

# Ageing, Investment and Foreign Trade – a Macroeconomic Perspective

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*In an ageing society, when a growing number of pensioners meets a decreasing number of working people, this leads to a decline in per capita GDP under otherwise unchanged conditions. However, the decline in the number of people in employment can be offset by higher labour productivity. Increased input of capital and technology increases the capital intensity of production and thus increases labour productivity. The investments required for this can be increased by net capital imports from abroad, including the corresponding trade balance deficit. Alternatively, in the phase when baby boomers are still in working age, the country can increase its investments at an early stage by reducing existing export surpluses.*

## 1. Society's ageing reduces individual material wealth

In an ageing society, a decreasing number of working people are confronted with an increasing number of pensioners. The employment rate of society as a whole, defined as the share of the employed persons (empl.) in the total population (pop.), is thus decreasing. Under otherwise unchanged economic conditions, material prosperity, as measured by gross domestic product (GDP) per capita, threatens to decline. This can be shown with the help of basic definitions:

$$\frac{GDP}{pop.} = \frac{GDP}{empl.} * \frac{empl.}{pop.} \text{ with: } \frac{GDP}{pop.} = \text{gross domestic product per capita}$$

$$\frac{GDP}{empl.} = \text{productivity per person employed}$$

$$\frac{empl.}{pop.} = \text{employment rate, based on total population}$$

A decline in the employment rate  $\left(\frac{empl.}{pop.} \downarrow\right)$  means a decline in gross domestic product per capita  $\left(\frac{GDP}{pop.} \downarrow\right)$  if labour productivity  $\left(\frac{GDP}{empl.} \rightarrow\right)$  remains unchanged.

## 2. Basic approaches to solutions

For a society facing this demographic challenge, there are essentially three approaches to preventing a decline in GDP per capita:

1. The first option is to increase the employment rate of people living in the country  $\left(\frac{empl.}{pop.}\right)$ , e.g. by extending working life in the form of an increase in the effective retirement age. This approach relates primarily to labour market and social policy. Possible measures include promoting lifelong learning, pension incentives to work in old age and improving health at work.
2. A second approach is to increase the influx of workers from abroad in order to counter the threat of labour shortages. Immigration of workers increases both the number of people in employment and the population. If only (or above all) employed persons migrate, this immigration increases the employment rate  $\left(\frac{empl.}{pop.}\right)$  ceteris paribus. However, the successful integration of immigrants into the labour market is a prerequisite.

3. Finally, a third approach concerns increasing labour productivity  $\left(\frac{GDP}{empl.}\right)$ . GDP per capita can also be increased in an ageing society if productivity per worker increases so much that the decline in the employment rate is more than compensated for. This increase in productivity can be achieved by increasing labour productivity. This presupposes appropriate investment in human capital, i.e. a qualitative and quantitative investment in educational activities. Higher labour productivity can also be achieved through increased use of capital and technologies, i.e. investments (investments in tangible assets).<sup>1</sup>

The following discussion focuses exclusively on the instrument of increasing investment to stabilise GDP per capita in an ageing society.

### 3. Increase of investments

With regard to macroeconomic investments, the following basic macroeconomic interdependencies apply:

- Investments ( $I$ ) can only be made in the economy as a whole if private households do not consume part of their income, but form savings ( $S$ ) (with  $I = S$ ).
- Investments are only made by companies if they yield a return above the real market interest rate. This return also depends on the wages to be paid.

The net impact of social ageing on these and other factors on investment activities is uncertain. Nevertheless, some basic interdependencies can be identified. A distinction must be made between a closed economy without external economic relations and an open economy.

#### 3.1 Investments in a closed economy

In an economy without any economic activities with foreign countries, the overall volume of investment is determined by domestic savings. Various demographically-related developments are possible:

- As a rule, pensioners have a lower disposable income than those in employment. A lower disposable income reduces the potential savings, as a higher proportion of income is needed to finance livelihoods. As a result, the propensity of an older population to save tends to decline. This means that the savings rate (defined as macroeconomic savings as a percentage of GDP) and thus also savings ( $S$ ) will fall.
- Ceteris paribus, lower savings mean a smaller supply of capital and thus a rising interest rate.
- If, in an ageing society, current workers know that they will only receive a low level of state pensions in their retirement phase, their incentive to make private provision for old age increases. This increases the savings rate ceteris paribus, with the result that the interest rate drops.

