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ANALYZING THE LINK BETWEEN POPULATION DIVERSITY, POPULATION GROWTH, AND INCOME: A PANEL DATA STUDY

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ABSTRACT

Introductions: Amidst shifting demographics across many countries, certain stylized facts related to fertility, population, and income have become less universally applicable as previously established empirical models of fertility were based on long-standing regularities—namely, the negative relationships between income and fertility as well as between women's labor force participation and fertility—many of which are now being reconsidered in light of evolving demographic trends. **Novelty**: This research addresses a significant gap in the literature by providing a comprehensive analysis of the relationship between population diversity, population growth, and income growth, incorporating both time-varying and cross-country components. While existing studies have examined these factors individually, our study integrates them to offer a more complete understanding of their interactions. **Methodology:** We employ the system generalized method of moments (GMM), a dynamic panel estimation technique that helps address endogeneity and unobserved heterogeneity in panel data settings. **Findings:** Our findings reveal a positive correlation between population diversity and population growth, suggesting that diversity and migration contribute to population expansion through strategic interactions among ethnic groups competing for influence in society, fostering pro-birth policies. However, we also find a negative association between population diversity and income growth, indicating potential ethnic conflict and rent-seeking behavior. In highly diverse societies, rent-seeking can lead to underinvestment in public goods, while frequent ethnic conflict is linked to lower economic growth. **Conclusion:** This paper highlights the complex relationship between diversity, demographic trends, and economic outcomes, underscoring the need for further research on mitigating the adverse effects of diversity on income growth.

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INTRODUCTION

The world's population is expected to increase by 2 billion, from 7.7 billion to 9.7 billion, by 2050 and reach a peak close to 11 billion at the end of the century as the world battles with declining fertility rates (United Nations, 2020). The global fertility rate is expected to fall from 2.5 in 2019 to 1.9 births per woman by the year 2100, and the global median age is also projected to rise from 31 to 42 in the same period (Cilluffo & Ruiz, 2019). The relationship between demographic parameters, such as population and fertility, is a complex and multifaceted topic that has been the subject of much research and debate. Fertility, or the birth of children per woman, is influenced by a wide range of factors, including biological, social, economic, and environmental factors (Bao, 2021). At the same time, demographic change, which studies how human populations change over time, is driven by a combination of fertility rates, mortality rates, the age profile of the population, and migration patterns (Pew Research Center, 2015; Ranganathan et al., 2015).

There is a surprising lack of research specifically examining how the racial and ethnic diversity of a population may influence its growth, despite the importance of understanding the impact of diversity on societal dynamics. Furthermore, cultural diversity is also found to significantly affect consumer behavior in Indonesia, a country with shared values and norms (Simanjuntak & Shahirah, 2024). This is of great significance, as a population with a variety of ethnic groups can result in strategic interactions that promote pronatalism and increase fertility rates, as leaders of these groups encourage policies that boost fertility and population (Papyrakis & Mo, 2014). The motivation to further examine this topic also originates from observing Japan with declining population growth and having one of the most homogeneous populations even among advanced economies. Japan's population has been dwindling mainly due to a falling fertility rate, which ranged at 1.3 for the 2019—2021 period, while the ideal replacement fertility rate, or the number of children a woman needs to have for the population to sustain itself is 2.1 children for every woman (OECD, 2023). At the same time, this population problem may be exacerbated by the fact that Japan is ethnically homogeneous. The Japanese population comprises 97.8% of Japan's total population, making it one of the most ethnically homogeneous countries among advanced economies (Statistics Bureau of Japan, 2021). Conversely, countries with higher fertility rates, such as India and Indonesia, tend to be more ethnically heterogeneous. Both countries have a fertility rate of 2.03 and 2.17,respecttively, in 2021, which are still relatively close to the ideal replacement fertility rate while having a large varying ethnicity number (OECD, 2023). India alone is a highly diverse country with over 2,000 ethnic groups representing each of the world's major religions (Statista, 2023). The majority of these ethnic groups in India are Indo-Aryan and Dravidian, constituting 72% and 25% of India's total population, respectively, while other ethnic groups account for 3% of the total population (Central Intelligence Agency, 2023). Similarly, the Indonesian population is also incredibly diverse, comprising over 1330 ethnic groups, with the two largest being the Javanese, who make up 40.05% of the total population, and the Sundanese, who make up 15.5%, while the proportion of the remaining ethnic groups is less than 5% each (Statistics Indonesia, 2015). These facts underline the possible connection between a given country's diversity and its population growth, highlighting the need for further research into the potential relationship between the aforementioned issues and how it affects economic outcomes.

Previous discussion on fertility has ushered in a new era that brings a different demographic implication as some of these initially stylized facts are no longer universally relevant. The first-generation empirical modeling for fertility was made to account for two regularities that have held for many decades across nations and within families in a particular country, i.e., a negative relationship between income and fertility as well as a negative relationship between women's labor force participation and fertility (Doepke et al., 2022). Such trade-offs relate heavily to the quantity-quality trade-off theory of Becker & Lewis (1973) that a smaller family size allows for more resources to be allocated to each child, which improves the overall child quality within a family given the limited resources available, therefore implying that a decrease in fertility would encourage more human capital investment for every child (Wang & Zhang, 2018). Lately, however, such consensus in said quantity-quality trade-offs mentioned beforehand has been undergoing a major shift. Across the high-income world, some evidence of the positive relationship between fertility and income has been observed with shifting key determinants of fertility choice, mainly due to changing family policy and social norms, the trend of accommodating fathers, and flexible labor markets (Doepke et al., 2022).

Meanwhile, the topics of racial or ethnic diversity and demographics have also gathered much attention in recent times. By 2050, it is estimated that half of the world's population growth mostly originates from Asian and African countries such as—in descending order of growth—India, Nigeria, Pakistan, the Democratic Republic of the Congo, Ethiopia, Tanzania, Indonesia, Egypt, and the United States of America (USA) (United Nations, 2020) with one in four of the total global population having Sub-Saharan African origin by that same period (Suzuki, 2019). India has overtaken China in terms of population number in 2023, becoming the world's most populous country, and both countries face divergent demographic futures with China suffering from declining populations due to falling fertility rates, and India's population is still set to continue growing (United Nations, 2019, 2023). Thus, it is projected that in 2050 the five most populous countries are India, China, the United States of America (USA), Nigeria, and Pakistan (United Nations, 2022). Various high-income countries, such as the United States, are also trending towards a more diverse population group. The white non-Hispanic will account for 47% of the total US population by 2050, while the rest consists of a mix of Hispanic/Latinos, Black, and Asian populations, signaling a trend towards what is referred to as "minority whites" in the US (Frey, 2018; Passel & Cohn, 2008).

The discussion on diversity is primarily influenced by two contrasting views in which one perspective portrays diversity as a catalyst for growth while the other suggests it hinders growth (Rodríguez-Pose & von Berlepsch, 2019). These contrasting perspectives indicate that the approaches to assess the relationship between population diversity and growth are not so straightforward. Several existing studies have shown how diversity has demographic and economic implications. Gören (2014) shows how ethnic diversity affected the economic growth of 100 countries from the 1960—1999 period. The study found that ethnic diversity led to higher fertility rates and indirectly contributed to international trade positively, which proved beneficial in rejuvenating declining populations (Gören, 2014). Collier (2001) found that countries characterized by dominance, where one group becomes the majority, have worse economic performance than fractionalized countries, where there are many ethnic groups.

For instance, China's efforts to improve income and education across all ethnic groups still causes income and educational gaps to persist among the non-Han ethnic minorities in China or even grew over time (Chia & Hruschka, 2023), but simply comparing the Han and non-Han does not paint a full picture of the experience of each minority group. One minority group—which is the Han—tends to have an overall higher income and education level than the Han, the Buyi have equivalent educational achievement with the Han, while the Miao and Tujia have lower overall achievement than the Han (Chia & Hruschka, 2023). Additionally, fractionalised societies also face poorer public sector performance than homogeneous societies (Collier, 2001). Ratna et al. (2009) analyzed the effect of diversity by measuring both racial and linguistic diversity and found mixed results, i.e., racial diversity negatively affects Gross State Product (GSP) growth, and linguistic diversity positively affects GSP growth.

On a similar note, there have been mixed results on how countries with varying income levels are affected by population changes. Montalvo & Reynal-Querol (2005) found that social polarization, which is the segregation of social groups due to economic factors such as income inequality and social displacement, negatively affects economic growth through the reduction in investment as well as an increase in public consumption and the incidence of civil wars. Another study by Peterson (2017) noted that rapid population growth in low-income countries can result in a demographic dividend in the long run as these youths grow to be productive adults. However, the study also noted that growth induced by high fertility rates commonly found in low-income countries reduces overall well-being, while growth induced by decreased mortality rates is viewed more favorably resulting in a higher positive impact on savings and economic growth. High-income countries often experience low or negative population growth, which can lead to an aging population. Higher population growth would alleviate the pressure on the working-age population and the government to support the elderly. However, this is unlikely to happen as fertility rates in high-income countries continue to decline (Peterson, 2017).

Despite numerous existing studies that have specifically analyzed how diversity causes demographic and economic change, studies that specifically analyze the relationship between population diversity and population growth while incorporating both time-variant and cross-country components are limited. To the best of our knowledge, the majority of existing research trades-off by either focusing on time-varying components that is limited to a narrow period in a given area or research with a cross-country component that is mostly limited to a single or multiple non-continuous time periods, such as in the case of Ananta et al. (2023), DiRienzo et al. (2007), Docquier et al. (2020), and Rodríguez-Pose & von Berlepsch (2019). Such analysis could not explain how the relationship between ethnic diversity, population, and income evolves over time and across different countries. Understanding this complex relationship would enable policymakers to formulate sound policies that could utilize the benefits of ethnic diversity while also addressing its potential problems.

