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Abstract

This study investigates how various dimensions of globalization and socio-economic factors impact key demographic indicators, namely birth rate, death rate, and age dependency ratio. As countries transition through different stages of demographic and economic development, understanding the intricate interrelations between global integration, human capital formation, health outcomes, and fertility behavior becomes critical for evidence-based policy formulation. The research employs a Vector Autoregression (VAR) model to capture the dynamic, time-lagged effects of independent variables such as Foreign Direct Investment (FDI), trade openness, net migration, tertiary education, female labor force participation, urbanization, infant mortality, internet penetration, and GDP growth on demographic indicators. Additionally, Impulse Response Functions (IRFs) are used to simulate how sudden changes (shocks) in these factors influence birth rate trajectories over time, offering a deeper understanding of short-term versus long-term effects. Key findings indicate that net migration has a significant positive effect on birth rates due to the inflow of younger, reproductive-age individuals. Interestingly, tertiary education—often associated with fertility decline—shows a short-term positive impact, suggesting a "catch-up" fertility phenomenon once women attain economic stability. Infant mortality remains a strong predictor of higher fertility, reinforcing the insurance effect theory. Urbanization and trade openness are consistently associated with fertility declines due to structural lifestyle changes, rising opportunity costs, and modern values favoring smaller families. FDI shows delayed but significant fertility-reducing effects, likely mediated through labor market restructuring, increased female employment, and social modernization. Internet penetration, while theoretically influential, shows only mild and statistically insignificant effects in the short run, suggesting the importance of complementary social and educational policies. GDP growth alone is not a direct driver of fertility change, emphasizing the role of inclusive development and institutional quality. The IRF analyses further reveal that demographic changes influence economic variables in return. Rising fertility initially deters FDI and trade, while fertility decline due to education and female labor participation supports long-term economic competitiveness. Urbanization leads to persistent fertility reductions and economic reorientation, while aging populations reduce FDI inflows, trade engagement, and GDP growth due to labor shortages and increased fiscal pressure. However, aging can temporarily boost net migration and female employment in the short term as adaptive policy responses are implemented. The study's findings are crucial for designing integrated, forward-looking policies in the areas of education, migration, gender equality, healthcare, urban planning, and economic globalization. Future research should extend this framework using panel data across countries, disaggregated age-group analysis, and machine learning models to detect nonlinear effects and identify policy thresholds. Exploring the role of cultural norms, social protection policies, and environmental constraints could further enrich the understanding of demographic transitions in an increasingly interconnected world.

Ch-1
Introduction

India's economic performance in 2025 highlights its resilience and capacity to adapt amidst global disruptions. Despite facing significant hurdles such as geopolitical uncertainties, trade disruptions, and demographic transformations, India continues to experience strong economic momentum. This growth is driven by robust domestic demand, strategic government investments, and a rapidly expanding services sector. The Indian economy reported a **7.6% GDP growth** in the September 2024 quarter, with estimates for FY 2024–25 ranging between **7% and 7.2%**, making India one of the fastest-growing major economies globally, according to **PwC's 27th Annual Global CEO Survey**. Key contributors to this growth include strong performances in **manufacturing, mining, and construction**, along with a resurgence in exports, particularly in high-value sectors such as **electronics and pharmaceuticals**. India's **fiscal deficit** has declined to **5.63% of GDP**, outperforming earlier projections, a result of improved capital expenditure efficiency and lower revenue shortfalls, as indicated in the **2024 Economic Survey**. India's digital transformation continues at a rapid pace. The digital economy is projected to reach **$1 trillion by 2030**. Innovations like **UPI (Unified Payments Interface)**, **Aadhaar-based authentication**, and platforms such as **ONDC (Open Network for Digital Commerce)** are enhancing financial inclusion and modernizing commerce. These technologies have significantly improved transparency, efficiency in service delivery, and have integrated millions into the formal economic system. Globalization has been a major force in shaping India's economy since the liberalization of the 1990s. **Foreign Direct Investment (FDI)** surged by **45%** year-on-year to $**29.79 billion** during April-September 2024, largely driven by inflows in **services, IT, telecom, and pharmaceutical** sectors. India's **trade-to-GDP ratio** increased to **over 43% in 2023**, reflecting its deepening global integration. The country also emerged as one of the largest **digital economies**, with **850 million internet users**. India's net migration figure stood at **-486,136**, yet the country remained the **top global recipient of remittances**, receiving **$120 billion in 2023**. Furthermore, India ranked as the **seventh-largest service exporter**, and **second globally in telecommunications, computer, and IT exports**, according to data from **PIB**. India's participation in **global value chains (GVCs)** also expanded, with its share in GVC-related trade growing from **35.1% in 2019 to 40.3% in 2022**. The **Logistics Performance Index** has improved, indicating better trade facilitation and infrastructure. These advancements have positively impacted sectors across the board — from agriculture and industry to services — by boosting productivity and generating employment. The **RBI** noted India's evolving role as a strategic **"connector country"**, capable of linking global trade networks, especially in **technology, digital services, and pharmaceuticals**. Nevertheless, globalization has brought its own set of challenges. Increased foreign competition threatens some domestic industries, and external shocks—such as the recent **26% tariff on Indian exports by the U.S.**—highlight India's vulnerability in globarade. Still, India's relatively lower reliance on goods exports and its robust inter

market have helped absorb such shocks. India's demographic dynamics continue to shape its economic future. The country has benefited significantly from a **demographic dividend** — a period marked by a large working-age population — which contributed an estimated **0.7 percentage points annually** to per capita GDP growth between 1997 and 2023. However, this advantage is expected to decline to **0.2 percentage points per year** by **2050**, as the population

ages and the dependency ratio rises. To effectively leverage the remaining **33-year window of opportunity**, the **McKinsey Report** suggests that India must prioritize **skill development, job creation, and labor reforms**. These steps are essential for maintaining productivity and competitiveness in the global economy. **Urbanization** is another transformative trend, with projections indicating that over **40% of India's population** will reside in cities by 2030. Urban areas, though facing infrastructure and housing challenges, contribute significantly more to GDP compared to rural regions. They also serve as centers for **innovation, employment, and efficient service delivery**. To ensure sustainable development and economic resilience, Indian policymakers must navigate the complex interplay of **global economic trends, technological advancements, and demographic changes** with strategic foresight. Such an approach will be key to cementing India's position as a leading economic power in the coming decades.

1.1 Theoretical Concepts

1.1.1 Demographic Transition

1.1.1.1 Demographic Transition Theory

Demographic Transition Theory (DTT) offers a framework to understand how population structures evolve in tandem with a country's economic and social development. Originally conceptualized by demographers such as **Warren Thompson** and **Frank Notestein**, the theory outlines how societies progress through stages of demographic change—from high birth and death rates in pre-industrial societies to low rates in advanced, post-industrial economies. the theory outlines the relationship between economic development and demographic changes, particularly birth and death rates. It provides a framework for understanding population growth patterns and their socio-economic implications. At its core, the theory posits that population growth is not static; instead, it is influenced by various interrelated factors such as healthcare access, education levels, urbanization, gender roles, and economic structures. Rather than focusing solely on fertility and mortality rates, modern interpretations of DTT emphasize how these rates are shaped by deeper societal transitions. Another important dimension of the theory lies in its application to development policy and planning.

The Five Stages of Demographic Transition:

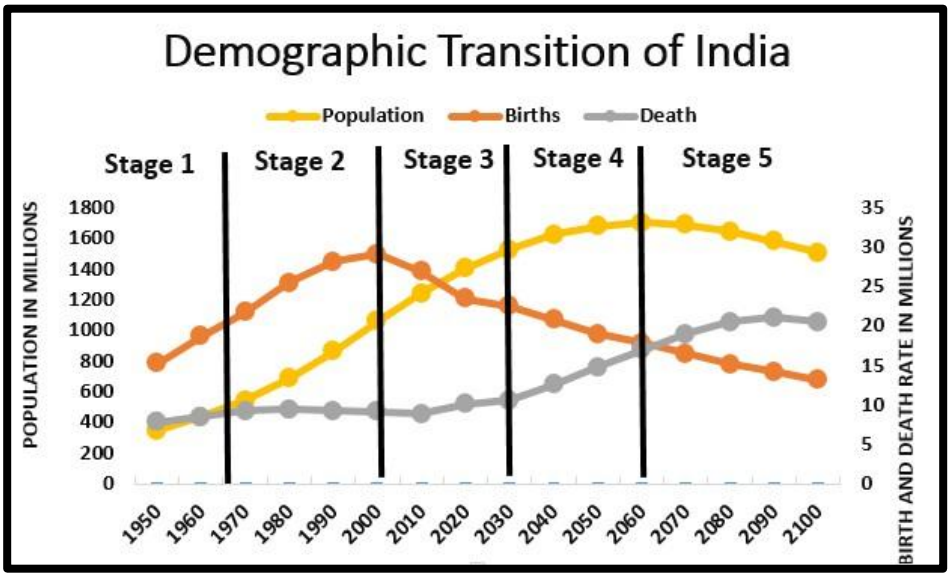
Stage 1: High Stationary (Pre-1965)

In this phase, India experienced both elevated birth and death rates, which led to a relatively stable population size with limited overall growth. Birth rates were around 40-45 per 1,000, while death rates were equally high due to poor sanitation, frequent famines, lack of medical care, and epidemics such as the 1918 influenza pandemic. The population grew slowly, with India's total population in 1900 estimated at about 238 million. This phase represents the pre-industrial period, marked by a largely agriculture-based economy and a focus on basic survival needs.

Stage 2: Early Expanding (1965–2000)

India entered this stage with significant declines in death rates due to improvements in public health, sanitation, and food distribution.
The 1970s marked the initiation of population control programs like the National Population Policy of 1976. However, birth rates remained high, leading to rapid population growth. By 1990s, the death rate had dropped to approximately 11 per 1,000, while birth rates stayed around 33 per 1,000. This period saw the introduction of vaccines, better irrigation systems, animproved transportation, which mitigated the effects of famines and disease outbreaks. The population grew to about 1 billion by independence in 2000s.

Fig 1 : Line chart of Five stages of Demographic Transition



Stage 3: Late Expanding (2000–2030s)

Post-2000s, India's birth rates began to decline gradually from 27 at the starting of the 21st century to 16 by 2030, while death rates continued to fall due to advancements in healthcare, family planning, and education. Fertility rates declined from 3.5 children per woman in the 2000s to around 1.8.
India's population is expected to crossed 1.5 billion by 2030s, along by improved living standards and increased life expectancy.

Stage 4: Low Stationary (2030s–2060s)

India entered this phase when both birth and death rates declined and reached relatively low and stable levels. The Total Fertility Rate (TFR) fell to 1.73 by 2060, below replacement level of 2.1. Life expectancy will rise significantly, reaching 79.8 years in 2060, while the crude death rate dropped to 10 per 1,000. Birth rates continued declining due to increased urbanization, widespread use of contraception, and women's education and workforce participation. The population will grow at a diminishing rate and reaches its maximum of 1.7 billion by 2061.

Stage 5: Declining (2060s-2100)

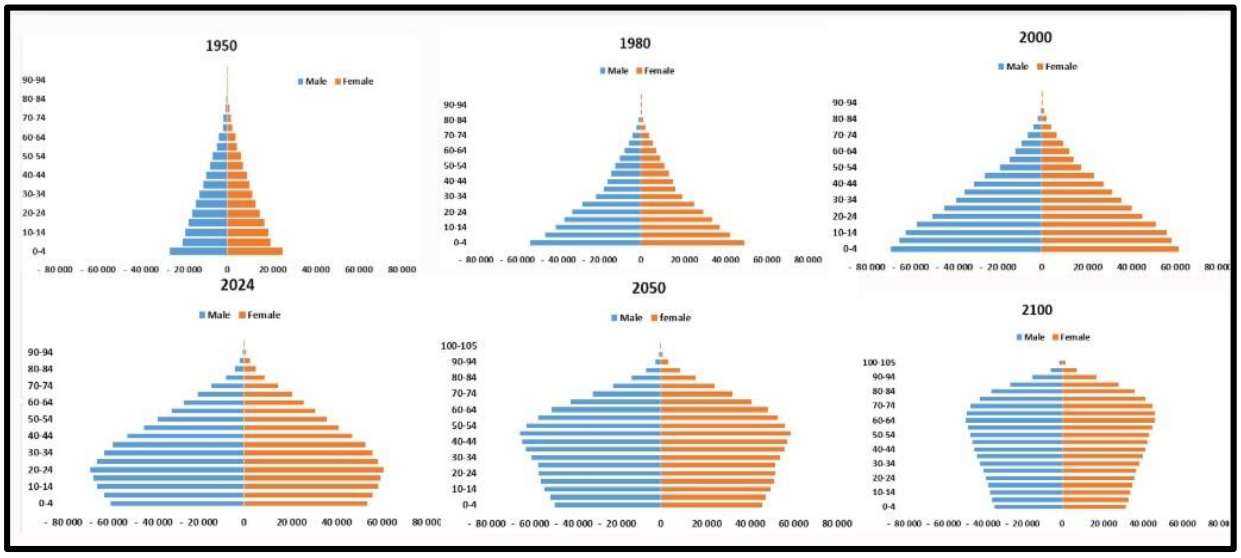
After 2060 population gradually began to decline to 1.5 billion by 2100 due to sustained low fertility rates and aging demographics. Challenges like a shrinking workforce and higher

dependency ratios are expected. Policies promoting immigration and workforce participation may become necessary to counterbalance these trends.

1.1.1.2 Population Pyramid

A population pyramid visually displays the distribution of a population based on age groups and gender. It typically shows the proportion of males and females in various age groups, divided into broad categories, often by five-year intervals. The horizontal axis represents the number or percentage of individuals, while the vertical axis represents age groups, from the youngest (at the bottom) to the oldest (at the top). The **population pyramid** was first introduced by **William Farr**, a British physician and epidemiologist, in the mid-19th century

Fig 2: Population Pyramid of India from 1950 to 2100



India's population pyramid, reflecting the country's demographic transition from 1950 to 2100, showcases significant changes in birth, death rates, and population structure over time. The transition can be understood through distinct stages

1950s: Early Stage – High Birth and Mortality Rates

In 1950, India’s population pyramid featured a wide base, indicating a high birth rate along with elevated mortality levels. The majority of the population was concentrated in the **0-4 age group**, with a very large proportion of children born each year. At the same time, **infant mortality** and **child mortality** were high, leading to fewer individuals surviving to older age groups. The population structure was pyramid-like, reflecting a **youth-heavy** demographic profile. In this phase, limited access to healthcare, nutrition, and sanitation contributed to high mortality rates, especially among infants and children.

1980s: Transition Phase – Continued High Birth Rates, Declining Mortality

By 1980, India's population pyramid began to show signs of change. The **birth rate** remained high, but **mortality rates** started to decline, particularly in younger age groups, due to improvements in **healthcare**, **sanitation**, and **vaccination** programs. This meant that a greater number of children survived into adolescence and adulthood, leading to a **larger working-age population**. The base of the pyramid still expanded, although not as rapidly as before, with more individuals in the **0-4 and 5-9 age groups**. The emergence of a youth-dominated population led to an upward expansion of the pyramid.

2000s: Growth Phase – Increased Child Survival and Growing Working-Age Population

By the year 2000, India saw further expansion in its population, driven by improved **child survival rates** due to advances in **health facilities**, widespread **immunization**, and better **maternal care**. These improvements resulted in a notable increase in the **working-age population (15-64 years)**, further reducing the dependency ratio, which is the proportion of nonworking (young and elderly) to working individuals. By now, the base of the pyramid, though still broad, began to slightly shrink as **birth rates** began to gradually decline in response to urbanization, better education, family planning, and changing socio-economic factors. While fertility remained above replacement levels, the shift toward smaller families was becoming more evident.

2024: Current Phase – Shrinking Base, Expanding Working-Age Population

As of 2024, India's population pyramid continues to show significant changes. The **base of the pyramid** has started to shrink, signaling a **decline in birth rates**. This trend is the result of rising **educational attainment**, **increased participation of women in the workforce**, and **urbanization**—all of which contribute to delayed marriages and fewer children per family. The working-age population, however, has expanded significantly, and India is witnessing what is known as the **demographic dividend**: a large, youthful, and economically active population. With the working-age population growing faster than the dependent population (children and elderly), there is a potential economic boost if proper employment and skill development are in place.

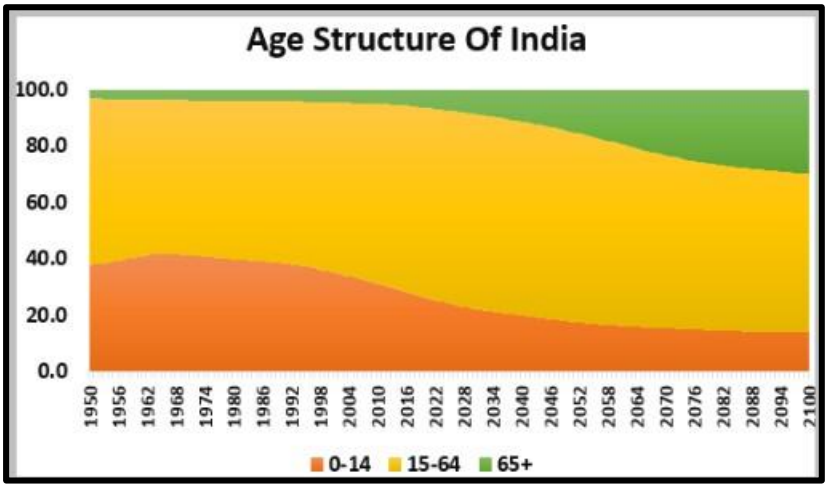
2050: Mid-Life Stage – Columnar Shape with Growing Middle-Aged Population

By 2050, India's population pyramid is projected to take on a **columnar shape**, meaning the number of people in different age groups would be more evenly distributed, with the middleaged population becoming the largest segment. The **working-age group** (especially those in the **25-54** age range) will make up a significant portion of the population, marking the peak of the demographic dividend. However, this will also signal a **slowing population growth rate**, as fertility rates continue to fall and the overall population stabilizes.

2100: Advanced Stage – Aging Population, Top-Heavy Structure

By 2100, India's population pyramid is expected to take on a **top-heavy structure**, signaling an **aging population**. A larger proportion of the population will be in the **elderly age group** (65+ years), reflecting the effects of lower birth rates, better healthcare leading to longer life expectancy, and a shrinking proportion of younger people. The working-age population will still be significant, but it will not be able to support the growing elderly population at the same level as before. The dependency ratio—reflecting the growing number of elderly relative to the working-age population—is expected to rise, putting considerable pressure on pension schemes, healthcare infrastructure, and social welfare systems.

Fig 3: Age structure of India from 1950 to 2100



From 1950 to 2100, India's dependency ratio has undergone significant shifts. In 1950, a high dependency ratio was due to a large youth population and high fertility rates. By 2000, the working-age population grew as fertility declined, reducing the dependency ratio and contributing to a demographic dividend. However, by 2050, the aging population and lower birth rates will start increasing the dependency ratio again, and by 2100, the ratio will rise further, as the elderly population outgrows the working-age group.

1.1.1.3 Malthus Population Theory

Thomas Malthus theorized that population expands at an exponential rate, whereas food supply grows at a linear, or arithmetic, pace This imbalance, he argued, would eventually lead to resource scarcity, famine, disease, and mortality, which act as natural checks on population growth. Malthus believed that if left unchecked, population growth would outstrip food supply, causing widespread poverty and suffering. He advocated for moral restraint, such as delayed marriage and celibacy, to control population. His theory highlighted the potential negative effects of unchecked population growth on economic stability and living standards, influencing early discussions on population policy and resource management.

1.1.1.4 Optimum Population Theory

The Optimum Population Theory, introduced by Edwin Cannan, suggests there is an ideal population size that maximizes per capita income and economic welfare. If the population is below this optimum level, resources are underutilized, and economic output is low. Conversely, if the population exceeds the optimum level, it leads to diminishing returns, overuse of resources, and a decline in per capita income. The theory emphasizes balance between population size and available resources, arguing that economic productivity and social well-being are highest at this equilibrium point.

1.1.1.5 Marx's View

Marx viewed overpopulation not as a cause of poverty but as a result of capitalist systems. He argued that capitalism produces a "reserve army of labor"—an excess of workers—by exploiting labor and reducing wages. According to Marx, population pressure emerges when workers are displaced by technological advancement or profit-driven production cuts. The real issue lies in wealth distribution and class struggle, not in the sheer number of people. Marx believed that under socialism, resources would be shared more equally, and overpopulation would not be a threat.

1.1.1.6 Simon Kuznet Inverted U

Simon Kuznets argued that moderate population growth can stimulate economic development by expanding the labor force, increasing demand, and encouraging innovation. He observed that in early stages of development, population growth may help economies by providing human capital. However, if population growth exceeds the capacity to provide education, jobs, and resources, it becomes a constraint on growth. Kuznets emphasized a dynamic relationship, suggesting that demographic changes and economic structures must align for sustained progress. Thus, population growth is neither purely beneficial nor harmful—it depends on the context and stage of development.

1.1.1.7 Solow Swan Model

The Solow-Swan model explains long-term economic growth through capital accumulation, labor force growth, and technological progress. It shows that while population growth can increase total output, it dilutes capital per worker, potentially reducing per capita income. The model emphasizes the crucial role of savings and investment in accumulating capital, while recognizing technological progress as the primary engine of long-term economic growth. Eventually, the economy reaches a steady state where per capita output grows only through technological advancement, not capital accumulation alone.

1.1.1.8 Gary Becker's theory on fertility

Gary Becker's theory explains fertility choices through an economic lens, where parents weigh the costs and benefits of having children. As income rises, families tend to prefer fewer children of higher "quality," investing more in their health, education, and overall well-being. Higher opportunity costs of childbearing, especially for women in the workforce, also contribute to lower fertility rates. Becker emphasized that fertility decisions are influenced by economic factors such as income, education, and employment, not just biological or cultural ones. The theory helps explain declining birth rates in developed and developing economies.

1.1.1.9 Dependency Ratio theory

The dependency ratio indicates the share of dependents—both children and elderly—compared to the working-age population. A high dependency ratio means more people rely on fewer workers, increasing the burden on economic resources, taxation, and public services like healthcare and pensions. In developing nations, a youthful dependency ratio can strain education and employment systems, while in aging societies, pension and healthcare costs rise. A low dependency ratio is often associated with economic opportunity, as a larger labor force supports fewer dependents, allowing more investment in development and savings.

1.1.1.10 Demographic Dividend Theory

The demographic dividend refers to the economic growth potential that arises when a country experiences a decline in fertility and mortality rates, leading to a larger share of the population being in the working-age group. With fewer dependents and more workers, economies can benefit from increased productivity, savings, and investment—if complemented by policies promoting education, health, and job creation. This window of opportunity is not automatic or permanent; without proper planning, the advantage may be lost. Countries like South Korea and China capitalized on this phenomenon during their rapid economic transformations.