On balance, I assume that the decline in the savings ratio and savings will prevail, so that interest rates will rise ceteris paribus in an economy with an ageing population (also: Stephenson/Scobie 2002: 19).

Likewise important for the volume of macroeconomic investment are incentives to invest. Here, too, there are opposing age-related developments:

- The outlined influence of demographic ageing on the formation of savings leads to an increase in interest rates via a tendency towards a decline in savings. This reduces the incentive to make credit-financed investments. It is becoming increasingly attractive for capital owners to invest their money in the capital market and receive the higher interest

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<sup>1</sup> For reasons of analytical simplification, investments are hereinafter understood as net investments. Depreciation is therefore neglected.

rate instead of making high-risk investments. Even in the case of credit-financed investments, investments are falling due to rising credit costs. In this respect, overall economic investment is declining.

- A shortage in the number of people in employment results in an increase in wages. This increases the incentive for companies to replace the factor labour with the factor capital. This in itself leads to an increase in investment and an increase in the capital intensity of production (defined as capital per worker). At the same time, the incentive to implement labour-saving technological progress is increasing. This technological progress, too, can only be achieved through investment, so that overall economic investment increases.

On balance, I assume that the higher investments to replace the increasingly scarce factor labour outweigh the overall economic need for investment in an aging society (also Stephenson/Scobie 2002: 20, Lee 2016: 2).

The consequences for the capital market are shown in Figure 1. The savings ( $S$ ) correspond to the supply of capital, while the investments ( $I$ ) represent the demand for capital. While the interest rate trend resulting from demographic ageing is obvious (interest rate increase from  $i_0$  to  $i_1$ ), the development of investments (and with them of savings) is not clear. However, if we assume that an ageing society needs more capital - i.e. more investment - an increase in investment is to be expected on balance ( $I_1 > I_0$ ). This means that the demographically-related decrease in savings ( $Sav. \downarrow$ ) is smaller in amount than the increase in investments due to ageing ( $Inv. \uparrow$ ).

