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Reasons for the declining real interest rates

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Reasons for the Declining Real Interest Rates

Markus Demary / Michael Voigtländer

Köln, 28.11.2018

INSTITUT DER DEUTSCHEN WIRTSCHAFT

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JEL classification:

E21 – Consumption, saving, wealth
E22 – Investment, capital, intangible capital, capacity
E43 – Interest rates: determination, term structure and effects
E44 – Financial markets and the macroeconomy

Summary

The low nominal interest rate environment is a hotly debated phenomenon among politicians, financial market participants and households. Savers fear the erosion of their retirement savings, while financial supervisors warn of the stability risks caused by declining bank profitability and by the declining profitability of life insurers. Moreover, financial supervisors fear an increase in household debt triggered by a high demand for cheap loans.

Most people are interested in whether inflation-adjusted interest rates will rise in the distant future, and, if this is the case, when and by how much they will increase. However, the possibility of increasing real interest rates depends on whether the evolution of real interest rates is due to a rebound of a long cycle or whether it is due to a longer-lasting trend.

Whether the evolution of real interest rates is based on a trend or a cycle cannot be judged by data visualisation. Instead, it needs a more rigorous statistical analysis. Therefore, we first identify the drivers of real interest rates and use a panel data regression model to test whether these drivers are predictive of the evolution of real interest rates. We then use forecasts of the drivers of real interest rates, mostly demographic variables, to identify whether there is a future trend or a mean-reverting behaviour in real interest rates.

The regression model for the real interest rate can be used to calculate the real interest rate that is determined by economic fundamentals. This model-implied interest rate can then be compared to the data in order to detect misalignments that could be caused by accommodative monetary policies or by risk premia. The detection of misalignments is important for our forecasting exercise, because the correction of the misalignment back to a possible trend could be confused with an interest rate cycle.

The analysis indicates that the current low interest rate levels are not solely caused by the accommodative monetary policies of central banks, but are also the outcome of a longer-term downward trend. Although interest rates are currently lower than indicated by macroeconomic factors and, thus, are likely to increase when central banks start to toughen their monetary policies, in the long-run real interest rates will decline predominantly because of demographic factors. This trend will be persistent, because demographic factors seem to be persistent.

For Germany, for example, we find a rebound from currently -0.4 percent to 1.3 percent by 2025 due to the elimination of the misalignment when the ECB starts to normalise its monetary policy. After the normalisation of this interest rate cycle, the negative trend in the real interest rates leads to a decline to a real interest rate of 0.5 percent in 2035 and a real interest rate of 0.0 percent in 2050.

The result of persistently low interest rates has important implications for the long-term investment decisions of savers, life insurers and pension funds.

1 The global decline in real interest rates

The low nominal interest rate environment is a hotly debated phenomenon among politicians, financial market participants and households. Savers fear the erosion of their retirement savings, while financial supervisors worry about the stability risks caused by declining bank profitability and by the declining profitability of life insurers. Moreover, financial supervisors fear an increase in household debt triggered by a high demand for cheap loans.

Most people are interested in whether interest rates will increase, and, if this is the case, when and by how much they will increase. However, the possibility of persistently higher or lower interest rates depends on whether the evolution of real interest rates is due to a long cycle or whether it is due to a longer-lasting trend. A visual inspection of data on real interest rates is inconclusive regarding whether there is a trend or a cycle in real interest rates (Figure 1-1). However, one can observe longer-term downward trends in inflation and nominal interest rates in industrialised countries (Demary, 2015, 2017):

- The first decline in nominal interest rates was triggered by a decline in inflation rates after the high inflation period of the 1970s. The median long-term real interest rate of the industrialised countries declined from 4 percent in 1961 to -7.5 percent in 1975, while inflation increased to historically high levels. Then the monetary consensus among central banks changed, leading to more inflation-averse monetary policies. During the period of declining inflation rates in the late 1970s and the 1980s, real interest rates increased to 6 percent at the end of the 1980s.

- The second decline in nominal interest rates was due to declining real interest rates, accompanied by stable inflation, beginning in 1990. Long-term real interest rates declined from 8 percent in 1992 to 2.1 percent in 2016, while short-term real interest rates went negative.

- During the global financial crisis in 2008, several central banks cut interest rates to zero percent and maintained them there for several years. Central banks now experience a hard time in normalising interest rates. While the Federal Reserve has already started its normalisation policy, the European Central Bank and the Bank of Japan are still on hold.

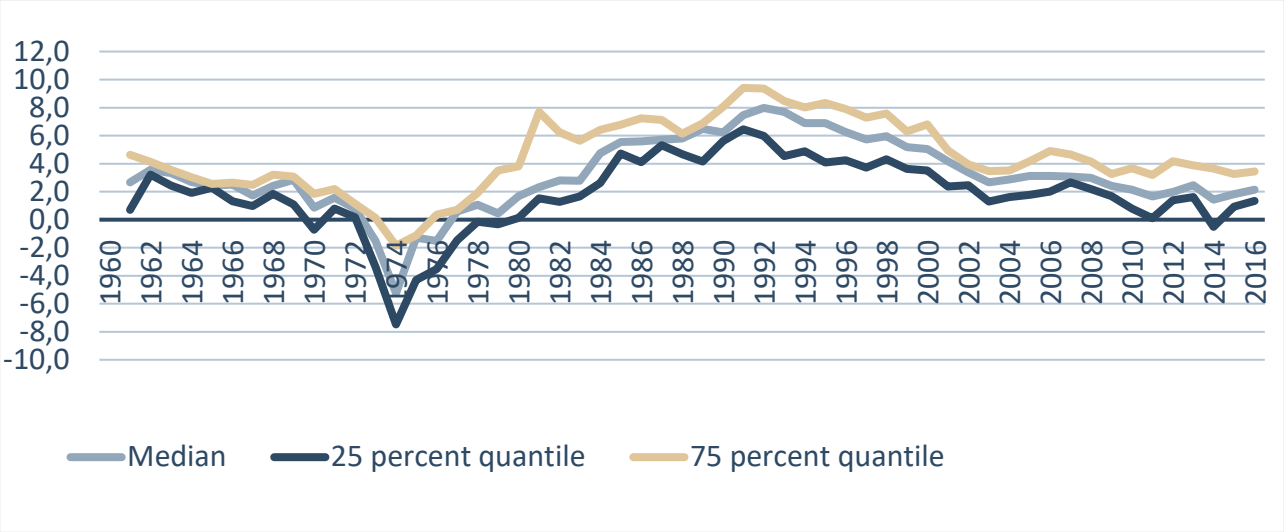
- There was a crisis-related flight-to-safety in the Eurozone in 2012, which caused the yields on safe assets to fall temporarily. This effect was seen in safe harbour countries, like Germany, where the nominal yields on highly liquid government bonds went negative for the first time in history. This effect was, however, a European one and not a global one.

The average long-term real interest rate across countries and time is 3.1 percent, while the average long-term real interest rate across countries in 2016 was one percentage point lower. Several theories predict this downward trend in real interest rates to be persistent (Bernanke, 2015; Summers, 2009; Caballero et al., 2013). Whether the current low interest rate environment is based on a falling trend or based on a cycle with the chance of a recovery in the future cannot be judged by data visualisation, but instead needs a more rigorous statistical analysis. Therefore, we first identify the drivers of real interest rates and use a panel data regression model to test whether they are predictive of the evolution of real interest rates. We then use

forecasts of the drivers of real interest rates to identify whether there is a persistent trend or a mean-reverting behaviour in real interest rates.