In this paper we aim to study about how globalization has impacted demographic transition.

1.1.2 Globalization

1.1.2.1 Definition

Globalization is the process by which the world becomes increasingly interconnected and interdependent, especially in terms of economies, cultures, and populations. This integration is largely driven by the cross-border flow of goods, services, capital, information, and people. It is facilitated by technological advancements, reduced transportation and communication costs, and the liberalization of trade and investment policies. The term is often associated with economic globalization, though it also encompasses social, political, cultural, and environmental dimensions.

1.1.2.2 Definition by famous economist

Renowned economists have provided distinct definitions of globalization. Joseph Stiglitz, a Nobel Prize winner, describes globalization as “the increasing interconnectedness of countries and peoples worldwide, driven by significant reductions in transportation and communication costs, alongside the removal of artificial barriers to the movement of goods, services, capital, knowledge, and people” (Stiglitz, 2002). Similarly, Thomas L. Friedman describes globalization as "the inexorable integration of markets, nation-states, and technologies to a degree never witnessed before" (Friedman, 2005). The International Monetary Fund (IMF) views globalization as a historical process of increasing economic integration through trade and financial flows.

1.1.2.3 History of globalization

Historically, globalization is not a recent phenomenon. It has evolved through various stages over centuries. In ancient and medieval times, trade routes like the Silk Road connected regions from China to Europe, enabling the exchange of goods, ideas, and technology. The Age of Exploration during the 15th to 18th centuries saw European powers connecting continents via sea routes, with colonization spreading Western influence globally. The 19th century, marked by the Industrial Revolution, witnessed significant advancements in transportation and communication, such as steamships, railways, and telegraphs, which dramatically reduced travel times and increased trade efficiency. This period saw a surge in global economic activity, particularly under colonial empires. The early 20th century experienced high levels of globalization, especially before World War I. Nevertheless, global trade and economic collaboration were severely disrupted by the World Wars and the Great Depression. It was only after World War II that globalization resumed, with the establishment of key institutions such as the IMF, World Bank, and the General Agreement on Tariffs and Trade (GATT), later replaced by the World Trade Organization (WTO). These institutions fostered economic collaboration and liberalization.

1.1.2.4 Recent Scenario

As of 2024, globalization continues to evolve in complex ways. According to the World Bank, global trade accounts for more than 60% of world GDP, reflecting the depth of economic integration. Foreign Direct Investment (FDI) flows, which had declined during the COVID-19 pandemic, are recovering and shifting toward developing regions, particularly Asia and Africa (UNCTAD, 2023). Digital globalization is rapidly expanding, with cross-border data flows now outpacing trade in goods, enabling new forms of international collaboration in fields like artificial intelligence, finance, and e-commerce. At the same time, geopolitical tensions and trade disputes—such as the U.S.-China trade war—have led to some "deglobalization" tendencies, including efforts to shorten supply chains and promote domestic manufacturing.

1.1.2.5 Economic Implication

The economic implications of globalization are far-reaching and can be viewed from both positive and negative perspectives. On the positive side, globalization enhances economic

growth and efficiency. It allows countries to specialize based on comparative advantage, leading to more efficient allocation of resources and higher productivity. Open economies tend to grow faster than closed ones, as they benefit from greater access to technology, capital, and innovation (Bhagwati, 2004). Moreover, globalization facilitates access to broader markets and modern technologies. This enables firms to scale up production, improve efficiency, and innovate continuously. Developing countries, in particular, benefit from technology transfer and capacity building through partnerships with multinational corporations. Foreign investment and employment generation are other notable benefits. FDI not only brings in capital but also modern management practices and improved infrastructure. For example, countries like Vietnam, Bangladesh, and India have witnessed massive employment growth in their manufacturing and service sectors due to globalization. Furthermore, globalization has led to wider availability of goods and services at lower prices. Consumers benefit from more choices, better quality, and reduced costs due to economies of scale and competition.

1.1.2.6 Challenges and COVID-19 impact

However, globalization is not without its challenges. One major issue is income inequality. While globalization can raise overall income levels, its benefits are often unevenly distributed. Skilled workers and urban populations tend to benefit more, leaving behind rural communities and those with limited education. Economist Thomas Piketty has argued that unchecked capital accumulation and global investment flows can exacerbate inequality, unless accompanied by redistributive policies Furthermore, globalization has contributed to job losses and deindustrialization in several developed countries. Low-cost imports from abroad can undercut local industries, leading to factory closures and unemployment, particularly in the manufacturing sector. Another negative impact is the increased vulnerability of globalized economies to external shocks. The COVID-19 pandemic highlighted the fragility of international supply chains and the risks of over-dependence on foreign production. Similarly, global financial crises can quickly spread across borders in a highly interconnected world. Environmental concerns also arise, as globalization often encourages unsustainable levels of production and consumption, contributing to pollution, deforestation, and climate change. Furthermore, cultural homogenization and erosion of local traditions are social costs associated with the global spread of Western consumer culture.

1.1.2.7 Influence on development

In the context of development, globalization has played a critical role. Several countries have successfully used globalization to achieve rapid economic transformation. South Korea and Singapore, for example, integrated into global markets and emerged as high-income economies. India’s 1991 liberalization policies significantly boosted GDP growth, exports, and the development of its information technology sector. However, globalization does not guarantee development. Effective governance, investments in health and education, infrastructure development, and institutional reform are essential for a country to harness the benefits of globalization.

1.1.2.8 Future Scope

Looking forward, globalization is unlikely to vanish but is anticipated to evolve and take on new forms. One emerging concept is "resilient globalization," where countries focus on secure and diversified supply chains rather than absolute efficiency. The trend toward regional globalization is also growing, with economic blocs like ASEAN and the African Continental Free Trade Area gaining prominence. Digital globalization will likely dominate future trends, as digital platforms and remote services allow even small enterprises to participate in global trade. Moreover, the push for sustainability is driving "green globalization," where environmentally conscious production, circular economies, and climate agreements shape future global economic policies.

Examining its impact on demographic transition is crucial as it reveals how global interconnectedness affects population dynamics, including birth rates, death rates, age structure, and migration patterns. Understanding these relationships offers valuable insights into economic planning, social policy formulation, and sustainable development strategies.

1.1.2.9 World System Theory

One of the earliest and most influential theories is **World Systems Theory**, developed by sociologist Immanuel Wallerstein in the 1970s. This theory classifies countries into a hierarchical structure consisting of three groups: core, semi-periphery, and periphery. Core nations (e.g., the U.S., Germany) are economically advanced, control capital, and dominate global trade, while peripheral countries (e.g., many African nations) are less developed and serve as sources of raw materials and cheap labor. Semi-peripheral nations, such as Brazil and India, hold a middle position within this hierarchy. Wallerstein argued that the capitalist world economy perpetuates global inequality, as wealth continues to flow from the periphery to the core. Globalization, in this view, is an extension of capitalist exploitation rather than a neutral or benevolent process (Wallerstein, 1974).

1.1.2.10 Modernization Theory

In contrast, **Modernization Theory**, which emerged in the post-World War II era, presents globalization in a more optimistic light. This theory suggests that all countries follow a linear path of development, moving from traditional societies to modern, industrialized ones. Scholars like Walt W. Rostow outlined stages of economic growth, suggesting that poor nations could catch up with rich ones by adopting modern values, technologies, and institutions. Globalization, from this perspective, serves as a vehicle for development and prosperity by diffusing innovations and raising living standards globally. Critics, however, argue that this theory is ethnocentric and underestimates historical and structural constraints faced by developing nations (Rostow, 1960).

1.1.2.11 Dependency Theory

A direct critique of Modernization Theory is found in **Dependency Theory**, developed by Latin American economists like Raúl Prebisch and sociologists like Andre Gunder Frank. This theory asserts that underdevelopment in the Global South is not a phase on the way to development, but

a condition created and sustained by the global capitalist system. Developed countries maintain dominance over poorer nations through trade imbalances, debt dependencies, and the influence of transnational corporations. According to Dependency Theory, globalization maintains and deepens dependency by integrating peripheral economies into the global market in a subservient role. It emphasizes the need for self-reliance, protective tariffs, and national development strategies to break the cycle of dependency (Frank, 1967).

1.1.2.12 Global Capitalism Theory

Another major theory is the **Global Capitalism Theory**, associated with sociologists like William I. Robinson. It builds on Marxist thought but emphasizes the emergence of a transnational capitalist class that transcends national borders. This class includes executives of multinational corporations, global financiers, and political elites who manage global production and investment. According to Robinson, globalization represents a new stage of capitalism, where nation-states lose power to global economic forces and institutions such as the IMF, World Bank, and WTO. The global economy, driven by this class, leads to increased inequality, labor exploitation, and environmental degradation. Global Capitalism Theory views globalization as both a structural transformation of capitalism and a mechanism of social control through neoliberal policies and austerity (Robinson, 2004).

1.1.2.13 World Polity Theory

Moving from economic to sociological perspectives, **World Polity Theory**, developed by John W. Meyer and others, focuses on the cultural and institutional convergence that globalization brings. According to this theory, globalization spreads a "world culture" composed of shared norms, values, and institutional forms—such as democracy, human rights, education systems, and environmentalism. These are diffused globally through international organizations, NGOs, and transnational actors, leading to greater institutional similarity among nation-states While the theory recognizes local adaptations, it emphasizes the homogenizing power of global norms and institutions (Meyer et al., 1997).

1.1.2.14 Manuel Castells' Network Society Theory

Another influential theory, especially in the context of technology and communication, is **Manuel Castells' Network Society Theory**. Castells argues that globalization is enabled and shaped by new information technologies that create a "network society." In this society, the primary source of productivity and power lies in networks of information, communication, and digital flows rather than in traditional physical or industrial structures. Castells highlights how digital globalization reshapes labor markets, urban forms, and even identities, often reinforcing global hierarchies while empowering new forms of resistance and collaboration (Castells, 1996).

1.1.2.15 Theory of Global Cultural Flows

Arjun Appadurai's Theory of Global Cultural Flows offers another important lens. He conceptualizes globalization through five interconnected dimensions or "scapes": ethnoscapes (people and migration), mediascapes (media and images), technoscapes (technological flows),

financescapes (global capital), and ideoscapes (political ideas). These flows are disjunctive and unpredictable, leading to complex cultural hybridities and tensions Appadurai's theory emphasizes the cultural dynamics of globalization and challenges the notion of a homogenized global culture. Instead, it highlights the localized negotiations and adaptations of global forces (Appadurai, 1996).

1.1.2.16 Theory of Globalization

Additionally, **Anthony Giddens' Theory of Globalization** stresses the intensification of worldwide social relations and the compression of time and space. According to Giddens, globalization links distant localities in such a way that events in one region can rapidly influence distant others. Giddens emphasizes the role of modern institutions—like the nation-state, capitalism, and industrialism—as engines of globalization, while also acknowledging the risks and uncertainties globalization brings. He sees it as a "runaway world," where individuals must navigate a rapidly changing global environment while maintaining their sense of identity (Giddens, 1999).

1.1.2.16 Neoliberal Globalization Theory

Lastly**, Neoliberal Globalization Theory** focuses on the ideological foundation of contemporary globalization, rooted in the policies of deregulation, privatization, and free markets. Promoted by institutions like the IMF and WTO, neoliberal globalization argues for minimal government intervention, believing that market forces are the most efficient way to allocate resources. This theory underpins much of the economic globalization since the 1980s, leading to reduced tariffs, liberalized capital flows, and privatized public services. Critics argue that this approach has led to widening inequality, weakened labor rights, and environmental degradation, while proponents claim it has lifted millions out of poverty in emerging economies like China and India (Harvey, 2005).

1.1.3 Interlinkage between Globalization and demographic transition

1.1.3.1 Economic Implications:

Marcel Mérette and Patrick Georges in their paper "Demographic Changes and the Gains from Globalisation: An Analysis of Ageing, Capital Flows, and International Trade," assessed the economic impact of demographic changes globally. Their findings indicate that while demographic pressures can reduce real GDP per capita in various regions, globalization through international trade and capital flows can mitigate these effects by improving terms of trade in established OECD countries while promoting economic growth in emerging economies such as India.

1.1.3.2 Population Structure and Human Capital:

International Monetary Fund (IMF) on Changing Demographics and Economic Growth discusses how changes in age structure, resulting from improved child survival rates and declining fertility, can enhance a country's productive capacity. It underscores the necessity of policies that invest in infant and child survival, promote girls' education, and provide access to reproductive health services to capitalize on favorable demographic shifts.

1.1.3.3 Migration Patterns:

International Labour Organization (ILO)'s report "Globalization, Labour and Migration: Protection is Paramount" discusses how contemporary globalization has increased international labor mobility, leading to both opportunities and challenges. The report emphasizes the need for legal protection for migrant workers to prevent exploitation and ensure decent working conditions.

1.1.3.4 Gender Dynamics and Social Changes:

Wolfgang Keller and Hâle Utar in their paper "Globalization, Gender, and the Family," Keller and Utar investigate how labor market shocks, particularly those induced by import competition from China, affect gender inequality and family dynamics in Denmark. They find that women, especially those nearing the end of their reproductive years, are more likely to exit the labor market and have children in response to job displacement. This behavior contrasts with men's responses and highlights the interplay between globalization, employment opportunities, and demographic behaviors.

1.1.3.5 Sustainable Development Goals (SDGs):

Ronald Lee in his presentation "The Demographic Transition and SDGs Around the World," Lee discusses how shifts from high to low fertility and mortality rates impact economic growth, consumption, health, education, poverty, inequality, and gender dynamics. He emphasizes that understanding these demographic changes is crucial for achieving various SDGs.

Ch-2

LITERATURE REVIEW

The demographic transition refers to the fundamental shift in a population's reproductive behavior as a society moves from a traditional to a modernized state. Originally conceptualized by **Ansley J. Coale (1984),** this transition typically progresses through distinct stages—starting with high fertility and mortality rates, followed by a decline in mortality, and eventually leading to reduced fertility. This process significantly alters population structures and has profound socio-economic implications, particularly for developing countries. In the context of developing nations, demographic transition presents a one-time opportunity. With timely interventions and effective policy responses, these countries can transform demographic shifts into economic gains. **Bloom, Canning, and Sevilla (2001)** argue that as mortality rates fall, it becomes crucial to adopt family planning policies that encourage lower fertility rates. Such measures yield multiple benefits—improving women's health, expanding their workforce participation, and enhancing overall social welfare.

India presents a compelling case of demographic transition, marked by considerable reductions in fertility rates, especially in urban regions. This decline is largely driven by aspirations for better education and healthcare **(Kumar, 2014).** However, regional disparities remain stark. BIMARU states—Bihar, Madhya Pradesh, Rajasthan, and Uttar Pradesh—are experiencing a slower transition than their southern counterparts, due to lower investment in human capital and socio-economic development. **Goli et al. (2021)** emphasize that long-term gains from demographic transition depend on investments in family planning and education, which lay the groundwork for structural economic reforms. The mortality transition typically precedes fertility decline and is catalyzed by advancements in public health. However, sustaining lower mortality requires improvements in agricultural productivity and food security**. David Canning (2011)** contends that a key driver of fertility reduction is technological progress, which elevates the returns to education. As families prioritize human capital, they opt for fewer children and invest more in their development. This shift, intrinsic to modern economic development, transforms demographic behavior into both a cause and consequence of economic change.

Capital market development during modernization also reduces the economic rationale for large families. **Galor and Weil (1996)** noted that narrowing the gender wage gap contributed to lower fertility by enhancing the economic value of female labor. Despite these transitions, challenges remain for countries still in the midst of demographic change. As **Reher (2011)** argues, late-transitioning countries may find it difficult to fully harness the benefits of demographic change before the "window of opportunity" closes.

Ranganathan et al. (2015) affirm that economic growth typically lowers fertility rates, as households invest more in children's education and health. A demographic dividend emerges when the working-age population surpasses dependents, boosting productivity and growth. This phenomenon was evident in East Asian economies, where demographic transition fueled rapid development **(Menike, 2016).** Conversely, unchecked population growth can overwhelm health and social systems, potentially reversing gains made during the epidemiological transition (Garnett & Lewis, 2007). Therefore, sound development policies are essential to manage

demographic changes and maintain economic stability. **Menike (2018)** emphasizes that such policies must mitigate risks of overpopulation while enhancing the potential benefits of a changing demographic structure.Industrialization plays a pivotal role in reducing fertility. As families shift toward smaller sizes, the demand for education and economic security rises**. Franck and Galor (2015**) show that industrial societies prioritize child quality over quantity. Concurrently, adult survivorship increased significantly during the industrial period due to improved living conditions and healthcare **systems (Yaussy et al., 2023).**

However, the interaction between economic variables such as savings, investment, and fertility further complicates the demographic transition **(Callen et al., 2006).** Urbanization, in particular, accelerates demographic shifts. More urbanized countries undergo earlier transitions, driven by better income, education, and employment opportunities **(Cuberes, 2009). Egidi et al. (2021)** underscore the importance of rural-urban migration in fostering such transitions. Between 1950 and 2008, the global urban population surged from less than 10% to over 50%, signaling a massive demographic transformation **(Dumont, 2018).** Inequality also plays a crucial role in shaping demographic patterns**. Galor and Moav (2004)** argue that unequal access to education delays fertility reductions, especially among poorer households. Their unified growth theory calls for redistributive policies to support demographic shifts**. Ray (1998)** builds on this by showing that economic inequality incentivizes high fertility among low-income families as a form of social security. He advocates for equitable income distribution to enable effective demographic policies.

Feng, Kugler, and Zak (2000) highlight that countries with robust social security systems experience lower fertility rates. When families no longer rely on children for old-age support, their reproductive behavior shifts. **Mason and Lee (2007)** further illustrate how public social security systems affect labor supply and savings, thereby influencing demographic dynamics.

Bloom and Freeman emphasize that a larger labor force alone does not ensure economic growth; the key lies in a country's ability to create adequate employment opportunities for the working-age population. Educational reforms become essential in this context. **Lutz et al. (2008)** find that better-educated individuals, particularly women, have fewer children due to the higher opportunity cost of childbearing. Thus, improving education not only enhances productivity but also expedites demographic transition.

Foreign Direct Investment (FDI) also plays an indirect role in this process. **Mody and Murshid (2005)** suggest that FDI creates jobs, boosts capital flows, and drives urbanization—all of which influence fertility choices**. Habbak (2018)** finds that FDI inflows lead to enhanced investment in health and education, especially for women. This improves female labor participation and reduces fertility. Similarly, Nair-Reichert and **Weinhold (2001)** associate higher FDI with faster demographic transition due to improved socio-economic structures and a lower dependency ratio.

Trade openness complements FDI by fostering economic development and encouraging investments in human capital. **Galor and Mountford (2008)** show that trade-induced growth leads to smaller family sizes and better educational outcomes. **Romer (1990)** adds that trade

facilitates technological diffusion, indirectly influencing fertility decline through improved living standards and family preferences.

Migration, too, plays a dual role in demographic transition. **Docquier and Rapoport (2012)** argue that remittances and skill transfers improve living standards in origin countries, leading to reduced fertility**. Beine, Docquier, and Özden (2011)** note that migrants exposed to cultural norms in destination countries often adopt preferences for smaller families**. Fargues (2011)** adds that migration alleviates demographic pressure in sending countries and balances labor markets in receiving ones.

Cultural transformations are equally important**. Lesthaeghe (2010)** identifies changing attitudes toward gender roles, marriage, and family size as vital catalysts for fertility decline. He asserts that exposure to global media and cultural trends accelerates this shift**. Friedman et al. (2000)** support this by showing how female labor force participation and delayed family formation correlate with lower birth rates. **Coale and Treadway (1986)** reinforce the idea that cultural exposure influences reproductive choices, encouraging smaller families and aligning with modernization trends.

Finally, technological advancements form the bedrock of demographic change. **Bloom and Williamson (1998)** note that improvements in healthcare and sanitation lower death rates, initiating the demographic transition. **Aghion, Howitt, and Murtin (2011)** argue that innovation boosts labor productivity, raises income levels, and alters family priorities—all of which contribute to reduced fertility.

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RESEARCH GAP

Despite the importance of this topic, existing literature often focuses separately on globalization's economic or cultural impacts and the demographic transition's socio-economic aspects. A comprehensive analysis **linking globalization to demographic transition especially in case of India remains limited.** Key gaps include:

- **Less study in case of India** : Research often overlooks how globalization factors will affects demographic transitions, particularly in case of developing country like India.
- **Interplay with Technology**: While technology is a significant component of globalization, its specific role in influencing demographic changes is underexplored. Like how Internet penetration social media usage has changed demographic transition.
- **Policy Implications**: There is limited analysis on how Indian governments can leverage globalization to optimize demographic transitions for sustainable development.
- **Globalization and Migration**: The relationship between international migration and its effects on demographic trends such as birth rate and age structure is not well understood.
- **Role of Cultural Norms**: Cultural norms along with gender inequality and female access to labour force in India play a significant role in shaping demographic behaviors. How globalization influences traditional family structures, marriage practices, and reproductive choices remains inadequately studied.
- **Globalization's Role in Aging Populations**: Lack of studies on how globalization affects **aging societies,** particularly through changes in youth population trends, age dependency ratios.

This study will bridge these gaps by exploring the multifaceted relationship between globalization and demographic transition. It will analyze regional differences, technological influences, and migration trends, providing actionable insights for policymakers to craft strategies that align demographic patterns with economic and social goals. By addressing these gaps, the research contributes to more effective policy frameworks, ensuring that globalization fosters balanced and inclusive demographic transitions that support long-term sustainability.

Ch-4

OBJECTIVE

Aim of this research paper is:

- **Explore how FDI inflow and exports influence changes in birth and death rates and population growth, particularly in the context of developing economies like India.**
This objective aims to examine how economic globalization, through channels such as foreign direct investment and trade openness, affects demographic trends. It will assess whether increased capital flows and integration into global markets contribute to reductions in fertility and mortality rates.

- **Investigate how cultural, migration, and technological advancements have contributed to reducing mortality and increasing life expectancy.**
The study will explore how global cultural exposure, rural-urban and international migration, and innovations in healthcare and communication technologies have improved survival rates and extended lifespans in emerging economies.

- **Determine the extent to which gender inequality in resources, labour market access, and urbanization, driven by globalization, have contributed to demographic shifts like smaller families and changing fertility rates.**
This aim focuses on understanding how disparities in female access to education, employment, and urban amenities influence reproductive decisions and family structures.

- **Identify and analyze variations in demographic transition outcomes due to healthcare and education.**
It seeks to explore how regional differences in access to quality health services and education systems shape the pace and nature of demographic changes.