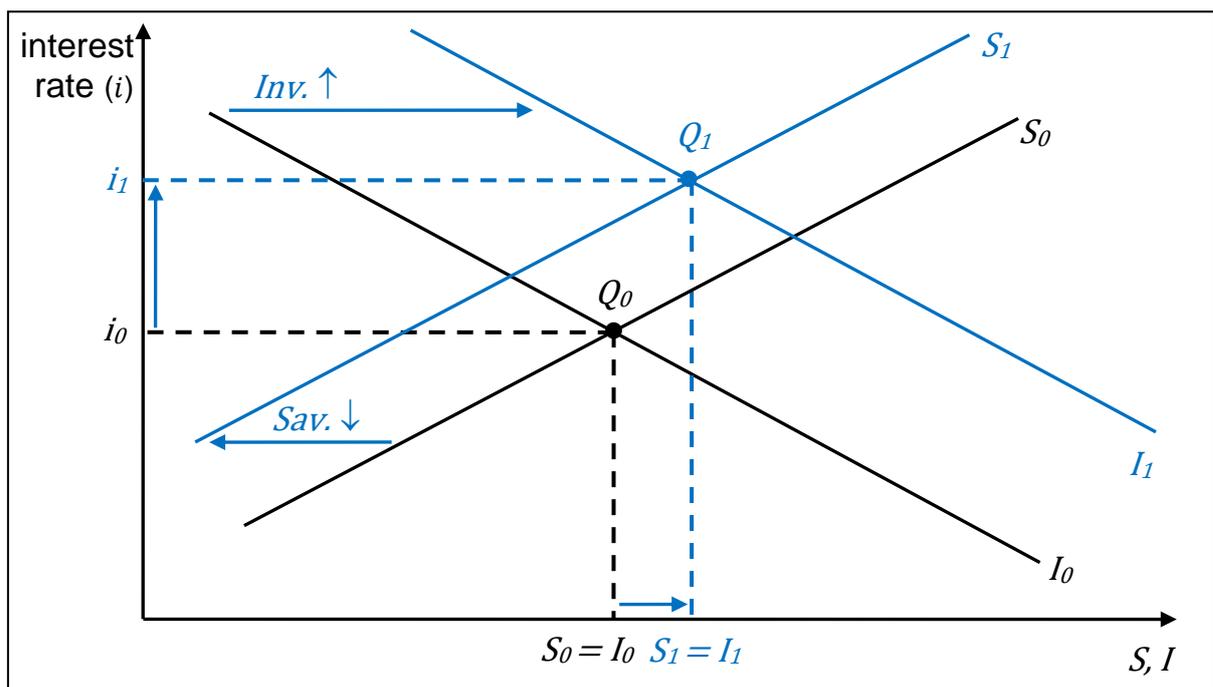


Fig. 1: Effects of demographic ageing on savings and investment in a closed economy.

The higher capital intensity of production associated with higher investments results in an increase in labour productivity. The higher labour productivity then also allows the payment of a higher wage - again due to demographic factors (wage equals marginal revenue product of labour).

### 3.2 Investments in an open economy

In an open economy, the resources required for macroeconomic investment (both the necessary goods and the necessary financial resources) can also come from abroad. Decisive for the willingness of foreign investors to invest their capital in the country of an aging society are the associated returns and investment income. The demographically induced rise in interest rates outlined above is helpful here:

- The rise in interest rates makes it more attractive for foreign investors to invest their capital in the economy with an aging society and to maintain the higher interest rates. The aging society thus receives additional capital from abroad (net capital import). This net capital import increases the capital supply and, ceteris paribus, causes a decline in interest rates.
- If foreign investors want to invest their capital in the aging economy in order to benefit from the higher interest rates, they ask the currency of this economy, because this is the only way to acquire interest-bearing assets. The higher demand for the currency of an aging society is leading to an appreciation of this currency.
- This appreciation in turn has an impact on foreign trade: as an appreciation of the domestic currency makes domestic products in the rest of the world more expensive, exports from an ageing society are declining, while imports are increasing. This results in a passivation of the trade or current account balance. Passivation of the trade balance - or more precisely a trade balance deficit - is ultimately the balance-mechanical counterpart of net capital imports.
- The trade deficit is the real economic aspect of the growing investments resulting from net capital imports from abroad: If the aging economy imports more than it exports, on balance more goods are consumed domestically than the domestic economy itself produces. The import surplus allows the economy to increase its own capital stock without affecting the material supply of its citizens.

In graphic terms, net capital import means that in addition to the capital supply of the domestic population (i.e. savings) there is also a capital supply from abroad (see Fig. 2). This capital supply corresponds to the net capital import ( $K^{IM}_{net}$ ) or the trade balance deficit of the country. The result of the additional capital supply is an expansion of macroeconomic investments (from  $I_1$  to  $I_2$ ) and a decline in interest rates (from  $i_1$  to  $i_2$ ).

