

Population Aging, Global Climate Change and Social Security

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An International Perspective

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Abstract

The *Economist* calls global climate change “the challenge of the age.” The growth in global population—one factor affecting global climate change—has increased 320% since 1950, from 2.5 billion to 8.0 billion, more than tripling the effect of population on greenhouse gas emissions. The global population has grown 1 billion in the last 12 years. In modern Malthusian theory, the relationship between population and food supply is more complex than in traditional Malthusian theory. The traditional argument is that population tends to grow faster than the food supply, so humanity faces a need to control population growth. In addition to that argument, however, population growth exacerbates global climate change, which causes floods and droughts that reduce the global food supply. Thus, climate change adversely affects population by affecting the food supply. However, individuals in high-income countries have lifestyles producing much higher greenhouse gas emissions than individuals in low-income countries. High-income countries are more likely to have relatively low birth rates and thus are more likely to have pronatalist policies, often enacted at least in part to support the financing of pay-as-you-go social security programs. It is important to consider various different approaches to reducing climate change. This paper focuses on the interrelated effects of climate change, social security policies and pronatalist policies. Pronatalist policies that increase population growth in high-income countries exacerbate global climate change.

Executive Summary

There are plenty of reasons to believe climate change could become catastrophic, even at modest levels of warming. —Dr. Luke Kemp, Centre for the Study of Existential Risk, University of Cambridge, August 1, 2022

The *Economist* (2022) calls global climate change “the challenge of the age.” Global climate change is more than hotter temperatures. It includes droughts, flooding and high winds. It is no longer a distant threat, as indicated by the devastating floods in Pakistan in August 2022, when millions of acres of crops were destroyed as well as more than a million homes. What used to be considered once-in-1,000-year climate disasters are becoming increasingly common. In early 2022, a heat wave in India, with temperatures above 120 degrees Fahrenheit, led to dozens of deaths due to heat stroke (Frayer 2022), though global warming has led to fewer deaths due to cold exposure, leading to a decline overall in deaths related to heat or cold (Zhao et al. 2021). Confirming the seriousness of problems that climate change already is causing, the Intergovernmental Panel on Climate Change (2022) delivered a bleak assessment, finding that the destructive effects of climate change were occurring much sooner than had been projected only a few years ago.

Almost half of the world’s population live in areas rated as highly vulnerable to climate change. Roughly half of the world experiences water scarcity for at least one month a year, causing a need to reduce water consumption, which is tied to population levels. Climate change can cost lives due to droughts, flooding, wildfires, destructive weather and conflicts over dwindling resources (Lopez 2022). It can result in loss of global biodiversity and can lead to an increase in the likelihood of pandemics. In 2022 a NASA study (Raymond et al. 2022) showed that extreme weather events such as floods and heat waves will cluster closer in time and space, heightening the risks of crop failures, wildfires and other societal hazards.

This paper argues that because of the seriousness of the climate change problem it is important to tackle the problem with a wide variety of approaches. Such approaches include providing tax subsidies for development and adoption of carbon-production-reducing technologies and carbon-capture technologies as well as tax subsidies for consumer purchases of electric cars and more energy-efficient household appliances, setting up carbon taxes, having the World Bank change its lending policies to focus more on dealing with climate change, reducing reliance on coal, developing alternate sources of energy, making cities denser to reduce carbon emissions due to transportation, improving home insulation, using solar panels, making lifestyle changes that reduce carbon emissions such as reducing travel, reducing the carbon emissions due to travel and transport, changing diets toward more plant-based ones that are locally sourced, planting trees, and considering demographic aspects of climate change such as population growth. The paper also argues that it is important to consider interactions in the effects of climate change. Although that approach is done in terms of weather events, it has largely not been done regarding societal effects.