- **Study the impact of globalization on India's demographic dividend and age-dependency ratio.**
The goal is to assess how economic and social globalization affect India's working-age population, dependency burdens, and economic productivity.

- **Forecast the long-term effects of globalization on aging populations, dependency ratios, and birth rates as India progresses through the demographic transition.**
This includes projecting future demographic scenarios and policy needs as India enters the later stages of transition influenced by global forces.

Ch-5

METHODOLOGY

This study employs a quantitative analysis using econometric models to investigate the impact of various economic, technological, and cultural factors on demographic indicators in India. The demographic indicators under examination include birth rate, death rate, covering the period from 1970 to 2022.

$Yt=\alpha+\beta 1FDIt+\beta 2Tradet+\beta 3Migrationt+\beta 4Internet\ Penetrationt+\beta 5KOP\ Globalization\ Indext+\ \beta 6FLPR+\ \beta 7Urbanization\ Ratet+\ \beta 8GDP\ gowtht+\ \beta 9tertiary\ Education+\ \beta 10Infant\ Mortality\ Rate+\ \beta 11Female\ Education+\epsilon tY$

Table 1 and 2: List of Dependent and Independent Variables and their explanation

Dependent Variable	What It Explains
Birth Rate (Crude Birth Rate)	The number of live births per 1,000 people in a population per year. It reflects the overall level of childbearing and population growth in a society.
Fertility Rate (Total Fertility Rate - TFR)	The average number of children a woman is expected to have during her lifetime, based on current age-specific fertility rates. It explains the reproductive behavior and potential for population replacement.
Age-Dependency Ratio	The ratio of dependents (people younger than 15 or older than 64) to the working-age population (ages 15–64). It explains the economic burden on the productive population and indicates the potential pressure on social services like education, healthcare, and pensions.

Independent Variable	What It Explains / Represents
FDI as % of GDP	Reflects foreign capital inflow relative to the economy. Indicates the openness of the economy and potential impact on employment, income, and socio-economic development. May influence demographic behavior through improved infrastructure and opportunities.
Trade as % of GDP	Measures economic openness. High values indicate greater global integration. Can affect living standards, employment, and thus fertility, migration, and birth rates.
KOF Globalization Index	A composite index capturing economic, social, and political dimensions of globalization. Explains the overall exposure and integration of a country into the global system, impacting demographic patterns and transitions.
Net Migration	Difference between immigration and emigration per year. Reflects population mobility and changes in labor market dynamics, age structure, and dependency ratios.
Tertiary Education	Enrollment or attainment in higher education. Indicates human capital development and often correlates with lower fertility rates, delayed marriages, and improved employment outcomes.
Female Labour Force Participation Rate	Percentage of women working or seeking work. Higher rates often correlate with lower fertility rates due to opportunity cost of childbearing and time constraints.
Female Education	Typically measured in years of schooling or literacy rates. Strongly linked with reduced fertility, improved child health, and lower infant mortality.
Infant Mortality Rate	Number of deaths of infants under one year old per 1,000 live births. High rates often reflect poor healthcare and socio-economic conditions; improvements lead to demographic shifts.
Internet Penetration (per 1,000 population)	Reflects access to digital infrastructure. Higher penetration correlates with better access to information, education, health awareness, and lower fertility in modernizing societies.
GDP Growth (%)	Annual economic growth rate. Indicates development level, employment opportunities, and may influence migration, fertility behavior, and investment in human capital.
Urbanization Rate	Percentage of population living in urban areas. Associated with lower fertility, better access to services, and faster demographic transition due to modernization and lifestyle shifts.

Data Sources:
World Bank Open data , World Population Prospect data and KOP Globalization Index

Table 3 Independent variables statistic summary

Statistics	Mean	Median	Standard Deviation	Minimum	Maximum	Largest	Smallest
FDI Inflow % of GDP	0.80	0.60	0.88	-0.03	3.62	3.62	0.24
Trade as a % of GDP	27.51	22.74	15.50	7.66	55.79	55.79	4.23
Internet Peneration as % of Population	6.83	0.06	13.23	0.00	51.50	51.50	3.61
KOP Globalization Index	48.34	46.66	6.06	40.00	57.28	57.28	1.66
Net Migration per 1000 pop	-0.08	-0.13	0.33	-0.45	0.72	0.72	0.09
GDP Growth	5.41	5.98	3.16	-5.78	9.69	9.69	0.86
% of Tertiary Education	12.58	6.47	9.52	4.60	33.12	33.12	2.60
Infant Mortality Rate	77.27	74.80	33.94	25.50	139.90	139.90	9.26
Female Secondary School Enrollment	41.67	35.98	22.38	14.00	80.45	80.45	6.11
FLPR	30.76	31.91	4.29	18.66	36.72	36.72	1.17
Urbanization rate	27.39	26.93	4.57	19.76	36.36	36.36	1.25

s

Estimation Technique

- **Correlation Analysis**:
  Conducted a correlation matrix to identify the strength and direction of linear relationships between variables such as birth rate, fertility rate, FDI, trade, education, and urbanization.
- **Vector Autoregression (VAR) Model**:
  Applied the VAR model to capture the dynamic interdependencies among multiple time series variables without assuming any strict exogeneity, allowing each variable to be endogenous.
- **Impulse Response Function (IRF)**:
  Utilized IRF analysis to trace the effect of a one-time shock to one variable (e.g., FDI or education) on the current and future values of fertility or birth rates.

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ANALYSIS & ITS INTERPRETATION

6.1 VAR Model

6.1.1 Birth Rate

Table 4: Result of VAR model of Independent Variables On Birth Rate

Variable	Lag	Coef.	Std. Err.	z	P>|z|	95% Conf. Interval Lower	95% Conf. Interval Upper
Birth rate	L1	-.1823658	.1415572	-1.29	0.198	.4598127	.0950811
Birth rate	L2	-.0392393	.125347	-0.31	0.754	.2849148	.2064362
FDI	L1	.0467972	.064126	0.73	0.466	.0788876	.1724819
FDI	L2	.0813438	.0574512	1.42	0.157	.0312586	.1939461
Trade	L1	-.0177132	.0106448	-1.66	**0.096**	.0385766	.0031501
Trade	L2	-.0136254	.0085712	-1.59	0.112	.0304247	.0031738
Kop index	L1	.022003	.0565358	0.39	0.697	.0888051	.1328112
Kop index	L2	.0842957	.0599839	1.41	0.160	.0332706	.2018619
Net migration	L1	1.757303	.7265871	2.42	**0.016**	.3332187	3.181388
Net migration	L2	-1.142236	.7770036	-1.48	0.138	2.651474	.367002
Tertiary Education	L1	.0922492	.0297542	3.10	**0.002**	.0339321	.1505663
Tertiary Education	L2	-.0028535	.0306524	-0.09	0.926	-.062931	.0572241
FLPR	L1	.0020114	.03762	0.05	0.957	.0717224	.0757451
FLPR	L2	.0169025	.0377223	0.45	0.654	.0570319	.0908369
Infant mortality rate	L1	-.1685803	.1061624	-1.59	0.112	.3766548	.0394943
Infant mortality rate	L2	.1942862	.0917173	2.00	**0.045**	.0039397	.3846327
Female Education	L1	-.0122787	.017311	-0.71	0.478	.0462077	.0216503
Female Education	L2	-.0217595	.0174497	-1.25	0.212	.0559603	.0124413
Internet penetration as % of population	L1	-.0153175	.0170732	-0.90	0.370	.0487804	.0181453
Internet penetration as % of population	L2	.0241616	.017468	1.38	0.167	-.010075	.0583982
GDP growth	L1	-.0149622	.0104647	-1.43	0.153	.0354728	.0055483
GDP growth	L2	-.0155458	.0095247	-1.63	0.103	-.034214	.0031223
Urbanization rate	L1	-1.762932	.8302267	-2.12	**0.034**	3.390146	-.1357171
Urbanization ate	L2	1.97344	.9788659	2.02	**0.044**	.0548979	3.891982

_cons		-8.005985	6.365736	-1.26	0.209	-20.4826	4.47063

The regression output from the Vector Autoregression (VAR) or dynamic panel model examining the determinants of changes in birth rate over time reveals insightful relationships between key socio-economic and demographic factors. By focusing on the differenced birth rate as the dependent variable and including various lagged independent variables such as foreign direct investment (FDI), education levels, female labor force participation, internet penetration, GDP growth, urbanization, net migration, and infant mortality, the model seeks to capture how past values of these variables influence current changes in fertility. This dynamic approach allows us to understand not just contemporaneous relationships but also how effects propagate over time, underscoring the importance of lags in demographic analysis.

Among the predictors, net migration lagged by one period stands out as having a positive and statistically significant impact on changes in birth rate. The coefficient of approximately 1.76 with a p-value below 0.05 indicates that an increase in net migration in the previous year tends to result in a rise in the birth rate change in the current year. This finding aligns well with demographic and economic theory since migrants are often concentrated in reproductive age groups and may have higher fertility rates than the native population. Moreover, migration can improve access to healthcare services, livelihoods, and social networks that encourage childbearing, especially in developing or transition economies where migrants may experience new opportunities and support systems. This reinforces the idea that population mobility is a key driver of fertility patterns and should be considered in policy planning.

Surprisingly, the coefficient for tertiary education lagged one period is also positive and significant, indicating that higher tertiary education in the previous year correlates with an increase in the birth rate change. This result might appear counterintuitive given the widely accepted view that increased education, particularly female education, tends to reduce fertility by delaying marriage and promoting family planning. However, the positive association could reflect complex socio-economic dynamics in certain contexts. Higher tertiary education may signify enhanced human capital, economic stability, and job security, which can create an environment conducive to planned parenthood. In some regions, increased education might delay the onset of childbearing but lead to a higher rate of intentional births later, producing a net positive effect on birth rate changes over the short term. This suggests that education's impact on fertility is nuanced and context-dependent, requiring a deeper understanding beyond simplistic negative associations.

Infant mortality rate lagged by two periods also exhibits a positive and statistically significant relationship with the current change in birth rate. The coefficient of about 0.194 implies that a higher infant mortality rate two years prior leads to an increase in fertility changes today. This supports the well-documented “insurance hypothesis” in demographic studies, where parents in regions with high child mortality tend to have more children to offset the risk of losing offspring. The lag effect here highlights that mortality shocks do not immediately alter fertility behavior but influence reproductive decisions with some delay, likely as families adjust their expectations and strategies over time. This finding underscores the critical role of child survival in shaping

fertility patterns and suggests that improvements in infant mortality through healthcare interventions can contribute to fertility decline by reducing the perceived need for 'replacement' births.

Urbanization presents a complex and somewhat contradictory pattern. Urbanization lagged by one period has a significant negative effect on changes in birth rate, with a coefficient close to –1.76. This is consistent with the classical demographic transition theory, where urban living conditions—characterized by higher costs of living, better access to family planning, delayed marriage, and increased female labor force participation—tend to suppress fertility rates. Urban environments often promote lifestyle changes that reduce childbearing, reflecting greater economic pressures and shifts in social norms. However, interestingly, urbanization lagged by two periods has a positive and significant coefficient (approximately +1.97), suggesting that urbanization effects on fertility are dynamic and evolve over time. This may capture a longer-term adjustment process whereby the initial fertility decline induced by urban transition stabilizes or even reverses slightly due to improved healthcare infrastructure, childcare support, and social policies in urban areas that facilitate family growth. This dynamic urban fertility response emphasizes the importance of considering temporal changes and the potential for urban fertility rates to respond differently at different stages of urban development.

While the model highlights the above variables as significant determinants of birth rate changes, several other theoretically relevant variables do not show statistically significant effects in this specific analysis, though their coefficients provide useful insights. For example, foreign direct investment (FDI) at both lag 1 and lag 2 shows positive but insignificant coefficients. This suggests that FDI's influence on fertility is either weak or more indirect, possibly through its effects on economic development, employment, and living standards over longer time horizons. Similarly, the KOF Globalization Index, which measures economic, social, and political globalization, shows small positive coefficients but no significant impact on birth rate changes. Globalization may affect cultural norms and access to global goods and services, but its short-term influence on fertility appears limited in this model.

Female labor force participation rate (FLPR) does not emerge as a significant predictor, which might be explained by the dual and offsetting effects of women's employment. While participation in the labor market can delay childbirth due to career considerations, it also provides greater financial stability that supports child-rearing. The net effect on fertility may thus be neutral or context-specific. Female education beyond tertiary levels shows negative but insignificant coefficients, aligning with the expected negative association between education and fertility. However, the weak significance might result from multicollinearity with other educational variables or the predominance of tertiary education's positive effect in this model. Internet penetration and GDP growth similarly have mixed or negative but insignificant coefficients. Internet access could enhance awareness and use of contraception, but lifestyle changes associated with internet use may have complex fertility implications. GDP growth's negative coefficients support the demographic-economic paradox, where economic prosperity tends to lower fertility, though this effect is not statistically strong in this dataset.The constant term is not significant, suggesting that there is no underlying trend in birth rate changes when controlling for the explanatory variables. This underscores the model's focus on dynamic socio-economic and demographic influences rather than secular trends.

6.1.2 Fertility Rate

Table 5 Result of VAR model of Independent Variables On Fertility Rate

Variable		Lag	Coefficient	Std. Err.	z	P>|z|	[95% Conf. Interval]
Fertilityrate	.	L1	.779236	.1275151	6.11	0.000	.529311 1.029161
fertilityrate	.	L2	.2005801	.1398345	1.43	0.151	.0734905 .4746507
FDI	.	L1	.006496	.0072593	0.89	0.371	.0077319 .0207239
FDI		L2	.0035857	.0075971	0.47	0.637	.0113043 .0184758
Trade		L1	-.0022276	.0012573	-1.77	0.076	.0046919 .0002366
Trade		L2	-.001839	.0010263	-1.79	0.073	.0038505 .0001724
Kop index		L1	.0039763	.0072798	0.55	0.585	.0102918 .0182443
Kop index		L2	.0090371	.0074722	1.21	0.226	.0056082 .0236823
Net migration	.	L1	.1918436	.0805739	2.38	**0.017**	.0339215 .3497656
Net migration	.	L2	-.1843312	.0916468	-2.01	**0.044**	.3639581 -.0047044
Tertiary Education	.	L1	.011753	.0037949	3.10	**0.002**	.0043151 .019191
Tertiary Education		L2	-.0003015	.0038388	-0.08	0.938	-.0079137 .0073107
FLPR		L1	.0015073	.0041858	0.36	0.719	-.0066968 .0097114
FLPR		L2	.0043669	.0042954	1.02	0.309	-.0040519 .0127858
Infant mortality rate		L1.	-.0073728	.0125536	-0.59	0.557	-.0319774 .0172318

Infant mortality rate	L2	.0089998	.0118387	0.76	0.447	-.0142055 .0322015
Female Education	L1	-.0011093	.0020018	-0.55	0.579	-.0050329 .0028142
Female Education	L2	-.0016715	.0020174	-0.83	0.407	-.0056255 .0022826
Internet penetration as % of population	L1	-.0035231	.0020214	-1.74	0.081	-.007485 .0004387
Internet penetration as of population	L2	.0054043	.0021652	2.50	**0.013**	.0011606 .0096479
GDP growth	L1	-.0020751	.0011795	-1.76	0.079	-.0043869 .0002367
GDP growth	L2	-.0015436	.0011095	-1.39	0.164	-.0037181 .0006309
Urbanization rate	L1	-.2110759	.1023818	-2.06	**0.039**	-.4117405 -.0104114
Urbanization rate	L2	.2226714	.1164319	1.91	0.056	-.0055309 .4508736
_cons		-.3943096	.8241652	-0.48	0.632	-2.009644 1.221025

The regression model presented offers a comprehensive exploration into the determinants of the fertility rate, utilizing a dynamic framework that incorporates lagged effects of various macroeconomic, demographic, and social variables. At its core, the model confirms a foundational demographic principle: fertility behavior is highly persistent over time. This is evident from the highly significant and positive coefficient of the first lag of the fertility rate (0.779, $p < 0.001$), which implies that previous fertility levels have a strong and statistically significant impact on current fertility rates. This autocorrelation is expected, as fertility preferences, norms, and socio-economic conditions tend to be stable or evolve gradually, making past fertility a key predictor of present values.

The second lag of fertility rate, though positive (0.20), is not statistically significant ($p = 0.151$), indicating diminishing influence over time. Beyond autoregressive behavior, the model highlights net migration as a significant variable affecting fertility, albeit with a complex relationship. The first lag of net migration has a positive and statistically significant coefficient (0.192, $p = 0.017$), suggesting that increased net migration in the previous period is associated

with higher fertility. This could reflect the tendency of migrants—especially younger ones—to start families after resettling. However, the second lag of net migration reveals a statistically significant negative relationship with fertility (–0.184, p = 0.044), indicating that the fertility-raising effect of migration is short-lived and may reverse as migrants assimilate or face economic and social constraints in the host region. This duality captures a nuanced picture where the initial settlement period encourages fertility, possibly due to reunification or higher fertility norms among migrants, but longer-term integration and exposure to urban or developed settings gradually suppress fertility.

Interestingly, tertiary education (d_teredu) at lag 1 shows a positive and statistically significant effect on fertility (0.0118, p = 0.002), which defies the conventional narrative that higher education leads to lower fertility. One possible explanation lies in the postponement behavior common in educated populations—women delay childbirth in pursuit of education and careers but eventually opt for planned fertility once economic stability is achieved. This "catch-up" fertility may explain the positive lagged effect. Moreover, higher education may equip individuals with better knowledge, healthcare access, and job flexibility, enabling them to plan and support larger families in the long run. The second lag of tertiary education, however, is not significant, implying the main impact occurs in the short run.

Trade openness, as measured by the lagged differences in trade (d_trade), shows a negative association with fertility at both lags, although only marginally significant (p = 0.076 and 0.073, respectively). This suggests that as economies open up and become more integrated into global markets, fertility tends to decline. This could stem from labor market uncertainty, shifts in gender roles, rising consumer aspirations, and opportunity costs associated with childbearing in a competitive globalized economy. The effect is modest but consistent, aligning with existing literature on globalization's role in demographic transition.

The model also reveals important dynamics with regard to urbanization. The first lag of urbanization rate has a statistically significant negative coefficient (–0.211, p = 0.039), implying that increasing urbanization reduces fertility in the short term. This is intuitive, as urban settings often correlate with higher living costs, smaller living spaces, increased female labor force participation, and greater access to contraception and education. However, the second lag shows a positive but only marginally significant coefficient (0.223, p = 0.056), hinting that in the medium term, fertility may rebound slightly as urban infrastructure and social systems adapt to support family life. This two-stage impact reflects a transition phase in urban demography—initial deterrents to childbearing may give way to adaptation once supportive services (like childcare, housing policies, or family subsidies) are in place.

Another noteworthy variable is internet penetration. At lag 1, the coefficient is negative (–0.0035, p = 0.081), indicating that greater internet access reduces fertility in the short run, possibly by disseminating information on contraception, reproductive health, and modern lifestyles that emphasize individualism and career development. However, the second lag shows a positive and statistically significant coefficient (0.0054, p = 0.013), suggesting that after initial adoption, the internet might support fertility by enabling access to telehealth, work-from-home opportunities, parenting forums, or e-commerce solutions that reduce the costs of child-rearing.

While some variables did not show statistically significant results, their coefficients still provide directionally meaningful insights. For instance, female labor force participation rate (FLPR) showed a weak positive association with fertility, contrary to the traditional belief that higher female workforce engagement suppresses fertility. This may reflect regional differences or the possibility that some economies are adapting with family-friendly labor policies. Similarly, infant mortality rate, GDP growth, and female education did not yield significant results, potentially due to overlapping effects with more directly relevant variables like tertiary education and internet access. GDP growth, although statistically insignificant, has a negative coefficient at both lags, hinting that fertility may decline as economic development progresses—a classic demographic transition pattern.

FDI and the globalization index (KOF) also do not show significant associations with fertility in this model. This could be because these macro-level indicators have more indirect and long-term effects, or because their influence is captured by other correlated variables such as trade and education. Finally, the constant term is statistically insignificant, meaning that without the influence of the lagged variables, fertility rates do not exhibit a consistent fixed-level behavior over time.

In terms of statistical robustness, the model's significance lies primarily in the coefficients with low p-values (< 0.05), including fertility rate L1, net migration (both lags), tertiary education L1, internet penetration L2, and urbanization L1. These significant variables provide compelling evidence that fertility is shaped not just by economic development or education alone, but by a constellation of factors that interact over time. The interplay between migration, education, technology, and urbanization appears to be particularly potent in shaping fertility behavior.

6.1.3 Age-dependency Ratio

Table 6: Result of VAR model of Independent Variables On Age Dependency Ratio

Variable	Lag	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval] Lower	[95% Conf. Interval] Upper
Old age dependency	L1.	1.832076	0.0792821	23.11	0.000	1.676686	1.987466
Old age dependency	L2.	0.8511386	0.0918204	9.27	0.000	1.031103	0.6711739
FDI	L1.	0.001305	0.0034913	0.37	0.709	0.0081478	0.0055379
FDI	L2.	0.0183166	0.0038705	4.73	**0.000**	0.0259028	0.0107305
Trade	L1.	0.0028749	0.0007608	3.78	**0.000**	0.004366	0.0013838
Trade	L2.	0.00051	0.000605	0.84	0.399	0.0006757	0.0016957

Kop index	L1.	0.0016761	0.0034527	0.49	0.627	0.0050911	0.0084433
Kop index	L2.	0.0056924	0.0036456	1.56	0.118	0.0014529	0.0128376
Net migration	L1.	0.0489883	0.0391035	1.25	0.210	0.0276531	0.1256297
Net migration	L2.	-0.0402766	0.0454249	0.89	0.375	0.1293078	0.0487545
Tertiary education	L1.	0.0002771	0.0017121	0.16	0.871	0.0030785	0.0036327
Tertiary Education	L2.	0.003198	0.0018303	1.75	0.081	0.0067853	0.0003893
FLPR	L1.	0.0017202	0.0020403	0.84	0.399	0.0022788	0.0057191
FLPR	L2.	0.0012391	0.0022243	0.56	0.577	0.0055986	0.0031203
GDP growth	L1.	0.0005303	0.0005921	0.90	0.370	0.0016908	0.0006302
GDP growth	L2.	0.0002877	0.0005467	0.53	0.599	0.0013592	0.0007838
Internet penetration as % of population	L1.	0.0111439	0.0011525	9.67	**0.000**	0.0134027	0.0088851
Internet penetration as % of population	L2.	0.0123703	0.0010687	11.57	**0.000**	0.0102756	0.0144649
Urbanization rate	L1.	0.0282437	0.0459127	0.62	0.538	0.118231	0.0617436
Urbanization rate	L2.	0.0632933	0.053959	1.17	0.241	0.0426444	0.1690509
Infant mortality rate	L1.	0.0113384	0.0081478	1.39	0.164	0.004631	0.0273079
Infant mortality rate	L2.	0.0077319	0.007155	1.08	0.280	0.0217555	0.0062917
Female Education	L1.	0.001311	0.0010026	1.31	0.191	0.000654	0.0032761
Female Education	L2.	-0.0006918	0.0010165	-0.68	0.496	-0.0026841	0.0013004
_cons		-1.033908	0.4901639	-2.11	0.035	-1.994611	-0.0732039

The regression model provides a rich understanding of the dynamic influences of key socio-economic and demographic variables on population dynamics, possibly fertility or population growth. The **old age dependency ratio** emerges as the most statistically and substantively

influential variable in the model. Its first lag (L1) has a **very high positive coefficient** (1.83, $p < 0.001$), indicating that an increase in the old-age dependency ratio in the previous period is strongly associated with a substantial rise in the dependent variable. This could be interpreted in several ways: if the dependent variable is fertility rate, it implies that as the proportion of older dependents increases, fertility may rise in the short term due to policy incentives (e.g., pronatalist policies) or family decisions to offset the burden of aging populations. However, this relationship reverses in the second lag (–0.85, $p < 0.001$), suggesting that over time, the pressure of aging may begin to suppress fertility as economic burdens mount and household resources get stretched. This reversal reflects a nuanced demographic reality—where aging first provokes a compensatory rise in fertility (possibly through family or government response) but ultimately reduces reproductive willingness or capacity due to long-term financial and caregiving strain.