This research attempts to fill this gap in the literature by examining how population diversity influences population growth and income. We utilized a panel dataset consisting of 150 countries ranging from 1960–2013 and analyzed using a dynamic panel regression model, specifically the system generalized method of moments (GMM) method, to account for fixed effects and dynamic panel model-specific bias. It also fits in an unbalanced panel data and data

that suffers from endogeneity in its variables. Based on the literature, we hypothesize that higher population diversity is associated with higher population growth, as more frequent interaction between ethnic groups leads to policies that promote births. However, population diversity is inversely correlated with income growth, meaning that higher population diversity is associated with lower income growth.

Our results find that ethnically diverse populations, net migration, and fertility rate contribute to the expansion of the population, as shown by the positive and significant relationships from population diversity, net migration, and fertility rate towards population growth. In contrast, mortality rate and female labor force participation contribute towards a negative population growth, as shown by the negative and significant relationship from mortality rate and female labor force participation to population growth. Population density and sex ratio is statistically insignificant towards population growth. This relates to the openness and acceptance of other ethnicities to migrate and the strategic interaction between ethnic groups to compete for influence, thus promoting pronatalist policies, as indicated by the rising fertility rate in such mixed demographic compositions. Additionally, we also found correlations that population diversity, population density, mortality rate, and sex ratio contribute towards a negative income growth. However, fertility rate, net migration, and female labor force participation show no statistical significance towards income growth. This implies that while diversity may foster population growth, it may not necessarily lead to income growth.

This paper is divided into several sections. Section two provides an insight into the literature review. Section three describes the methodology utilized in this research. Section four elaborates on the empirical result, and section five provides a discussion and conclusion to this research.

LITERATURE REVIEW

The discussion on diversity is not a straightforward matter that is often controversial and discussed across a diverse range of disciplines from both natural and social science. The discourse on diversity is dominated by two opposing perspectives, with one view depicting diversity as growth-promoting while the other view depicts it as obstructing growth (Rodríguez-Pose & von Berlepsch, 2019). Differing perspectives mean the angles in evaluating the link between population diversity and population growth are not uniform, also implying that a variety of parameters as a proxy for diversity are used with a distinct aspect of the notion. The most prevalent proxies for diversity studies include population fractionalization, polarization, and segregation; therefore, the fact that diversity may either promote or hinder growth depends on the proxy being used (Rodríguez-Pose & von Berlepsch, 2019).

Literatures on how diversity promotes growth highlight the role of innovations and skills as well as competition as its key determinants. Although competition theory states that a reduction in inequality between regions or groups intensifies competitive conflict among ethnic groups by triggering exclusionary pressures and intergroup tensions (Olzak, 2015), the positive effects tend to outweigh the negative effects as competition brings economic progress, incentivizes innovation, and enhances overall productivity. The movement of migrants from to a host country brings along a novel range of skills, knowledge, and perspectives that are beneficial for nurturing technological innovation and positive economic outcomes (Bove & Elia, 2017). For instance, immigrant diversity is positively correlated with economic prosperity,

with a one percentage point in skilled migrant diversity increasing GDP per capita by 2 percent (Alesina et al., 2016). On a similar note, diversity has also been shown to have a positive impact on wages among high-income jobs that demand complex problem-solving skills (Cooke & Kemeny, 2017) as well as the diversity of high-skilled immigrants on economic growth, as confirmed by the fact that that there is an increase of 6% in GDP per capita for every 10% increase in high-skilled diversity (Docquier et al., 2020). Similar evidence was also found regarding the positive effect of diversity on GDP per capita, but this effect is found to be stronger and more consistent among developing countries (Bove & Elia, 2017). However, it is necessary to note that diversity has consistently been proven to have no significant effect on economic outcomes for low-skilled jobs (Cooke & Kemeny, 2017; Docquier et al., 2020; Suedekum et al., 2014). Production specialization is also found to act as a catalyst for diversity, promoting growth in the form of trade. Montalvo & Reynal-Querol (2021) highlight the positive relationship between ethnic diversity and economic growth due to the increase in inter-ethnic groups' trade activities, specifically in smaller regions, as different ethnic groups have different production preferences.

There is a strong argument against discrimination and non-inclusion in the diversity context as, evidently, the exclusion of a sizable population group comes at the severe cost of demographic change related to an aging population and the growing proportion of traditionally underprivileged groups in the labor market (OECD, 2020). Aside from the positive economic outcome of diversity, one literature also suggests that ethnic diversity may induce higher fertility rates, leading to population growth, mainly due to political factors. A diverse population leads to strategic interactions among ethnic groups, promoting pronatalism and increasing fertility rates as group leaders incentivize fertility-boosting policies (Papyrakis & Mo, 2014). Some evidence also reveals the cost of sustaining non-inclusion of diverse groups. For instance, France could see an increase of around EUR 150 billion over 20 years by increasing employment rates of disadvantaged groups to the average level, translating to a 0.35 percent yearly GDP increases, or reducing the labor force participation gender gap by a quarter across the OECD by 2025 may result in 1 percentage point rise in projected baseline GDP growth from 2013-25 while halving the gap could result in an almost 2.5 percentage point increase (OECD, 2017). This is consistent with the findings that the gender gap plays an important role in the economy, specifically in income inequality (Sulistyaningrum & Michael Tjahjadi, 2022).

A common theme among the literature arguing that diversity promotes growth is that the diversity is based on the number of different population groups within an area with variation based on language, religion, and ethnicity. These literatures incline to use a fractionalization index as a measure of population diversity. The idea of a fractionalization index presumes that the greater the number of ethnic groups, the higher the diversity in a society, thus positively inducing the potential for the growth of economic outcomes (Rodríguez-Pose & von Berlepsch, 2019). Unfortunately, these fractionalization indices and preceding literature on diversity usually do not consider the size and distance of different ethnic groups. Additionally, most studies emphasize more on evaluating how diversity affects the outcome within a country or even at an individual level, indicating the lack of studies that incorporate an examination at a wide cross-country level.

The opposite view that argues diversity inhibits growth considers diverse groups to be the main destabilizing factor with the potential to escalate into a social turmoil or conflict. Literature that suggests diversity inhibits growth includes fractionalization as a proxy for diversity similar to the growth-promoting group but places increasing emphasis on segregation and polarization indices (Rodríguez-Pose & von Berlepsch, 2019). The cost of fractionalization on a macroeconomic scale has been empirically ingrained as measured through the ethno-linguistic diversity lens in a study by Easterly & Levine (1997) that discovers ethnic fragmentation is associated with lower economic growth, particularly in Africa, mainly due to the frequent ethnic conflict occurring in the region. Consequently, this diversity causes rent-seeking behavior among different groups that further undermine efforts to adopt sound public policies, as well as resulting in poor education attainment, high financial debt, and low infrastructure quality as a result of high segregation levels. (Gören, 2014) further highlighted the negative direct consequence of ethnic diversity on economic growth, the indirect negative consequence of ethnic polarization on economic outcomes through human capital, investment, trade openness, and civil war, as well as noting that ethnically diverse countries possess a higher average fertility rate.

One study further examines the effect of diversity by separating between dominance, in which one group becomes the majority, and fractionalization, where there are many ethnic groups. (Collier, 2001) finds that countries characterised by dominance are found to have worse economic performance than fractionalized countries, which are generally nonproblematic in democracies but can be damaging in dictatorships. Additionally, fractionalized societies also face poorer public sector performance than homogeneous societies (Collier, 2001). Moreover, Montalvo & Reynal-Querol (2021) conclude that social polarization negatively affects economic growth through the reduction in investment, increase in public consumption and the incidence of civil wars. Meanwhile, Ratna et al. (2009) studied the macroeconomic effects of social diversity across 48 states in the United States (US), finding mixed empirical results for the effect of diversity on Gross State Product (GSP) per capita growth while racial diversity decreases GSP growth and linguistic diversity increases GSP growth.

There are mixed results on how countries with varying income levels are affected by population changes. According to Peterson (2017), rapid population growth in low-income countries can lead to short- and medium-term challenges due to a larger young population but can result in a demographic dividend in the long run as these youths grow to be productive adults. However, the study also finds that growth induced by high fertility rates commonly found in low-income countries reduces overall well-being, while growth induced by decreased mortality rates is viewed more favorably resulting in a higher positive impact on savings and economic growth. In contrast, low or even negative population growth found in high-income countries can result in an aging population, putting a burden on the productive age group and the government to support the elderly population (Peterson, 2017).

Once again, there is a common theme among the literature that establishes the fact that diversity inhibits growth. Diversity is emphasized as the cause of the negative consequences of polarization and segregation, and separate indices have been used to investigate these consequences from a distinct aspect of diversity altogether. Polarization indices focus more on the size of one group to another and the distance

separating them rather than the quantity of groups within a given population. Groups with more distance amongst each other would have more similarity in size and a stronger separation between groups, reducing communications which negatively affects economic development due to diversity (Rodríguez-Pose & von Berlepsch, 2019). The diverse culture pervasive among different groups affects trust, disturbing the coordination of economic actors and their interaction, as well as enlarging the gap in preferences and giving rise to conflict. Nevertheless, the interaction among diverse groups concurrently generates a myriad of experiences, skills, and knowledge that advance technological innovation and ideas, increase productivity and the quality of goods and services, and procreation of society (Alesina et al., 2016; Rodríguez-Pose & von Berlepsch, 2019).