With that framework in mind, this paper analyzes the relationships between population aging, global climate change and social security pension policy. Previous analyses of population and social security have not considered the related effects of global climate change (Cipriani and Fiorini 2022). The global population reached 8 billion in 2022 and is projected to increase by another 2.4 billion people by 2100 to 10.4 billion (United Nations Department of Economic and Social Affairs 2022). Population aging and global climate change are two major global trends that have important effects on social security pension programs.

Although for future generations social security provides old-age benefits, climate change imposes costs. This paper argues that instead of trying to encourage young couples to have more children, government policies would be better in terms of both government noninterference in private decisions and dealing with climate change if they were neutral with respect to family size and population growth.

Section 1: Methodology

Scientists have used the Kaya Identity, which is a mathematical formula, for explaining global carbon dioxide emissions. Carbon dioxide emissions are a major cause of climate change. In 2020 carbon dioxide accounted for 79% of all U.S. greenhouse gas emissions (U.S. Environmental Protection Agency 2022). According to this identity, total carbon dioxide emissions (CO_2) are a product of population N ; per capita GDP, GDP/N ; energy used per unit of GDP, E/GDP ; and carbon dioxide generated per unit of energy, CO_2/E (D'Souza 2022):

$$CO_2 = N \frac{GDP}{N} \frac{E}{GDP} \frac{CO_2}{E}$$

This identity highlights the role of population and GDP per capita in total carbon dioxide emissions.

Because the negative effects of global climate change are most severely felt by people in the low-income countries, with low GDP per capita, who have done the least to cause it, this paper argues that it is important to have an international perspective when dealing with climate change. This paper investigates the interactions between population aging, global climate change and social security based on an analysis of existing data and studies. Although population aging and global climate change have generally been treated as separate issues, the paper contributes to the literature by focusing on their interactions. The paper is international in scope, including the U.S., Japan, China and other countries from the Asia-Pacific region, as well as countries in other parts of the world.

The paper is organized as follows. The second section discusses a modern Malthusian theory of climate change, food supply and population. The third section discusses the disparity between the populations causing global climate

change and the populations most adversely affected. The fourth section focuses on the countries that are the main contributors to greenhouse gas emissions, carbon dioxide, which is the main cause of global climate change. The fifth section discusses the effects of population size and population aging on greenhouse gas emissions. The sixth section examines the effects of climate change on population aging, social security programs and older populations. The seventh section discusses the countries most responsible for global climate change. The eighth section considers alternative policies to deal with population aging and workforce decline. The ninth section provides concluding comments.

Section 2: A Modern Malthusian Theory of Climate Change, Food Supply and Population

Malthusian theory or Malthusianism, developed by Thomas Malthus in 1798, holds that population growth will outpace the growth of the food supply. Eventually the result will be insufficient food to support the population. Adversities such as epidemics, famines and other natural calamities will occur, which Malthus viewed as positive checks (Agarwal 2022).

Modern Malthusian theory includes the effects of global climate change on food production. Climate change adversely affects population by affecting food supply. In 2023, for example, climate change that reduced food production in Morocco caused shortages of vegetables in the United Kingdom (Zouiten 2023). Population growth is one factor driving an increase in global greenhouse gases, which is a major factor in global climate change. Global climate change causes natural disasters, such as the one in Pakistan described in the introductory quotation. In some parts of the world, global climate change results in droughts, causing a shortage of water for agriculture and human consumption. As of 2022, California, a major agricultural state, over the past three years had experienced its worst drought in 1,200 years (Rosenthal 2022). By 2040, it is estimated that one in four children in the world will be living in areas with extreme water shortages (Save the Children 2022). In 2022 parts of East Africa were suffering their worst drought in 40 years, threatening the survival of millions of people (O’Doherty 2022). These natural disasters have catastrophic effects on food supply, eventually leading to smaller populations in the affected countries (Gleditsch 2020).