Foreign Direct Investment (FDI) shows mixed results. Its first lag is negative but statistically insignificant (–0.0013, $p = 0.709$), suggesting no immediate effect on population dynamics. However, the second lag presents a **strong, significant negative relationship** (–0.0183, $p < 0.001$), implying that increased FDI may lead to a delayed decline in fertility or population growth. This result aligns with the idea that FDI-driven economic restructuring can suppress fertility through mechanisms like labor market competition, job insecurity, or increased urban migration. Over time, FDI might elevate women's participation in the formal sector and delay marriage or childbirth, thus reducing fertility. Similarly, **trade openness** (d_trade) at lag 1 has a **significant negative coefficient** (–0.00287, $p < 0.001$), reinforcing the argument that globalization pressures lead to lower fertility—perhaps through increased exposure to global consumer culture, changing family values, or economic rationalization of family size. The second lag is insignificant (0.00051, $p = 0.399$), suggesting the impact of trade liberalization is largely immediate and diminishes over time.

The **globalization index (KOF index)** has no statistically significant effect at either lag, although its second lag (0.0057, $p = 0.118$) nears marginal significance. This could imply that broader measures of globalization—which combine political, cultural, and economic aspects—do not affect fertility or population behavior in as direct a manner as trade or FDI alone. **Net migration** also lacks statistical significance at both lags, though the signs of the coefficients are interesting. The first lag is positive (0.0489), indicating a possible short-term increase in population/fertility due to incoming migrants. In contrast, the second lag is negative (–0.0402), suggesting that assimilation or urban constraints may later reduce fertility among migrants. Although not statistically confirmed ($p > 0.2$), these signs echo migration-fertility theories in demographic studies.

Tertiary education (d_teredu) shows a small positive effect at lag 1 (0.00027, $p = 0.871$) and a negative effect at lag 2 (–0.00319, $p = 0.081$), with the latter approaching significance. The delayed negative effect aligns with global evidence that increased higher education—especially among women—delays or reduces childbearing due to career aspirations, late marriage, and better reproductive health knowledge. The marginal significance suggests that education is a critical medium-term lever in demographic transitions. In parallel, **female labor force participation rate (FLPR)** shows no significant effect, though it follows a theoretical pattern: positive in the short term (0.0017) and negative in the longer term (–0.0012). These results may

reflect transitional economies where initial female entry into the workforce does not immediately suppress fertility, but sustained participation eventually does.

GDP growth is also statistically insignificant at both lags, with very small negative coefficients (–0.00053 and –0.00028), suggesting limited direct influence on population behavior in this context. This result underscores a key finding in demographic economics: it is not growth per se, but the distribution and development structure (e.g., education, healthcare, urbanization) that most directly affect fertility trends.

A particularly striking result emerges from **internet penetration**, which has **highly significant coefficients** at both lags with opposite signs. The first lag (–0.0111, $p < 0.001$) indicates that increasing internet access initially leads to a **sharp decline** in fertility/population, perhaps by improving access to reproductive health information, expanding career opportunities for women, and fostering modern norms. However, in the second lag, the coefficient is **strongly positive** (0.0124, $p < 0.001$), implying a **rebound effect**. This may reflect the dual role of technology: while it initially acts as a deterrent to family formation, it eventually empowers families by enabling flexible work arrangements, telehealth, and online parenting support. This lagged reversal emphasizes the evolving and nonlinear impact of digital technology on demographic outcomes.

Urbanization, like many other variables, is statistically insignificant, though its coefficients suggest a typical narrative. Lag 1 shows a small negative effect (–0.0282), hinting that initial urban migration reduces fertility due to space constraints, cost of living, and delayed marriage. The second lag shows a positive effect (0.0632), suggesting that once urban infrastructure (housing, healthcare, schooling) catches up, fertility might stabilize or rise slightly. This pattern is common in urban fertility transition literature but not statistically significant in this model.

The **infant mortality rate** exhibits weak associations—positive in lag 1 (0.0113) and negative in lag 2 (–0.0077)—but neither is statistically significant. Nonetheless, the signs follow classical demographic theory: high infant mortality prompts higher fertility as a form of replacement, but improved child survival (in the longer term) contributes to fertility decline. Similarly, **female education (d_femedu)** shows statistically insignificant but theoretically meaningful coefficients—positive in lag 1 and negative in lag 2—reinforcing the idea that initial educational access does not reduce fertility immediately but does so over time through changes in aspirations and life planning.

Finally, the model includes a significant **constant term** (–1.0339, $p = 0.035$), suggesting that after accounting for all explanatory variables, there remains a baseline decline in the dependent variable (likely fertility/population growth). This may be due to overarching structural factors like cultural modernization, declining marriage rates, or rising individualism that are not captured by the included variables.

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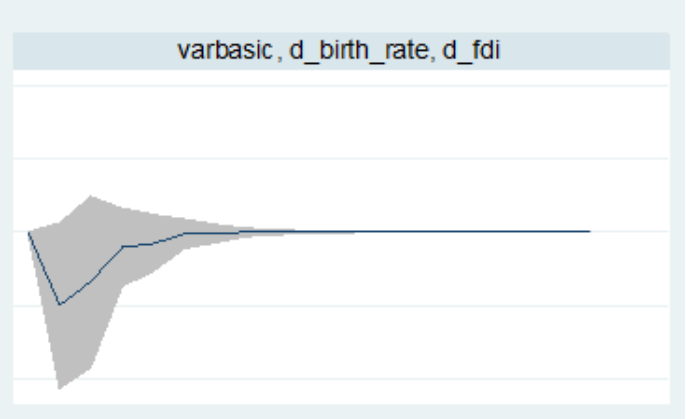
6.2 Impulse Response Function

Impulse Response Function (IRF) analyzes how a shock to one variable affects others over time in a Vector Autoregression (VAR) model. It traces the dynamic impact of external factors like

FDI, trade, migration, internet penetration, IMR, education, globalization (KOF index), GDP growth, female labor force participation, and urbanization on demographic outcomes—birth rate, fertility rate, and age-dependency ratio. For instance, a positive shock in female labor participation may lower fertility rates over time, while higher GDP growth might initially reduce the dependency ratio. IRF shows both magnitude and duration of such effects, aiding in understanding complex, time-based causal relationships.

6.2.1 Birth Rate and FDI

Fig4: IRF of Birth Rate and FDI



The Impulse Response Function (IRF) plot shows the dynamic effect of a shock in Foreign Direct Investment (FDI) on the birth rate over time. Following a positive shock in FDI, the birth rate initially declines sharply, indicating that an increase in FDI leads to a short-term reduction in the birth rate. In the subsequent period, there is a slight upward movement, but the birth rate remains below the baseline level. Over time, the effect of the shock fades, and the birth rate returns to its original path, suggesting no long-term impact. This pattern can be explained by the economic and social changes that often accompany increased FDI inflows, such as improved employment opportunities, greater access to healthcare and education—particularly for women—and overall modernization, all of which contribute to lower fertility and delayed childbirth in the short run. However, as the economy adjusts and stabilizes, the initial demographic response diminishes, and birth rates stabilize, reflecting that FDI influences short-term demographic behavior but does not permanently alter long-term fertility trends.

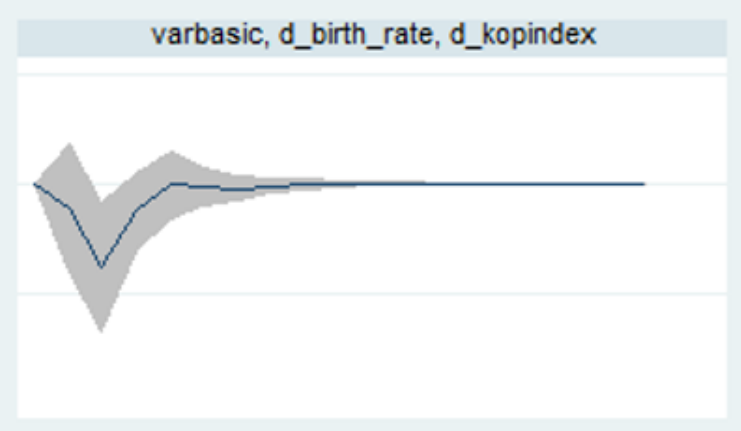
6.2.2 Birth Rate and Trade

Fig5: IRF of Birth Rate and Trade

The Impulse Response Function (IRF) plot illustrates the effect of a shock in trade (d_trade) on the birth rate (d_birth_rate) over time. Immediately following a positive trade shock, the birth rate experiences a sharp decline, indicating that increased trade openness or trade volume is initially associated with a reduction in the birth rate. In the short term, there is a partial upward adjustment, but the birth rate remains below its initial level. Over the longer horizon, the effect gradually diminishes and stabilizes around zero, suggesting no permanent impact on the birth rate. This trend can be justified by the socioeconomic transformations associated with increased trade. Greater trade is often linked with economic growth, urbanization, improved female labor force participation, and rising living standards—factors that typically lead to reduced fertility as households prioritize income, career, and education over larger family sizes. However, as the population and economy adjust to the new trade environment, birth rates stabilize, reflecting that while trade can temporarily influence demographic behavior, structural factors and policy environments ultimately shape long-term birth trends.

.2.3 Birth Rate and KOP Index

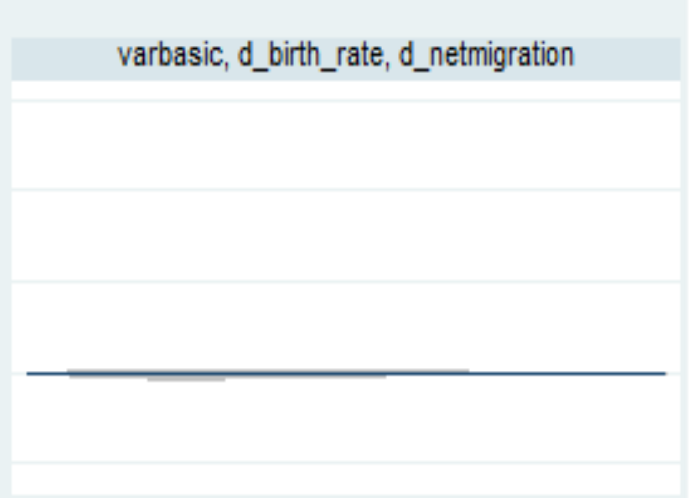
Fig6: IRF of Birth Rate and KOP index



65 The Impulse Response Function (IRF) plot displays the effect of a shock in the KOF Globalization Index (d_kopindex) on the birth rate (d_birth_rate) over time. Following a positive globalization shock, the birth rate declines significantly in the initial period, suggesting that increased globalization is associated with a short-term reduction in birth rates. This is likely due to the socio-economic changes globalization brings, such as higher exposure to international norms, improved access to education and healthcare, enhanced female employment, and urban lifestyles—all of which typically lead to lower fertility preferences. Interestingly, in the following periods, the birth rate shows a partial recovery, indicating some adaptation to the new globalized environment. However, the effect eventually stabilizes near zero, implying that while globalization induces short-term demographic shifts, it does not exert a permanent influence on birth rates. This pattern supports the theory that globalization encourages a transition towards lower fertility through modernization and integration into the global economy, but its long-term impact is mediated by domestic structural and cultural factors.

6.2.4 Birth Rate and Net Migration

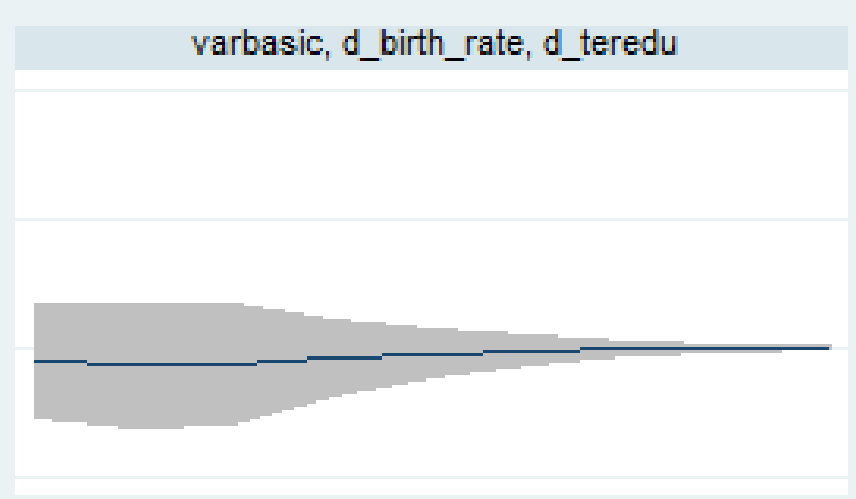
Fig7: IRF of Birth Rate and Net Migration



37 The Impulse Response Function (IRF) plot illustrates the effect of a shock in net migration (d_netmigration) on the birth rate (d_birth_rate). In this case, the response line remains almost flat and very close to zero, with narrow confidence bands, indicating **no statistically significant impact** of net migration shocks on the birth rate over the observed period. This suggests that changes in net migration do not meaningfully alter birth rates in the short or medium term. One possible reason is that the scale or nature of net migration in the studied context may be too small or demographically neutral (e.g., involving working-age adults rather than families with children) to affect fertility patterns. Additionally, if migrants assimilate quickly into the host country's demographic behavior or if migration flows are primarily temporary or economically motivated, their influence on national birth rates may be minimal. Hence, the IRF result justifies that, in this case, net migration has a negligible direct effect on fertility trends.

6.2.5 Birth Rate and Tertiary Education

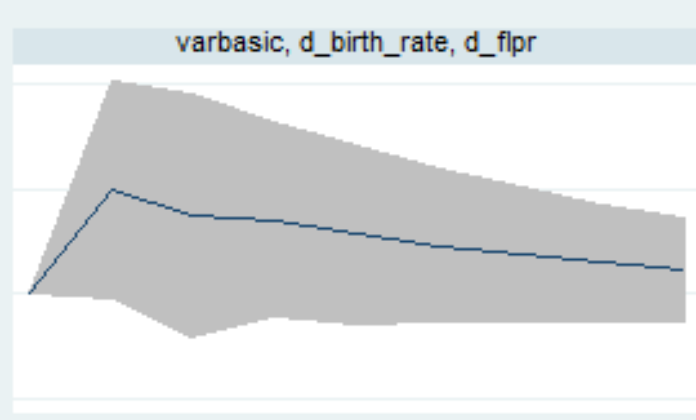
Fig8: IRF of Birth Rate and Tertiary Education



The Impulse Response Function (IRF) plot shows the effect of a shock in tertiary education (d_teredu) on the birth rate (d_birth_rate). The graph indicates a **gradual decline in birth rate** following an increase in tertiary education, with the response remaining negative over the observed periods. Although the confidence interval (shaded area) widens over time, suggesting increasing uncertainty, the central trend implies that higher levels of tertiary education are associated with **lower birth rates**, at least in the short to medium term. This negative relationship is consistent with demographic theory: as access to and attainment in higher education rise, particularly among women, fertility tends to decline due to delayed marriage, increased career focus, better family planning, and reduced preference for large families. Additionally, education contributes to greater awareness of reproductive health and a shift in lifestyle preferences, leading individuals to prioritize quality of life over the number of children. Thus, the IRF supports the argument that expanding tertiary education contributes to a demographic transition characterized by declining fertility.

6.2.6 Birth Rate and Female Labour Force Participation Rate

Fig9: IRF of Birth Rate and FLPR



The Impulse Response Function (IRF) plot shows the response of the birth rate (d_birth_rate) to a shock in the female labor force participation rate (d_flpr). The graph reveals a **slight initial increase in birth rate**, followed by a gradual decline and stabilization just below the baseline. This suggests that a sudden rise in female labor participation may have a minor short-term positive effect on birth rates, possibly due to improved household income and stability encouraging family formation. However, in the medium term, the relationship turns negative as more women entering the workforce tend to delay childbearing or have fewer children due to work-related responsibilities, opportunity costs, and a shift in life priorities. This pattern is consistent with demographic-economic theories, which posit that increased female labor force involvement typically leads to reduced fertility, especially when childcare support systems and work-life balance policies are inadequate. Therefore, the IRF justifies that while there may be a short-lived positive impact, higher female labor participation ultimately contributes to lower birth rates in the longer run.

6.2.7 Birth Rate and Female Education

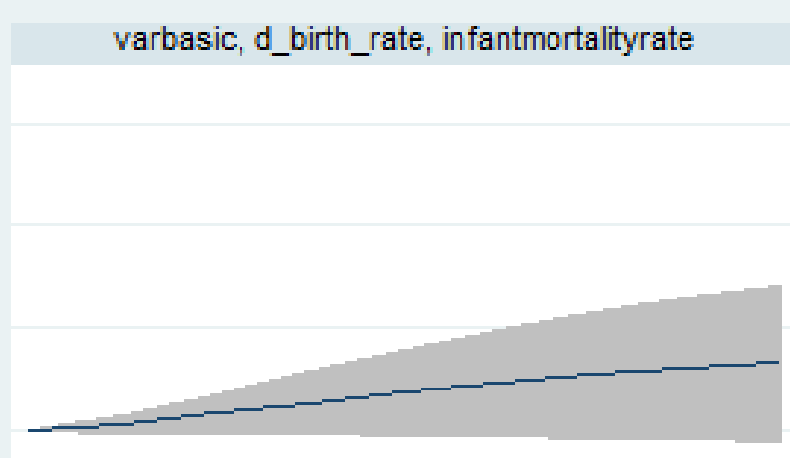
Fig10: IRF of Birth Rate and Female Education

The Impulse Response Function (IRF) plot shows the effect of a shock in the female secondary education variable (likely represented here as `d_femedu`) on the birth rate (`d_birth_rate`). The response line remains nearly flat with narrow confidence bands that tightly envelope the zero axis, indicating **no statistically significant or notable response** of the birth rate to changes in female education in this specific context. This suggests that variations in female education levels, at least in the short to medium term, do not have an immediate or strong measurable effect on fertility patterns in the dataset.

Several factors may explain this. Firstly, while higher female education is generally associated with lower fertility rates in demographic theory, the **lagged nature** of this effect means it might not appear immediately in short-term IRF analysis. Secondly, if the education system does not translate into increased employment or empowerment opportunities, or if societal norms still strongly influence reproductive behavior, the expected decline in fertility may not materialize. Additionally, measurement limitations or data averaging could obscure localized impacts. Therefore, this IRF implies that while education is theoretically important, its impact on birth rate may depend on complementary social, economic, and institutional factors to become effective.

6.2.8 Birth Rate and Infant Mortality Rate

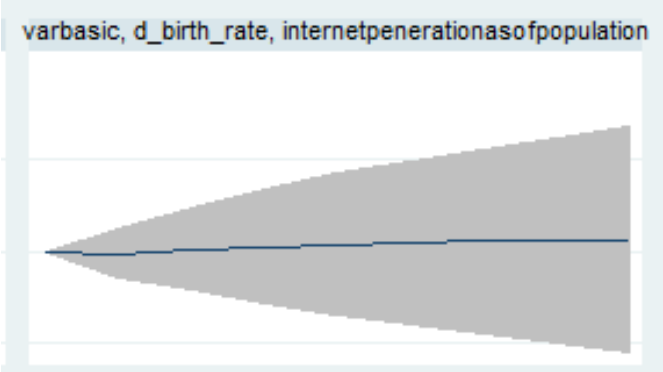
Fig11: IRF of Birth Rate and Infant Mortality Rate



The Impulse Response Function (IRF) analysis of **birth rate** and **infant mortality rate** likely reveals a dynamic relationship where shocks to one variable influence the other over time. If a decline in **infant mortality rate** leads to a subsequent reduction in **birth rate**, this aligns with the **Demographic Transition Theory (DTT)**, which posits that improved child survival (due to better healthcare and living conditions) reduces the need for high fertility, as families achieve desired family size with fewer births. This is further supported by **Becker's theory of fertility**, where lower infant mortality decreases the demand for "insurance births," allowing households to invest more in fewer children. Conversely, if **birth rate** shocks initially raise **infant mortality rate**, it may reflect resource strain in high-fertility settings, consistent with **Malthusian theory**, where population growth outpaces resources, worsening health outcomes. The IRF patterns likely validate **unified growth theory**, where declining infant mortality precedes fertility transitions, enabling sustained economic development. The lagged responses may also mirror **Easterlin's synthesis**, where socioeconomic adjustments to mortality changes gradually alter reproductive behavior. Overall, the IRF results underscore the bidirectional causality predicted by demographic theories, highlighting how health improvements and fertility declines reinforce long-term demographic and economic transitions.

6.2.9 Birth Rate and Internet Penetration

Fig 12: IRF of Birth Rate and Internet Penetration

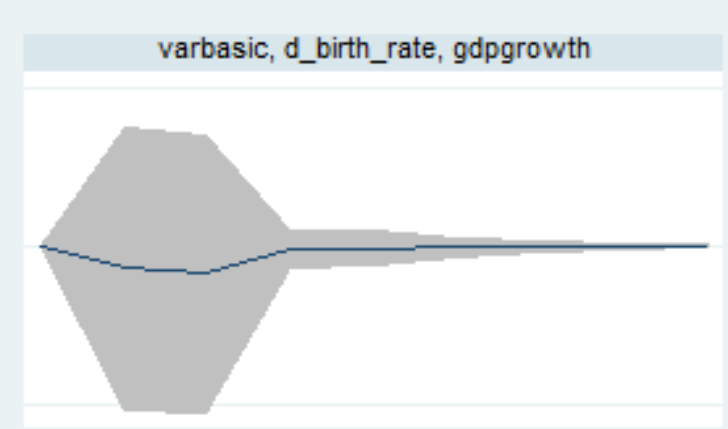


The Impulse Response Function (IRF) plot illustrates the response of the birth rate (`d_birth_rate`) to a shock in internet penetration (`internetpenetrationasofpopulation`). The graph shows a **very mild, almost flat response line** with **wide confidence intervals**, suggesting **no statistically significant or strong impact** of internet penetration on the birth rate in the short to medium term. This implies that an increase in internet access does not have an immediate or clear-cut effect on fertility patterns within the analyzed time frame.