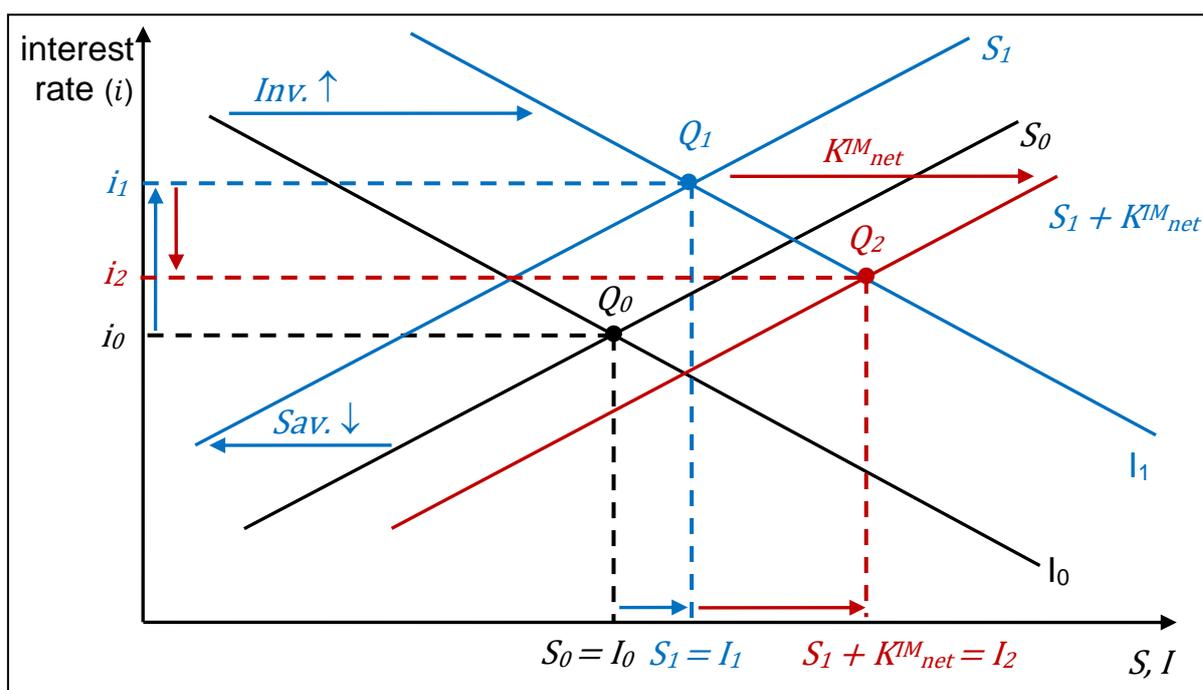


Fig. 2: Effects of demographic ageing on savings and investment in an open economy.

As a result, the assumptions made here result in an increase in investments in an aging economy. The increasingly scarce factor labour is being replaced by capital. The capital intensity of production is thus increasing. This in turn has an impact on the average productivity of the working population and thus also on GDP per capita.

#### 4. Investment and material prosperity per capita

The starting point of the following explanations is a neoclassical production function with the typical properties (positive but decreasing marginal productivity, substitutability of production factors, constant returns to scale, etc.). Solow's neoclassical growth model used below works with per capita values (cf. instead of many Jones/Vollrath, 2013, Chapter 2 and Petersen 2008). The per capita savings ( $s$ ) result from the exogenously specified and constant share ( $\sigma$ ) of GDP per capita ( $y$ ). Therefore:  $s = \sigma y$

A growth equilibrium requires that the actual per capita investments ( $i$ ), which are determined by the per capita savings ( $i = s$ ), correspond to the necessary per capita investments ( $i^{neces}$ ). The latter are determined by the capital intensity ( $k$ ) of production (defined as capital input per worker, i.e.:  $k = \frac{\text{amount of work}}{\text{amount of capital}}$ ) and by the growth rate of the working population ( $n$ ). Therefore:  $i^{neces} = n k$ .

Graphically, the growth equilibrium ( $\sigma y = n k$ ) results from the intersection of the straight line, which represents the necessary investments per capita, and the curve, which represents the per capita savings ( $Q_0$  in Fig. 3). With the corresponding capital intensity ( $k_0$ ), GDP per capita  $y_0$  can be produced (or to be more precise: GDP per worker).

If the workforce grows more slowly ( $n \downarrow$  with  $n_0 > n_1$ ) due to demographic change and the ageing of society, the factor labour becomes scarce in relation to the factor capital. This increases the wage rate. A rising wage is an incentive for profit-maximizing companies to replace labour with capital. When labour input decreases and capital input increases, the capital intensity of production increases ( $k \uparrow$  with  $k_1 > k_0$ ). The higher capital intensity of production is accompanied by a higher GDP per capita ( $y \uparrow$  with  $y_1 > y_0$ ).