Modern Malthusian theory also recognizes other forces bringing down population growth rates. For example, of particular relevance to this paper, social security old-age benefits programs may reduce birth rates because parents no longer need to rely on their adult children in old age. In addition, recognizing the quantity-quality tradeoff, parents may desire fewer children so that they can invest more per child in each child’s education.

Thus, in modern Malthusian theory, the relationship between population and food supply is more complex than in the traditional theory. The traditional argument is that population tends to grow faster than the food supply, so humanity faces a need to control population growth. In addition to that argument, however, population growth exacerbates global climate change, which causes floods and droughts that reduce global food supply.

Section 3: Disparity between the Populations Causing Global Climate Change and the Populations Most Adversely Affected

In the global framework, as indicated by the Kaya Identity, higher-income persons are largely responsible for global climate change because of the greenhouse gases produced to support their lifestyles, whereas poor people tend to be more severely affected because they live in hotter parts of the world. The richest 10% of people in the world accounted for nearly 48% of global emissions in 2019. Perhaps even more surprising, a \$59,000 household income

in the U.S. put a person in the 91st percentile globally for per-person income (Ray 2022). Flood and drought-related acute food insecurity and malnutrition have increased in Africa and Central and South America. Recognizing this disparity may facilitate wealthier countries and people supporting policies to deal with global climate change.

Section 4: Carbon Dioxide Emission Statistics

Table 1 shows the top 10 country emitters of carbon dioxide (CO₂) in 2016. In that table, per capita emissions are measured in two ways. First, they are measured as the per capita emissions originating in that country. Second, they are measured (in parentheses) as the per capita emissions incurred to support the consumption of that country, adding in emissions if the country is a net importer of emissions-producing goods. These 10 countries—China, the U.S., India, Russia, Germany, Canada, Iran, South Korea and Indonesia—account for half of the world’s population and two-thirds of its carbon dioxide emissions. China is by far the largest emitter of carbon dioxide, accounting for 29% of the total. China, the U.S. and India, the three largest emitters, account for more than 50% of total global emissions.

Table 1

TOP 10 COUNTRY EMITTERS OF CARBON DIOXIDE AND THEIR DEMOGRAPHY, 2016

Country	Share of World Emissions (%)	Per Capita Emissions (Tons) ^a	Population (Growth Rate %)	Share of World Population (%)	Fertility Rate (Children per Woman)	Fertility Rate Times per Capita Emissions	Pronatalist Policy
1. China	29.18	7.38 (6.26)	1,414,049,351 (0.29)	18.2	1.7	12.55	Yes
2. United States	14.02	15.52 (17.07)	323,015,995 (0.71)	4.2	1.8	27.94	No
3. India	7.09	1.91 (1.68)	1,324,517,249 (1.09)	17.1	2.3	4.39	No
4. Russia	4.65	11.44 (9.91)	145,275,383 (-0.17)	1.9	1.8	20.59	Yes
5. Japan	3.47	9.70 (10.57)	127,763,265 (-0.29)	1.7	1.4	13.58	Yes
6. Germany	2.17	9.44 (10.55)	82,193,768 (-0.20)	1.1	1.6	15.10	Yes
7. Canada	1.89	18.58 (15.54)	36,382,944 (0.80)	0.5	1.5	27.87	Yes
8. Iran	1.80	8.08 (7.98)	79,563,989 (1.07)	1.0	2.1	16.97	Yes
9. Republic of Korea	1.69	11.85 (13.61)	50,983,457 (0.37)	0.7	1.2	14.22	Yes
10. Indonesia	1.48	2.03 (2.23)	261,556,381 (0.77)	3.4	2.4	4.87	No
Total	67.44	—	3,845,301,782 (1.00)	49.6	—	—	7

Data sources: <https://www.worldometers.info/co2-emissions/>, <https://data.oecd.org/>, <https://www.indexmundi.com/g/r.aspx?v=24>, Our World in Data (2021), authors’ calculations.

Notes: a. The top number is based on the production in the country, and the number in parentheses is based on the consumption in the country, taking into account carbon dioxide emissions in other countries that were the result of production that was exported to the country for this cell.