Figure 1-1: Real interest rates

In percent per year, 24 OECD countries



Sources: OECD, own calculations

2 Theories on declining interest rates

Several theories predict a decline in interest rates over time:

- The global savings glut hypothesis

The global savings glut hypothesis states that there is a global excess of desired savings over desired investment, which puts a downward pressure on real interest rates. A large part of the huge savings come from China and other emerging market economies in Asia, as well as from oil-producing countries like Saudi Arabia. The high savings rates are also attributable to government policies in Asia that aim at reducing borrowing and building up international reserves after the Asian financial crisis in the late 1990s (Bernanke, 2005, 2015). The global savings glut hypothesis predicts that interest rates will stay low for a longer period because of the persistency of the drivers of real interest rates.

- The secular stagnation hypothesis

The secular stagnation hypothesis predicts low interest rates due to low investment, which is caused by a declining population growth, a reduced capital intensity and a falling relative price of capital goods (Summers, 2009). Similar to the global savings glut hypothesis, the secular stagnation hypothesis predicts that real interest rates will stay low for a longer period because of the persistency of the underlying drivers of real interest rates.

- The safe asset shortage hypothesis

The safe asset shortage hypothesis sees a growing gap between the supply of safe assets and the demand for safe assets. One reason for the shortage is that the growth rates of the advanced economies, which are major issuers of safe assets, were lower compared to the high growth rates of high-saving emerging economies such as China (Caballero/Farhi, 2014). In the view of the authors, the growing demand for safe assets and the limited supply of safe assets made it possible for countries like Italy and Greece to issue their government debt at favourable conditions. Moreover, it facilitated the possibility to issue mortgage-backed securities. After the global financial crisis and the banking and sovereign debt crisis in the Eurozone, these assets were no longer regarded as safe assets, making the safe asset shortage more severe. This depressed the yields on safe assets even more.

- Demographic change

Demographic factors, e.g. increasing life expectancy, the ageing of societies and low population growth, also contribute to the decline in real interest rates (Krueger/Ludwig, 2007; Weizsäcker, 2014). The higher life expectancy requires a higher savings rate in order to maintain old-age consumption. Thus, on the aggregate level, desired savings should increase. The lower population growth slows the growth rate of the capital stock, which decreases the necessity for investments. Thus, on the aggregate level, savings should grow faster than investment, thereby putting downward pressure on real interest rates. Because of the persistency of the drivers of real interest rates, real rates are expected to decline in the long run.

- Growing demand for intangibles

Investments in intangible assets, e.g. data and licenses, become more important to companies. These investments require lower investment costs compared to investments in tangible assets, e.g. machinery and buildings. Moreover, companies that rely more on intangible capital save more. Glaeser (2014) notes that the development of high value-added services by Google, Microsoft, Amazon and Facebook requires relatively little investment. A shift from tangible investment to intangible investment would imply a slower growth rate of desired investment over desired savings, which would lead to downward pressure on real interest rates.

What these hypotheses have in common is that they assume the loanable funds model is valid (Bean et al., 2015). In this model, desired savings are an increasing function of real interest rates, while desired investment is a decreasing function of real interest rates. Desired savings can be interpreted as the capital supply curve, whereas desired investment can be interpreted as the capital demand curve. In equilibrium, real interest rates and observed savings and investment are then determined by the intersection of desired savings and desired investment.

If people intend to save more, e.g. in response to an increase in their life expectancy, the capital supply curve shifts to the right, leading to lower equilibrium real interest rates and higher equilibrium savings and investment. An increase in desired investment, e.g. because of an increase in the workforce, shifts the capital demand curve to the right, leading to higher equilibrium real interest rates and higher equilibrium savings and investment.

But there is also a strand of the literature that sees low productivity growth as a cause for the low interest rate environment (Rachel/Smith, 2015; Fischer, 2016, 2017; Yi/Zhang, 2017):

- On the one hand, a slower pace of innovation tends to push down investment demand, according to this hypothesis, because there are fewer profitable opportunities in which to invest. On the other hand, lower productivity growth reduces the future income prospects of households. Households then respond to the lower future income prospects by increasing their savings and lowering their consumption in order to maintain a sufficiently high old-age consumption level (Fischer, 2016).

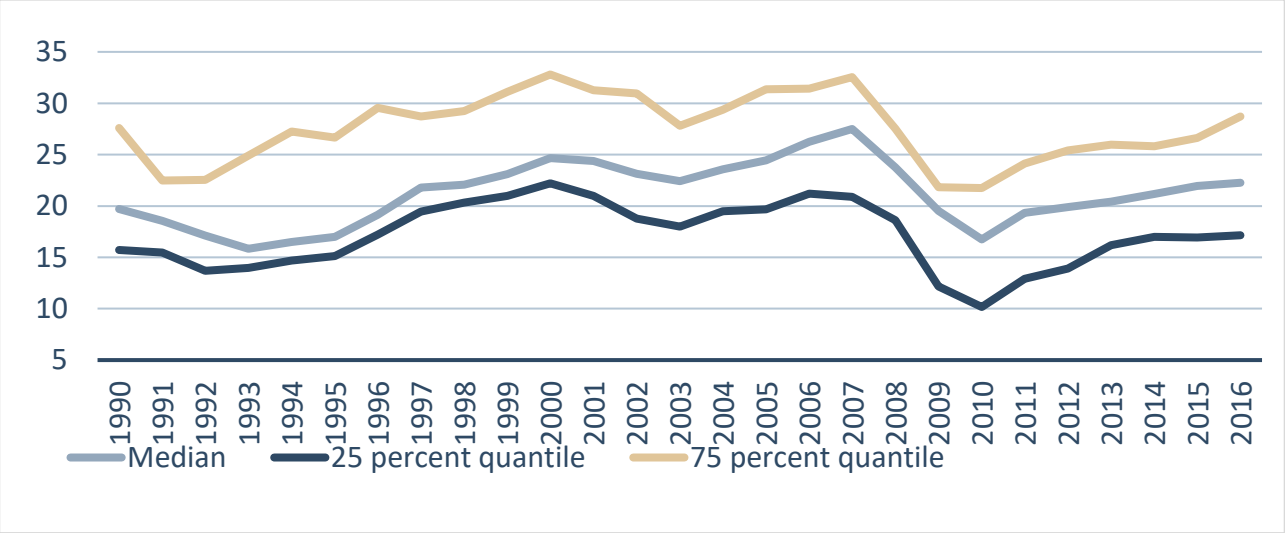
In the following sections, we will analyse the data behind these hypotheses and their explanatory power for the observed decline in real interest rates.

3 Have desired savings increased?

If desired savings have increased as implied by the global savings glut hypothesis, we will expect equilibrium real interest rates to decline and equilibrium savings to increase at the same time as predicted by the loanable funds model.