Aligning with most of the previous research, this study will focus on a single dimension, which is ethnic diversity that is measured by the Historical Index of Ethnic Fractionalization (HIEF) (Drazanova, 2019). The HIEF is defined as the probability that two randomly chosen individuals in the same country do not share the same ethnicity. This variable is used to measure the degree of population diversity in a country, which is the main independent variable in this research. The dependent variables, namely population growth and income growth, are measured by the population growth and GNI per capita variables that are sourced from the World Bank Dataset. The use of GNI per capita as a proxy for income growth has been previously observed in empirical literature (Janvry & Sadoulet, 2000).

The control variables in this research, namely population density, fertility rate, mortality rate, age structure, net migration, sex ratio, and female labor force participation rate, are selected by examining earlier literature and theoretical arguments. According to Malthus, from his book titled "An Essay on the Principle of Population", higher population size will limit the available resources for each person, which leads to a decrease in population growth. Both fertility rate and mortality rate are found to affect economic growth, which is closely related to income growth (Ashraf et al., 2013; Zhang et al., 2001). Furthermore, Ozgen et al. (2010) have established that net migration is positively correlated with per capita income growth. Meanwhile, an imbalanced sex ratio is also found to negatively affect birth rates, which leads to a decrease in population growth (Hesketh & Xing, 2006). Additionally, an increase in sex ratio at birth that tends to skew the proportion between male and female will significantly reduce economic growth in the short and longterm (Wu et al., 2022). Moreover, the female labor force participation rate has a negative effect on population growth through the reduction in the fertility rate, since women that are involved in the labor force tend to delay their childbearing due to the work's demands (Rafique Umar & Shoaib, 2015). On the other hand, an increase in the female labor force participation rate is found to have a positive and significant effect on economic well-being (Tsani et al., 2013).

METHODOLOGY

1. Data

The panel dataset that is utilized in this research consists of 156 countries from 1960 to 2013, considering the availability of the latest data from the World Bank Dataset, the Historical Index of Ethnic Fractionalization (HIEF) dataset that is derived from the Cline Center for Democracy Composition of Religious and Ethnic Groups (CREG) that is further extended by Drazanova (2020) to account for cross-country and time-varying effects, and the International Labor Organization (ILO). The

Historical Index of Ethnic Fractionalization (HIEF) represents the proxy for diversity (EF_{it}) and has a ratio between 0 (complete homogeneity) and 1 (complete heterogeneity). The rationale behind ethnic fractionalization as a parameter of diversity within a population is the probability that two randomly selected individuals from a nation's populace do not belong to the same group of ethnicity, religion, or any specified criterion. The Historical Index of Ethnic Fractionalization (HIEF) expands upon earlier indices of ethnic fractionalization by including a time factor, enabling researchers to examine the changes and influences of ethnic fractionalization across different nations and throughout various periods.

Incorporating a time-varying aspect in ethnic diversity research is rarely observed and often overlooked, as it is often treated as a constant (Drazanova, 2020). It has created a gap in understanding the long-term effects of ethnic diversity, which may vary depending on the overtime trend of ethnic diversity. For example, countries with a history of rich and steadily increasing ethnic diversity may be more inclined to establish institutions that manage diversity-related issues and experience different outcomes in population, economic, social, and governance aspects than countries that recently experienced a rapid increase in ethnic diversity. Similarly, countries experiencing a swift decline in ethnic diversity may face new challenges, contrasting with long-established homogeneous countries. Therefore, incorporating time-varying aspects in this study could enrich our understanding of ethnic diversity in a real-world setting. Utilizing HIEF is crucial in this context, as it accurately portrays the dynamics of ethnic diversity in a more comprehensive manner in terms of time-variation and the number of countries covered in unveiling the true relationship between ethnic diversity and other outcomes (Drazanova, 2020).It is important to note that HIEF lacks recent data, covering only the period from 1960 to 2013. Despite this limitation, recent literature continues to use HIEF as a measure of ethnic fractionalization for their estimation model (Parsons & Naghshpour, 2023; Vaccaro, 2022; Xinyi, 2021). The HIEF is still used because it is particularly useful for examining long-term trends and patterns in ethnic diversity and socio-political or economic impacts. Despite the availability of newer ethnicity-related measures, HIEF remains one of the most comprehensive datasets for ethnic fractionalization, particularly in its global coverage (maximum of 156 countries) and focus on long-term data(Parsons & Naghshpour, 2023). Additionally, HIEF employs a widely accepted standard based on the Herfindahl–Hirschman index to measure the probability that two randomly selected individuals belong to different ethnic groups, ensuring a robust and consistent quantification of ethnic diversity (Vaccaro, 2022).

Alternatively, we found a similar dataset from the World Values Survey (WVS) and European Values Study (EVS) integrated survey reports. Upon further inspection, there is a significant limitation in this dataset regarding the definition of ethnicities. Respondents in WVS/EVS are required to report both their skin color and language. The issue arises from the fact that different countries have varying methods to accurately identify ethnic diversity. For example, in most African countries, ethnicities are better defined by language rather than color, since the majority of the population is Black. This contrasts with the situation in Asian countries, which have a greater variety of skin colors, allowing for the use of both skin color and language variables. Consequently, HIEF is still the preferred proxy on measuring ethnic diversity due to its easier interpretability and usability.

Moving to the definition of control variables, the population density (PD_{it}) is defined as the number of people per square kilometer of land area in a given year and period, the fertility rate (FR_{it}) is represented by the total fertility rate or the total number of births per woman during her childbearing years in a given country and period, the mortality rate (MR_{it}) is represented by the infant mortality rate or the death of an infant before 1 year of age for every 1000 live births in a given country and period, net migration (Mig_{it}) is obtained from the number of immigrants minus the number of emigrants including citizens and noncitizens in a given country and period, the sex ratio (Sex_{it}) utilizes the sex ratio at birth or the ratio of male births per female births on a 5-year average in a given country and period. All the aforementioned data were obtained from the World Development Indicator from the World Bank Database. Finally, the female labor force participation rate (FLC_{it}) was obtained from a combination of data from the International Labor Organization's (ILO) estimates and complemented by the national estimates of respective countries in a given period, also available in the World Bank Database. We also incorporate the country's income class variable to test the model's robustness that follows the World Bank Income Classification.

In the study of population growth, the inclusion of fertility rate, mortality rate, and net migration as control variables in regression models, despite being functions of population growth, is imperative. These variables provide insights into the population structure, capturing demographic shifts and variations across regions, as well as predicting future population patterns and controlling for confounding factors. Thus, their inclusion enhances the accuracy and comprehensiveness of understanding population dynamics, thereby contributing to a more robust analysis of population growth. The current population growth is a cumulative outcome of several decades of dynamic changes in fertility, mortality, migration patterns, and other contributing factors. These factors collectively shape the current rates of population growth and help determine the individual impact of each demographic factor on overall growth. Therefore, the historical patterns of these demographic elements play a significant role in influencing the growth of the population (Canudas-Romo et al., 2022).

The countries comprise 2 from Northern America, 49 from Africa, 39 from Asia, 36 from Europe, 8 from Oceania, and 22 from Latin America and the Caribbean, as detailed in the

Table 1. List of Variables

Variables	Sources
Population growth	World Bank's World Development Indicator (WDI)
GNI per capita	World Bank's WDI
HIEF	(Drazanova, 2020)
Population density	World Bank's WDI
Fertility rate	World Bank's WDI
Mortality rate	World Bank's WDI
Net migration	World Bank's WDI
Sex ratio	World Bank's WDI
Female labor participation rate	World Bank's WDI and ILO
Country's income class	World Bank's Classifications of Income 2013

appendix section. Measuring diversity has proven to be a challenge due to data limitations, and, therefore, it is necessary to explain the reason why these countries were chosen, especially in making sure that the population of countries can represent the appropriate sample size within a certain region and thus ensure unbiasedness. For example, the two countries in Northern America are the USA and Canada; they were chosen to ensure representation of diverse population compositions, as these two countries collectively account for up to 99% of the region's population, based on Worldometer data, and show varying degrees of ethnic diversity given the availability of the data. Large and demographically diverse countries, such as the previously mentioned, provide a solid basis for regional representation due to their population scale, diverse ethnic composition, and varying economic context. Moving on, the 49 African countries were chosen due to their nearly unmatched diversity and ensuring proportional representation among different sub-regions to achieve generalizability (Rudolph et al., 2023), such as North Africa (e.g., Egypt, Tunisia), West Africa (e.g., Nigeria, Ghana), East Africa (e.g., Kenya, Ethiopia), Southern Africa (e.g., Botswana, South Africa), and Central Africa (e.g., DR Congo, Central African Republic). Meanwhile, Asia is the largest and most populated continent with high variation of demographic diversity, with China and India alone representing 60% of Asia's population. However, Southeast Asian nations (e.g., Singapore, Indonesia), Middle Eastern (e.g., Saudi Arabia, Iran), Central Asian (e.g., Kazakhstan, Uzbekistan), and East Asian countries (e.g., Japan, Korea) are equally important, as it adds dimensions of ethnic variety along with a history of colonialism that is often overlooked to capture Asia's regional diversity.

