# Globalization and Inequality: Theoretical Insights from Japan's Shrinking Economy

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## Abstract

This paper examines the effects of population decline in an open economy with international capital mobility and trade, considering the role of transportation costs. As firms and capital relocate from the shrinking economy to a larger foreign market, residents of the shrinking economy face rising import costs and declining real wages. However, capital owners can offset these losses through returns to capital, leading to increased real income disparity. The findings suggest that population decline, when coupled with globalization forces, exacerbates economic inequality within the shrinking economy.



Keywords: globalization; population decline; income inequality; international trade; capital mobility

JEL classification: F12, J11, D63

## 1. Introduction

There is growing interest in domestic economic inequality between individuals, with ongoing debate over its causes. While technological change and economic globalization are commonly cited as key factors, this paper examines international differences in population as an additional driver of present and future domestic inequality. Specifically, given the international mobility of both goods and capital, this study demonstrates that domestic inequality increases in countries experiencing relative population decline.

The focus on population is inspired by the situation of Japan. The country is going through a population decrease at an unprecedented pace. After reaching its peak of 128.08 million in 2008, population of Japan has been on the decline to date. The Latest population of Japan is 123.24 million in September 2024. According to the National Institute of Population and Social Security Research (2023), the total population of Japan, 126.15 million counted in the Population Census in 2020, is projected to decrease to 87 million in 2070 (down to 69.0% of the population in 2020) under their medium-fertility/medium-mortality scenario.

A preview of the results suggests that population decline, which reduces the size of the domestic economy, prompts capital outflows to larger markets, expanding the range of imported differentiated goods. When international transport costs exist, this reliance on imports imposes additional costs on the home population. However, capital owners are compensated through returns to capital, particularly when global population growth drives up capital returns. As a result, inequality between capital owners and non-capital owners widens in the presence of international capital mobility and trade costs. Therefore, unless capital is evenly distributed among the population, population decline serves as a source of domestic inequality.

In the next section I use the footloose capital model originally proposed by Martin and Rogers (1995) who analyzed the role of public infrastructure on the international location of industries. The model is recognized by Baldwin et al. (2003) as one of the core new economic geography models that focus on the agglomeration of economic activities. In the present analysis the focus will be on international population difference and the location of firms. In section 3, three different patterns of population changes are studied, followed by concluding comments.

## 2. A footloose capital model focusing on international difference in population

*Assumptions*

There are two types of goods in the economy – differentiated final goods and homogeneous goods. All consumers are assumed to have the same preferences. These preferences are described by the following two-tier structure:

$$U = M^{\mu}H^{1-\mu} \ (0 < \mu < 1) \tag{1a}$$

$$M = \left[\int_0^n m(i)^{\rho} di\right]^{\frac{1}{\rho}} \ (0 < \rho < 1) \tag{1b}$$

The upper tier (1a) is a Cobb-Douglas function of the consumption of an aggregate of the variety of differentiated goods (M) and the homogeneous good (H). The second tier (1b) defines $M$ as a constant elasticity of substitution (CES) function, where $m(i)$ is the consumption of each variety $i$. $M$ is therefore a CES composite of the total mass of varieties, $n$. The elasticity of substitution between any differentiated goods is $1/(1-\rho) \equiv \sigma \ (\sigma > 1)$.

On the production side, a firm producing a particular variety of the differentiated good requires a unit of capital, in addition to $c$ units of workers per unit output. The firm thus faces increasing returns to scale. Its total cost for producing a given amount $q_m$ is then

$$C(q_m) = r + cwq_m, \tag{2}$$

where $r$ is per unit return to capital and $w$ is the wage of the workers. It is assumed that the differentiated good industry is monopolistically competitive.

The technology for producing a homogeneous good is that of constant returns to scale using only labor as a factor of production. A unit of worker produces a unit of the homogeneous good. Therefore, the cost of producing a given amount of homogeneous goods ($q_H$) is

$$C(q_H) = wq_H. \tag{3}$$

There are two economies, home and foreign. Both home and foreign have the differentiated good and the homogenous good industry. Each economy is endowed with labor and capital. The population of home, which is the total amount of labor in home, is $L_H$ and that of foreign is $L_F$. They are also consumers. World stock of capital is $\overline{K}$, half of which exists in each country. It is assumed that international trade costs exist only for the differentiated good.

