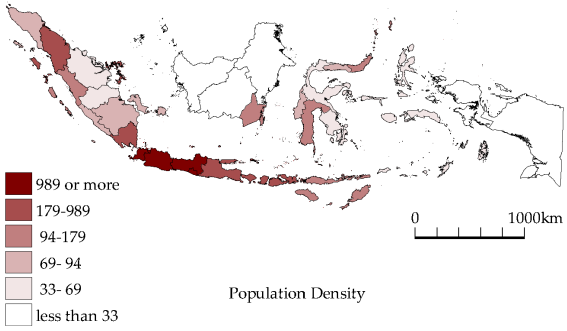
(b) Total Fertility Rate



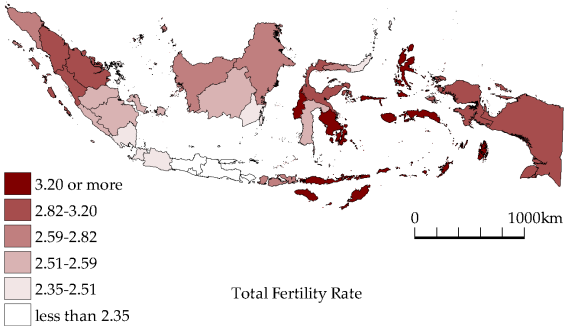
(c) Total Fertility Rate and Population Density

Figure 5. Total Fertility Rate and Population Density in Vietnam, 2011

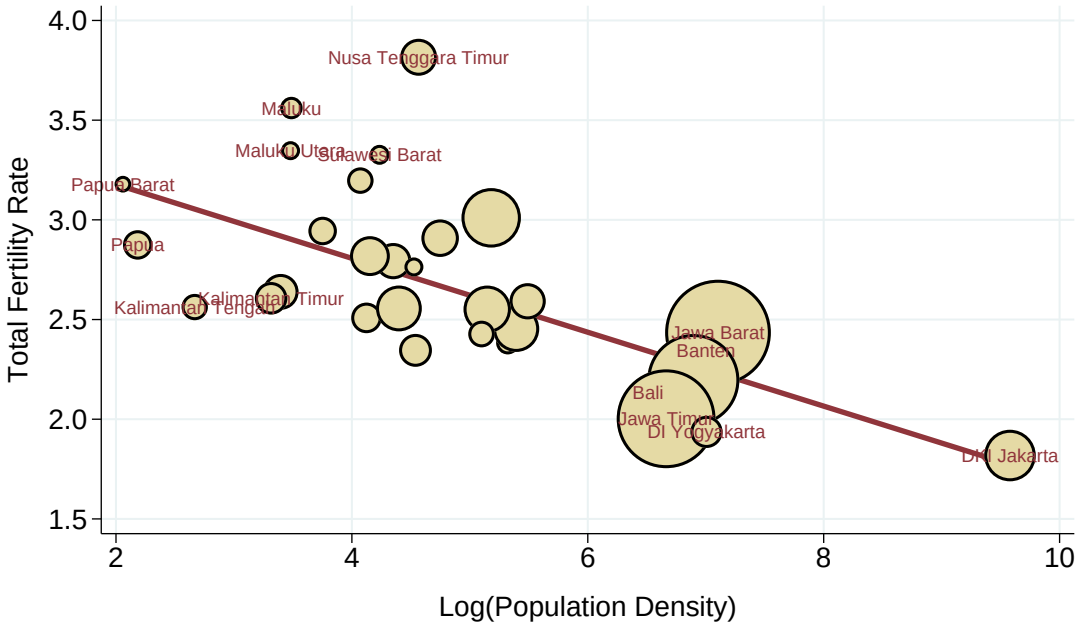
Note: Author's creation using the data taken from National Statistics Office of Vietnam (2026). Circle size in Panel (c) represents population size.