Europe is characterized by its advanced socioeconomic development and historical diversity that is reflected mostly in its sub regional distinction of Western Europe (e.g., France, Germany, UK) and Eastern Europe (e.g., Former Soviet States, Azerbaijan).The former is characterized by its economic prominence, while the latter contributes unique insights into migration trends, post-Soviet development, and economic and demographic transition. Including both large nations (e.g., Russia, a transcontinental state) and smaller, culturally distinct ones (e.g., Iceland) enhances the generalizability of findings, as accounting for sub regional disparities allows for an unbiased finding. Similarly diverse characteristics but with a relatively small population are also observed in the Oceania region, encompassing Australia, New Zealand, and various Pacific Island States. Australia and New Zealand dominate most samples due to their significant populations and economic roles. However, smaller nations like Papua New Guinea and Fiji add critical insights into indigenous cultures and the impact of small economies in global and regional contexts. Effective sampling in Oceania involves ensuring representation beyond the dominant Anglo-Saxon influence of Australia and New Zealand(Rudolph et al., 2023). Finally, Latin America and the Caribbean's demography is concentrated in a few large countries that also represents notable ethnic diversity due to its colonial and migration history, similar to Asia, and the varying geographical characteristics of the region. Countries such as Argentina, Brazil, Colombia, and Chile provide additional perspectives on economic diversity and cultural practices. However, it is necessary to complement this by including countries of geographical extremes, such as Andean countries (e.g., Peru, Bolivia) and the Southern Cone nations (e.g., Uruguay, Chile). All in all,

ensuring the representativeness of samples across these regions involves selecting countries that reflect not only population size but also economic, ethnic, and cultural diversity. Furthermore, diversity could be defined in many terms since any person could be categorized into multiple groups, such as gender, age, religion, ethnicity, etc. Therefore, the majority of economic analyses about diversity focus on only one dimension (OECD, 2020) and in this research we focus specifically on how the aspect of ethnic diversity relates to population growth and income.

2. Empirical Strategy

In order to investigate how population diversity may be related to population growth and income growth, the following equation is used to perform the estimation:

$$y_{it} = \alpha_0 + \beta_1 EF_{it} + \beta_2 PD_{it} + \beta_3 FR_{it} + \beta_4 MR_{it} + \beta_5 Mig_{it} + \beta_6 Sex_{it} + \beta_7 FLC_{it} + \vartheta_i + \varepsilon_{it} \quad (1)$$

Where y_{it} refers to both the population growth (Model A) and gross national income per capita (Model B) as the dependent variables in country i and year t. Notation EF_{it} is the independent variable that refers to the HIEF. Meanwhile, PD_{it}, FR_{it}, MR_{it}, Mig_{it}, Sex_{it}, and FLC_{it} are a set of control variables that consist of population density, fertility rate, mortality rate, net migrations, sex ratio, and female labor force participation, respectively. Finally, ϑ_i and ε_{it} are the country-specific effect and error term. Among the data, several require adjustments into natural logarithms to allow a proper estimation for the model, namely net migration (Mig_{it}), gross national income, and population density (PD_{it}). Because the net migration series contains negative values, a constant equal to the absolute value of its minimum observation plus one was added to the series so that all observations become strictly positive prior to applying the natural logarithm transformation.

The selected control variables represent an expansion of those used by Peter & Bakari (2019)who performed panel data estimation on the impact of population growth on economic growth, which incorporate fertility rate and mortality rate as the control variables. We extend their model by including population density, net migrations, sex ratio, and female labor participation in the model. These variables have been employed as independent variables in related studies on population – growth dynamics (Ciommi et al., 2020; Hasan, 2023; Srivastava & Maurya, 2015; Suyanto & Kotani, 2012).

Population density plays a pivotal role in shaping economic growth by influencing labor market dynamics, urbanization, and technological innovation. High population density can foster economic efficiency through economies of scale, better infrastructure utilization, and increased market size for goods and services (Klasen & Nestmann, 2006). Migration significantly influences labor markets, demographic structures, and public finances. Positive net migration contributes to economic growth by increasing the labor supply, fostering innovation, and addressing skill shortages. Conversely, reductions in migration have been shown to negatively affect GDP growth due to demographic imbalances (Lisenkova et al., 2014). The sex ratio affects social dynamics, labor market participation, and fertility decisions. Imbalanced sex ratios can lead to adverse socioeconomic outcomes such as increased crime rates or reduced economic productivity. Empirical research highlights the importance of addressing skewed sex ratios to ensure balanced development (Gulczyński, 2023). Female labor force participation is a key driver of economic growth through its impact on household incomes and consumption patterns. Higher participation rates

among women contribute to GDP growth by expanding the effective labor force and enabling greater gender equality in economic opportunities(Thaddeus et al., 2022).

To perform the estimation above, the dynamic panel regression method is chosen. This decision is made by considering the two following issues as stated by (OECD, 2020). First, the issue of unobserved heterogeneity could affect both the outcome variable and ethnic diversity and can lead to bias in the estimated effects of diversity (Alesina & Ferrara, 2005). Second, there is a limited amount of research that has established the causal relationship between diversity and economic outcomes by utilizing the estimation of instrumental variables (IV).

Traditional estimation methods like Ordinary Least Squares (OLS) and fixed effects models present significant limitations when applied to our research context. The OLS estimator is particularly problematic when dealing with dynamic panel data models that include lagged dependent variables. In such cases, OLS estimates of the coefficient on the lagged dependent variable tend to be biased upward due to positive a correlation between the lagged dependent variable and unobserved country-specific effects. This upward bias would significantly distort our understanding of the relationship between ethnic diversity and economic outcomes. The fixed effects estimator, while addressing some limitations of OLS by controlling for time-invariant unobserved heterogeneity, introduces its own set of problems. When applied to dynamic models, fixed effects estimates of the lagged dependent variable coefficient are typically biased downward. Additionally, the fixed effects approach exclusively utilizes variation within countries while discarding potentially valuable cross-sectional variation (Fukase, 2010). This limitation is particularly problematic for our research, as ethnic diversity often exhibits greater variation across countries than within countries over time, meaning that a fixed effects approach might obscure important relationships in the data.

The dynamic panel regression method, which allows the use of the lag value of the variable in the model, is capable in overcoming issues in the cross-sectional type of model that arise from the country-specific and time-specific unobserved variables that lead to omitted variable bias and endogeneity problem (Levine et al., 2000). Among the various dynamic panel regression methods, the GMM method is found to be able to tackle various issues in model estimation, such as fixed effect, endogeneity, and dynamic panel model-specific bias. The flexibility of this method enables it to be used in an unbalanced panel data and data that suffers from endogeneity in its variables. The capability to tackle various issues and estimation problems leads to the widespread use of GMM, mainly difference GMM and system GMM in empirical literature (Rahman et al., 2019; Roodman, 2009).

This research specifically prefers using the system GMM method rather than the difference GMM method for conducting the model estimation. The system GMM method allows for estimation in both first difference and level forms, whereas the latter method only utilises the first-difference form for its estimation. This distinction in characteristics results in higher precision, efficiency, and lower bias from the system GMM method compared to the difference GMM method, particularly when dealing with small panel data (Soto, 2009). This observation aligns with the findings of Bond (2002) who concludes that the difference GMM method is more susceptible to finite sample bias than the system GMM method.

These limitations have led to a greater preference in the empirical literature for using the system GMM approach over the difference GMM. For instance, Levine et al. (2000), Rahman et al. (2019), and Zarra-Nezhad et al. (2014) have opted for the system GMM method for model estimation after comparing it to the difference GMM method in order to mitigate potential issues in their research. The preference for using the system GMM approach is also evident in literature discussing similar topics. Choudhury & Sahu (2022), in their examination of the role of ethnic fragmentation on the relationship between fiscal decentralization and government size, employ the system GMM method as one of their research techniques. Additionally, Ajide et al. (2019), who investigate the mediating role of institutions in the nexus between ethnic diversity and inequality, also utilize the system GMM method alongside pooled OLS and fixed effects methods.

In ensuring the robustness of our model, we utilize an additional variable that categorizes countries based on income level, following the World Bank historical classifications by income as of 2013 according to the latest available period in our dataset. The equation is as follows:

$$y_{it} = \alpha_0 + \beta_1 EF_{it} + \beta_2 PD_{it} + \beta_3 FR_{it} + \beta_4 MR_{it} + \beta_5 Mig_{it} + \beta_6 Sex_{it} + \beta_7 FLC_{it} + \beta_8 IC_i + \vartheta_i + \varepsilon_{it} \quad (2)$$

where y_{it} refers to the population growth (Model C) and log of gross national income per capita (Model D) as the dependent variables in country *i* and year *t*. The additional categorical variable to indicate the country's income class is represented with ICi. This variable also provides a clearer view of understanding the relationship between diversity, population growth, and income growth by factoring in the country's income level.

To ensure the validity of the utilized GMM models, a post-estimation test is conducted. The Difference-in-Hansen tests of exogeneity are applied to assess the validity and exogeneity of the instruments in the GMM models. The instrumental variables used in the model are the lagged values of population growth and the lagged values of the logarithm of gross national income per capita, which serve as the dependent variables in their respective models. The null hypothesis of this test posits that the instruments, specifically the subset, are exogenous and not correlated with the error term. Conversely, the alternative hypothesis suggests that the instruments are endogenous, indicating a correlation with the error term.