*Consumer behavior*

For a given income $I$, and given prices $p_m(i)$ for each variety of the differentiated good and $p_h$ for the homogeneous good, the consumer's problem is to maximize her utility, subject to the budget constraint

$$\int_0^n p_m(i)m(i)di + p_hH = I. \tag{4}$$

Since the preference for differentiated varieties and the homogeneous good are separable, and the second tier is homothetic in $m(i)$, the problem can be solved in two steps. The first step is to choose $m(i)$. That is, consumers should choose $m(i)$ to minimize the cost of consuming $M$. This implies minimizing expenditure

$$\int_0^n p_m(i)m(i)di$$

subject to

$$\left[\int_0^n m(i)^\rho di\right]^{\frac{1}{\rho}} = M. \tag{5}$$

Then the standard result of demand function for variety $j$ is

$$f(j) = p_m(j)^{-\sigma}P^{\sigma-1}\mu I, \tag{6}$$

where $\sigma$ becomes the price elasticity of demand, and $P$ is called the price index:

$$P \equiv \left[\int_0^n p(i)^{\frac{\rho}{\rho-1}}di\right]^{\frac{\rho-1}{\rho}} = \left[\int_0^n p(i)^{1-\sigma}di\right]^{\frac{1}{1-\sigma}}. \tag{7}$$

The second step is to allocate the expenditure between $M$ and $H$. The demand function for the homogeneous good is then

$$H = \frac{(1-\mu)I}{p_h}. \tag{8}$$

*Firm behavior*

In the differentiated good sector, because of the infinite number of potential varieties and increasing returns to scale at the firm level, each firm becomes a sole producer of a differentiated variety. The

first-order condition of profit maximization is then the equalization of marginal revenue and marginal costs. Since the demand elasticity that each firm faces is $\sigma$, firms will exhibit the following mark-up pricing behavior:

$$p_m\left(1-\frac{1}{\sigma}\right)=cw. \tag{9}$$

The mark-up depends solely on $\sigma$. A decrease in $\sigma$ makes price competition tougher and increases the mark-up to widen the gap between the marginal cost and price. The international trade cost is reflected in its delivered price abroad. That is, the delivered price is $p_m t$, where $t>1$. Then the corresponding price indices of the differentiated goods in home and foreign are

$$P_H = n_H^{\frac{1}{1-\sigma}}p_m + n_F^{\frac{1}{1-\sigma}}(p_m t) \tag{10a}$$

and

$$P_F = n_H^{\frac{1}{1-\sigma}}(p_m t) + n_F^{\frac{1}{1-\sigma}}p_m, \tag{10b}$$

respectively.

Equilibrium mass of the differentiated good firms in the world is $\bar{K}$. Denoting the share of capital operating in home as $s$, the firm mass in home and in foreign are

$$n_H = s\bar{K} \tag{11a}$$

and

$$n_F = (1-s)\bar{K}, \tag{11b}$$

respectively.

In the homogeneous goods sector, perfect competition leads to marginal cost pricing. Therefore, $p_h = 1$ and $w = 1$.

*Equilibrium*

Equilibrium is defined as a situation in which all markets clear, under free entry and exit in both sectors. Free entry and exit in the differentiated goods sector leads to zero profits, that is,

$$r_H = p_m q_{mH} - cq_{mH} \tag{12a}$$

for home differentiated good producers, and

$$r_F = p_m q_{mF} - cq_{mF} \tag{12b}$$

for foreign differentiated good producers. (12a) and (12b) mean that operating profits cover the fixed costs. Further, using (9), (12a) and (12b) can be rewritten as

$$r_H = \frac{c}{\sigma-1}q_{mH} \tag{13a}$$

and

$$r_F = \frac{c}{\sigma-1}q_{mF}, \tag{13b}$$

respectively. (13a) and (13b) imply that lower marginal cost of production needs to be matched by larger output to cover the fixed costs.

Market clearing in the final goods sector requires that each firm's output equals global demand. Therefore,

$$q_{mH} = \mu {p_m}^{-\sigma} {P_H}^{\sigma-1} Y_H + \mu (p_m t)^{-\sigma} {P_F}^{\sigma-1} Y_F t \tag{14a}$$

for differentiated goods produced by home firms, and

$$q_{mF} = \mu (p_m t)^{-\sigma} {P_H}^{\sigma-1} Y_H t + \mu {p_m}^{-\sigma} {P_F}^{\sigma-1} Y_F, \tag{14b}$$

for differentiated goods produced by foreign firms. Here, reflecting international trade costs, $t$ units of the good must be produced and shipped for a unit of the good to arrive at the foreign destination.