Figure 3-1: Savings rate

In percent of gross domestic product, 24 OECD countries



Sources: OECD, own calculations

Figure 3-1 shows the median savings rates, i.e. aggregate savings divided by GDP, as well as the 25 and the 75 percent quantiles over 24 industrialised countries. It can be found that the median savings rate as well as the confidence intervals are characterised by an increasing trend from 1995 to 2007, followed by a drop after the global financial crisis and the great recession of 2009. After that savings rates have improved. When we analyse the situation of increasing savings rates and decreasing real interest rates in a loanable funds model, we can infer that an increase in desired savings is necessary to reach the new equilibrium with a lower interest rate and a higher savings rate. While the data gives an indication that desired savings have increased as

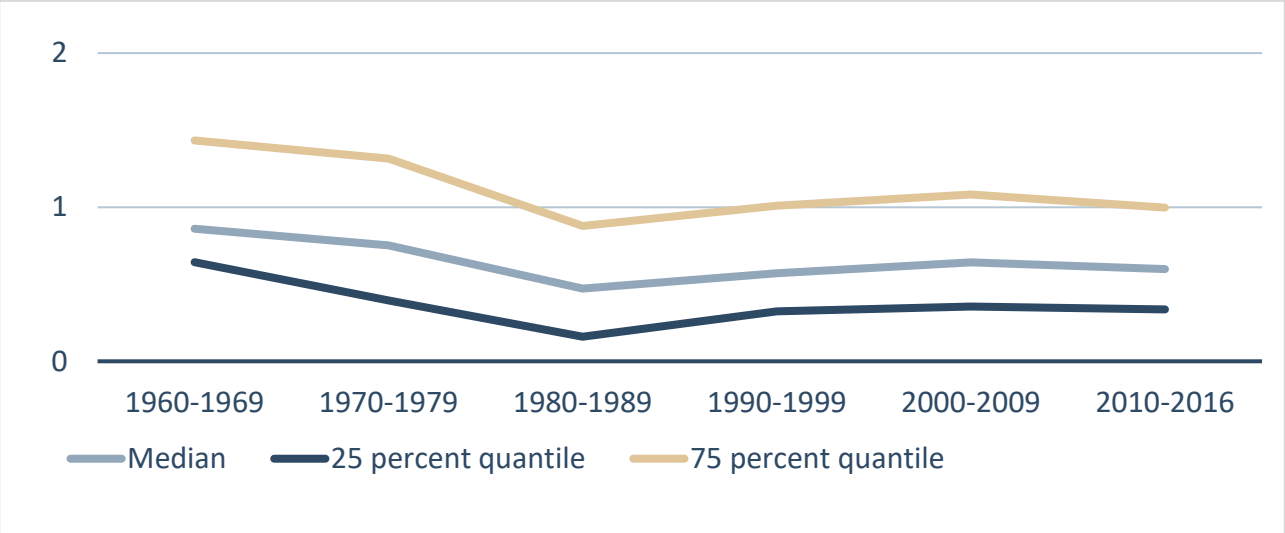
implied by the global savings glut hypothesis, a more detailed analysis is necessary to understand the drivers of the growth of desired savings.

3.1 Population growth

Population growth could shift the capital supply curve to the right, because a larger population is accumulating more savings for any given real interest rate. However, population growth has declined in industrialised countries. While the median yearly growth rate was 0.75 percent in the 1960s, the population growth rate has declined to 0.60 percent in the years since 2010. On the one hand, the declining population growth slows down the growth in aggregate savings; on the other hand, it also slows down the growth of aggregate income with a theoretically undetermined effect on the savings rate.

Figure 3-2: Population growth

In percent per year, 24 OECD countries



Sources: OECD, own calculations

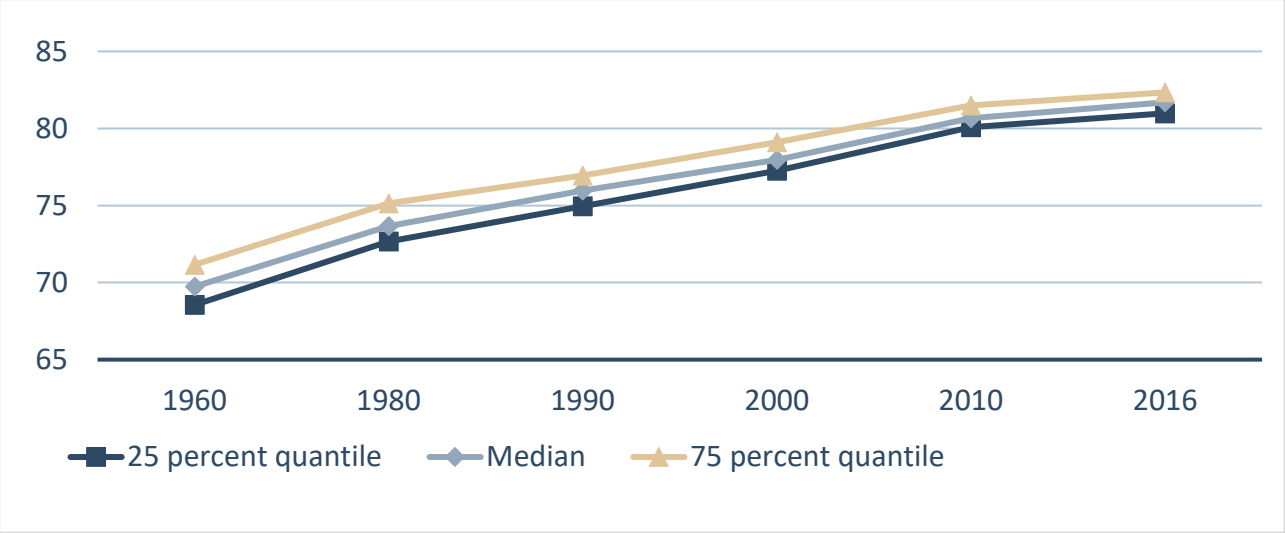
3.2 Ageing of society

One potential driver of an increase in desired savings could be the ageing of society (Bean et al., 2015). If life expectancy increases while the retirement age stays more or less constant, people have to save more during their working life in order to maintain their old-age consumption levels.

Data on life expectancy clearly shows that life expectancy has increased by 10 years between the 1960s and now (Figure 3-2). However, the higher life expectancy does not necessarily imply that aggregate savings are higher, because there can also be a composition effect. Even if younger and middle-aged households have higher savings rates compared to older households, a majority of older households in the population would imply a lower aggregate savings rate due to ageing. In order to get more insight into the composition effect, an analysis of the composition of the different cohorts is necessary.