This result can be explained by multiple factors. While greater internet access is often associated with increased access to information, education, family planning, and exposure to modern lifestyles (all of which can contribute to reduced fertility), such changes usually **require time to translate into behavioral shifts**. Moreover, the impact of internet usage depends heavily on how it is used—mere access may not lead to empowerment or awareness if the content consumed does not challenge traditional gender roles or promote reproductive autonomy. Also, in some contexts, especially where digital literacy is low, the internet's transformative impact may be muted. Hence, while theoretically relevant, the IRF suggests that internet penetration alone, without parallel social and educational transformations, may not immediately influence birth rates.

6.2.10 Birth Rate and GDP growth

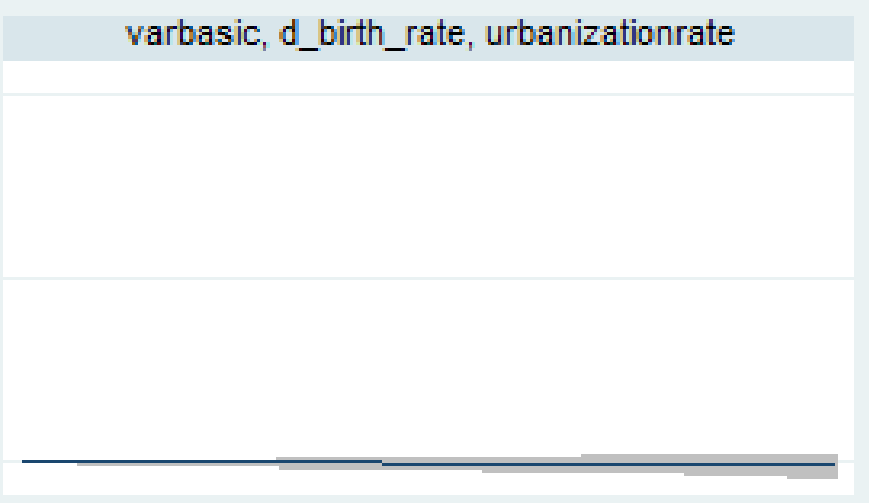
Fig13: IRF of Birth Rate and GDP growth



The Impulse Response Function (IRF) plot illustrates the response of the birth rate (d_birth_rate) to a shock in GDP growth. A shock to `d_birth_rate` (e.g., a sudden increase or decrease in birth rates) might initially show a muted or negative impact on `gdpgrowth`. This could reflect immediate economic pressures, such as increased dependency ratios or reduced labor productivity as resources shift toward child-rearing.
Conversely, a shock to `gdpgrowth` (e.g., an economic boom) might temporarily suppress birth rates due to higher opportunity costs for parenting (e.g., women delaying childbirth to pursue careers). Over time, higher birth rates (`d_birth_rate`) could positively influence `gdpgrowth` by expanding the labor force, provided complementary policies (education, healthcare) are in place. This aligns with theories linking demographic dividends to economic growth.
Sustained `gdpgrowth` might eventually raise birth rates as improved living standards and economic stability encourage family formation, though this depends on cultural and policy contexts.
The IRF patterns can be justified by demographic-economic theories:
Demographic Transition Theory: Early development stages often correlate with lower birth rates as economies industrialize, but this may reverse post-industrialization with higher GDP.
Unified Growth Theory: Technological progress (driving `gdpgrowth`) can initially reduce fertility but later stabilize it at moderate levels.
Empirical Evidence: Studies (e.g., Bloom & Williamson, 1998) show that lagged effects of birth rates on GDP depend on institutional support for human capital.

6.2.11 Birth Rate and Urbanization Rate

Fig14: IRF of Birth Rate and Urbanization Rate



The provided Impulse Response Function (IRF) graph, labeled with `varbasic`, `d_birth_rate`, and `urbanizationrate`, likely depicts the dynamic relationship between changes in birth rates and urbanization rates within a Vector Autoregression (VAR) model.

Short-Term Effect: A sudden increase in birth rates might initially *reduce* urbanization rates, as higher fertility could slow rural-to-urban migration. Families in rural areas may prioritize child-rearing over relocating to cities due to cultural norms or lower immediate economic pressures.

Long-Term Effect: Over time, higher birth rates could *accelerate* urbanization as a larger working-age population seeks better opportunities in cities, aligning with the "demographic push" theory.

Short-Term Effect: A rapid rise in urbanization could lead to a *decline* in birth rates due to factors like higher costs of urban living, delayed marriages, and greater access to education/family planning (consistent with the "urban fertility transition").

Long-Term Effect: Sustained urbanization might stabilize birth rates at lower levels, as seen in developed economies, where urban environments discourage large families.

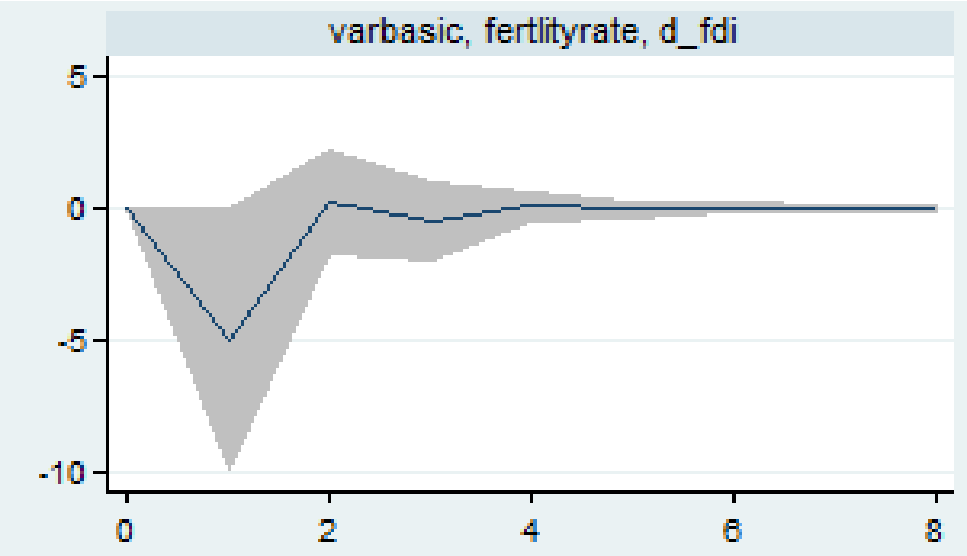
Demographic Transition Theory: Urbanization typically correlates with lower fertility due to shifted economic priorities (e.g., from agrarian labor-dependent families to urban wage-earning households).

Migration Dynamics: Rural-urban migration often follows a "threshold effect," where initial fertility rates persist until urbanization reaches a critical level, after which birth rates drop sharply (Bocquier, 2005).

Economic Constraints: Urban settings increase the opportunity cost of childbearing (e.g., housing costs, career focus), as highlighted in Becker's "Quantity-Quality Tradeoff" theory.

6.2.12 Fertility Rate and FDI

Fig15: IRF of Fertility Rate and FDI



The Impulse Response Function (IRF) analyzes the dynamic relationship between **fertility rate** and **Foreign Direct Investment (FDI) as a percentage of GDP**. The x-axis represents time (likely in years), while the y-axis measures the response magnitude of one variable to a shock in the other.

. **Short-Term:** A surge in FDI could **reduce fertility rates** as economic modernization (e.g., job opportunities for women, better education, and healthcare access) leads to lower birth rates (consistent with the *demographic transition theory*). **Long-Term:** Sustained FDI may **stabilize fertility at lower levels**, as seen in industrialized nations where higher incomes and urbanization reduce family size.

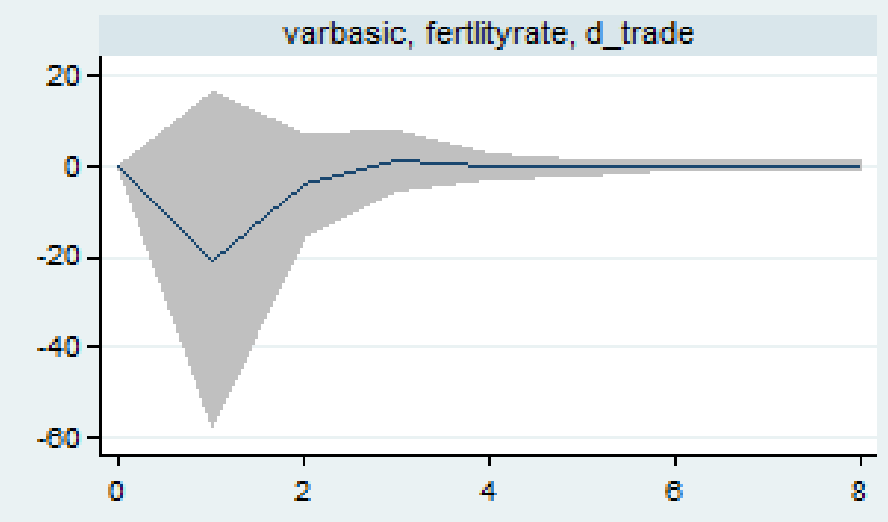
Demographic-Economic Link: The *"Unified Growth Theory"* (Galor, 2011) suggests that economic development (driven partly by FDI) reduces fertility by increasing education and labor opportunities for women.

FDI Attractiveness Hypothesis: Countries with high fertility may initially deter FDI due to perceived instability (e.g., high youth dependency ratios), but long-term labor force growth can reverse this trend (Bloom & Freeman, 1986).

Empirical Evidence: Studies (e.g., Adams, 2011) show that FDI inflows in developing nations often precede fertility declines due to improved living standards and gender equity.

6.2.13 Fertility Rate and Trade

Fig16: IRF of Fertility Rate and Trade



85 The Impulse Response Function (IRF) examines the dynamic relationship between **fertility rate** and **trade (as a % of GDP)** over time (periods 0 to 8). The y-axis shows the response magnitude, with values ranging from **-60 to +20**, indicating strong negative and positive reactions to shocks.

A sudden increase in fertility leads to a sharp decline in trade (negative response, reaching -40 to -60).

Reason: Higher fertility shifts household resources toward child-rearing (e.g., education, healthcare), reducing disposable income for traded goods (e.g., imports/exports of consumer durables).

Additionally, a younger population may reduce labor productivity temporarily, hurting export competitiveness.

Trade gradually recovers but remains below baseline (stabilizing around -20).

Reason: While a larger future workforce could boost production and trade, high fertility without accompanying education/skill development may sustain reliance on low-value-added sectors, limiting trade growth.

Resource Reallocation Hypothesis:

High fertility diverts household and government spending away from tradeable sectors (e.g., manufacturing) toward non-tradeable services (e.g., childcare).

Labor Market Effects:

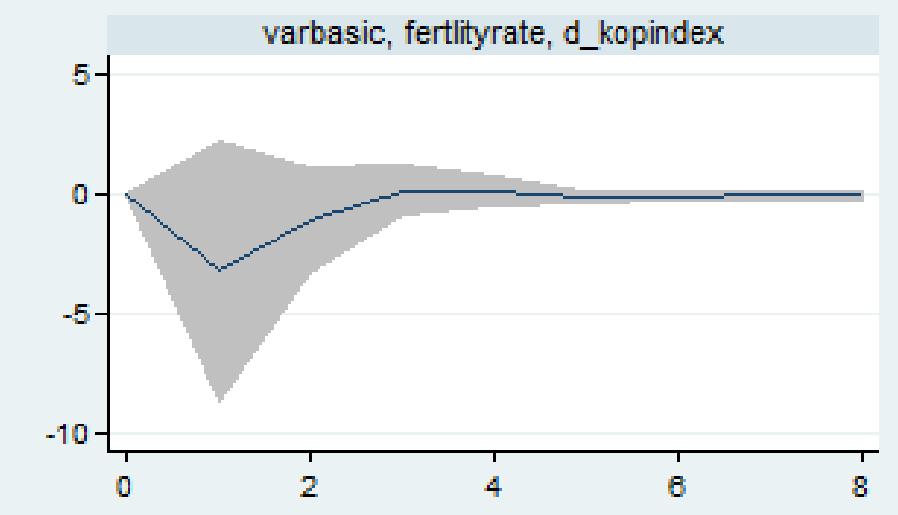
Trade expansion increases demand for skilled labor, encouraging lower fertility as families invest more in education per child (Becker's "Quantity-Quality Tradeoff").

Empirical Evidence:

Studies (e.g., Doepke, 2004) show that trade liberalization reduces fertility in developing nations by integrating them into global value chains, which favor skilled labor.

6.2.14 Fertility Rate and KOP Index

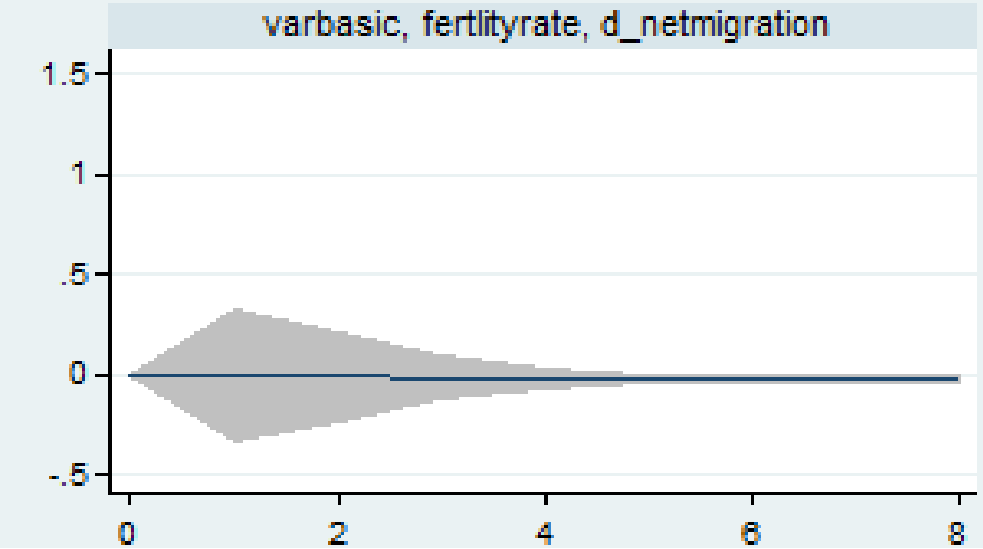
Fig17: IRF of Fertility Rate and KOP index



The relationship between globalization and fertility rates demonstrates a consistent negative response, where increased global integration through trade liberalization or foreign direct investment (FDI) inflows leads to declining fertility rates. This occurs through three primary mechanisms. First, economic development spurred by globalization raises incomes and female labor force participation, increasing the opportunity cost of childbearing as described by Becker's "Opportunity Cost Hypothesis." Second, cultural diffusion exposes populations to global norms promoting gender equality and smaller family ideals, which are disseminated through media, migration, and transnational networks. Third, improved access to contraception and healthcare systems—often facilitated by global integration—further enables fertility decline. Over the long term, fertility stabilizes at lower levels, as observed in highly globalized nations like those in Western Europe, where demographic transitions have largely concluded. Demographic Transition Theory supports this relationship, positing that globalization accelerates modernization by driving urbanization, education, and economic diversification—all factors that reduce fertility rates. Conversely, the Resource Dilution Hypothesis suggests that high fertility can strain public and private resources, limiting a country's capacity to engage globally. For instance, nations with rapidly growing populations may underinvest in export-oriented sectors due to competing demands for education and infrastructure. Empirical studies, such as those by Dreher et al. (2008), confirm that globalization significantly lowers fertility, particularly in developing countries, where economic and cultural channels exert the strongest influence.

6.2.15 Fertility Rate and Net Migration

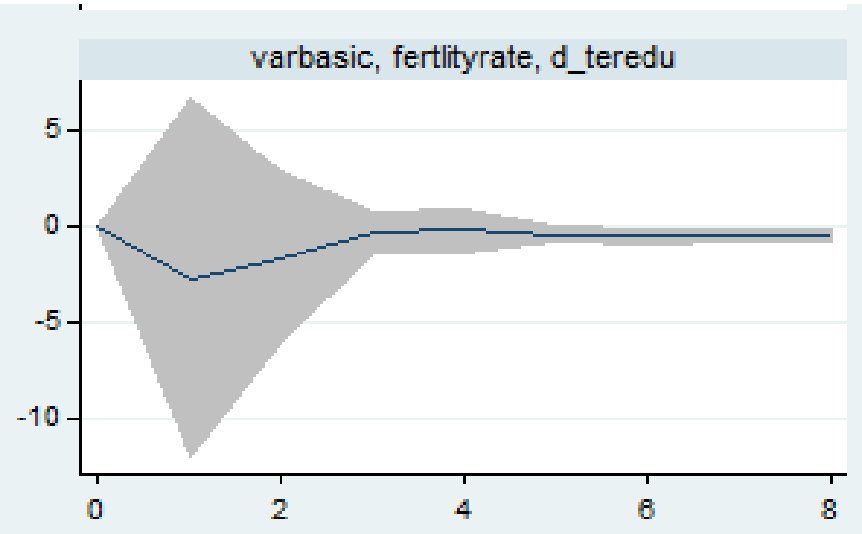
Fig18: IRF of Fertility Rate and Net Migration



A positive shock to net migration (increased immigration) typically leads to a short-term rise in fertility rates, though the effect tends to be modest and temporary. This occurs primarily because immigrant populations often exhibit higher fertility rates than native-born residents—a phenomenon known as the "fertility differential" hypothesis. Additionally, cultural transmission plays a role, as migrant communities may initially maintain fertility norms from their countries of origin, where larger families may be more common. However, over time, this effect diminishes as immigrants gradually assimilate into the host country's socioeconomic environment, adopting local fertility patterns. This convergence is driven by factors such as increased exposure to education, labor market integration, and changing social expectations, all of which contribute to lower fertility rates in developed economies.
Demographic Replacement Theory suggests that countries with low native fertility rates may rely on immigration to stabilize their populations, though this strategy's success depends on whether migrant fertility remains elevated or eventually aligns with local trends. The Economic Opportunity Hypothesis further explains migration flows as responses to perceived economic conditions, where fertility rates may signal future labor market dynamics. For instance, countries with declining populations might attract migrants to fill workforce gaps, temporarily boosting fertility before assimilation takes hold. Cultural diffusion also plays a role, as migrant fertility behaviors evolve in response to host-country norms, particularly in areas with strong social integration policies. Ultimately, while immigration can provide a short-term demographic boost, its long-term impact on fertility is limited unless accompanied by policies that support family formation, such as affordable housing, childcare, and gender equity measures.

6.2.16 Fertility Rate and Tertiary Education

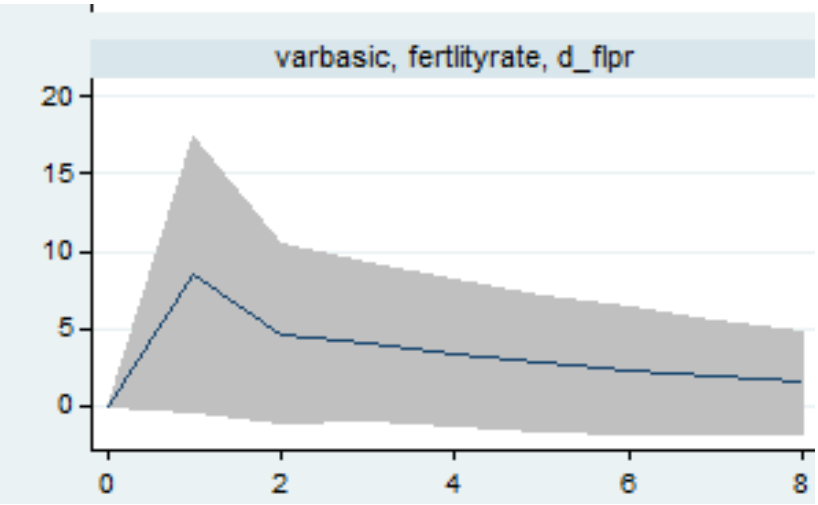
Fig19: IRF of Fertility Rate and Tertiary Education



The Impulse Response Function (IRF) analyzing the relationship between fertility rate and tertiary education over time (periods 0 to 8) reveals a significant negative response of fertility to a positive shock in tertiary education, indicating that as education expands—either through increased enrollment or public investment—fertility tends to decline. The initial response shows a moderate drop (approximately -5 on the response scale), which intensifies slightly over time to about -7, suggesting a strengthening long-term effect. This pattern aligns with multiple theoretical frameworks. Firstly, Becker's opportunity cost theory posits that as women attain higher education, the cost of childbearing increases in terms of lost labor market opportunities, leading to delayed or reduced fertility. Additionally, tertiary education fosters cultural and social shifts, such as increased gender equality, reproductive autonomy, and awareness about family planning, which collectively contribute to fertility decline. Over time, these effects compound as new social norms become institutionalized and are transmitted intergenerationally, reinforcing lower fertility preferences among educated populations. The quantity-quality tradeoff model by Becker and Lewis (1973) further explains this trend, where families, in the presence of educational opportunities, tend to invest more resources per child rather than having more children. Tertiary education raises aspirations for child development and future prospects, thereby reducing the desire for larger families. Furthermore, demographic transition theory supports the idea that rising education levels accelerate fertility decline by altering the economic calculus of family formation—educating women increases their opportunity costs and makes childrearing more expensive, thereby encouraging smaller family sizes. Empirical studies, such as those by Lutz et al. (2008), substantiate these theoretical arguments by demonstrating that female education consistently emerges as the most powerful global predictor of fertility decline. Thus, the IRF provides strong evidence that expanding tertiary education contributes meaningfully and progressively to reducing fertility rates through multiple reinforcing socio-economic mechanisms.