Free international mobility of capital leads to international equalization of the returns to capital. Denoting the equilibrium returns to capital as $r$, from (9), (13a) and (13b),

$$q_{mH} = q_{mF} = \frac{r(\sigma-1)}{c} \equiv q_m. \tag{15}$$

Global full employment of labor is required in equilibrium, that is,

$$\bar{K}cq_m + (1-\mu)(Y_H + Y_F) = L_H + L_F. \tag{16}$$

Substituting (10a), (10b) and (15) into (16) and rearranging, we have the equilibrium returns to capital:

$$r = \frac{\mu(L_H+L_F)}{(\sigma-\mu)\bar{K}}. \tag{17}$$

Then the total income of home ($Y_H$) is

$$Y_H = L_H + \frac{1}{2}r\bar{K} \tag{18a}$$

and the total income of foreign ($Y_F$) is

$$Y_F = L_F + \frac{1}{2}r\bar{K}. \tag{18b}$$

Using (9), (10a), (10b), (11a), (11b), (14a) and (14b), we have the relationship between the price indices and the aggregate incomes of the two countries

$$\frac{{P_H}^{\sigma-1}}{{P_F}^{\sigma-1}} = \frac{Y_F}{Y_H}, \tag{19}$$

implying that equilibrium price indices reflect economic size. That is, the larger economy has a lower price index than the other.

Substituting (10a), (10b), (11a), (11b), (18a) and (18b) into (19) and solving for $s$, we have

$$s = \frac{[(\mu-2\sigma)L_H - \mu L_F]t^\sigma - [(\mu-2\sigma)L_F - \mu L_H]t}{2\sigma(L_H+L_F)(t-t^\sigma)}, \tag{20}$$

which is the equilibrium share of capital operating in home. Comparative statics show that

$$\frac{\partial s}{\partial L_H} = \frac{L_F(\sigma-\mu)(t^\sigma+t)}{(L_H+L_F)^2(t^\sigma-t)\sigma} > 0 \tag{21a}$$

and

$$\frac{\partial s}{\partial L_F} = -\frac{L_H(\sigma-\mu)(t^\sigma+t)}{(L_H+L_F)^2(t^\sigma-t)\sigma} < 0\,. \tag{21b}$$

Therefore, a population decrease in the home country and/or an increase in the foreign country leads to a geographic shift of the M sector abroad. Without loss of generality, the following analysis focuses on the population decline in the home country, represented by a decrease in $L_H$. As indicated by equation (21a), this decline reduces $s$, which, according to equations (11a) and (11b), results in a decrease in $n_H$ and an increase in $n_F$. These changes are reflected in the price indices (10a) and (10b), leading to an increase in the price index in the home country and a decrease in the foreign country. At a given wage level, this dynamic lowers the real wage in the home country while raising it abroad. The impact of reduced real wages on overall economic welfare in the home country depends on capital ownership. While workers who rely solely on wages experience losses, capital owners may be compensated through returns to capital, which serve as an additional income source.

Furthermore, since

$$\frac{\partial s}{\partial \mu} = -\frac{(L_F-L_H)(t^\sigma+t)}{2(L_H+L_F)(t^\sigma-t)\sigma}, \tag{22}$$

when the foreign country is larger ($L_F > L_H$), an increase in the share of the differentiated goods sector ($\mu$) facilitates further agglomeration of differentiated goods production and capital in the foreign country.

Interestingly, because

$$\frac{\partial s}{\partial t} = \frac{t^{\sigma}(\sigma-1)(\sigma-\mu)(L_F-L_H)}{(L_H+L_F)(t^{\sigma}-t)^2\sigma}, \tag{23}$$

when the foreign country is larger ($L_F > L_H$), an increase in transportation costs ($t$) reduces the agglomeration of the differentiated goods production and capital in the foreign country. This result can be interpreted as follows: Firm profits depend on both market size and the price index in each country. Higher profits are expected in larger markets and/or in countries with higher price indices. An increase in $t$ raises the price index in the home country, making it relatively more attractive for firms. Consequently, all else being equal, agglomeration in the foreign country decreases.