Figure 3-3: Life expectancy

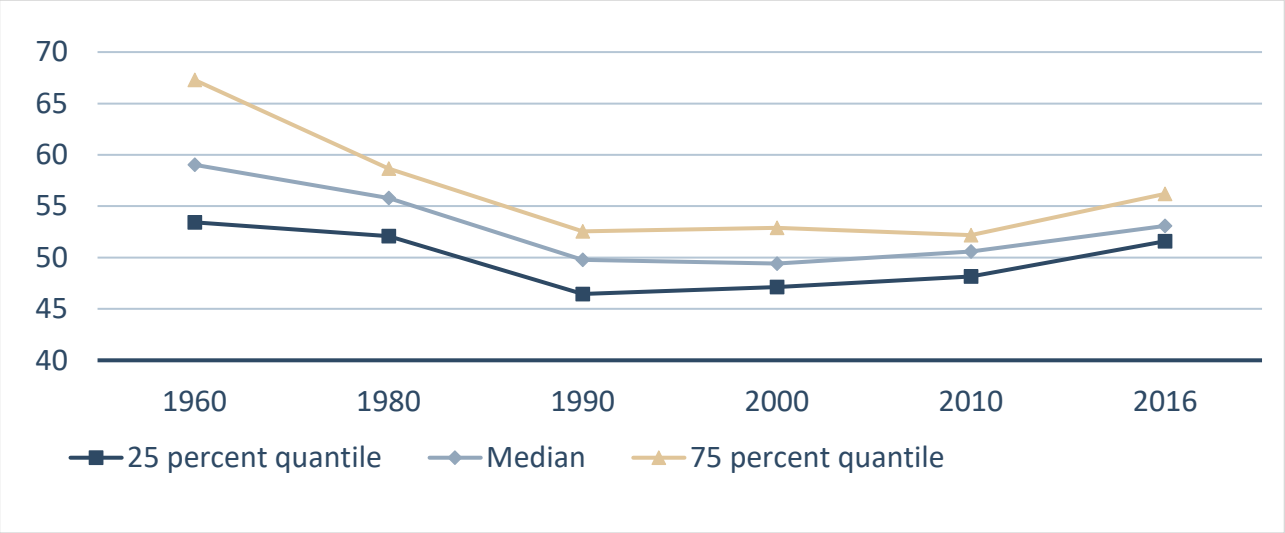
In years, 24 OECD countries



Sources: World Bank, own calculations

Figure 3-4: Age dependency ratio

Age dependency ratio is the ratio of dependents – people younger than 15 or older than 64 – to the working-age population – between the ages 15-64. Data is shown as the proportion of dependents per 100 of the working-age population, 24 OECD countries



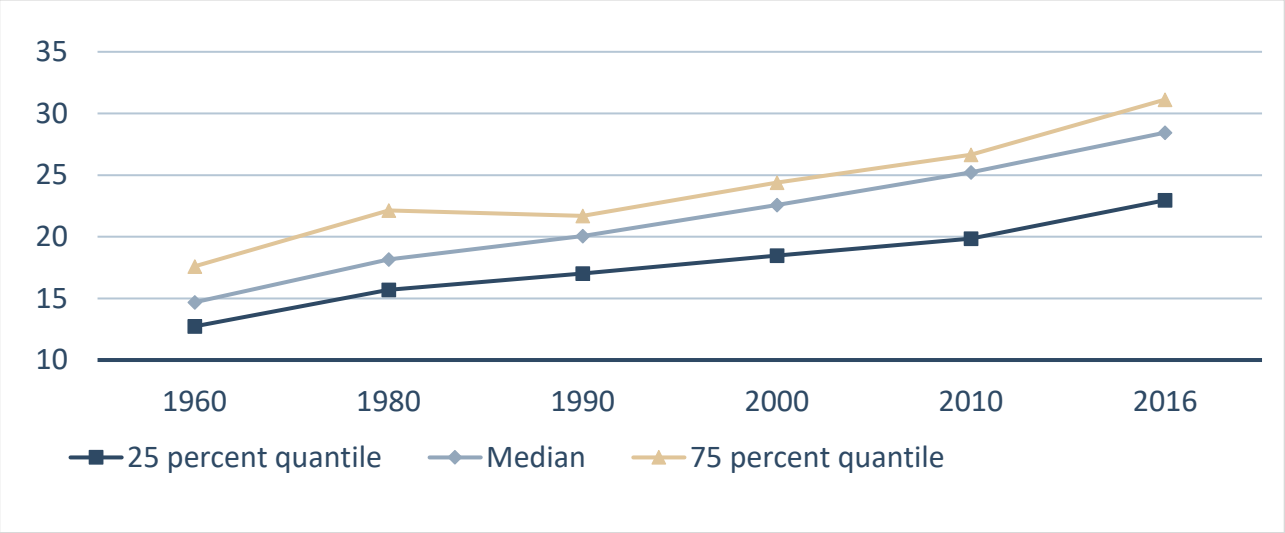
Sources: World Bank, own calculations

The change in the age dependency ratio gives some indication about the change in the composition of the population. The ratio is defined as the number of people younger than 15 and older than 64 divided by the number of persons in the working-age population. While there were around 60 dependents for every 100 workforce members in 1960, the ratio had fallen to around 53 in 2016. This fall is mainly due to the fact that the baby-boomers, people who were born between 1940 and 1965, entered the workforce. From 1990 to 2010, the age dependency ratio stayed more or less constant, while it increased from 2010 to 2016, in part because the first

baby boomers started retiring. Because the members of the workforce have on average higher incomes and thus higher savings rates compared to the dependents, the entry of the baby boomers into the workforce could have contributed to the increase in desired savings. The retirement of the baby boomers could, on the other hand, reduce the aggregate savings rate, because of the composition effect or because the baby boomers start to dissave (Abel, 2001).

Figure 3-5: Old-age dependency ratio

Old-age dependency ratio is the ratio of older dependents – people older than 64 – to the working-age population – those between the ages 15-64. Data is shown as the proportion of dependents per 100 of the working-age population, 24 OECD countries



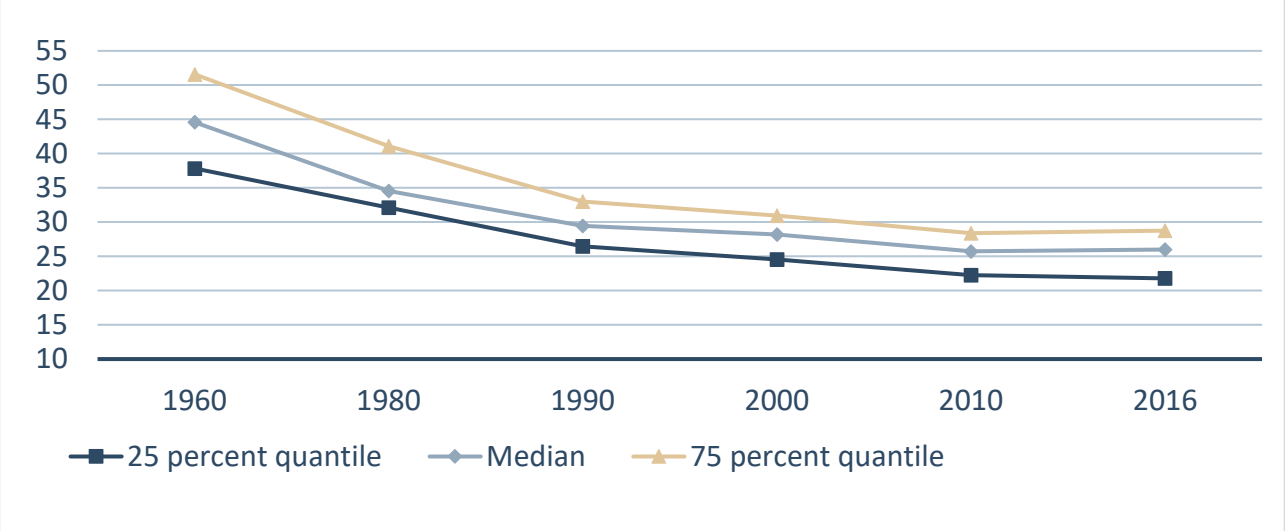
Sources: World Bank, own calculations

More insights can be gained from an analysis of the old-age dependency ratio. This ratio is defined as the number of people older than 64 divided by the working-age population. This ratio has increased since 1960, indicating a steady ageing of society. The impact of ageing on the aggregate savings rate could be twofold. On the one hand, retirees have on average lower savings rates compared to the working-age population, so ageing will reduce the aggregate savings rate. On the other hand, the working population will increase their savings if they anticipate a higher life expectancy.