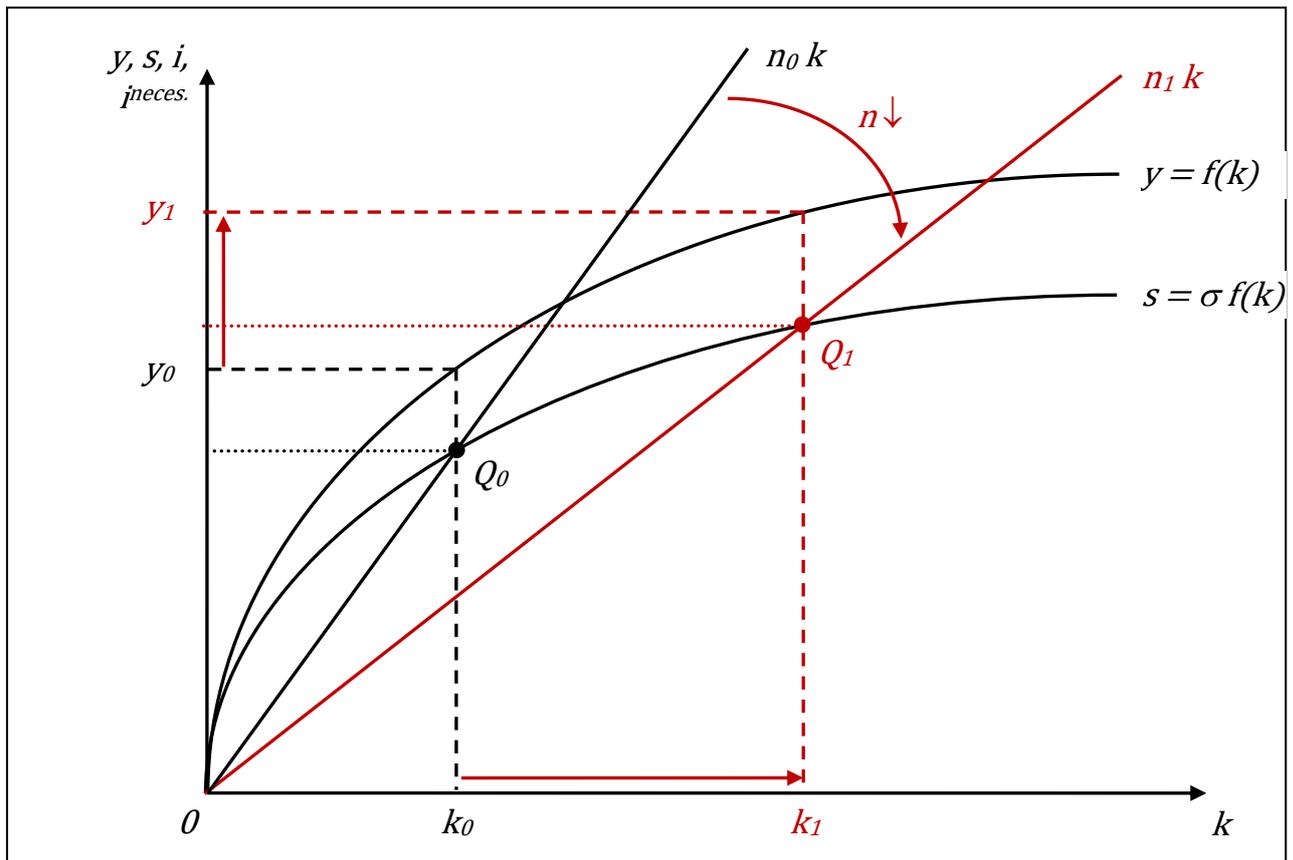


Fig. 3: Steady state growth equilibrium in the Solow model with per capita figures, effects of a decline in the labour force ( $n \downarrow$ ).

Figure 3 does not yet fully capture the relationships outlined in sections 3.1 and 3.2. In addition to the decline in population growth ( $n \downarrow$ ), the two other macroeconomic effects must also be taken into account:

- The demographically-induced decline in the overall economic savings rate ( $\sigma$ ) has the consequence that per capita savings ( $s$ ) will be lower. Graphically this means a downward rotation of the  $s$ -curve.
- The assumed net capital import increases the overall economic capital supply. The capital supply from abroad can be represented graphically by shifting the  $s$ -curve upwards.