RESULTS

1. Descriptive Statistics

A closer look at the data shows that both South Korea and North Korea have the lowest Historical Index of Ethnic Fractionalization (HIEF) value, measuring at 0 in the 1960s. Even in the latest available data of 2013, both countries still had relatively low HIEF values at 0.095 for South Korea and 0.02 for North Korea. Meanwhile, African countries are found to be highly diverse in terms of ethnic groups, such as Liberia, Uganda, and Togo, with HIEF values measuring at 0.89, 0.88, and 0.87, respectively. The complete list of countries along with their HIEF rankings at the earliest and latest available years are available in the Appendix.

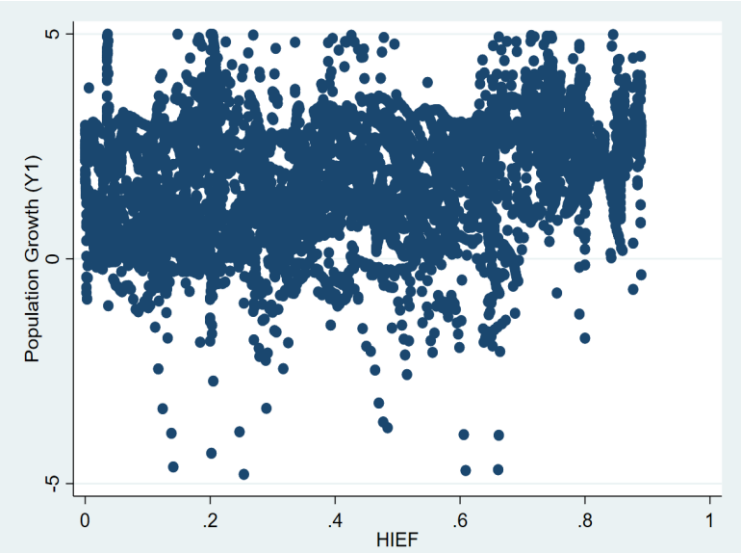
Further inspection based on scatter plots to examine the association between HIEF, population growth, and GNI per capita shows a tendency for population growth to be higher in ethnically diverse populations, adjusting for outliers. Meanwhile, higher GNI per capita is observed more in lower diversity settings. These results signify the potential of a positive correlation between HIEF and population growth and a negative correlation between HIEF and income growth.

Table 2. Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Population Growth	8,108	1.909	1.770	-27.722	19.360
GNI per Capita	3,526	9805.006	14023.18	189.518	86012.46
HIEF	7,287	0.440	0.270	0	0.89
Log Population Density	6,150	3.848	1.389	-0.098	8.940
Fertility Rate	8,262	4.215	2.065	1.078	8.25
Mortality Rate	7,479	56.984	47.040	2.1	228.9
Log Net Migration	8,262	14.582	0.185	0	15.209
Sex Ratio	8,262	1.049	0.018	1.003	1.178
Female Labor Participation Rate	4,060	48.509	16.066	2.44	93.13

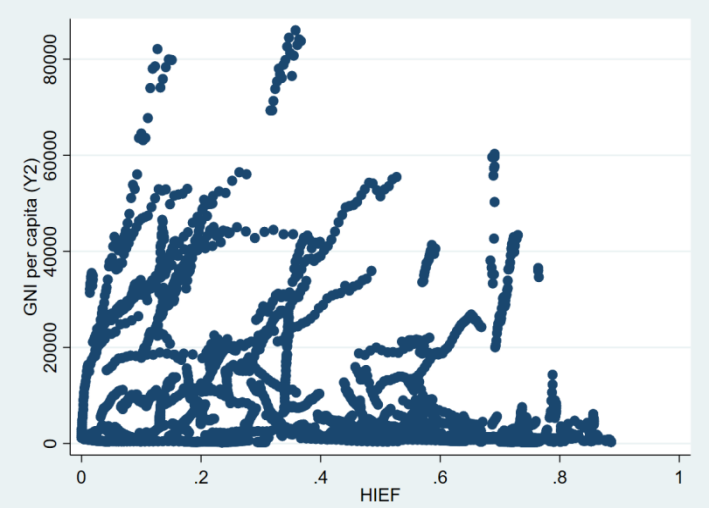
Source: Authors' calculation based on the data obtained from various sources in Table 1

Graph 1. Scatter Plot of HIEF and Population Growth



Source: Authors' calculation based on the Historical Index of Ethnic Fractionalisation (HIEF) and Population Growth data

Graph 2. Scatter Plot of HIEF and Income Growth



Source: Authors' calculation based on the HIEF and Income Growth data

2. Regression Results

Before proceeding with the regression analysis, panel unit root tests were conducted on all variables to assess their stationarity. The panel unit root tests were conducted using the Fisher-type Augmented Dickey Fuller (ADF) method to test for the presence of unit roots in each series. The null hypothesis (H_0) for the Fisher-type ADF test is that a series within a panel contains a unit root and is non-stationary, while the alternative hypothesis (H_1) is that a series does not contain a unit root and is stationary. Stationarity is determined if the p-value for each series tested using the Fisher-type ADF test is lower than the 5% significance level (p-value < 0.05), thus rejecting the null hypothesis and accepting the alternative hypothesis. The results, as presented in the appendix section, indicate that all variables are already stationary in the level form, as determined by the Fisher-type Augmented Dickey Fuller (ADF) test. Moving on to the baseline regression results in Table 3 below, population diversity represented by the HIEF is positive and statistically significant at 1% to population growth. In model A, the fertility rate and net migration are positively correlated to population growth while the mortality rate is negatively correlated to population growth. All three of the previously mentioned control variables are statistically significant at the 1% level. Conversely, population density and sex ratio show no significant relationship to population growth. On a similar note, population diversity also shows a statistical significance at the 1% level but a negative relationship to income growth. In model B, population density, mortality rate, and sex ratio are negatively correlated with income growth at the 5%, 1%, and 5% significance levels respectively. Fertility rate and net migration in model B do not show any significant relationship to income growth. Additionally,

Table 3. System GMM Baseline Estimation Results

	Model A (Dependent: Population Growth)	**Model B (Dependent: Income Growth)**
Diversity (HIEF)	**2.0661*** ** (0.7959)	**-2.0308*** ** (0.56511)
Log Population Density	0.1818 (0.1750)	**-0.2188** ** (0.1035)
Fertility Rate	**0.8115*** ** (0.1815)	-0.1747 (0.1504)
Mortality Rate	**-0.0259*** ** (0.0085)	**-0.0301*** ** (0.0079)
Log Net Migration	**3.0876*** ** (1.1253)	0.1849 (0.3058)
Sex Ratio	-7.1887 (9.0649)	**-12.7315** ** (5.0046)
Female Labor Participation Rate	**-0.0232**** (0.0097)	0.0042 (0.0084)
Constants	**-38.1278**** (17.9830)	**22.1870*** ** (7.1313)
Observations	3946	2564
Countries	150	127

Notes: Standard errors are shown in parentheses. ***, **, and * show significant level of 1%, 5%, and 10% respectively. Source: Authors' estimation, processed.

Table 4. System GMM Estimation Results with Income Level Classification

	Model C (Dependent: Population Growth)	**Model D (Dependent: Income Growth)**
Diversity (HIEF)	**2.4310***** (0.8265)	**-0.8350**** (0.3960)
Log Population Density	0.2108 (0.1620)	**-0.0929**** (0.0444)
Fertility Rate	**0.8962***** (0.1712)	-0.0684 (0.0881)
Mortality Rate	**-0.0180**** (0.0073)	**-0.0081**** (0.0041)
Log Net Migration	**2.8950***** (1.0204)	0.1345 (0.1253)
Sex Ratio	-8.9130 (8.8632)	**-12.5981***** (3.2192)
Female Labor Participation Rate	**-0.0183**** (0.0083)	**0.0148**** (0.0061)
Interaction Variable: Middle-Income to Low-Income Countries	0.8684* (0.4796)	**1.3814***** (0.3566)
Interaction Variable: High-Income to Low-Income Countries	**1.6536***** (0.5497)	**3.0056***** (0.3543)
Constants	**-17.6425**** (6.5861)	**14.0091**** (5.3010)
Observations	778	471
Countries	150	127

Notes: Standard errors are shown in parentheses. ***, **, and * show significant levels of 1%, 5%, and 10% respectively. Source: Authors' estimation, processed.

female labor force participation has also been shown to be statistically significant at 5% and have an inverse relationship with population growth in model A while showing no relationship at all with income growth in model B.

The baseline estimation results do not describe the full picture, as they only show how population growth and income per capita growth (GNI per capita) are explained by population diversity and other control variables at a global scale. To obtain a more accurate description of the aforementioned condition, we show how population diversity relates to population growth and income per capita growth by categorizing it based on the World Bank historical classifications by income as of 2013, following the latest available data for this research.

Table 4 above shows the relationship between population diversity and population growth as well as the relationship between population diversity and income growth with the addition of a categorical variable based on countries income level, which also provides consistency with the measure of our baseline estimation. With the addition of a categorical variable, the results illustrate that population diversity is statistically significant to both population growth and income growth which is consistent with the previous baseline estimation result. Other independent variables in model C, consisting of fertility rate and net migration, as well as the high-income categorical variable are positive and statistically significant towards population growth, while mortality rate and

female labor force participation are negative and statistically significant towards population growth as the dependent variable. Conversely, population density, sex ratio, and middle-income categorical variable are shown to not have any significant relationship with population growth. On the other hand, the results in model D show that population density, mortality rate, and sex ratio show a negatively significant relationship with income growth as the dependent variable, while the female labor force participation, middle-income, and high-income categorical variables are positively significant towards income growth. Fertility rate and net migration are the independent variables that are not statistically significant towards income growth as the dependent variable.