In contrast to this, the young-age dependency ratio indicates a steady decline, indicating that fewer children were born. Fewer children can be seen as a forecast of a shrinking future workforce. At the moment, the effect of fewer children in the population means that there are fewer persons with low savings rates, which will lead to an increase in the economy-wide savings rate.

Figure 3-6: Young-age dependency ratio

Young-age dependency ratio is the ratio of younger dependents – people younger than 15 – to the working-age population – those aged between 15 and 64. Data is shown as the proportion of dependents per 100 of the working-age population, 24 OECD countries



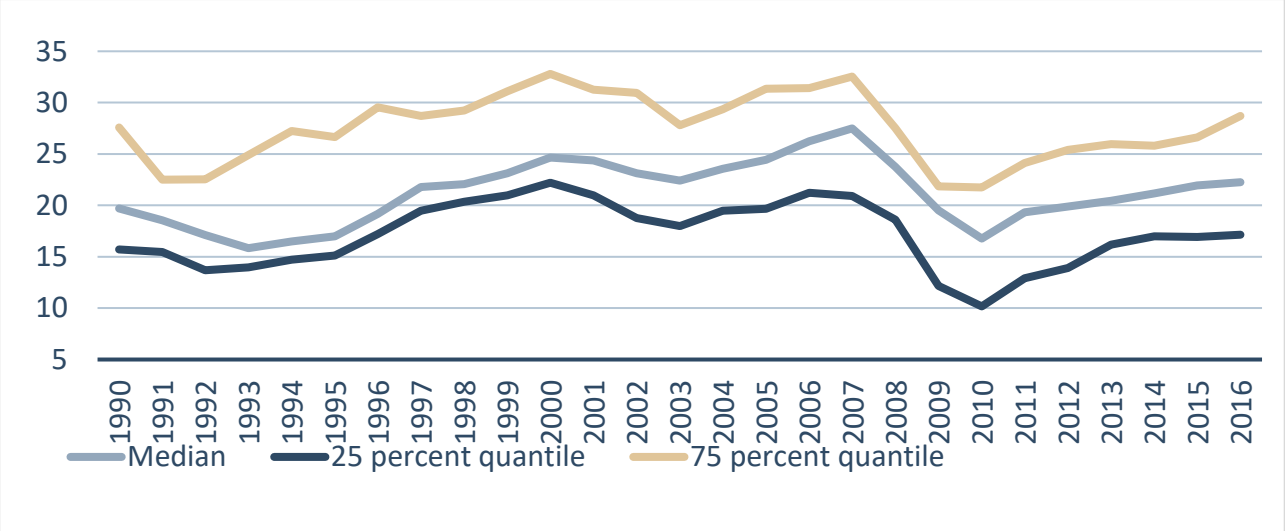
Sources: World Bank, own calculations

4 Has desired investment fallen?

A decline in desired investment, as indicated by the secular stagnation hypothesis, leads according to the loanable funds model to a decline in equilibrium real interest rates and a decline in equilibrium investment at the same time.

Figure 4-1: Investment rates

In percent of gross domestic product, 24 OECD countries



Sources: OECD, own calculations

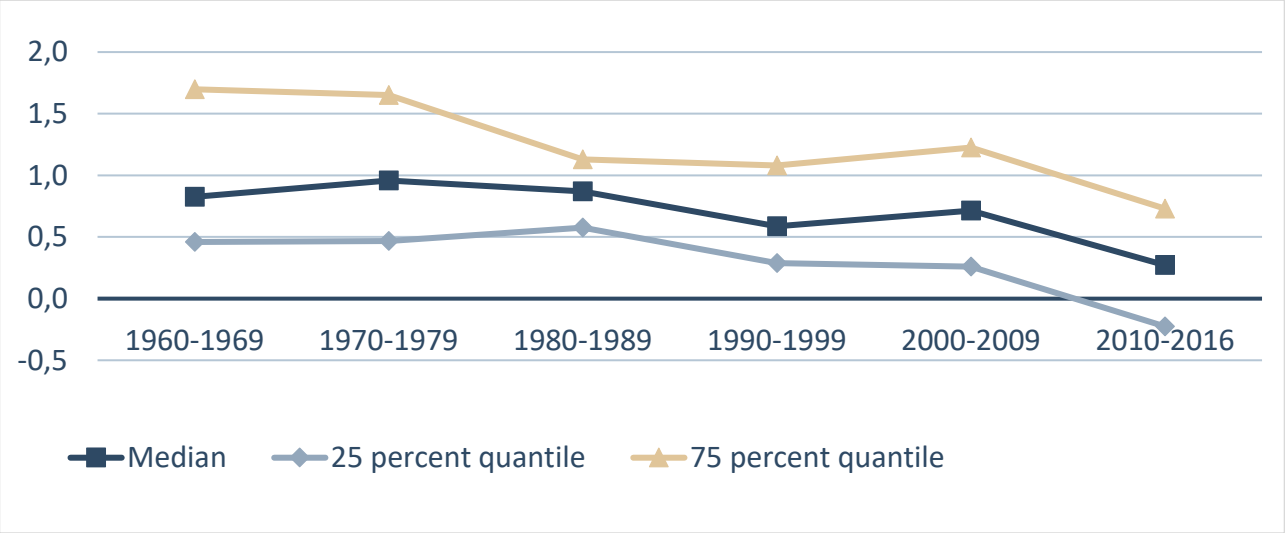
Investment rates have increased from 1990 to 2007, which at first sight contradicts the hypothesis that the decline in real rates was due a decline in desired investment. However, the aggregate investment rate is determined by supply and demand for capital. In the loanable funds model, a decline in real interest rates and an increase in the investment rate can happen if desired savings increase and desired investment declines. The reason is that the decline in desired investment is counteracted by a larger supply of funds and lower interest rates, which will promote additional investment as indicated in the data. To understand the dynamics of the investment rate, one has to take a closer look at its determinants: the growth rate of the workforce, public investment and the growing relevance of intangible assets.

4.1 Growth rate of the workforce

One factor that could have contributed to the fall in desired investment could be the slowdown in the growth rate of the workforce (Bean et al., 2015). While the labour force grew by 1 percent per year during the period 1970-1979, its growth rate slowed to 0.3 percent per year during the period 2010-2016 (Figure 4-2). Under a constant capital-labour-ratio, a slowdown in the growth of the labour force translates into a slowdown in the growth of the capital stock, i.e. less investment is needed to maintain the growth rate of the capital stock.