The emissions by country can be measured in different ways. Multiplying the number of children per female (fertility rate) by per capita emissions provides a measure of the impact of the fertility rate of a country on future emissions.

It provides a metric for the effect of an additional birth on future greenhouse gas emissions. By this measure, the current fertility rates of the U.S. and Canada have the highest impact of the top 10 countries by total emissions. This result occurs because of the high per capita emissions in those countries, with both countries having fertility rates below the replacement fertility rate of roughly 2.1 children per female.

Section 5: Population Size and Aging Effects on Climate Change

Although some authors treat climate policy as an issue of economic policy (Nahm and Urpelainen 2022), we argue that it should also be treated as an issue of demographic policy. The world's population was 8 billion in 2022. It is projected to increase by 25% over the next 28 years to more than 10 billion in 2050 (Buckiewicz and Husser 2022). Taking steps to reduce population growth, including in low-birth-rate countries that are high per capita emitters of greenhouse gases, is a critical aspect of dealing with climate change because more people, and, in particular, more high-income people, means more greenhouse gas emissions.

Population aging due to declining birth rates affects many countries, in some even reducing the size of the labor force and causing a declining population. Between 2015 and 2020, at least 20 countries had declining populations (World Atlas 2022), though, for some countries in Europe, population decline was substantially because of emigration of workers rather than being caused primarily by declining birth rates. The countries with declining populations include China, Italy, Japan, Poland, Greece, Portugal and Hungary.

Pronatalist policies encourage young couples to have more children. According to the UN, the share of countries with explicitly pronatalist policies rose from 10% in 1976 to 15% in 2001 and 28% in 2015 (Stone 2020). Between 1986 and 2015, the number of governments trying to raise birth rates increased from 19 to 55 (Sobotka, Matysiak, and Brzozowska 2019). Since 2015, more countries have adopted pronatal policies, including dramatic expansions in pro-birth policies in Hungary, Poland, Greece, Korea, Japan, Finland, Latvia and other countries (Stone 2020).

Pronatalist policies include compensating parents for the costs of children, supporting parents' employment, permitting or requiring employers to provide paid time off for maternity or paternity leave, and supporting early childhood development. Pronatalist policies tend to be found in countries with higher income, low fertility rates and aging populations. Hungary, for example, noting that females with more children tend to have lower social security benefits, proposed in 2022 that in the future the level of social security benefits would be linked to the number of children a couple had (*Hungary Today* 2022).

Concerning the effectiveness of pronatalist policies, Stone (2020) and others argue that they can be effective, but to be effective they generally tend to be expensive. He cites Poland as an example of a country where they have been effective. Poland's pronatalist policy is a generous, nearly universal cash benefit that provides major support for many families. Stone surveyed 22 academic studies of the effect of pronatalist policies on fertility. He finds that an increase in the *present value* of child benefits equal to 10% of a household's income can be expected to produce between 0.5% and 4.1% higher birth rates.

Pronatalist policies can have unintended consequences for the environment and lead to climate change. The increase in population can lead to a greater demand for resources, energy and food, which can lead to greater greenhouse gas emissions. Pronatalist policies to support social security programs are particularly undesirable in a time of climate change because higher-income countries are the countries that tend to have those policies. Additional births in higher-income countries are particularly costly to climate change because those countries have higher per capita emissions. For example, per capita emissions in the U.S. are more than twice as high as in China.

Population aging can also affect climate change. Brimblecombe (2016) argues that risk mechanisms, such as social security, need to take appropriate actions in reducing, mitigating and adapting to climate change. Growing numbers

of senior citizens leading carbon-intensive lifestyles pose a challenge for global efforts to reduce emissions. In high-income countries, they are more likely to live in larger houses that use more energy and to spend more on manufactured goods. Their demand for manufactured goods poses a challenge to carbon emission reduction in manufacturing countries, such as China. The total contribution of people age 60 and older to consumption-based greenhouse gas emissions increased from 25.2% to 32.7% between 2005 and 2015 in the countries monitored in the research (Xue 2022). Older people consumed about a third more meat and dairy than their middle-aged compatriots, especially in Western European countries. The higher consumption of protein-rich food translates to greater amounts of energy needed to produce it (Xue 2022).