Our estimation that involves the income class categorical variable highlights the importance of the significant relationship between diversity and population growth, as this particular situation has been plaguing high-income economies, which may potentially cause social and economic problems if left alone (Peterson, 2017). Model C in Table 5 shows a positive significant relationship between diversity and population growth at the 1% level. To no surprise, the fertility rate, mortality rate, and net migration, which serve as the control variables, are showing statistical significance towards population growth. It is worth noting that female labor force participation causes a positive income growth, and this relationship is statistically significant at the 5% level.

DISCUSSIONS AND CONCLUSION

1. Discussion

The main findings from the baseline estimation indicate that ethnic diversity is statistically significant on both population growth and income growth. Diversity has a positive correlation with population growth and a negative correlation with income growth. The positive correlation of diversity with population growth aligns with Gören (2014), which concludes that diversity leads to higher population growth through fertility rates. Papyrakis & Mo (2014)provide an explanation for this phenomenon that a more diverse population could foster strategic interaction among ethnic groups to compete for influence within the society. To gain more influence, ethnic group leaders may promote pronatalism policy to increase the number of populations within the ethnic group, thus elevating their position and dominance in the society. As a result, this will enhance the fertility rate and increase the population growth in the highly diverse society. A similar explanation is also provided by Janus (2013) who argues that ethnic groups may promote a higher fertility rate to increase their relative voting power. Janus (2013) also further specifies that weak political institutions are the key factor in the emergence of this condition, using fertility rates as the key to increasing ethnic political power.

The negative correlation found in income growth is supporting the view that diversity inhibits economic development. The results are in line with Easterly & Levine (1997) who also identified a negative association between ethnic fragmentation and economic growth due to the frequent ethnic conflict occurring in the highly diverse region. A diverse society is prone to exhibit a propensity for rent-seeking behavior, which hinders the effective formulation and implementation of sound public policies. This can lead to adverse consequences, such as poor education attainment, high financial debt, and low infrastructure quality, due to heightened levels of societal segregation. Gören (2014) also elucidated the adverse direct impact of ethnic diversity on economic growth and the indirect repercussions of ethnic polarization on economic

outcomes through four channels, namely human capital accumulation, investment levels, trade openness, and the proclivity towards civil conflict.

In Gören (2014), it was stated that education, as one form of human capital accumulation, may not be properly and fairly distributed in an ethnically diverse environment due to the government's intention of using education as a tool to control and influence particular ethnic groups. This situation may lead to lower schooling levels, which negatively affects human capital and income growth. Easterly & Levine (1997) also noted that diverse societies may be less satisfied with the quality of education due to the disagreements between ethnic groups on the characteristics and aspects of the education itself, such as the language used and the learning materials, which could lead up to less investment in human capital. Ogbu & Simons (1998) further pointed out that minority groups are more likely to become suspicious of the public schools that are considered to favor the ruling ethnic group and discriminate against the minorities, thus discouraging them from taking on schooling.

The next channel, level of investment, has been partially explained by Easterly & Levine (1997) in the previous discussion. Countries with highly diverse populations are prone to rent-seeking behavior by each ethnic group. These rent-seeking activities may generate conflict of interest and lead to a problem in reaching an agreement on the kind of public goods that will be provided to the society due to the disharmony between ethnic groups. As a result, this will hinder the development of public infrastructure, educational institutions, healthcare, and government policy. This disruption would reduce the level of investment in the productive sector, which will weaken the economic growth and income growth. Ethnic diversity could also affect the economy through free trade channels. Regions with higher ethnic diversity are found to have lower-quality exported goods than the lower ethnic diversity regions due to the difficulties in communicating and collaborating between ethnic groups to produce high-quality differentiated products (Luong, 2021). Lower quality of exported goods will weaken the export sector and lead to lower income from export activities. Another channel, which is civil war, has also been identified as hampering economic development and tends to happen in ethnically diverse countries. According to Collier (2001), civil war could rapidly escalate and cause human and physical capital destruction and also mass exodus of the educated population. The consequences of this would severely inhibit the country's human development and the economy, as the country is unable to function properly.

Furthermore, an increased level of ethnic diversity can lead to fierce competition for jobs among different ethnic groups. In an ideal scenario, this heightened competition should act as a filter for employers to recruit the most competent applicants. As a result, this competitive environment can be beneficial for highly skilled workers. However, those who are unsuccessful in this competition and have already relocated to these regions may find themselves settling for lower-tier jobs, which subsequently leads to lower earnings according to the statistical discrimination theories (Horvath & Huber, 2019). Additionally, DiRienzo et al. (2007) found that countries with higher ethnic diversity tend to be less competitive. Consequently, lower competitiveness means having lower productivity and this causes a country's likelihood of sustained growth to be lower than more competitive countries, also causing the quality of labor to also be less competitive.

Table 5. Difference-in-Hansen Tests of Baseline Estimation

	Dependent: Population Growth	**Dependent: Income Growth**
Hansen test excluding group	Chi-squared = 142.90 P-value = 1.000	Chi-squared= 118.53 P-value = 1.000
Difference	Chi-squared = 3.14 P-value = 1.000	Chi-squared = 0.46 P-value = 1.000

Notes: H_0 = The instruments subset are exogenous. Source: Authors' estimation, processed.

It is worth noting that our study uses HIEF to capture ethnic diversity that closely resembles ethnic fractionalization. Ethnic fractionalization is defined as the extent to which a population is divided among many small groups. In contrast, ethnic polarization describes a configuration in which a society is divided between two or a few large, relatively equal groups. This could lead to different ethnic diversity impacts on population and income growth depending on the variable that is used as a measure (Rodríguez-Pose & von Berlepsch, 2019). In highly fragmented societies, the presence of many small groups might foster competitive interactions among groups, potentially leading to both positive effects and negative outcomes. By contrast, societies characterized by ethnic polarization tend to have a dominant divide that may intensify intergroup conflict, rent-seeking behavior, and political instability, which could more severely undermine income growth. Empirically, ethnic fractionalization measures are generally related to higher economic growth, while ethnic polarization measures are frequently related to lower economic growth (Ananta et al., 2023). The results of our estimation that show a negative correlation between ethnic diversity, as measured by the ethnic fractionalization index, and economic growth do not support the general conclusions that are found in the literature.

The validity of these results is supported by the difference-in-Hansen tests shown in Table 5 below. The Hansen test excluding the group is conducted to assess the model's validity without its instruments. Additionally, the difference test aims to examine the validity of the instruments. Based on the results, it can be concluded that the GMM models are valid, and the instruments are exogenous, as the p-values suggest not rejecting the null hypothesis of exogenous instruments.

The estimation results with income level classification reveal a consensus across countries at all income levels that net migration is correlated with a positive relationship towards population growth. On the other hand, it has been proven that the historical decline in world population due to falling fertility rates occurred in response to higher levels of economic development (Murdoch et al., 2018). In general, the high population growth often found in low-income economies and the low population growth in high-income economies are likely to cause social and economic inequalities as well as inhibit development efforts (Peterson, 2017). While international migration may help in adjusting these imbalances, such policies are often opposed by many and quite unpopular (Peterson, 2017). The primary reason for the unpopular view of migration is, among others, the perceived low labor quality of migrants, and political and sociocultural differences. However, such views may not always reflect the actual migrants' economic contributions. In fact, the perceived negative effects of immigrants are often baseless and create a dilemma, as most migrants' destination countries could benefit with more human capital and expertise brought by immigrants (OECD/ILO, 2018). Therefore, increased efforts to improve the overall well-being of less wealthy populations across the

world are vital to solving the dilemma between the perceived low labor quality of migrants and the plummeting population of a country (Murdoch et al., 2018; OECD/ILO, 2018). Additionally, asylum process claims, which are commonly faced by refugee migrants, who are most consistently considered as low labor quality on arrival, should be kept short, as this has a strong impact on their future labor outcomes, and facilitates them to join the labor market at the earliest possible stage helps, to minimize skill losses and increases the effectiveness of human capital investment (Brell et al., 2020). This is particularly relevant in light of Gören's (2014) findings, as prolonged asylum processes may exacerbate disparities in human capital accumulation through education in ethnically diverse environments, leading to an inequitable distribution of resources due to government policies targeting specific ethnic groups.

We also found that female labor force participation is statistically significant and positive towards income growth, implying that there has indeed been a shift in the paradigm of how people in high-income countries think about posterity and labor market conditions. Initial fertility models in the past decades across many countries were developed to sufficiently explain two consistent trends: lower fertility rates mean higher income and higher women's workforce participation (Doepke et al., 2022). However, our findings on female labor force participation indicate that these facts seem to have been changing in recent times, as some observations by Doepke et al. (2022)have confirmed the positive relationship between fertility and income, implying that women are more active in the workforce while still maintaining the same or even achieving a higher level of income. Furthermore, such trends are also supported by flexible labor market conditions with favorable family policies, especially towards women, and changing social norms with fathers caring for their children.

Ultimately, policymakers should consider the effects of population diversity on population growth and income growth when designing and implementing policies that affect these outcomes. Adopting a dynamic and context-specific approach to those three aspects is also important as these factors may vary over time and across countries. For example, policies that aim to expand the population of advanced economies or reduce the population growth of developing economies may need to account for the different preferences, behaviors, and incentives of diverse ethnic groups in society. It is also worth pointing out that policies may work well only in certain countries or certain time periods, which further reinforces the need for policymakers to assess and adjust their policies accordingly. Additionally, policymakers' awareness should also be raised regarding the potential challenges and opportunities that population diversity brings to social cohesion, political stability, and economic development. For instance, policies that promote interethnic cooperation, integration, inclusion, and equitable distribution of income may help to mitigate the negative effects of ethnic conflict, rent-seeking, and policy inefficiencies in highly diverse settings. Meanwhile, policies that foster ethnic diversity, recognition, and representation may help to enhance the positive effects of cultural diversity, innovation, and creativity in society.