Figure 4-2: Growth rate of the working-age population

In percent per year, 24 OECD countries



Sources: World Bank, own calculations

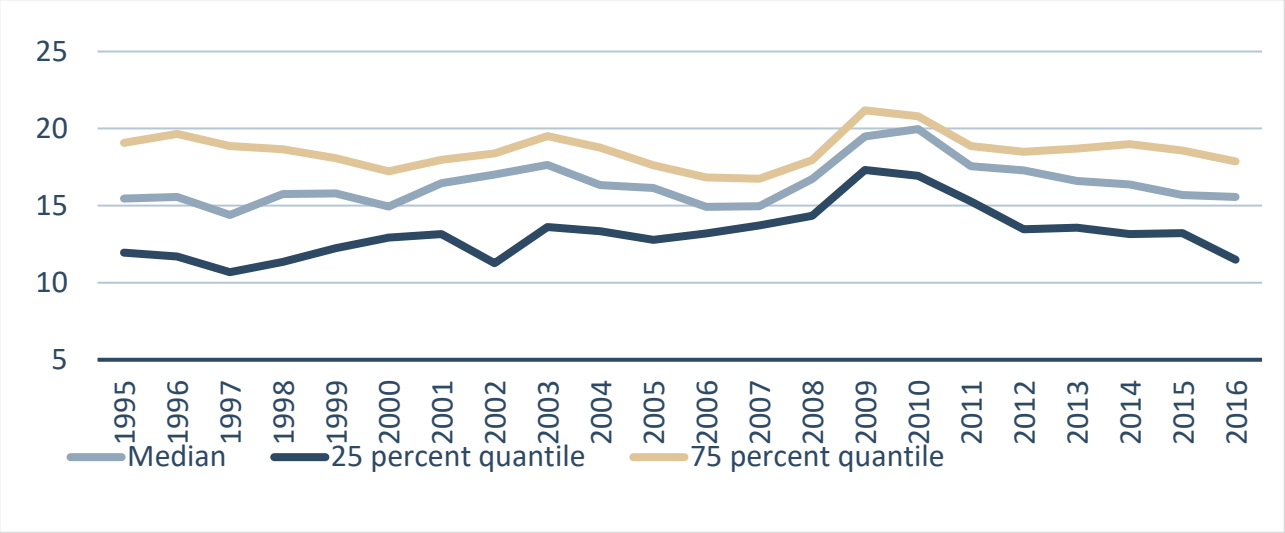
4.2 Public investment

Another factor that could have contributed to the decline in the propensity to invest is the decline in the public investment rate (Figure 4-3), because public investment is in part complementary to private investment. Specifically, infrastructure investments have decreased in recent years, as for example the European Commission highlights (see Fransen et. al., 2018). A central reason for this drop in investment rates are high levels of sovereign debt, which require a consolidation of budgets. However, as the world economy is growing at a higher pace

and tax revenues are increasing too, an increase of public investments could be likely in the future.

Figure 4-3: Public investment rate

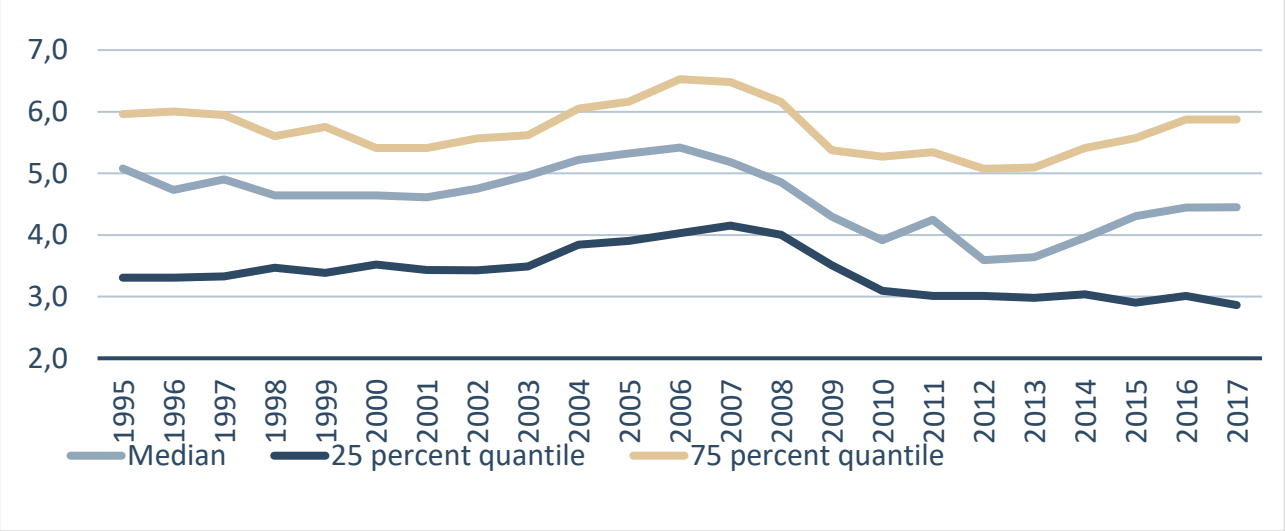
In percent of gross fixed capital formation, 24 OECD countries



Sources: OECD, own calculations

Figure 4-4: Investments in dwellings

In percent of gross domestic product, 24 OECD countries



Sources: OECD, own calculations

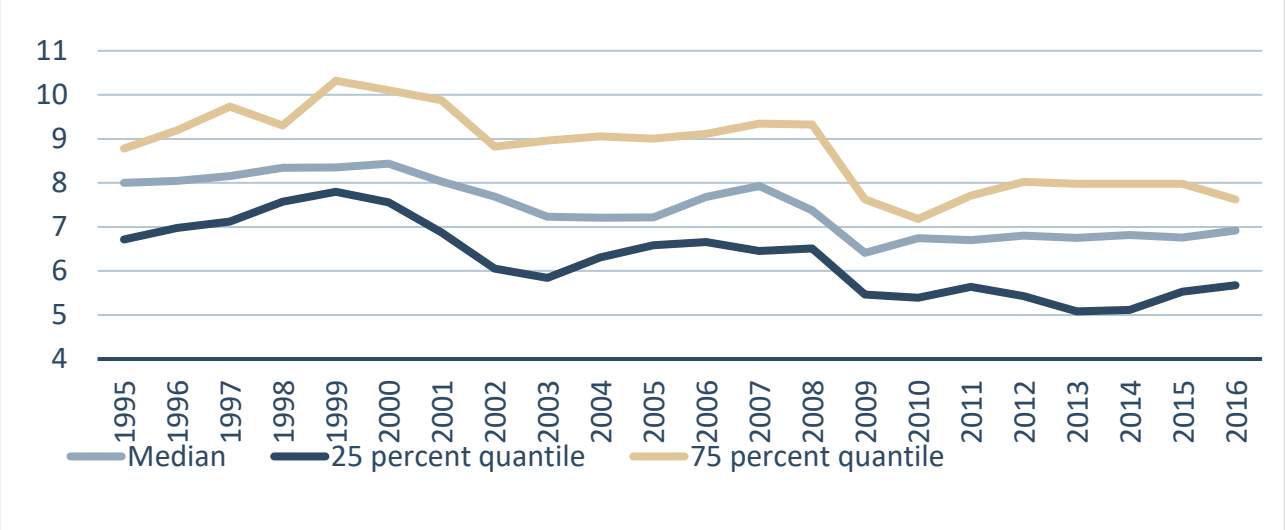
4.3 Intangible assets

The digitalisation of the economy increases the relevance of intangible assets such as data and licenses. Internet companies, such as Google or Facebook, have high stock market valuations. These companies predominantly invest in intangible assets, which are less costly than physical

assets, like buildings and machinery (Glaeser, 2014). The relevance of intangible assets has also risen for the whole business sector, while the relevance of tangible assets seems to have fallen. For example, investment in dwellings fluctuated around 5 percent of GDP from 1995 to 2007; it then experienced a drop during the global financial crisis and only a small rebound (Figure 4-4).