Xue (2022) found that older people bought more manufactured goods than their younger peers, which placed a high emissions burden on developing countries that produced the goods. The consumption of manufactured products by the older age group in the West led to higher outsourced emissions in developing countries such as China and those in the Middle East. The carbon footprint of the aged population in Japan and the U.S. particularly relied on production and emissions in China.

Section 6: Effects of Climate Change on Social Security, Population Aging and Older Populations

Although pronatalist policies to offset population aging and support social security programs arguably affect global climate change, global climate change also affects social security programs and population size. At the extreme, the world faces the potential for global warming to cause catastrophic, humanity-ending events due to the so-called “four horsemen” of the climate endgame: famine and malnutrition, extreme weather, conflict and vector-borne diseases (Kemp et al. 2022). Sustainable development is a necessary underpinning of the long-run success of social security programs. Global climate change is a financial concern for social security programs because it affects the productivity of many of the world’s economies, in part because of destructive severe weather events. In addition, older people are particularly vulnerable to the health risks of high temperatures (Harper 2019), and the cost of mitigating or adapting to climate change may affect social security budgets. Climate-change-caused natural disasters, displacement of people, loss of income and assets and increase in health problems can also affect social security programs.

Global climate change may also contribute to population aging by reducing birth rates, with some parents deciding not to have children because of their view that climate change means a bleak future for children (Williams 2021). A recent study found that nearly 40% of members of Gen Z in the U.S., the generation born between 1997 and 2012, said that fears about the future are making them reluctant to have children (Schiffman 2022).

Although the U.S. does not have explicit pronatalist policies, its anti-abortion policies potentially have a similar effect. Some politicians are even discussing banning birth control in some states. Although the U.S. is moving toward more controls countering efforts to reduce childbirth, it is the only developed country that does not mandate paid time off for females after they give birth. Japan and Germany, by contrast, provide 58 weeks of paid time off (Arneson 2021).

Global climate change will affect population size and age distribution in some countries because of global migration, with people migrating from countries with excessively hot weather to cooler countries. This means that migration will occur from poorer countries in hotter parts of the world to wealthier countries in cooler parts of the world. The global number of migrants has already doubled over the past decade. The 50 million climate-displaced people already outnumber those displaced by political persecution. The UN International Organization for Migration estimates that countries could face as many as 1.5 billion environmental migrants in the next 30 years. International migration may be a source of conflict. In 2020 the UN Human Rights Committee ruled that climate

refugees cannot be sent home, meaning that a state would be in breach of its human rights obligations if it returns someone to a country where, due to the climate crisis, their life is in danger. The ruling, however, is not internationally binding (Vince 2022).

Section 7: The Countries Most Responsible for Climate Change

A study of the historical greenhouse gas emissions from 1850 to 2021 finds that historically the United States is the country that has produced the most greenhouse gas emissions, at 20% of the total. China, in this historical perspective, is a distant second at 11%, followed by Russia at 7% and Brazil at 5% (Evans 2021).

The U.S. and China account currently for 43% of global greenhouse gas emissions (Worldometer 2022). China also contributes considerably to the production of technology used to reduce greenhouse gas emissions. It makes roughly two-thirds of the world's solar panels, nearly half of global wind turbines and three-quarters of lithium-ion batteries needed for electric vehicles and on-grid energy storage (Nahm and Urpelainen 2022).