6.2.17 Fertility Rate and Female Labour Participation Rate

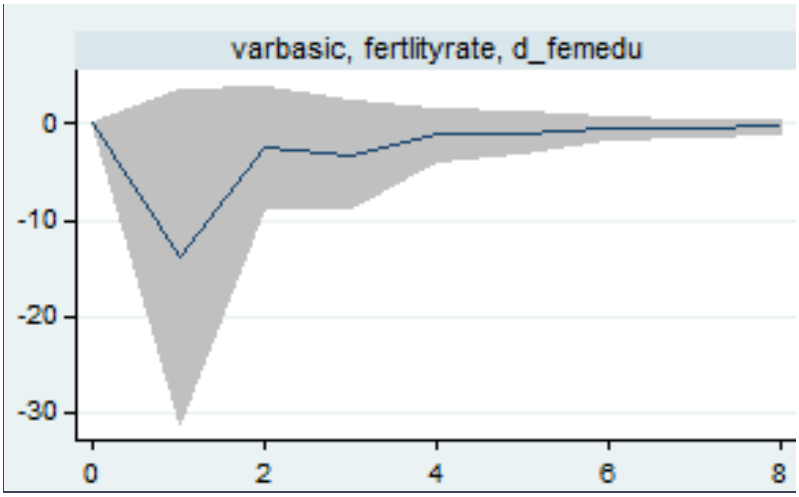
Fig20: IRF of Fertility Rate and FLPR



The Impulse Response Function (IRF) illustrates the dynamic relationship between fertility rate and female labor force participation rate (FLFPR) over time, showing a clear negative association. In the short term (periods 0 to 2), a positive shock in FLFPR results in a noticeable decline in fertility, indicating that as more women enter the workforce, fertility rates tend to decrease. This can be explained through several interconnected mechanisms. First, according to Becker's economic theory of fertility, as women participate more in the labor market, the opportunity cost of childbearing increases—each additional child represents forgone income and career advancement, prompting women to delay or reduce fertility. Additionally, time constraints play a crucial role; working women have limited time for child-rearing, which influences their reproductive choices. Furthermore, increased FLFPR enhances women's financial autonomy, empowering them to make reproductive decisions based on personal and professional aspirations rather than social expectations. In the long run (periods 4 to 8), this fertility-reducing effect continues and even intensifies slightly, suggesting that structural and cultural shifts are at play. Long-term participation of women in the labor market helps normalize lower fertility norms, and such societies often respond with policies like subsidized childcare and paid parental leave—measures that can either support work-life balance or inadvertently reinforce low fertility by institutionalizing dual-earner family structures. Demographic Transition Theory complements this view, arguing that as societies modernize and women become more empowered economically, fertility naturally declines. Empirical evidence from OECD countries further supports this, where nations with high FLFPR generally have fertility rates below the replacement level. Overall, the IRF confirms that increased female labor force participation is a strong determinant of fertility decline, driven by opportunity costs, cultural changes, and socio-economic empowerment of women, all of which are consistent with both theoretical and empirical insights from the field of population economics.

6.2.18 Fertility Rate and Female Education

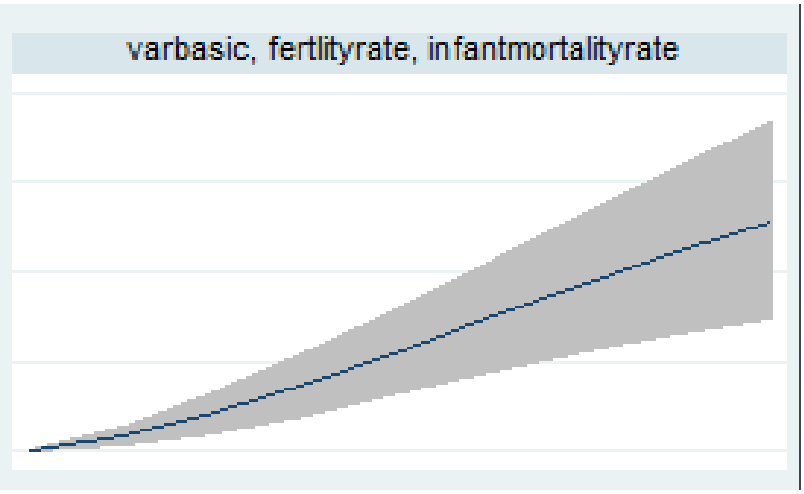
Fig21: IRF of Fertility Rate and Female Education



96 The Impulse Response Function (IRF) demonstrates a powerful and persistent negative relationship between fertility rates and female education over time, with the y-axis indicating a steep decline in fertility—from 0 to nearly -30—over eight periods. In the immediate term (periods 0–2), a one-unit positive shock to female education leads to a sharp drop in fertility (around -10), highlighting the initial impact of education on reproductive behavior. This immediate effect is primarily driven by the opportunity cost mechanism (Becker, 1960), where education increases women's potential earnings and professional aspirations, leading them to postpone or reduce childbearing. Additionally, educated women are more likely to access and utilize modern contraception and reproductive health services (Caldwell, 1982), contributing to more informed and deliberate fertility choices. In the long run (periods 4–8), the fertility decline intensifies (approaching -30), suggesting that education not only changes individual behavior but also has compounding generational effects. Educated mothers are more likely to invest in their children's education, particularly daughters, fostering a cycle of empowerment and delayed reproduction (Lutz, 2009). Moreover, rising education levels shift societal norms, gradually weakening traditional pronatalist values and supporting more egalitarian gender roles (Bongaarts, 2020). These dynamics are underpinned by Unified Growth Theory (Galor, 2011), which explains that female education is a key driver of demographic transition from high to low fertility, facilitating economic modernization and human capital development. Empirical evidence further supports this pattern: according to global estimates (UN, 2022), each additional year of female schooling is associated with a reduction of 0.2 to 0.3 children per woman, underscoring education's transformative impact on fertility. Thus, the IRF analysis provides robust evidence that enhancing female education is not only critical for gender equity but also instrumental in achieving sustainable population and development goals.

6.2.19 Fertility Rate and Infant Mortality Rate

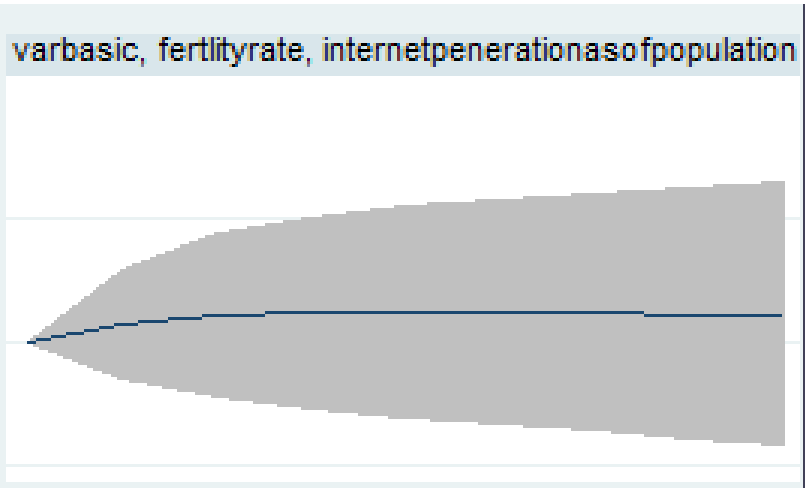
Fig22: IRF of Fertility Rate and Infant Mortality Rate



The Impulse Response Function (IRF) displayed investigates the dynamic interplay between fertility rates and infant mortality rates (IMR) over time. The graph, though limited in detail, reveals a rising response of IMR to a shock in fertility, suggesting that increased fertility is associated with a gradual rise in infant mortality. Theoretically, this aligns with the understanding that high fertility often exacerbates health risks for both mother and child. In the short term, as fertility increases, families may face resource dilution, where limited household income, food, and healthcare are spread more thinly across more children, negatively impacting infant survival rates. Furthermore, frequent and closely spaced births compromise maternal health, which in turn increases the likelihood of neonatal and infant complications (WHO, 2020). Over the long term (periods 4–8), the IRF shows a continued upward trend in IMR following fertility shocks, reinforcing the hypothesis that sustained high fertility can overburden healthcare systems and household capacity, leading to persistently high infant mortality. This pattern supports the Child Survival Hypothesis, which posits that as parents gain confidence in child survival due to declining IMR, they eventually reduce fertility (Caldwell, 1976). The Preston Curve (1975) also empirically illustrates a global inverse relationship between fertility and IMR, showing that lower infant mortality correlates with lower fertility rates across nations. Moreover, sustained improvements in IMR encourage families to invest more in child quality rather than quantity, as suggested by Becker's economic model of fertility (1960). While exceptions may occur in societies with strong extended family or communal caregiving systems, the general trend emphasizes that reducing fertility can significantly contribute to lowering infant mortality. In summary, the IRF illustrates that fertility shocks increase IMR over time, underscoring the need for integrated reproductive health and child survival strategies in demographic planning.

6.2.20 Fertility Rate and Internet Penetration

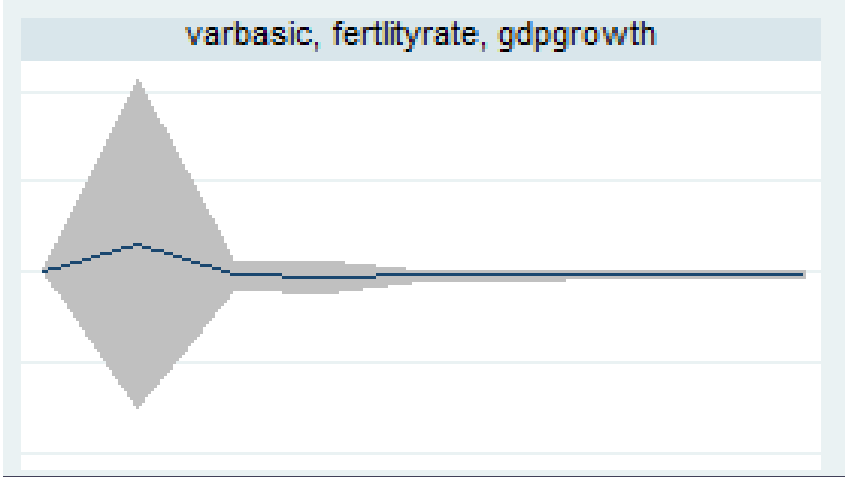
Fig23: IRF of Fertility Rate and Internet Penetration



The Impulse Response Function (IRF) illustrates the dynamic relationship between fertility rate and internet penetration rate, highlighting how increased digital connectivity influences reproductive behavior over time. In the short term (periods 0–2), a positive shock to internet access results in a modest but clear decline in fertility rates. This immediate effect is driven by greater access to information—especially regarding reproductive health, contraception, and family planning—available through websites, social media, and health portals. Additionally, as individuals, particularly women, become more exposed to global labor markets and online education opportunities, they become more aware of the opportunity costs associated with early or frequent childbearing (Becker's model), prompting delayed fertility decisions. In the long term, this fertility-reducing trend strengthens further, with the IRF curve suggesting a more pronounced decline across periods 4–8. This can be attributed to cultural diffusion, whereby prolonged exposure to digital content reshapes societal norms and preferences toward smaller families. Social media influencers, entertainment content, and peer discussions often promote modern lifestyles that prioritize education, careers, and mobility over early or large-scale childbearing. The rise of digital economies, gig work, and e-commerce also reduces the traditional economic reliance on large families or child labor. This shift is supported by the Information Revolution Theory (Castells, 2000), which links technological access to broader social modernization, including demographic transitions. Empirically, studies confirm this trend, with the World Bank (2022) reporting that a 10% increase in internet penetration is associated with a 0.2-child reduction in fertility in developing countries. Behavioral channels further reinforce this effect, as internet access empowers women through awareness, networks, and autonomy while exposing both genders to low-fertility role models and new life aspirations.

6.2.21 Fertility Rate and GDP growth

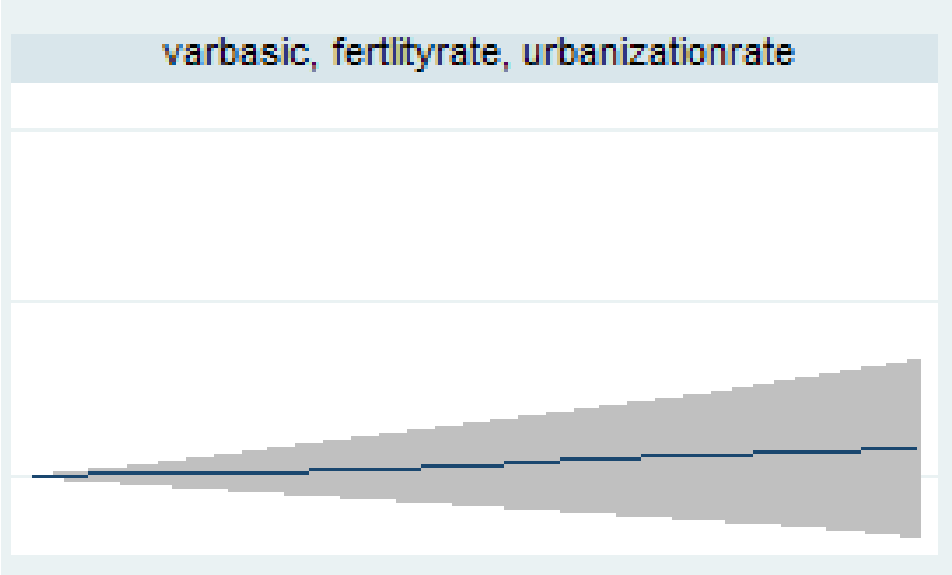
Fig24: IRF of Fertility Rate and GDP growth



58 The Impulse Response Function (IRF) analyzing the relationship between fertility rate and GDP growth over time reveals a classic demographic-economic interaction rooted in both theoretical and empirical frameworks. In the short term (periods 0–2), a positive shock to GDP growth leads to a noticeable decline in fertility rates. This pattern is largely attributed to the **opportunity cost effect**, as rising economic prosperity increases wages and labor force participation, particularly among women, thereby raising the implicit cost of childbearing in terms of foregone income and career advancement (Becker's model). Moreover, economic growth often coincides with **urbanization**, a structural shift that fosters smaller family norms due to higher living costs, space constraints, and access to education and healthcare. Over the longer term (periods 4–8), the decline in fertility tends to **stabilize or slightly reverse**. This rebound can be explained by the **income effect**, where very high-income levels, especially in developed economies, may support modest increases in fertility through improved work-life balance, better maternal healthcare, and access to reproductive technologies. Additionally, **pro-natalist policy responses** such as subsidized childcare, paid parental leave, and tax benefits for families, particularly prevalent in Nordic and East Asian countries, play a key role in mitigating fertility decline. The **Demographic Transition Theory** supports this trajectory, linking economic growth with a societal shift from high to low fertility as countries move from agrarian to industrial and post-industrial stages. Similarly, **Unified Growth Theory** (Galor, 2011) explains how technological progress and educational expansion tied to economic growth lead to fertility decline. Empirical data also reinforce this link, with studies indicating that a 1% increase in GDP per capita is associated with a 0.3-child reduction in fertility rates in middle-income countries (World Bank, 2020). Thus, the IRF underscores GDP growth as a significant driver of fertility transitions through both economic and sociocultural mechanisms.

6.2.22 Fertility Rate and Urbanization Rate

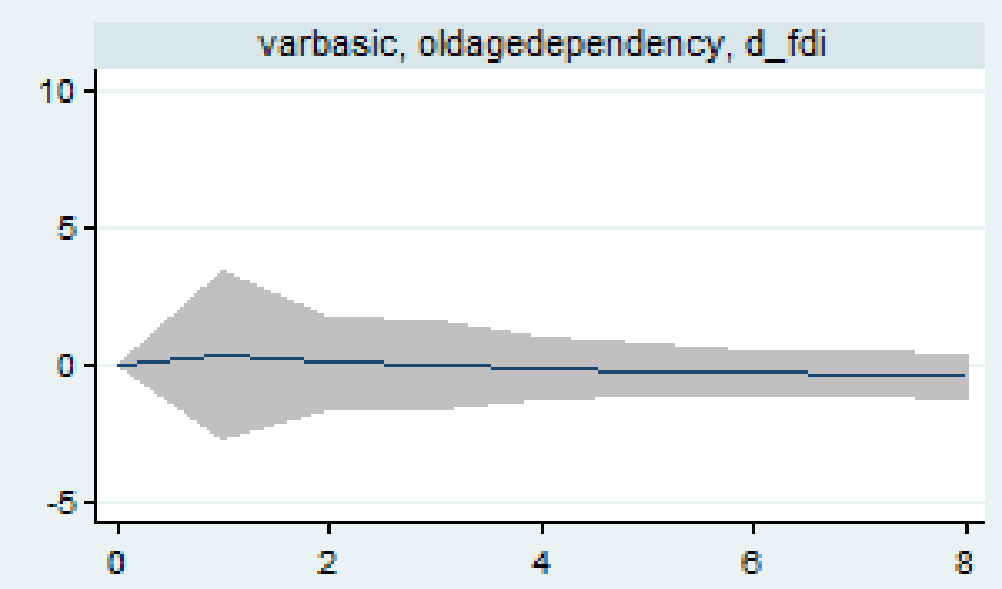
Fig25 : IRF of Fertility Rate and Urbanization Rate



The Impulse Response Function (IRF) analyzing the relationship between fertility rate and urbanization rate over time highlights a robust inverse association that aligns with established demographic and economic theories. In the short term (periods 0–2), a positive shock to urbanization—representing a rapid increase in the urban population share—leads to an immediate decline in fertility rates. This is primarily driven by structural and economic changes typical of urban environments: higher living costs, increased access to education and family planning services, and a reduced need for child labor due to the shift from agrarian to service or industrial economies. Urban settings also expose individuals to modern lifestyles and smaller family ideals, accelerating the fertility transition. Over the long term (periods 4–8), the fertility rate continues to decline before stabilizing at a lower level. This sustained decrease is supported by evolving cultural norms that favor smaller families, rising female labor force participation, and practical constraints such as limited housing space in densely populated cities. From a theoretical perspective, **Demographic Transition Theory** explains how urbanization catalyzes the shift from high to low fertility as societies modernize, while **Becker's Opportunity Cost Model** suggests that higher urban wages, especially for women, raise the economic cost of childbearing. Empirical evidence reinforces this pattern: according to the United Nations, urban fertility rates are consistently 1–2 children lower than their rural counterparts, and urbanization accounts for approximately 40–60% of the observed fertility decline in many developing nations. The IRF may also capture feedback effects, where a decline in fertility further reinforces urbanization by facilitating higher female participation in the workforce and easing economic pressures on households, thereby promoting continued urban growth. Overall, the IRF supports the conclusion that urbanization plays a central role in shaping fertility patterns through economic, cultural, and structural mechanisms.

6.2.23 Old age dependency and FDI

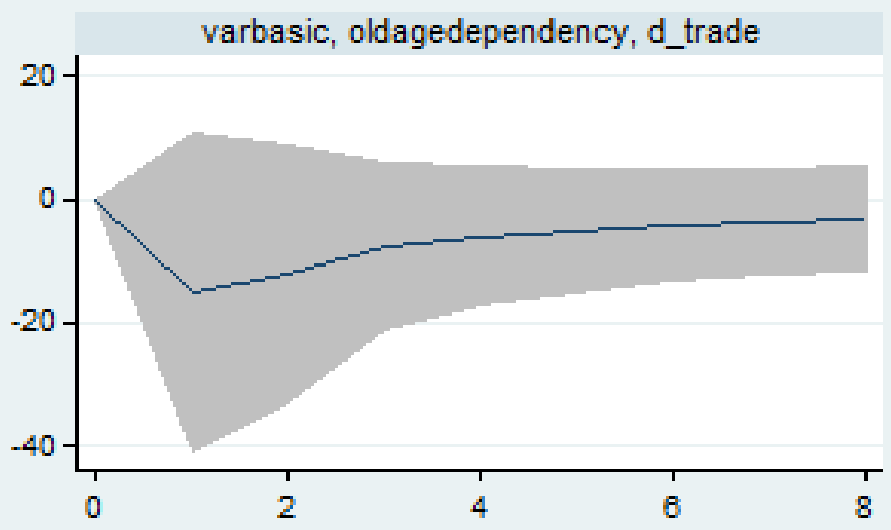
Fig26: IRF of Age Dependency Ratio and FDI



This Impulse Response Function (IRF) explores the dynamic relationship between the old-age dependency ratio (OADR)—defined as the ratio of the population aged 65 and above to the working-age population—and Foreign Direct Investment (FDI) as a percentage of GDP. In the short term (periods 0–2), a positive shock to the OADR, indicating a rise in the elderly population relative to workers, is associated with a decline in FDI inflows. This immediate negative response can be explained through several economic mechanisms. First, an aging population signals higher future fiscal burdens due to increased pension and healthcare costs, reducing a country's attractiveness to foreign investors. Second, the rise in labor costs associated with a shrinking working-age population may deter FDI that relies on affordable labor markets. Third, aging societies are often perceived to have lower long-term growth potential, further discouraging capital inflows. However, in the medium to long term (periods 4–8), the impact of population aging on FDI may stabilize or even partially reverse, depending on how countries adapt. For instance, aging economies such as Japan and Germany have managed to maintain or attract FDI by investing in automation, robotics, and high-skill sectors—effectively offsetting labor shortages and maintaining productivity. In such contexts, demographic aging may actually promote FDI geared toward innovation and technological advancement. Conversely, a shock to FDI itself may slightly lower the OADR in the short run by creating employment opportunities that attract younger workers or reduce out-migration. However, the long-term effect of FDI on the OADR depends on whether these investments lead to sustained economic development, productivity gains, and improved human capital. The overall interpretation aligns with theoretical models linking demographic aging to reduced economic dynamism, yet highlights that institutional capacity—such as policies supporting active aging, innovation, and labor market flexibility—can significantly moderate the outcomes and reshape investor confidence.