Figure 4-5: Investments in machinery and equipment

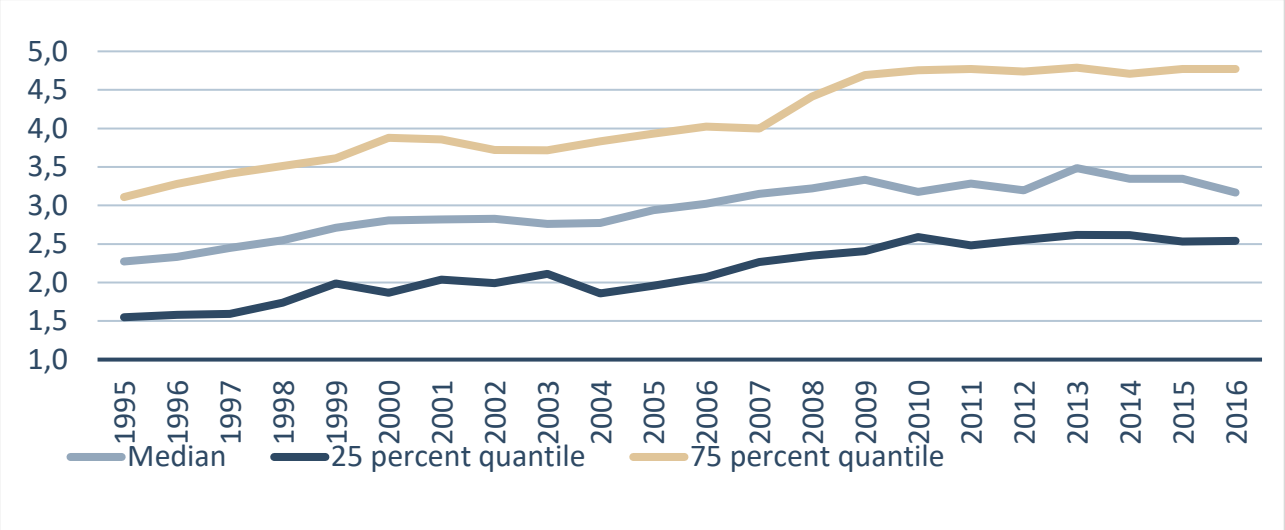
In percent of gross domestic product, 24 OECD countries



Sources: OECD, own calculations

Figure 4-6: Investments in intellectual property

In percent of gross domestic product, 24 OECD countries



Sources: OECD, own calculations

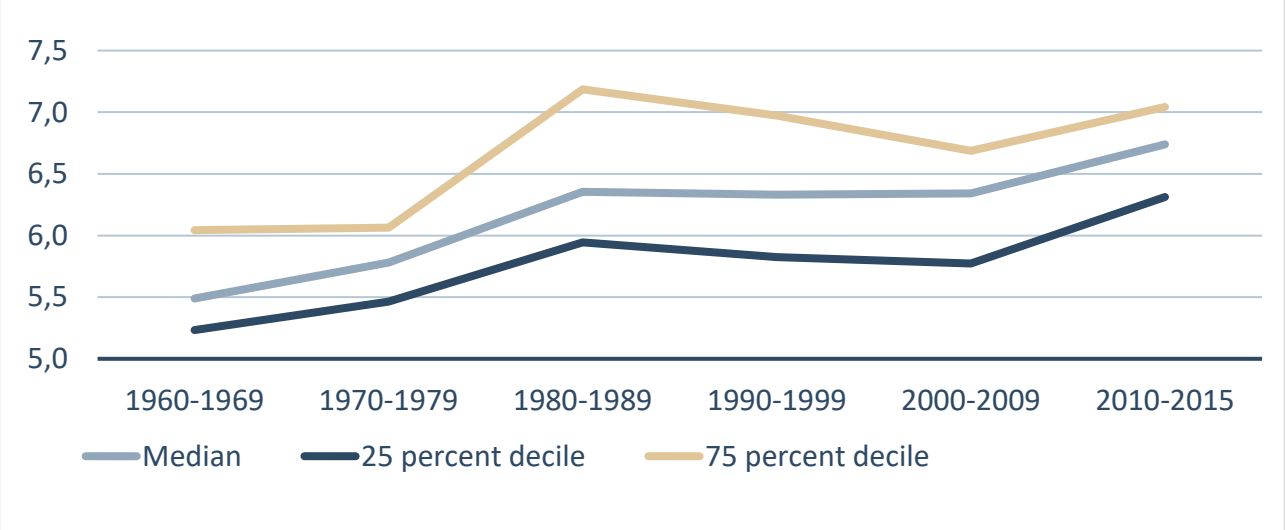
A larger decline can be found in investments in machinery and equipment (Figure 4-5). Investment rates dropped from 8 percent of GDP to 7 percent of GDP, and it seems that investments in these tangible assets will plateau at this level for the moment.

In contrast to tangible assets, investments in intangible assets are characterised by a steady upward trend (Figure 4-6). Investments in intellectual property increased from 2.3 percent of GDP in 1995 to 3.2 percent of GDP in 2016. These investments are different from the classical investment goods, since the funds needed to finance the investments are smaller and they are financed by different financial instruments. While tangible assets can be used as collateral for a bank loan, intangible assets cannot (Cecchetti/Schoenholtz, 2018). This is one reason why intangible assets are mostly financed by cashflows, which can be seen from the investment and financing behaviour of Internet companies.

Because companies invest to a larger degree in intangible assets and because these intangible assets are able to generate profits for the companies, the savings rates of the corporate sectors have increased, while business investment has fallen.

Figure 4-7: Average age of equipment capital stock

In years, 24 OECD countries



Sources: OECD, own calculations

4.4 Age of capital stock

The age of capital stock could be an indicator for future investment. If capital stock is old on average, replacements of capital goods are more likely compared to a situation with young capital stock.

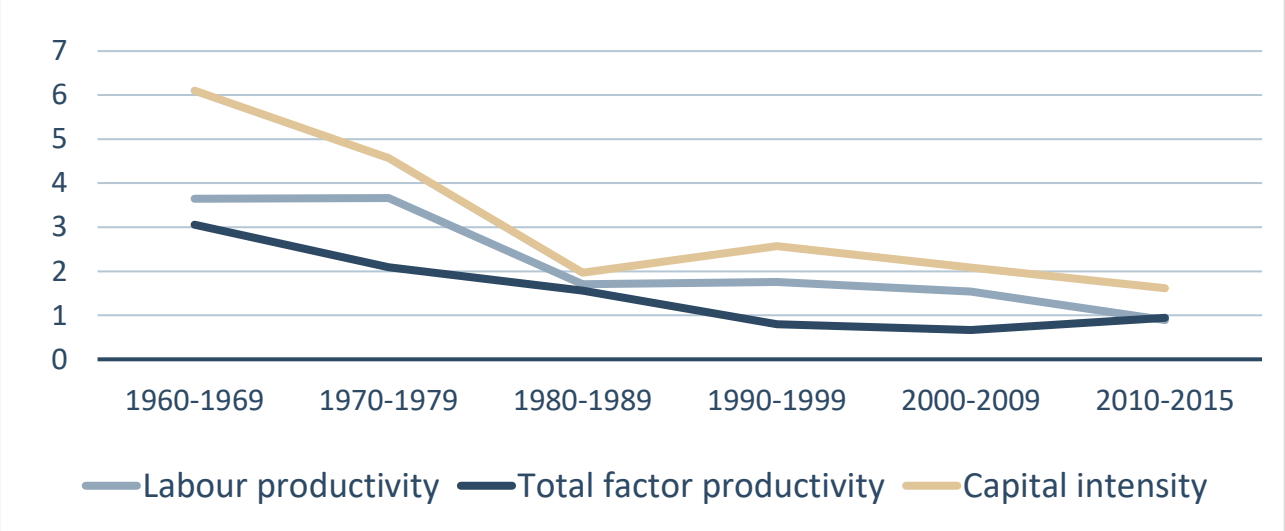
The average age of equipment capital stock has risen from 5.5 years in the 1960s to 6.7 years at present (Figure 4-7). The increase of the age of capital stock can be due to maintenance investments being needed less often, which could have contributed to the decline in desired investment.