(a) Population Density



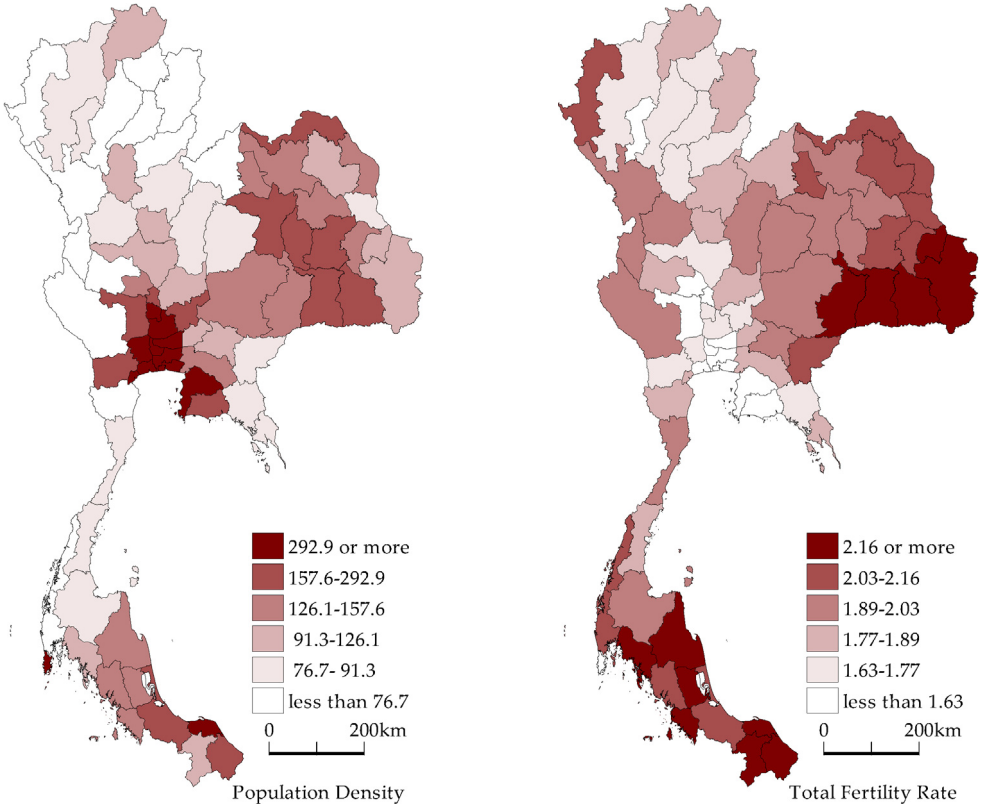
(b) Total Fertility Rate



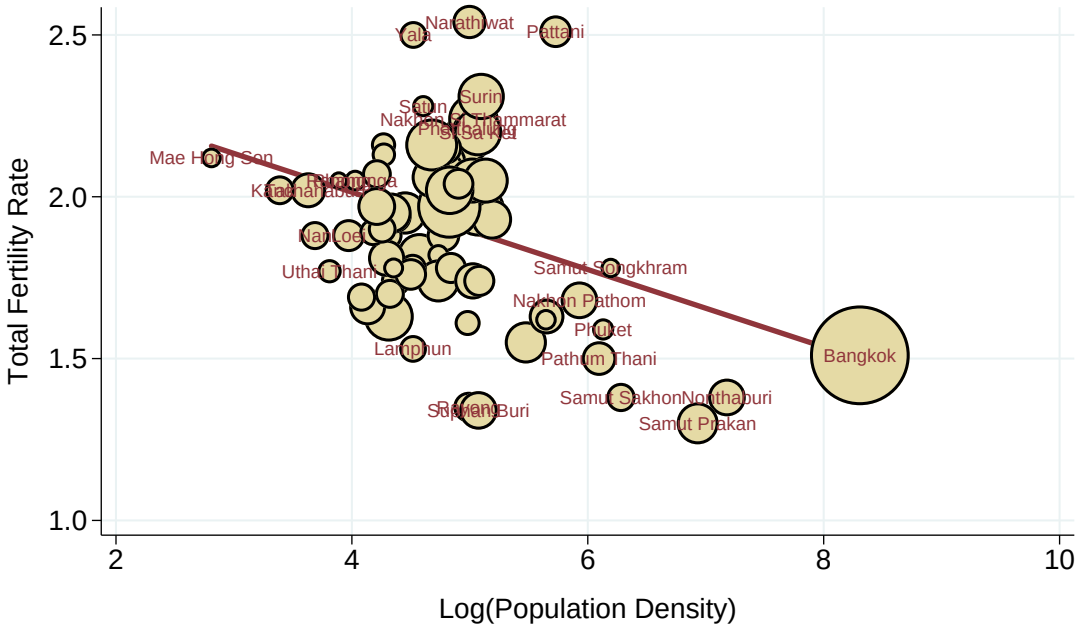
(c) Total Fertility Rate and Population Density

Figure 6. Total Fertility Rate and Population Density in Indonesia, 2010

Note: Author's creation using the data taken from BPS-Statistics Indonesia (2026). Circle size in Panel (c) represents population size.



(a) Population Density **(b)** Total Fertility Rate



(c) Total Fertility Rate and Population Density

Figure 7. Total Fertility Rate and Population Density in Thailand, 2000

Note: Author's creation using the data taken from National Statistical Office of Thailand (2026). Circle size in Panel (c) represents population size.