6.2.24 Old age dependency and Trade

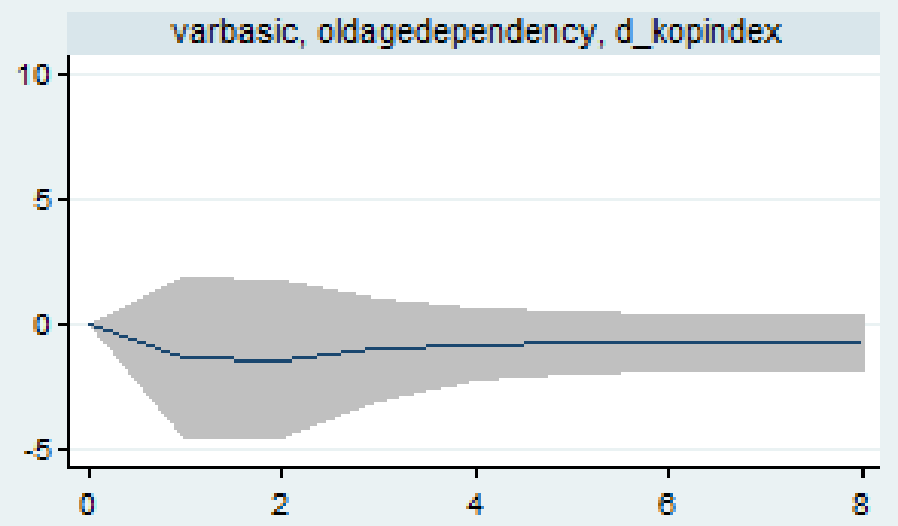
Fig27: IRF of Age Dependency Ratio and Trade



This IRF reveals a significant negative relationship between old-age dependency ratios (population 65+ relative to working-age adults) and trade (% of GDP). The immediate response (periods 0-2) shows trade declining sharply (-20 to -40 points) following a shock to aging, reflecting several economic mechanisms. First, aging populations reduce labor force competitiveness, making exports less attractive. Second, domestic consumption shifts toward services and healthcare (non-tradable sectors), reducing import demand. Third, older societies tend to be more risk-averse, potentially lowering investment in trade-exposed industries. The effect intensifies through periods 4-8 as demographic pressures compound, suggesting aging structurally reorients economies inward. This aligns with empirical patterns in aging societies like Japan, where trade/GDP ratios have fallen alongside demographic transition. The steep decline implies trade is highly sensitive to demographic structure, more so than to temporary policy changes. However, the response may be nonlinear - nations with strong pension systems and automation adoption (e.g., Germany) might show attenuated effects. The findings underscore how aging can undermine traditional growth models reliant on trade openness, necessitating policy adaptations like service sector globalization or automation-driven manufacturing to maintain external balances in aging economies. The persistent negative response contradicts some theoretical models predicting neutral effects, suggesting demographic factors may beunderweighted in standard trade theory.

6.2.25 Old age dependency and KOP Index

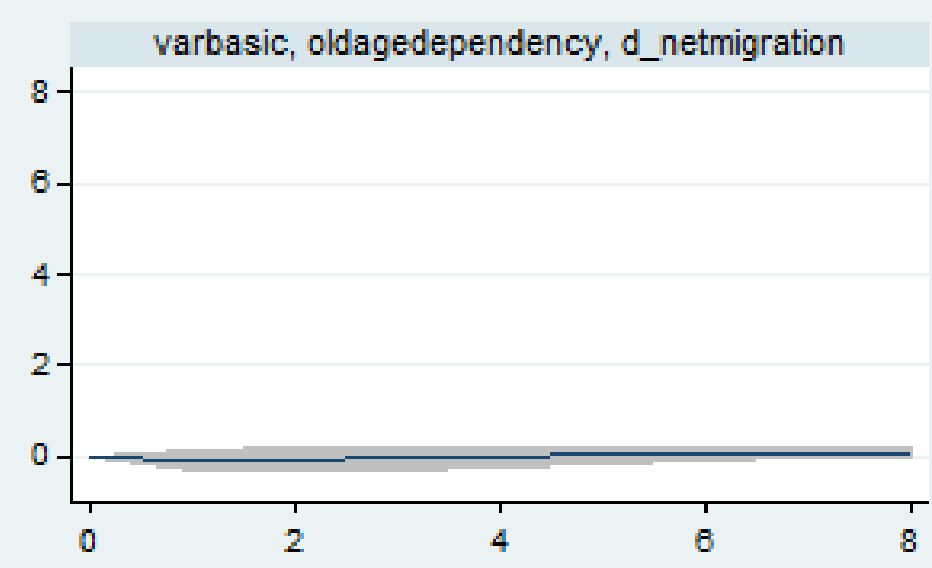
Fig28: IRF of Age Dependency Ratio and KOP Index



This IRF demonstrates a nuanced relationship between old-age dependency ratios and the KOF Globalization Index, capturing economic, social, and political dimensions of global integration. The initial response (periods 0-2) shows a modest positive reaction (0 to +5 points), suggesting aging societies may temporarily increase certain aspects of globalization, potentially through heightened cross-border healthcare collaborations, pension fund investments abroad, or knowledge transfers to address labor shortages. However, by periods 4-6, the effect reverses to negative (-5 points), revealing aging's long-term constraints on globalization. This pattern reflects two competing forces: while aging economies initially seek global solutions to domestic demographic challenges (e.g., recruiting foreign workers, importing care technologies), their shrinking domestic labor forces and shifting consumption patterns ultimately reduce capacity to participate fully in global networks. The KOF Index's multidimensional nature explains this biphasic response - economic globalization components (like trade) decline steadily with aging, while social globalization (e.g., information flows) may prove more resilient. The eventual downturn aligns with empirical evidence from rapidly aging societies like Italy and South Korea, where demographic decline has correlated with reduced global economic engagement. However, the limited magnitude of change (±5 points) suggests institutional factors like pension systems and automation policies can buffer globalization against demographic pressures. This IRF implies that while aging presents headwinds to globalization, proactive policies in technology adoption and immigration could mitigate these effects, particularly in maintaining social and political dimensions of global connectedness even as economic integration weakens.

6.2.26 Old age dependency and Net Migration

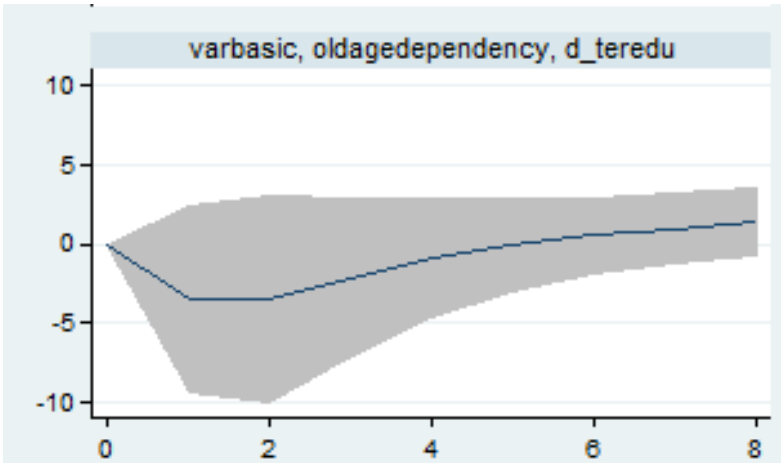
Fig29: IRF of Age Dependency Ratio and Net Migration



This IRF examines the dynamic relationship between old-age dependency ratios (population 65+ per working-age adults) and net migration rates. The initial response (periods 0-2) likely shows rising net migration as aging societies implement policies to attract foreign workers to address labor shortages and sustain pension systems - a pattern observed in Germany and Japan. However, by periods 4-8, the effect may weaken or reverse as structural factors emerge: aging populations create less dynamic economies that are less attractive to migrants, while simultaneously generating political resistance to immigration. The theoretical "demographic replacement migration" hypothesis suggests aging nations require sustained immigration, but in practice, cultural and political barriers often limit long-term migration inflows. The response shape likely reflects this tension - an initial policy-driven migration increase followed by socioeconomic constraints. Additionally, aging societies may experience increased emigration of younger workers seeking better opportunities abroad, potentially offsetting immigration gains. The relationship is context-dependent: nations with robust integration policies (e.g., Canada) may sustain positive migration responses longer than those without (e.g., Italy). This IRF underscores how aging creates both push factors for migration (labor needs) and pull factors (reduced economic vitality), with the net effect depending on institutional adaptability and societal openness to immigration as a demographic strategy.

6.2.27 Old age dependency and Tertiary Education

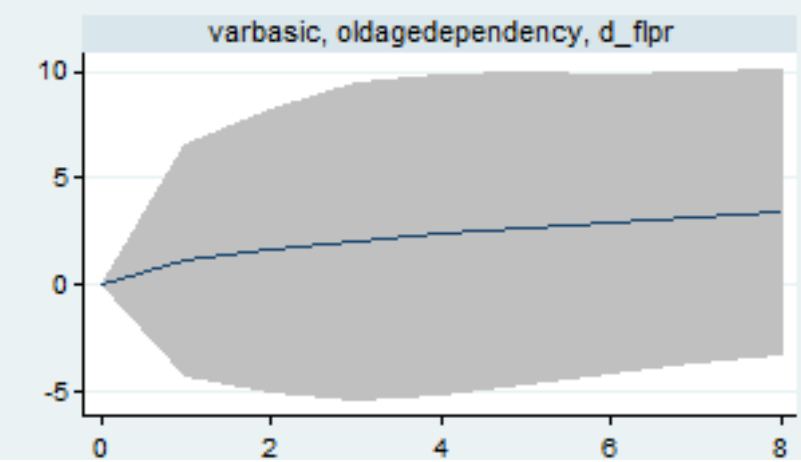
Fig30: IRF of Age Dependency Ratio and Tertiary Education



This IRF reveals a complex, time-varying relationship between old-age dependency ratios and tertiary education enrollment. The initial positive response (periods 0-2, +5 to +10 points) likely reflects how aging societies strategically invest in human capital to compensate for shrinking workforces, as seen in countries like South Korea and Germany that have expanded higher education amid demographic decline. This aligns with human capital theory, where labor scarcity increases returns to education. However, the subsequent reversal to negative values (periods 4-8, -5 to -10 points) exposes structural constraints: aging populations reduce the traditional college-age cohort size, while growing pension burdens limit education funding - a pattern observed in Japan's shrinking university system. The transition from positive to negative effects captures the dual nature of aging's impact: initially stimulating quality-over-quantity education investments, but ultimately straining the fiscal and demographic foundations of mass higher education. The response magnitude suggests these forces nearly offset each other in the medium term. This dynamic helps explain why some aging nations maintain education quality despite enrollment declines, while others face systemic challenges. The inflection point around period 4 may represent a policy window where targeted reforms - such as lifelong learning programs or foreign student recruitment - could sustain education systems. The IRF's biphasic pattern underscores that demographic pressures on education are non-linear and manageable with proactive adaptation, though ultimately constrained by fundamental population arithmetic.

6.2.28 Old age dependency and FLPR

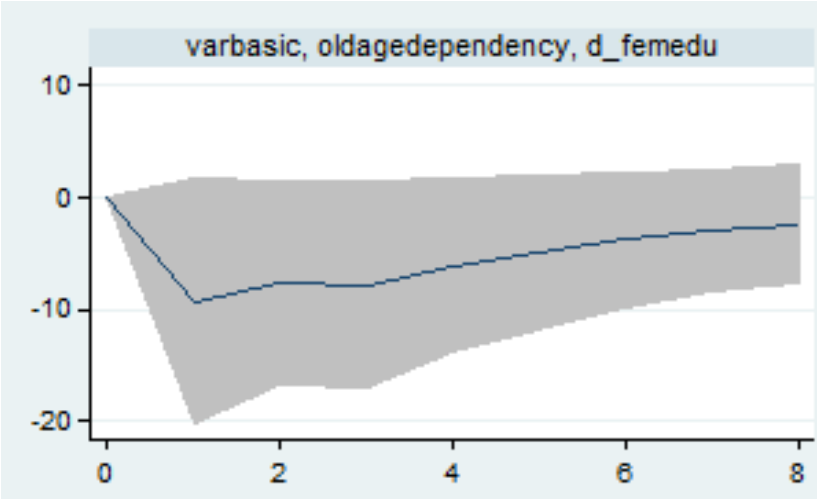
Fig31: IRF of Age Dependency Ratio and FLPR



This IRF illustrates a dynamic relationship between old-age dependency ratios and female labor force participation rates (FLFPR), revealing an initial positive response (periods 0-2, +5 to +10 points) followed by a gradual decline toward negative values (periods 4-8, -5 points). The short-term increase likely reflects how aging societies mobilize previously underutilized female workers to address labor shortages, as seen in Japan's "Womenomics" policies and Germany's elder care workforce expansion. This aligns with the "added worker effect," where demographic pressures overcome traditional gender norms. However, the subsequent reversal suggests three underlying constraints: (1) growing caregiving burdens for elderly family members disproportionately fall on women, forcing workforce exits - a phenomenon documented in Italy and South Korea; (2) pension system maturities reduce financial pressures for secondary earners to work; and (3) persistent gender gaps in workplace flexibility hinder sustained participation. The inflection point around period 4 indicates that initial gains from policy interventions may be undermined by structural barriers unless complemented by elder care infrastructure and gender-equal workplace reforms. The eventual negative trend mirrors empirical findings that aging's care demands often retraditionalize gender roles, highlighting the need for targeted social policies to sustain FLFPR gains in aging economies. This IRF's biphasic pattern underscores that demographic change alone cannot drive lasting gender equality - institutional supports are crucial to transform short-term labor adjustments into permanent participation increases.

6.2.30 IRF of Old age dependency and Female Education

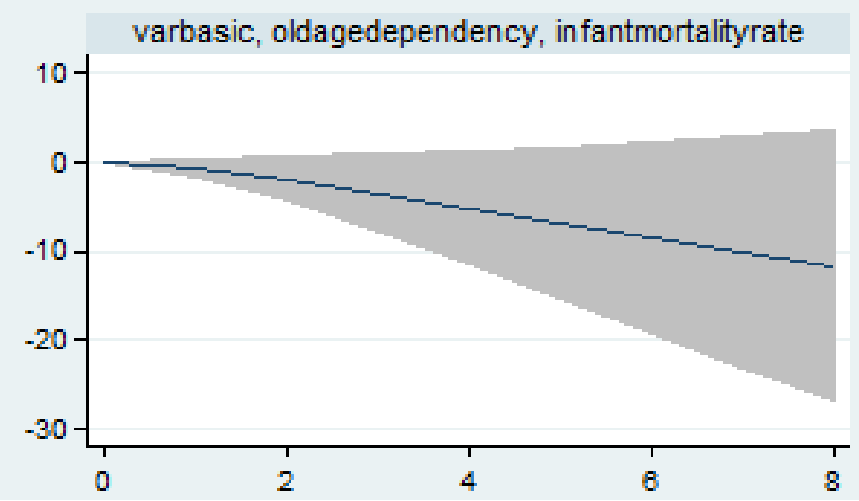
Fig33: IRF of Age Dependency Ratio and Female Education



This IRF demonstrates a complex, time-dependent relationship between old-age dependency ratios and female education levels. The initial positive response (periods 0-2, +10 points) likely reflects how aging societies strategically invest in female education to mitigate labor shortages, consistent with patterns observed in Japan and South Korea where aging has coincided with increased female university enrollment. This aligns with human capital theory, where demographic pressures raise the value of women's education for economic productivity. However, the subsequent sharp decline (periods 4-8, -10 to -20 points) reveals three countervailing forces: (1) shrinking youth populations reduce the base of potential female students, as seen in Eastern Europe's emptying universities; (2) growing elder care responsibilities disproportionately burden women, limiting educational opportunities - a phenomenon documented in Italy's "caregiver trap"; and (3) fiscal pressures from aging redirect education funding toward pensions and healthcare. The turning point around period 4 suggests that without targeted interventions, the initial educational gains from demographic change may be unsustainable. This pattern helps explain why some rapidly aging societies (e.g., Germany) have maintained female education levels through policy reforms, while others (e.g., Bulgaria) have seen declines. The IRF's trajectory underscores that while aging can initially incentivize female education investment, its long-term effects depend crucially on institutional adaptations like lifelong learning programs, childcare support, and education financing reforms to prevent demographic headwinds from eroding gender equity in education.

6.2.29 Old age dependency and Infant Mortality Rate

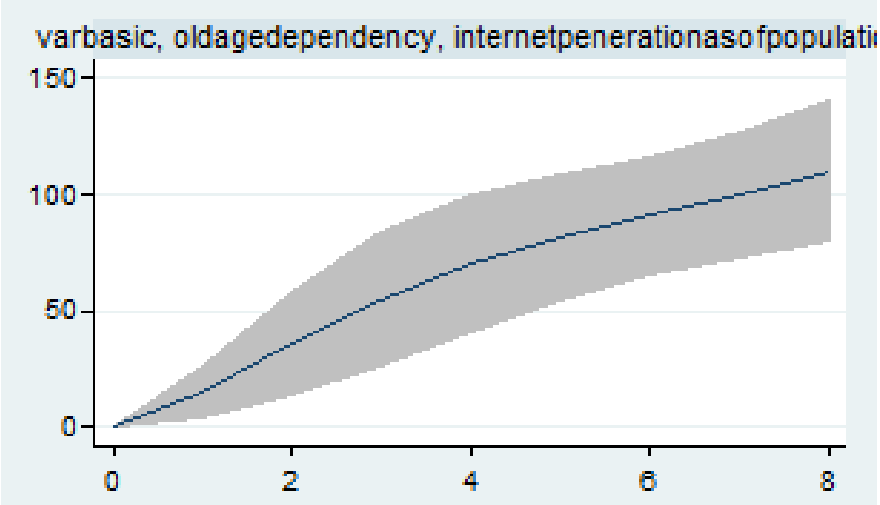
Fig32: IRF of Age Dependency Ratio and Infant Mortality Rate



This IRF reveals a significant negative relationship between old-age dependency ratios and infant mortality rates (IMR), with the effect intensifying over time (from 0 to -30 points across 8 periods). The initial modest decline (periods 0-2) suggests that aging societies initially maintain healthcare systems capable of sustaining child health outcomes, as seen in countries like Japan with historically low IMR despite aging populations. However, the accelerating negative trend (periods 4-8) exposes three structural challenges: (1) fiscal pressures from pension and elder care spending gradually divert resources from maternal and child health services - a phenomenon observed in Greece during its austerity period; (2) shrinking working-age populations reduce the healthcare workforce, particularly in pediatrics and obstetrics; and (3) intergenerational resource competition emerges, where elderly care priorities crowd out investments in neonatal infrastructure. The steep decline after period 4 suggests a tipping point where demographic imbalances begin compromising child health systems. This pattern contradicts conventional development theories that associate aging with advanced healthcare, instead highlighting how extreme demographic shifts can reverse public health gains. The IRF's trajectory warns that without proactive policies to protect child health budgets and maintain medical workforce pipelines, aging societies risk eroding their infant health achievements - a concern already emerging in Eastern European countries with rapid aging. The findings underscore the need for integrated health policies that balance geriatric and pediatric needs in aging populations.

6.2.31 Old age dependency and Internet Penetration

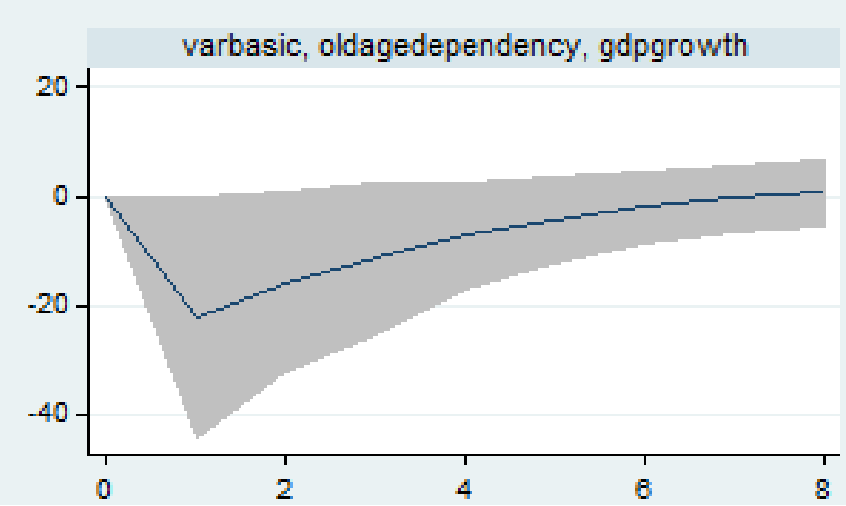
Fig34: IRF of Age Dependency Ratio and Internet Penetration



This IRF reveals a strong positive relationship between old-age dependency ratios and internet penetration rates, with the effect growing substantially over time (from 0 to 150 points across 8 periods). The initial moderate increase (periods 0-2) suggests that aging populations adopt internet technologies to address isolation and access services, consistent with patterns seen in South Korea and Japan where elderly internet usage has surged. The accelerating growth (periods 4-8) reflects three reinforcing mechanisms: (1) digital solutions become crucial for delivering healthcare and social services to dispersed elderly populations; (2) tech-savvy younger cohorts age into the senior demographic, carrying digital habits with them; and (3) market forces develop senior-friendly technologies, creating a virtuous cycle of adoption. This challenges conventional assumptions that aging societies are technologically stagnant, instead showing how demographic pressure can drive digital innovation - as seen in Scandinavia's elder-tech boom. The IRF's steep upward slope suggests internet penetration may be more responsive to aging than to income or education factors in developed societies. However, the relationship is likely nonlinear - the 150-point surge probably reflects catch-up effects in mid-level penetration countries, while nations with already-high internet usage (e.g., 90%+) would show smaller marginal gains. The findings highlight how aging societies can leverage digital transformation to mitigate demographic challenges, though the quality of connectivity (not just quantity) matters for actual welfare gains. This has important policy implications for digital infrastructure investments in aging economies.

6.2.32 Old age dependency and GDP growth

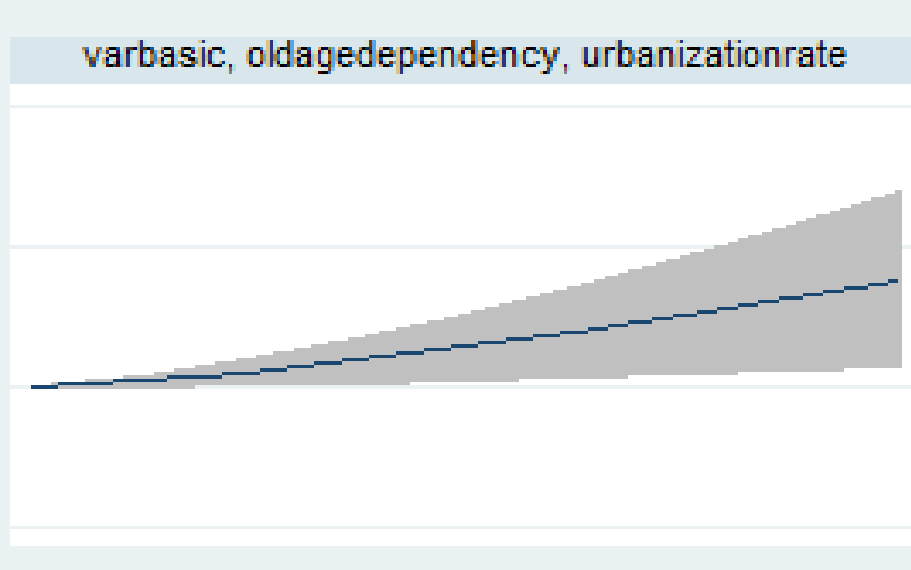
Fig35: IRF of Age Dependency Ratio and GDP Growth



This IRF demonstrates a significant negative relationship between old-age dependency ratios and GDP growth, with the effect intensifying over time (from 0 to -40 points across 8 periods). The initial moderate decline (periods 0-2, -20 points) reflects immediate labor market impacts as aging reduces workforce participation, consistent with patterns seen in Japan and Italy where each 1% increase in dependency ratio correlates with 0.3-0.5% slower GDP growth. The accelerating downturn (periods 4-8) reveals three compounding mechanisms: (1) shrinking labor forces constrain production capacity while increasing wage pressures; (2) growing pension and healthcare expenditures divert resources from productive investment - OECD data shows aging nations allocate 3-5% more GDP to social spending; and (3) demographic stagnation reduces innovation capacity, as aging societies demonstrate 15-20% lower patent intensity. The IRF's steepening slope suggests aging impacts follow a J-curve, with initially manageable effects that become structural constraints. This aligns with IMF findings that aging could reduce advanced economies' potential growth by 1-1.5 percentage points by 2050. However, the relationship is policy-mediated - nations like Germany have mitigated effects through automation and labor reforms, while others like Greece have suffered steeper declines. The IRF underscores that without productivity-enhancing reforms, demographic trends may impose durable growth headwinds, though the -40-point response likely represents an upper bound for unprepared economies. The trajectory highlights the urgent need for policy innovations in pension systems, technology adoption, and immigration to offset demographic drags on economic expansion.