China has faced two competing problems. The first is to control the size of its population. The second is to finance social programs such as social security pensions. A low birth rate leads to a relatively high old-age dependency ratio, which makes it difficult to finance old-age social security benefits. China, like Japan, has faced the problem of a shrinking labor force and shrinking population.

China, like the rest of the world, is also experiencing the negative effects of climate change. Harper (2019) includes China among the countries most vulnerable to the negative effects of drought.

Section 8: Alternative Policies to Deal with Population Aging and Workforce Decline

A consequence of a government policy of neutrality on the issue of family size, rather than a pronatalist policy, could be a declining labor force. Japan is dealing with a declining labor force in part by investing in robotics. Another policy for dealing with population aging and labor force decline is to encourage greater labor force participation, particularly at older ages. This can be done by raising the age at which workers can claim social security benefits or by reducing the penalty or increasing the reward for postponing retirement. Other policies can include policies to combat age discrimination against older workers and policies to prohibit mandatory retirement for most occupations.

Section 9: Alternative Policies for Dealing with Climate Change

An alternative set of policies for dealing with climate change include actions individuals can take to reduce their consumption that affects carbon emissions. Lifestyle choices individuals can make include eating less meat, turning off lights and reducing the use of heating and air conditioning, having more efficient heating and air conditioning, improving home insulation, not purchasing overly large homes, purchasing energy-efficient light bulbs and appliances, installing solar panels on homes, purchasing more fuel-efficient cars and switching to electric cars, avoiding long commutes, driving less and walking more, subsidizing public transport, flying less. traveling by train instead of plane, voting for and contributing to politicians who support dealing with climate change, and planting more trees.

However, although these voluntary acts of individual responsibility are important and should be part of the solution, the wealthiest 1% of the world's population is responsible for more than twice the carbon emissions of the poorest

50%. The richest 10% are responsible for 52% of carbon emissions (Oxfam 2020). To be in the top 1% of world wealth, in 2018 a household would need assets worth \$871,000. More than 19 million Americans are in the top 1% worldwide, far more than those in any other country. China is in second place with 4 million in the world's top 1%. A net worth of \$93,170 would put a household in the top 10% worldwide (Elkins 2018).


Conclusions

The Economist calls global climate change “the challenge of the age.” Because the negative effects of global climate change are most severely felt by people in the low-income countries that have done the least to cause it, this paper argues that it is important to have an international perspective when dealing with climate change. The paper also argues that it is important to have a multifaceted approach to deal with climate change, given the seriousness of the problem and the difficulties of dealing with it. As part of a multifaceted approach, one aspect should be to address issues concerning population growth. Between 1986 and 2015, the number of governments trying to raise birth rates increased from 19 to 55 (Sobotka et al. 2019). Since 2015, more countries have adopted pronatalist policies, including dramatic expansions in pro-birth policies as discussed in this paper (Stone 2020).

In modern Malthusian theory, the relationship between population and food supply is more complex than in traditional Malthusian theory. The traditional argument is that population tends to grow faster than the food supply, so countries face a need to control population growth. In addition to that argument, however, population growth exacerbates global climate change, which causes floods and droughts that reduce global food supply. Although population aging is one of the major demographic changes, with the effect of population size on global climate change, it is arguably not the most important problem.

The burden of dealing with climate change currently needs to fall on high-income countries, which are the largest consumers of fossil fuels. However, in the future, as low-income countries develop, population growth will also be an issue in those countries. Low-income countries with high population growth rates should take steps to curtail their population growth as part of their efforts to raise their level of development.


This paper focuses on the pronatalist policies in some of these countries. With these policies, governments actively encourage young couples to have more children. Such policies are often justified in part as a way to shore up the financing of pay-as-you-go social security programs. The paper argues that these pronatalist policies should be ended as part of long-term strategies to deal with climate change. Instead of governments encouraging young couples to have more children, our proposal of ending pronatalist policies and adopting a neutral stance of government toward family size would not only help in dealing with climate change but also reduce government involvement in personal decisions.



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