## 3. Analysis of Three Population Scenarios

The presence of international trade costs makes it more profitable for firms to operate in the larger economy. A population decline in the home country leads to the exit of differentiated goods firms and the entry of new firms in the foreign country, driving capital migration abroad in pursuit of higher returns. Consequently, the home country experiences a rising cost of living and a decline in real wages, while real wages in the foreign country increase due to greater local production of differentiated goods. As a result, individuals in the home country who do not own capital suffer income losses, whereas capital owners are compensated through returns to capital. Thus, unless capital ownership is evenly distributed, population decline exacerbates income inequality between capital owners and wage-dependent individuals. The following numerical examples illustrate three scenarios, with the greatest increase in inequality occurring in Scenario 3, where the foreign population growth exceeds the home country's population decline.

**Table 1: The three scenarios**

| | |
|---|---|
| Scenario 1 | Population decrease in home (no change in foreign) |
| Scenario 2 | Population decrease in home (increase in foreign population with global population unchanged) |
| Scenario 3 | Population decrease in home (increase in foreign population with global population increase) |

For graphical representation in Figures 1 and 2, the following parameters and exogenous variables are used: $\bar{K} = 100$, $\sigma = 5$, $c = 0.01$, $\mu = 0.2$, $t = 1.5$, $L_H$ declining from 1000 to 700. The foreign population is set at $L_F = 1000$ in Scenario 1, increases to 1300 in Scenario 2, and rises further to 1600 in Scenario 3. It is assumed that half of the home population owns capital, which is equally distributed among them.

Real wages are determined by the price of goods, with imported differentiated goods being more expensive due to international trade costs. A shrinking domestic economy results in a higher proportion of imported goods, as capital and differentiated goods firms relocate abroad. Consequently, real wages are lowest in Scenario 3 and highest in Scenario 1. In the foreign country,

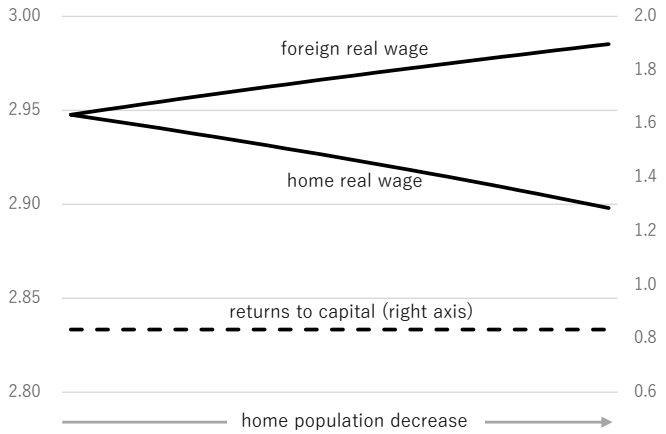
real wages increase in all scenarios due to a relative population gain, with absolute population growth further amplifying this effect in Scenarios 2 and 3.

Returns to capital are influenced by global population dynamics. In Scenario 1, returns to capital decline as both the home and global populations shrink. In Scenario 2, they remain stable since the global population remains unchanged. In Scenario 3, returns to capital rise alongside global population growth.

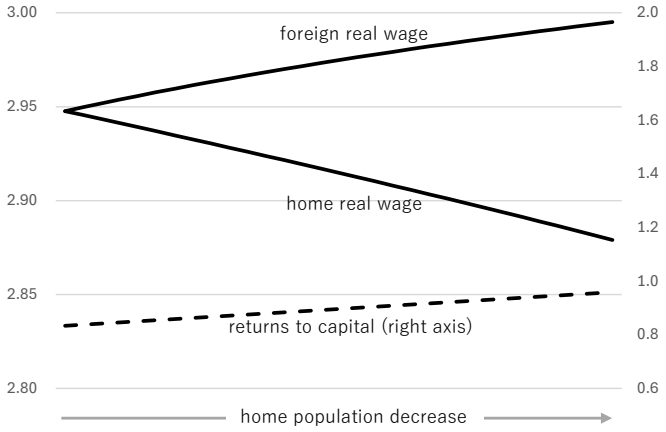
Total income, defined as the sum of wages and capital returns, varies across individuals depending on capital ownership. Non-capital owners, who rely solely on wages, experience declining real incomes, while capital owners see their real incomes increase in all scenarios, reaching their highest level in Scenario 3.

Inequality within the home economy can be assessed by comparing real incomes between capital owners and non-capital owners. Inequality is lowest in Scenario 1 and highest in Scenario 3, where rising capital returns further widen the income gap.