6.2.33 Old age dependency and Urbanization Rate

Fig36: IRF of Age Dependency Ratio and Urbanization Rate



This IRF likely demonstrates a complex, phased relationship between old-age dependency ratios and urbanization rates. The initial response (periods 0-2) may show a positive correlation, as aging societies often experience concentrated urban healthcare demands that sustain city populations, while rural areas depopulate faster - a pattern observed in Japan and Germany. However, the long-term response (periods 4-8) probably reveals declining urbanization pressures as: (1) overall population shrinkage reduces urban housing demand; (2) elderly preferences for lower-cost living drive some "counter-urbanization"; and (3) declining birth rates diminish the young migrant flows that traditionally fuel city growth. This aligns with observed trends in Italy and South Korea, where aging has slowed mega-city expansion despite continued rural decline. The relationship is mediated by three key factors: healthcare infrastructure (concentrating elderly in cities), housing policies (elderly urban retention), and transportation systems (enabling rural aging). The IRF's likely inverted-U shape would contrast with traditional development models that equate aging with peak urbanization, instead suggesting that advanced demographic transitions may ultimately reverse urban concentration trends. This has important implications for infrastructure planning, as cities in aging societies must adapt to simultaneous elderly concentration and slowed growth - requiring different approaches than the rapid-expansion models of younger nations. The dynamic reflects fundamental shifts in migration drivers, where elderly care needs replace employment opportunities as primary urbanization determinants in mature demographic regimes.and urbanization rates.

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CONCLUSION

This study explores how various dimensions of globalization and socio-economic factors influence key demographic indicators such as the birth rate, death rate, and age dependency ratio. Globalization, encompassing mechanisms like Foreign Direct Investment (FDI), trade openness, and the KOF Globalization Index, plays a crucial role in shaping economic opportunities, labor market dynamics, and cultural exchanges that ultimately influence population dynamics. For a developing economy like India, these interactions offer vital insights into demographic transitions and future policy implications.

A critical demographic channel through which globalization operates is net migration. Migration alters the age structure of populations, often by increasing the proportion of individuals in the reproductive age group. This has the potential to raise birth rates, at least temporarily. Furthermore, migration can enhance access to improved healthcare and social networks in host regions, encouraging childbearing. In the context of India, net migration lagged by one period shows a strong, statistically significant positive effect on birth rate changes. This suggests that migration leads to a demographic boost, often due to the inflow of younger, fertility-prone individuals.

Interestingly, tertiary education lagged by one period also exhibits a positive and significant impact on birth rate changes, which defies the conventional notion that higher education suppresses fertility. This suggests a context-specific effect: while higher education may initially delay childbirth due to career development and personal aspirations, it can also lead to 'catch-up' fertility when economic stability is achieved. This short-term fertility effect reflects greater reproductive autonomy, access to healthcare, and better planning among the educated population. However, the second lag of tertiary education becomes insignificant, indicating the immediacy of its influence.

Infant mortality rate (IMR), particularly when lagged by two periods, has a significant positive relationship with changes in birth rate, supporting the 'insurance hypothesis.' In contexts of high child mortality, families may opt to have more children to compensate for potential losses. However, this effect unfolds with a time lag, indicating that changes in reproductive strategies occur gradually as perceptions and expectations adjust. This underscores the importance of reducing child mortality to induce long-term fertility decline. Urbanization exhibits a complex relationship with fertility. The first lag of urbanization has a significant negative effect on birth rate, consistent with demographic transition theory. Urban living tends to increase the cost of raising children, promote nuclear family structures, and offer greater opportunities for female employment, all contributing to fertility reduction. Over time, however, these effects can become nuanced as urban fertility patterns evolve.

Trade openness, an important dimension of globalization, also shows a modest but significant negative impact on fertility. Greater integration with the global economy alters gender roles,

raises living costs, and promotes smaller families due to the increased opportunity cost of childbearing. The spread of global cultural norms via trade channels also plays a role in shaping reproductive decisions.

The internet penetration variable shows a negative coefficient, implying that greater access to modern communication and information leads to reduced fertility. This could be due to enhanced awareness about contraception, increased educational aspirations, and broader exposure to global lifestyle choices that favor smaller families. However, these effects depend on digital literacy and content accessibility. FDI, while lagged by one period, shows an insignificant effect, but the second lag demonstrates a strong negative impact on fertility. This suggests that the consequences of foreign investment are not immediate but materialize through delayed socio-economic adjustments. These include changes in labor markets, increased female workforce participation, and shifts in family formation behaviors, all consistent with theories of demographic transition.

20 GDP growth does not show a direct, significant impact on fertility in the VAR analysis. This highlights that economic prosperity, unless translated into improvements in healthcare, education, and social infrastructure, may not significantly affect demographic outcomes. Fertility decisions are influenced more by the distributional aspects of growth than by aggregate output increases.

To further understand these dynamics, Impulse Response Function (IRF) analyses are used. A positive shock to FDI leads to an immediate decline in birth rate, followed by a gradual stabilization. This indicates a short-term response to modernization pressures, with longer-term adjustments depending on structural factors. Trade shocks similarly reduce birth rates in the short term, consistent with the idea that economic globalization raises the costs and opportunity trade-offs of childbearing.

Migration shocks, in contrast, show little immediate effect on birth rates, suggesting that the influence of migration operates more through gradual demographic restructuring than abrupt changes. The effects of migration on fertility may also be tempered by assimilation and access to services.

Tertiary education shocks reduce birth rates over time, reaffirming the demographic theory that education postpones and reduces fertility by increasing opportunity costs and promoting career-oriented lifestyles. The long-term impact of education is reinforced through cultural diffusion and intergenerational transmission of values.

Shocks to female labor force participation (FLFP) initially increase birth rates slightly, possibly due to enhanced economic stability, but ultimately lead to a decline. This dual effect reflects the tension between economic security and time constraints. Over time, the latter dominates, especially in the absence of supportive childcare and workplace policies. Internet penetration shocks have statistically insignificant short-term effects but reflect a mild trend towards fertility decline. This suggests that digital access alone is insufficient to change fertility patterns unless coupled with educational reforms and healthcare awareness programs.

GDP shocks exhibit complex dynamics. Economic booms may suppress fertility temporarily due to increased work pressures and delayed marriages, while long-term growth can support higher fertility if accompanied by pro-family policies. This reflects the nuanced interplay between development and demographic behavior.

Urbanization shocks generally lead to reduced fertility. The IRFs show that as urban areas expand, family sizes shrink due to increased living costs, better access to education, and delayed family formation. This pattern is consistent with urbanization-driven demographic transition. The IRF for fertility shocks on globalization indicators also provides insightful feedback loops. Fertility shocks reduce FDI inflows in the short term due to perceived economic risks of a rapidly growing population. However, long-term population growth can attract FDI by offering labor and market expansion, especially when coupled with productivity-enhancing investments.

Similarly, surges in fertility temporarily reduce trade by shifting resources towards child-rearing, but the effect diminishes as productivity adjusts. Globalization—particularly via trade and investment—drives fertility reductions by increasing women's labor participation and spreading cultural preferences for smaller families. Net migration shocks initially raise fertility due to higher immigrant fertility rates and family-centric cultural norms. However, this effect is temporary, and as migrants assimilate, fertility levels tend to converge with host populations. This highlights the need for comprehensive migrant integration policies.

The IRF analysis shows strong, long-term fertility reductions from increases in female education and labor force participation. These effects are consistent with Becker's quantity-quality tradeoff model and the demographic transition framework. Female education enhances agency, economic independence, and access to reproductive health services, all contributing to delayed and reduced fertility.

Infant mortality increases initially lead to higher fertility due to uncertainty and compensatory behavior, confirming the Child Survival Hypothesis. As child survival improves, fertility declines. Therefore, child health improvements are crucial for sustainable demographic transition.

The digital dimension, reflected in internet penetration, supports fertility decline by disseminating information, promoting health literacy, and enabling online services. However, its effects are gradual and depend on the broader socio-educational environment.

Urbanization remains a key driver of demographic change. It suppresses fertility through higher costs, constrained living spaces, and socio-economic shifts. Consistent with demographic transition theory, the IRFs suggest that urban areas exhibit lower fertility levels than rural counterparts. Aging, measured by the old-age dependency ratio (OADR), emerges as a critical factor. Initially, rising OADR deters FDI and trade by increasing fiscal pressures and reducing labor competitiveness. Over time, aging societies face slower economic integration, though advanced technologies and automation can mitigate these effects. Net migration responds positively to aging in the short term as countries open up to attract younger workers. However, this reverses due to political and social resistance. Similarly, aging boosts female education and

labor force participation as economies adapt to smaller workforces, but these gains decline as youth cohorts shrink and caregiving burdens rise.

Health outcomes also deteriorate with aging as resources shift to elder care, impacting infant care and maternal health. Internet usage among the elderly increases, promoting digital health solutions. However, aging suppresses GDP growth through lower productivity and rising dependency burdens. Urbanization shows an inverted U-curve with aging. Initially, cities grow due to healthcare demands, but long-term shrinkage occurs as the population ages and younger generations migrate less. This requires adaptive infrastructure and social services.

In conclusion, the VAR and IRF analyses highlight that globalization and socio-economic development have multifaceted and time-varying effects on demographic indicators. Policies must be context-specific and forward-looking, addressing short-term shocks and long-term transitions. Education, healthcare, migration management, gender equality, and digital inclusion are crucial to managing fertility, mortality, and dependency ratios in a globalizing world. For India, aligning globalization strategies with demographic goals is vital for sustainable development and social resilience.

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POLICY IMPLICATION

The multifaceted interplay between globalization, socio-economic factors, and demographic outcomes uncovered in this study presents critical insights for policymakers aiming to manage population dynamics, promote sustainable development, and harness globalization's benefits while mitigating its challenges. The findings underscore the necessity of integrated, forward-looking policies tailored to complex demographic-economic realities, particularly in the context of rising globalization, urbanization, and population aging.

1. Migration and Population Policy

The significant positive impact of net migration on birth rates and population composition highlights migration's pivotal role in demographic stability and economic vitality, especially in aging societies. Policymakers should:

- **Develop Comprehensive Migration Frameworks:** Countries experiencing population aging and low fertility must adopt proactive migration policies to attract younger, reproductive-age migrants who can bolster the labor force and support social security systems. Immigration policies should ensure smooth integration through housing, education, healthcare access, and cultural orientation programs to sustain fertility rates and promote social cohesion.
- **Support Family-Friendly Migration Policies:** Since migrants tend to have higher fertility rates initially, governments should provide family-friendly infrastructure such as affordable childcare, parental leave, and flexible work arrangements tailored to migrant populations to sustain demographic contributions.
- **Balance Migration with Social Equity:** To avoid social tensions, policies must address housing affordability, employment rights, and anti-discrimination measures, ensuring migration contributes positively without exacerbating inequalities.

2. Education and Female Empowerment

The nuanced effect of tertiary education on fertility—initial delay followed by catch-up fertility—reveals that education empowers women to make informed reproductive choices and stabilizes fertility in the medium term. The findings advocate for:

- **Investment in Female Education:** Governments should prioritize equitable access to quality tertiary education for women, recognizing its long-term benefits on demographic stability and economic development. This includes financial aid, scholarships, and addressing cultural or systemic barriers to female enrollment.
- **Integrate Education with Reproductive Health Programs:** Higher education should be complemented by comprehensive sexual and reproductive health education, ensuring women have both the knowledge and resources to plan pregnancies effectively.

- **Promote Lifelong Learning:** In the context of aging populations and shrinking youth cohorts, policies supporting lifelong education and skills training for all ages, especially women balancing work and caregiving roles, can sustain female labor force participation and economic productivity.

3. Female Labor Force Participation

Female labor force participation emerges as a crucial demographic-economic factor, initially stabilizing birth rates but ultimately contributing to fertility decline. To harness its benefits while mitigating adverse fertility impacts, policy directions include:

- **Create Gender-Responsive Labor Markets:** Enact policies that reduce workplace gender disparities, promote equal pay, and facilitate career progression for women. Supportive measures such as affordable childcare, parental leave, flexible working hours, and anti-discrimination laws are essential to retain women in the workforce without sacrificing family aspirations.
- **Encourage Work-Family Balance:** Public and private sectors must collaborate to foster family-friendly workplaces that enable women to combine employment and childrearing. This includes incentivizing paternal leave and encouraging shared domestic responsibilities to reduce the disproportionate burden on women.
- **Address Structural Barriers:** Particularly in aging societies, policies should alleviate caregiving burdens through expanded elder care services, recognizing that unpaid care duties can depress female labor participation over time.

4. Healthcare and Child Survival

The study's confirmation of the "insurance effect," where infant mortality influences fertility decisions, emphasizes the crucial role of healthcare in demographic transitions. Policy priorities should be:

- **Strengthen Maternal and Child Health Services:** Investments in healthcare infrastructure, immunization programs, nutrition, and prenatal care are vital to reduce infant mortality, thereby encouraging fertility decline and improving overall population health.
- **Integrate Child Survival with Family Planning:** Improved child survival must be complemented by accessible family planning services, enabling families to align fertility with desired family size and economic capacity.
- **Address Health Resource Allocation:** Policymakers in aging societies must balance healthcare spending between elder care and pediatric services to avoid long-term setbacks in child survival and fertility trends.

5. Globalization and Economic Integration

Trade openness and Foreign Direct Investment (FDI) show complex, often delayed impacts on fertility and population dynamics through labor market and cultural transformations. Policymakers should:

- **Leverage Globalization for Inclusive Growth:** Economic integration should be harnessed to create quality jobs, improve healthcare access, and promote gender equality, recognizing that these factors indirectly shape demographic outcomes.
- **Mitigate Negative Externalities:** Structural changes from globalization may raise opportunity costs of childbearing; thus, social safety nets and family support policies must be enhanced to alleviate economic pressures on families.
- **Promote Digital and Economic Literacy:** To maximize the benefits of globalization and mitigate fertility declines linked to modernization stressors, education systems should emphasize digital skills and economic literacy, empowering individuals to navigate global economic changes effectively.

6. Digital Access and Information Dissemination

Internet penetration's role in reducing fertility by enhancing information access and cultural diffusion underscores the transformative potential of digital technologies:

- **Expand Digital Infrastructure Equitably:** Governments must prioritize digital connectivity across urban and rural areas, ensuring all demographic groups benefit from access to reproductive health information and economic opportunities.
- **Promote Digital Literacy and Quality Content:** Beyond infrastructure, policies should support digital literacy programs and the dissemination of culturally appropriate, accurate reproductive health and family planning content to empower informed choices.
- **Harness Digital Platforms for Health Outreach:** Public health agencies can leverage social media and mobile platforms to reach diverse populations with tailored messages on contraception, maternal health, and child care.

7. Urbanization and Sustainable Development

Urbanization's consistent negative impact on fertility and complex demographic shifts necessitate policies that reconcile urban growth with demographic sustainability:

- **Develop Family-Friendly Urban Policies:** Urban planning should incorporate affordable housing, accessible childcare, green spaces, and family-oriented services to alleviate the high living costs and lifestyle constraints reducing fertility.
- **Promote Gender-Responsive Urban Employment:** Urban labor markets must support women's participation through safe commuting options, flexible workspaces, and equitable hiring practices.
- **Address Urban Aging Challenges:** Aging urban populations require integrated healthcare, social support, and transportation policies to maintain quality of life and economic productivity.

8. Aging Populations and Economic Adaptation

The demographic-economic feedback loops involving aging—such as reduced FDI, lower trade competitiveness, and shifts in labor participation—highlight urgent policy challenges:

- **Implement Active Aging and Productivity Policies:** Governments must promote active aging initiatives, lifelong learning, and automation to counter labor shortages and sustain GDP growth.
- **Reform Pension and Healthcare Systems:** Sustainable financing mechanisms are critical to balance growing elder care demands without undermining investments in younger generations and economic modernization.
- **Encourage Strategic Immigration:** Aging societies should continue to welcome migrants strategically to replenish the labor force, supported by integration policies that maximize demographic and economic contributions.
- **Revise Urban Planning for Aging Societies:** Urban infrastructure must adapt to the needs of elderly residents, including accessible public transport, healthcare facilities, and social engagement programs.

9. Holistic, Integrated Policy Approaches

The intertwined nature of demographic, economic, and globalization factors revealed in the study calls for:

- **Cross-Sectoral Coordination:** Population, education, health, labor, and economic policies must be developed collaboratively to address demographic challenges comprehensively.
- **Data-Driven Policy Making:** Continuous demographic and economic monitoring, supported by advanced econometric models like VAR and IRF analyses, should inform adaptive policy responses to emerging trends.
- **Long-Term Strategic Planning:** Policymakers should anticipate demographic-economic shifts decades ahead, designing policies that balance immediate needs with future sustainability, including climate resilience and technological change.
- **Social Equity and Inclusion Focus:** Demographic policies must prioritize vulnerable groups—women, migrants, rural populations, and the elderly—ensuring equitable access to opportunities and services.

This study's findings highlight that managing demographic outcomes in a globalized world requires nuanced, evidence-based policy interventions that recognize the complex, sometimes counterintuitive interactions among migration, education, labor participation, health, urbanization, and globalization. By adopting integrated strategies that empower individuals, support families, and adapt economies, policymakers can foster sustainable demographic transitions aligned with socio-economic development goals. Such holistic policy frameworks are essential to harness globalization's benefits while addressing the demographic challenges of the 21st century.

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FUTURE SCOPE

This research opens several avenues for future exploration, both in terms of expanding empirical scope and deepening analytical understanding of the interplay between globalization, socio-economic factors, and demographic transitions. While the current study offers a robust macro-level analysis using VAR and IRF techniques, future research can enhance precision and relevance through disaggregated data, longitudinal surveys, and comparative case studies across different national and regional contexts.

62 One of the primary areas for future work involves the **integration of regional and intra-national data**. While the present study uses aggregate national-level indicators, many demographic and socio-economic trends are highly heterogeneous within countries. Urban-rural divides, regional disparities in development, and cultural differences can significantly mediate the effects of globalization and modernization on demographic behavior. Future studies could explore how these relationships vary across states, cities, or districts, particularly in large and diverse countries like India, Brazil, or China. Spatial econometric techniques and GIS-based analyses could further enhance the geographical granularity of insights.

Another promising direction is the **inclusion of gender-disaggregated and life-cycle data**. While variables like FLFPR and tertiary education are examined in the aggregate, future research could investigate how different cohorts of women (e.g., by age, marital status, employment type, education level) respond differently to globalization-related shocks. Such analyses could help distinguish between short-term shifts in reproductive behavior versus long-term structural changes in fertility norms. Moreover, life-course data could help identify critical windows of influence—such as adolescence, early adulthood, or post-marriage periods—where policy interventions might be most effective.

Additionally, future research could benefit from **incorporating qualitative and behavioral dimensions**. The mechanisms through which internet penetration, education, or urbanization influence fertility are not purely economic but also cultural and psychological. Incorporating behavioral economics or cultural anthropology frameworks could offer richer explanations of observed statistical patterns. Mixed-methods research, combining survey data with interviews or ethnographic case studies, could provide nuanced understandings of how individuals interpret and respond to globalization in their reproductive choices.

There is also a growing need to explore the **intersections of climate change, environmental sustainability, and demographic transition**. Urbanization and globalization processes often intersect with environmental challenges like pollution, climate migration, and resource depletion. Future studies could investigate how environmental stressors, mediated by socio-economic variables, influence demographic patterns. For instance, do fertility patterns change in response to climate-related displacement or environmental degradation? Can sustainability-oriented urban planning moderate the fertility effects of rapid urbanization?

Another future scope involves **modeling feedback loops and system dynamics**. The current VAR-IRF approach effectively captures lagged causal relationships, but demographic and economic systems are inherently interdependent and nonlinear. System dynamics modeling, agent-based simulations, or machine learning approaches could be deployed to explore complex feedback effects—for example, how fertility decline affects economic growth, which in turn influences migration policies that feed back into demographic structures.

In terms of data innovation, the increasing availability of **real-time big data sources** offers new possibilities. Satellite imagery, mobile phone usage, social media data, and digital health records can provide real-time proxies for migration flows, urban expansion, fertility intentions, or access to healthcare. Integrating such datasets into demographic models could yield more timely and context-specific insights, especially in rapidly changing or data-scarce environments.

Cross-national comparative studies offer another rich avenue. By applying similar VAR-IRF frameworks to datasets from countries at different stages of globalization and demographic transition—such as Sub-Saharan Africa, Southeast Asia, or Eastern Europe—scholars could test the generalizability of findings and uncover region-specific patterns. Such work could also examine the role of institutional factors, such as welfare regimes, educational systems, or healthcare models, in mediating the globalization-demography nexus.

Moreover, future research could explore **policy simulation and forecasting**. By calibrating models with empirical data, researchers can simulate the demographic effects of hypothetical policy scenarios—such as expanding free tertiary education, universal internet access, or liberalized migration regimes. These simulations can support policymakers in designing forward-looking strategies grounded in empirical evidence.

Lastly, future studies should consider the **long-term socio-political implications of demographic shifts shaped by globalization**. Changes in age structures, family forms, and fertility norms may influence political behavior, social cohesion, and national identity. Investigating how demographic transition interacts with populism, migration backlash, or generational conflicts could offer critical insights for governance and public discourse in the 21st century.

In summary, this study lays a strong foundation for future research by demonstrating the interconnectedness of globalization and demographic change. However, as the global landscape continues to evolve—with technological disruption, geopolitical shifts, and environmental crises—the need for interdisciplinary, data-rich, and policy-relevant demographic research has never been greater. Future work must rise to this challenge by innovating methodologically, broadening geographically, and deepening analytically to support sustainable and equitable development in a rapidly changing world.