With regards to economic inequality due to the high level of ethnic diversity, implementing a minimum wage has been shown to increase the incomes of low- and mid-income families and potentially push them out of poverty as well as reduce income disparities between ethnic groups (Wursten & Reich, 2021). Note that raising the minimum wage would potentially bring some

families out of poverty but would also result in some job loss as labor becomes more expensive. However, the net effect would still be an overall decrease in the total number of families in poverty as the minimum wage effect is more prominent compared to the job loss (National Academies of Sciences, 2023). As ethnically minoritized populations and tribal communities are overrepresented among those affected by a higher minimum wage, increasing it could help reduce economic inequities, raise incomes, and lift families out of poverty, ultimately improving well-being.

Countries with a high ethnic diversity can also better manage the challenges due to population growth and income inequality by improving education policies and workforce development programs. Education inequality begins early, with notable disparities in math and reading scores among racial and ethnic groups as children start kindergarten, and evidence indicates that attending preschool enhances, among others, kindergarten readiness and boosts academic performance(Fryer Jr. & Levitt, 2004; Reardon & Portilla, 2016). Despite the promising impacts, it is of no use if children do not attend early childhood education (Cabrera et al., 2022). Government interventions can help improve access to early childhood education by investing directly in national programs and indirectly through regional efforts that improve affordability and availability. One example of such a program is implementing a voluntary universal high-quality early education system and ensuring that universal goals are pursued with strategies tailored to different communities' needs(National Academies of Sciences, 2023). Effective programs should adapt to community needs, account for the true cost of quality care, and incorporate robust accountability systems to bridge the gaps in access and opportunity. Finally, ensuring political inclusion is important to foster a sense of social cohesion and ensure equitable economic policies in diverse societies, starting from early years. Strengthening civic infrastructure, such as encouraging political participation, ensuring fair representation in decision-making, and promoting voting rights, which contributes to more inclusive governance structures that benefit all ethnic groups (National Academies of Sciences, 2020). Increases in youth civic engagements from early years have important implications for equity, as they allow those of lower socioeconomic backgrounds to have more access to opportunities that lead to economically successful endeavors (Ballard, 2019; Pancer, 2015). Additionally, fostering a sense of belonging is important to connect with the community. True belonging goes beyond group membership, as it involves active participation, accountability, and contribution to society, including economic contribution (Fuligni, 2018).

2. Conclusion

In conclusion, our study reinforces the notion that ethnic diversity is a double-edged sword, with beneficial effects on population growth and potentially adverse implications for income growth. The conclusion on population growth may relate to the consensus that regions with diverse ethnic populations are known for their open social dynamics, making them pleasant places to reside and drawing new ethnicities to move in. Diverse populations could also be associated with an increase in strategic interaction between ethnic groups to compete for influence, thus promoting pronatalist policies, which is indicative of a heightened fertility rate within such varied demographic compositions. Our results on income growth can be explained by the adverse direct impacts of ethnic diversity on economic growth through various potential channels and the correlation between ethnic

diversity, lower competitiveness, and productivity, which in turn may reduce a country's potential for sustained growth and labor quality. It is worth pointing out that this study only used HIEF as the proxy variable for ethnic diversity. Therefore, the results may not accurately capture the full extent of the correlation between ethnic diversity, population growth, and income growth.

As for the policy relevancy, we note that ethnic diversity is linked with both positive and negative socioeconomic outcomes. Policies that enhance interethnic cooperation, equitable representation, and resource allocation are crucial to reducing ethnic conflict and rent-seeking behaviors, which were identified as barriers to income growth. In addition, the findings suggest that population diversity positively impacts population growth, often through higher fertility rates. For countries experiencing population decline and low fertility rates, particularly high-income homogeneous societies like Japan, strategic immigration policies could counteract demographic contraction and help rejuvenate aging populations. One example is by developing regional immigration incentives for under populated areas, connecting immigration policy with regional development objectives. The research also demonstrates that fertility rates significantly impact population growth across diverse societies. Consequently, policymakers should design family support systems that accommodate cultural variations in family formation and childrearing practices among different ethnic groups, particularly in low-income countries. One of the implementations is by creating targeted financial incentives for families, such as childcare subsidies, education allowances, and housing benefits calibrated to local economic conditions and cultural preferences. Lastly, the negative impact of diversity on income growth could be mitigated by implementing targeted policies that could maximize economic benefits while minimizing potential drawbacks of diversity. The targeted policies can include establishing inclusive entrepreneurship programs and implementing skills development programs tailored to the needs of diverse communities. Tailoring these services to diverse populations can reduce disparities and build trust across ethnic groups.

While this study provides important insights into the relationship between population diversity, population growth, and income growth, further study is needed in several areas. Future research may examine how these relationships differ across various regional situations, while also considering factors such as economic structure, migration patterns, and historical legacies of ethnic integration. A comparative study comparing developed and developing economies may reveal whether the observed effects are universal or region-specific. Meanwhile, a comparative study between countries with high diversity and low diversity allows for a deeper understanding of how ethnic diversity influences economic outcomes under different social and institutional conditions.

Additionally, the role of governance and institutional quality in shaping these relationships remains a critical aspect for investigation. Strong institutions and inclusive policies may mitigate the negative economic effects of ethnic diversity by fostering social cohesion, reducing rent-seeking behavior, and improving policy implementation. Exploring how different governance frameworks influence the economic impact of diversity could provide insightful policy implications.

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APPENDICES

Historical Index of Ethnic Fractionalization (HIEF) Ranking in 1960 and 2013 respectively

Ranking	Country	Year	HIEF	Ranking	Country	Year	HIEF
1	Liberia	1960	0.887	1	Liberia	2013	0.889
2	Togo	1960	0.884	2	Uganda	2013	0.883
3	Nigeria	1960	0.868	3	Togo	2013	0.88
4	South Africa	1960	0.853	4	Nepal	2013	0.86
5	Mali	1960	0.846	5	South Africa	2013	0.856
6	Philippines	1960	0.819	6	Chad	2013	0.855
7	D.R. of Congo	1960	0.816	7	Kenya	2013	0.855
8	Chad	1960	0.805	8	Mali	2013	0.852
9	Nepal	1960	0.804	9	Nigeria	2013	0.85
10	Senegal	1960	0.803	10	Guinea-Bissau	2013	0.808
11	Ethiopia	1960	0.803	11	Philippines	2013	0.807
12	Benin	1960	0.782	12	Indonesia	2013	0.803
13	Gabon	1960	0.77	13	East Timor	2013	0.802
14	Yugoslavia	1960	0.756	14	Sierra Leone	2013	0.801
15	Guinea	1960	0.752	15	Malawi	2013	0.791
16	Sudan	1960	0.745	16	Central African Republic	2013	0.79
17	Côte d'Ivoire	1960	0.744	17	Gabon	2013	0.789
18	Ghana	1960	0.736	18	Ethiopia	2013	0.783
19	Central African Republic	1960	0.733	19	Angola	2013	0.779
20	Burkina Faso	1960	0.73	20	Burkina Faso	2013	0.767
21	Iran	1960	0.73	21	Kuwait	2013	0.765
22	Indonesia	1960	0.709	22	Benin	2013	0.764
23	Congo	1960	0.7	23	Afghanistan	2013	0.763
24	Niger	1960	0.683	24	Gambia	2013	0.762
25	Canada	1960	0.682	25	Namibia	2013	0.76
26	USSR	1960	0.665	26	Pakistan	2013	0.748
27	Ecuador	1960	0.665	27	Senegal	2013	0.747
28	Colombia	1960	0.657	28	Sudan	2013	0.746
29	Peru	1960	0.637	29	Iran	2013	0.743
30	Trinidad and Tobago	1960	0.625	30	Ghana	2013	0.736
31	Bolivia	1960	0.614	31	Côte d'Ivoire	2013	0.731
32	Malaysia	1960	0.601	32	Canada	2013	0.73
33	Guatemala	1960	0.598	33	Guinea	2013	0.727
34	Mauritania	1960	0.59	34	Mauritania	2013	0.713
35	Afghanistan	1960	0.586	35	Qatar	2013	0.708
36	Pakistan	1960	0.585	36	Zambia	2013	0.706
37	Brazil	1960	0.57	37	Congo	2013	0.704
38	Laos	1960	0.562	38	Democratic Republic of Congo	2013	0.7
39	Mexico	1960	0.539	39	Guyana	2013	0.695
40	Belgium	1960	0.515	40	United Arab Emirates	2013	0.684