**Scenario 1: Population decrease in home (no change in foreign)**

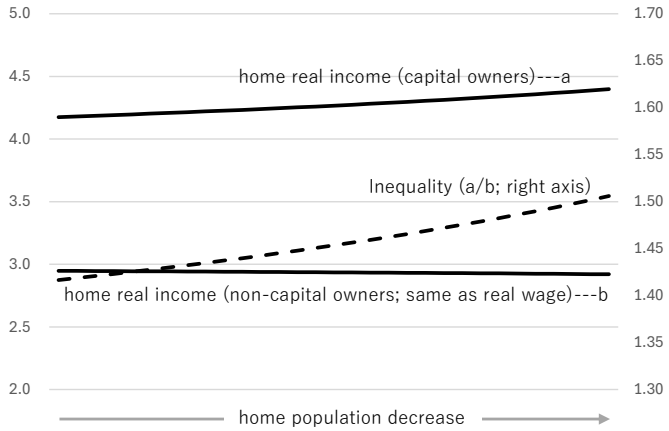



**Scenario 2: Population decrease in home (increase in foreign population with global population unchanged)**

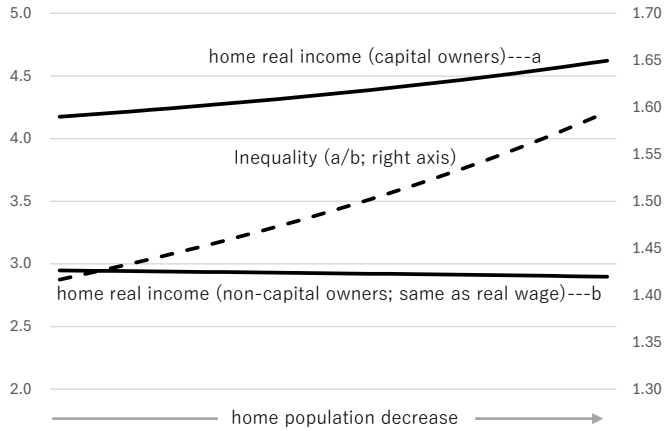



**Scenario 3: Population decrease in home (increase in foreign population with global population increase)**

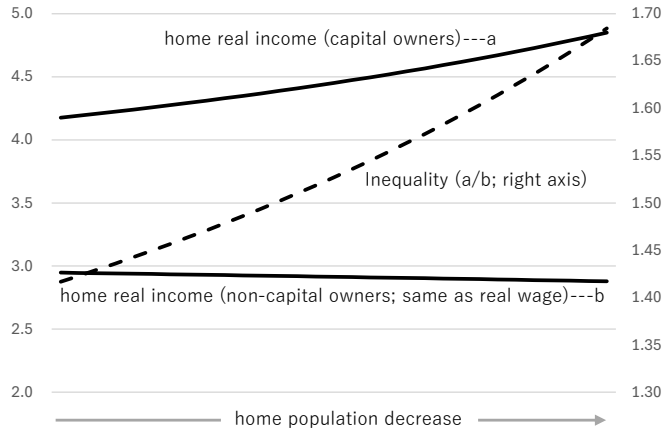
**Figure 1: Real Wages and Returns to Capital Across Three Scenarios**




**Scenario 1: Population decrease in home (no change in foreign)**




**Scenario 2: Population decrease in home (increase in foreign population with global population unchanged)**




**Scenario 3: Population decrease in home (increase in foreign population with global population increase)**

**Figure 2: Home Real Incomes and Inequality Across Three Scenarios**

## 4. Concluding comments

This study examined international differences in population dynamics as a potential driver of domestic inequality. In a globalized economy, where both goods and capital move across borders, firms and capital tend to concentrate in larger economies when international transportation costs are present. Consequently, unless capital ownership is evenly distributed within the smaller country, real income inequality increases between capital owners and individuals who rely solely on wage income. This occurs because real wages decline as a greater share of goods is produced abroad, leading to a higher proportion of imported varieties that incur transportation costs. In contrast, capital owners can offset these wage losses through returns on their capital holdings.

The extent of real wage decline, the level of returns to capital, and the overall impact on real incomes and domestic inequality depend on global population trends. Domestic inequality is most pronounced when global population growth surpasses the population decline in the smaller country, as this scenario leads to the highest returns on capital, further widening the income gap between capital owners and non-owners.

In the case of Japan, a rapid population decline appears inevitable unless countered by large-scale immigration. However, given the model's findings—where living costs continue to rise and real wages steadily decline in the smaller country—it is unlikely that a shrinking economy will attract sufficient immigration to offset these demographic challenges.

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