The complete representation of the three macro-economically relevant changes can therefore be depicted in a graphical analysis of the Solow model as follows:

- (1) The decline in population growth turns the  $nk$ -curve downwards, i.e. in the direction of the  $k$ -axis.
- (2) The decrease in the savings rate turns the  $s$ -curve downwards in the direction of the  $k$ -axis.
- (3) The net capital import from abroad shifts the new  $s$ -curve upwards again.

Whether the capital intensity in the resulting new growth equilibrium is higher or lower than in the original equilibrium cannot be said a priori. If the assumptions made in the above assumptions are adopted, there will be - as in Figure 2 - an increase in investments and thus a higher capital intensity. These developments are finally presented in Figure 4.

This does not take into account the fact that technological progress further increases labour productivity. Graphically, this means that the  $y$ -curve is turned upwards. This also turns upwards the  $s$ -curve, which depends on GDP per capita.

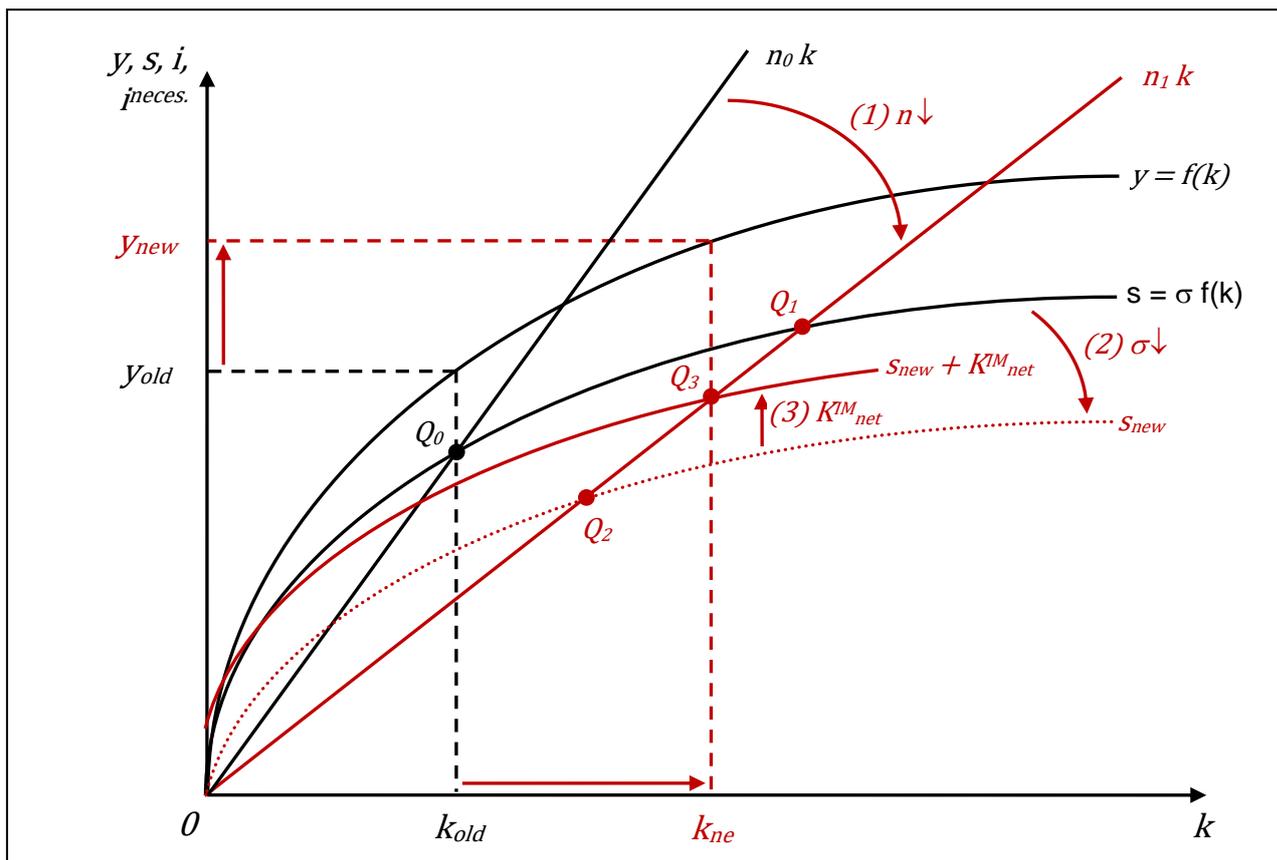


Fig. 4: Steady state growth equilibrium in the Solow model with per capita figures, effects of a decrease in the active population ( $n \downarrow$ ), a decrease in the savings rate ( $\sigma \downarrow$ ) and positive net capital imports ( $K^M_{net}$ ).