Ranking	Country	Year	HIEF	Ranking	Country	Year	HIEF
41	Chile	1960	0.514	41	Spain	2013	0.669
42	Bhutan	1960	0.502	42	Niger	2013	0.666
43	Panama	1960	0.497	43	Eritrea	2013	0.659
44	Czechoslovakia	1960	0.478	44	Trinidad and Tobago	2013	0.655
45	Nicaragua	1960	0.465	45	Bhutan	2013	0.651
46	Venezuela	1960	0.457	46	Djibouti	2013	0.649
47	Morocco	1960	0.453	47	Colombia	2013	0.639
48	Cuba	1960	0.451	48	Bosnia-Herzegovina	2013	0.637
49	Sri Lanka	1960	0.451	49	Laos	2013	0.634
50	Spain	1960	0.438	50	Peru	2013	0.618
51	Myanmar	1960	0.433	51	Panama	2013	0.612
52	Dominican Republic	1960	0.405	52	Oman	2013	0.597
53	Mongolia	1960	0.4	53	Belgium	2013	0.592
54	Thailand	1960	0.387	54	Tanzania	2013	0.591
55	Singapore	1960	0.385	55	Myanmar	2013	0.59
56	Iraq	1960	0.366	56	Mexico	2013	0.587
57	Cyprus	1960	0.336	57	Bahrain	2013	0.582
58	United Kingdom	1960	0.309	58	Bolivia	2013	0.572
59	D.R. of Vietnam	1960	0.264	59	Malaysia	2013	0.57
60	Costa Rica	1960	0.26	60	Morocco	2013	0.566
61	United States of America	1960	0.259	61	Macedonia	2013	0.562
62	Bulgaria	1960	0.249	62	Brazil	2013	0.559
63	Romania	1960	0.236	63	Latvia	2013	0.547
64	Republic of Vietnam	1960	0.233	64	Nicaragua	2013	0.544
65	Cambodia	1960	0.231	65	Kazakhstan	2013	0.538
66	Switzerland	1960	0.23	66	Ecuador	2013	0.528
67	Israel	1960	0.222	67	Fiji	2013	0.528
68	Uruguay	1960	0.211	68	United States of America	2013	0.527
69	Syria	1960	0.199	69	Turkey	2013	0.521
70	El Salvador	1960	0.197	70	Venezuela	2013	0.52
71	Saudi Arabia	1960	0.195	71	Cuba	2013	0.517
72	Taiwan	1960	0.195	72	Guatemala	2013	0.511
73	New Zealand	1960	0.185	73	Kyrgyz Republic	2013	0.487
74	Yemen Arab Republic	1960	0.18	74	New Zealand	2013	0.485
75	Rwanda	1960	0.164	75	Mauritius	2013	0.466
76	Oman	1960	0.154	76	Estonia	2013	0.458
77	Honduras	1960	0.153	77	Dominican Republic	2013	0.453
78	Libya	1960	0.142	78	Iraq	2013	0.446
79	Turkey	1960	0.13	79	Cape Verde	2013	0.442
80	Lebanon	1960	0.125	80	Chile	2013	0.439
81	Finland	1960	0.117	81	Moldova	2013	0.427
82	Sweden	1960	0.117	82	Zimbabwe	2013	0.415
83	Haiti	1960	0.108	83	United Kingdom	2013	0.399
84	Paraguay	1960	0.105	84	Costa Rica	2013	0.398

Ranking	Country	Year	HIEF	Ranking	Country	Year	HIEF
85	China	1960	0.101	85	Serbia	2013	0.396
86	Tunisia	1960	0.1	86	Botswana	2013	0.395
87	German Federal Republic	1960	0.086	87	Singapore	2013	0.395
88	Albania	1960	0.07	88	Swaziland	2013	0.39
89	Ireland	1960	0.068	89	Russia	2013	0.376
90	Somalia	1960	0.066	90	Israel	2013	0.376
91	Argentina	1960	0.066	91	Taiwan	2013	0.373
92	Austria	1960	0.06	92	Algeria	2013	0.372
93	Hungary	1960	0.052	93	Ukraine	2013	0.37
94	Greece	1960	0.045	94	Switzerland	2013	0.367
95	Italy	1960	0.041	95	Georgia	2013	0.367
96	Jordan	1960	0.035	96	Tajikistan	2013	0.367
97	German Democratic Republic	1960	0.031	97	Netherlands	2013	0.354
98	Poland	1960	0.027	98	Thailand	2013	0.352
99	Norway	1960	0.021	99	Cyprus	2013	0.347
100	Australia	1960	0.021	100	Sri Lanka	2013	0.323
101	Netherlands	1960	0.013	101	Mongolia	2013	0.315
102	Denmark	1960	0.012	102	Lesotho	2013	0.313
103	Japan	1960	0.012	103	Uzbekistan	2013	0.313
104	Madagascar	1960	0.005	104	Belarus	2013	0.309
105	Egypt	1960	0.003	105	Burundi	2013	0.308
106	Portugal	1960	0.001	106	Bulgaria	2013	0.289
107	Democratic People's Republic of Korea	1960	0	107	Lithuania	2013	0.284
108	Republic of Korea	1960	0	108	Rwanda	2013	0.28
				109	Australia	2013	0.276
				110	Democratic Republic of Vietnam	2013	0.263
				111	Czech Republic	2013	0.262
				112	Libya	2013	0.259
				113	Slovenia	2013	0.258
				114	Turkmenistan	2013	0.255
				115	Austria	2013	0.248
				116	Slovakia	2013	0.241
				117	Hungary	2013	0.232
				118	Honduras	2013	0.229
				119	Saudi Arabia	2013	0.224
				120	Somalia	2013	0.222
				121	Portugal	2013	0.22
				122	Sweden	2013	0.219
				123	Syria	2013	0.213
				124	Jamaica	2013	0.21
				125	Romania	2013	0.207

Ranking	Country	Year	HIEF	Ranking	Country	Year	HIEF
				126	Madagascar	2013	0.194
				127	China	2013	0.19
				128	German Federal Republic	2013	0.189
				129	Paraguay	2013	0.179
				130	Denmark	2013	0.177
				131	Uruguay	2013	0.176
				132	Ireland	2013	0.174
				133	Croatia	2013	0.171
				134	Greece	2013	0.167
				135	El Salvador	2013	0.165
				136	Argentina	2013	0.158
				137	Cambodia	2013	0.158
				138	Norway	2013	0.151
				139	Albania	2013	0.139
				140	Finland	2013	0.138
				141	Lebanon	2013	0.133
				142	Yemen Arab Republic	2013	0.126
				143	Azerbaijan	2013	0.122
				144	Italy	2013	0.11
				145	Haiti	2013	0.105
				146	Solomon Islands	2013	0.097
				147	Republic of Korea	2013	0.095
				148	Poland	2013	0.069
				149	Comoros	2013	0.054
				150	Armenia	2013	0.045
				151	Jordan	2013	0.044
				152	Egypt	2013	0.041
				153	Tunisia	2013	0.034
				154	Bangladesh	2013	0.025
				155	Democratic People's Republic of Korea	2013	0.02
				156	Japan	2013	0.019

List of Selected Countries

Continent	Number of Countries	Name of Countries	Percentage population out of the total population of the continent
Africa	49	Liberia, Uganda, Togo, South Africa, Chad, Kenya, Mali, Nigeria, Guinea-Bissau, Sierra Leone, Malawi, Central African Republic, Gabon, Ethiopia, Angola, Burkina Faso, Benin, Gambia, Namibia, Senegal, Sudan, Ghana, Côte d'Ivoire, Guinea, Mauritania, Zambia, Congo, Democratic Republic of Congo, Niger, Eritrea, Djibouti, Tanzania, Botswana, Swaziland (Eswatini), Algeria, Zimbabwe, Cape Verde, Libya, Burundi, Rwanda, Lesotho, Somalia, Madagascar, Egypt, Tunisia, Comoros, Mauritius, Morocco, Mozambique.	92%
Asia	39	Nepal, Kuwait, Afghanistan, Pakistan, Iran, United Arab Emirates, Qatar, Oman, Bahrain, Malaysia, Kazakhstan, Kyrgyz Republic, Iraq, Bhutan, Laos, Myanmar, Bangladesh, Sri Lanka, Mongolia, Uzbekistan, Tajikistan, Turkmenistan, Saudi Arabia, Syria, Israel, Taiwan, Georgia, Thailand, Cyprus, Democratic People's Republic of Korea, Japan, Democratic Republic of Vietnam, China, Lebanon, Yemen Arab Republic, Azerbaijan, Armenia, Philippines, Indonesia.	65%
Europe	36	Bosnia-Herzegovina, Belgium, Macedonia, Latvia, Estonia, Moldova, United Kingdom, Serbia, Russia, Ukraine, Switzerland, Netherlands, Lithuania, Czech Republic, Slovenia, Austria, Slovakia, Hungary, Portugal, Sweden, Romania, Germany, Denmark, Ireland, Croatia, Greece, Albania, Finland, Italy, Spain, Poland, Bulgaria, Belarus, Norway, France, Montenegro.	90%
Northern America	2	Canada, United States of America	99%
Latin America and the Caribbean	22	Colombia, Peru, Ecuador, Bolivia, Brazil, Venezuela, Argentina, Paraguay, Uruguay, Chile, Guyana, Nicaragua, Trinidad and Tobago, Panama, Dominican Republic, Honduras, Jamaica, Costa Rica, Cuba, Guatemala, Haiti, Mexico.	97%
Oceania	8	Fiji, New Zealand, Australia, Solomon Islands, Papua New Guinea, Samoa, East Timor, Tonga.	97%

Fisher Type Augmented Dickey-Fuller (ADF) Panel Unit Root Test

Variables (in level)	p-value
Population Growth	**0.0000**
Log GNI per Capita	**0.0193**
Diversity (HIEF)	**0.0000**
Log Population Density	**0.0000**
Fertility Rate	**0.0000**
Mortality Rate	**0.0000**
Log Net Migration	**0.0000**
Sex Ratio	**0.0000**
Female Labor Participation Rate	**0.0000**