It should be noted that the Solow model assumes that the total population is the same as the working population. The increase in the ratio of pensioners to employed persons that occurs in the course of demographic ageing is thus definitively excluded. Moreover, the average GDP per inhabitant does not reflect the actual distribution of income. When the overall economic production processes become more capital-intensive, this changes the overall economic income distribution in favour of the capital owners. This has an impact on the financing of social security systems, which is ignored in this theoretical analysis. In this respect, statements on GDP per capita should be interpreted with caution. Nevertheless, these theoretical model considerations show that an increase in capital intensity, accompanied by a demographically induced decline in the number of employed persons, increases GDP per employed person (see also Acemoglu/Restrepo 2017: 8).

## 5. Economic policy conclusions

An ageing society can maintain the economic prosperity of its citizens (as measured by GDP per capita) if production becomes more capital-intensive and scarce labour is replaced by machinery and technology. The higher capital intensity of production is accompanied by a tendency for GDP per capita to rise - this is one of the central statements of neoclassical growth theory. A slowly growing population is thus beneficial for material prosperity per capita.

The increase in the capital intensity of production in an open economy is supported by the inflow of capital and goods from abroad: The demographically-induced higher demand for capital to carry out investments, coupled with falling savings, is leading to a rising interest rate in an aging society. A rising interest rate attracts capital from abroad. This is accompanied by a net capital import and trade balance deficit.

The prerequisite for this economic development is free goods and capital markets, because net capital imports and trade deficits are two sides of the same coin. For example, if the ageing economy imposes import restrictions in the form of tariffs or non-tariff barriers, there would be no higher imports and no trade deficit. This means that the goods necessary to increase the capital stock without restricting the supply of goods to citizens are not imported.

The fact that these are states with a functioning legal system and a high level of protection of private property helps the highly developed industrial nations. The associated security makes it additionally attractive for foreign investors to invest their money in the aging industrial nations. Even if the returns in economies with a young, fast-growing population should be higher than in industrialized nations because of the shortage of capital there, the security of private property can ultimately lead international capital to the highly developed industrialized nations.

However, there are not entirely no side effects of this approach: when foreign investors invest their capital in an aging society, they are entitled to related income payments (interest or capital income) and thus also to the goods produced in an aging society. GDP per capita may therefore rise in an ageing society, but per capita disposable income (national income or net national income) may fall at the same time. Should foreign investors withdraw their capital at some point in the future, the aging society would have to repay its debts to foreign countries. This would restrict the consumption possibilities of the people living at the time and further exacerbate the imminent demographically-related decline in material wealth per capita outlined above.

To mitigate these possible disadvantages, a society that still faces demographic ageing to a large extent should expand its capital stock at an early stage through appropriate investments. For highly developed economies with an export surplus such as Germany and Japan this means: Current export surpluses should be reduced by private and public investment in the country.

## Literature

Acemoglu, Daron/Restrepo, Pascal (2017): Secular Stagnation? The Effect of Aging on Economic Growth in the Age of Automation, NBER Working Paper Series, Working Paper 23077, Cambridge, MA.

Jones, Charles I./Vollrath, Dietrich (2013): Introduction to economic growth, 3. Aufl., New York.

Lee, Ronald (2016): Macroeconomics, Aging and Growth, NBER Working Paper Series, Working Paper 22310, Cambridge, MA.

Petersen, Thieß (2008): Die neoklassische Wachstumstheorie, in: Das Wirtschaftsstudium (WISU), 37. Jg., S. 1500 – 1506.

Stephenson, John/Scobie, Grant (2002): The Economics of Population Ageing, New Zealand Treasury Working Paper 02/05, Auckland.