5 Have productivity and capital intensity fallen?

The growth rates of labour productivity, capital intensity and total factor productivity have slowed down (Figure 5-1). Capital intensity grew by 4.6 percent annually in the 1960s, while its growth rate has decreased to 1.6 percent at present. These trends could be due to the growing relevance of the service sector. A similar decline can be seen for labour productivity, which declined from 3.7 percent to 0.9 percent, or total factor productivity, which declined from 3.1 percent to 0.9 percent. Rachel and Smith (2015), Fischer (2016, 2017), and Yi and Zhang (2017) see these developments as causal for the decline in real interest rates.

Figure 5-1: Productivity and capital intensity

In percent per year, 24 OECD countries

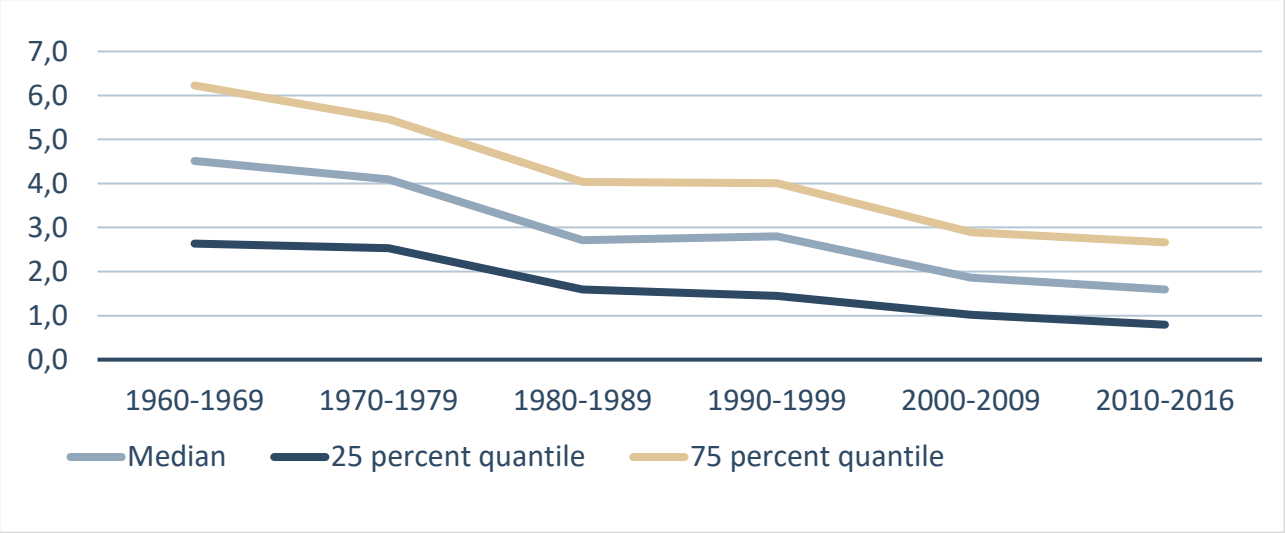


Sources: Long-Term Productivity Database, own calculations

The growth rate of GDP has declined from the median value of 4.1 percent per year in the 1960s to 1.6 percent annually in the years after 2010 (Figure 5-2). The decline in GDP is in part due to the fact that the industrial economies are maturing and there is a lack of catch-up effects. A smaller growth of GDP also translates into a lower real interest rates, because it signals either fewer investment opportunities or lower future income prospects, to which households respond by increasing their old-age provisions. The safe asset shortage hypothesis sees a growing gap between the supply of safe assets and the demand for safe assets. One reason for the shortage is that the growth rates of the advanced economies, which are major issuers of safe assets, were lower compared to the high growth rates of high-saving emerging economies such as China (Caballero/Farhi, 2014).

Figure 5-2: Growth rate of gross domestic product

In percent, 24 OECD countries



Sources: World Bank, own calculations

6 Econometric analysis

In the loanable funds model, the real interest rate, investment and savings are jointly determined through the intersection of capital demand and capital supply. While additional capital demand leads to an increase in the equilibrium real interest rate as well as in equilibrium investment and savings, an increase in capital supply causes the interest rate to fall, while savings and investment increase. Therefore, we estimated three equations: one for the real interest rate, one for savings and one for investment. After we have interpreted the coefficients and determined the plausibility of the models, we use them to determine interest rate misalignments and to forecast future real interest rates.

The panel dataset ranges from 1990 to 2016 and covers 24 OECD countries. The time series are the long-term real interest rate, savings and investment in percent of GDP, population growth, the growth rate of the labour force, the growth rate of GDP, life expectancy, the young age and the old age dependency ratios, the public deficit and the net capital outflow. A second dataset with data on the age of capital stock, labour productivity and total factor productivity, and capital intensity is also available for the years 1990 to 2015, but only for 18 OECD countries.

Some data, like the savings rate and the investment rate, is evolving very smoothly. Thus, unit roots in the data generating process could be a problem for estimation. However, both rates are constrained between zero and 100 percent, while a unit root process is defined as a process with a linear growing variance, i.e. that the process tends to plus or minus infinity. Unit roots in the data are therefore merely a small sample property.

6.1 Estimation results

Table 6-1 contains the estimated relationships for the real interest rate, savings and investment and their determinants calculated by the first dataset. For the savings function, we do not find a statistically significant relationship with the real interest rate, while we find a negative and statistically significant relationship between investment and the real interest rate. Thus, while lower interest rates do not cause savings to fall, they lead to a higher investment. One reason for the missing interest rate sensitivity of savings might be that for households' intertemporal consumption decision-making, the rate of return is less important compared to the growth of their income as measured by GDP growth here, which seems to be the major determinant of savings. In contrast to this, investment decisions seem to be more interest rate sensitive, since the successful implementation of investments depends on the financing conditions.

Table 6-1: Estimated regression models

Regression coefficients, t-statistics in parenthesis, * / ** indicates statistical significance on the 5 percent / 1 percent level.

Coefficient	Real rate	Savings	Investment
Country fixed-effects			
Real rate		-0.020 (-0.28)	-0.172** (-5.47)
Net capital outflow	0.214** (7.12)		0.722** (29.51)
Public deficit	-0.066* (-2.00)		1.141** (44.21)
GDP growth	-0.078 (-1,90)	0.775** (10.70)	0.175** (5.36)
Life expectancy	-1.036** (-11.13)	0.187 (0.99)	-0.291** (-3.65)
Labour force growth	-0.469** (-3.23)	1.302** (4.88)	0.462** (4.02)
Age dependency old	0.031 (0.62)	-0.089 (-0.97)	-0.280** (-7.19)
Age dependency young	-0.485** (-9.12)	-0.197 (-1.88)	-0.333** (-7.51)
Goodness-of-fit	0.625	0.969	0.995
F-statistic	35.89**	668.3**	3646**
Observations	648	648	648

Sources: Own calculations based on OECD, World Bank

We included the net capital outflow as a regressor, because all countries in the sample are open economies. In the loanable funds model, an increase in the net capital outflow, i.e. in the difference between domestic capital invested abroad and foreign capital invested in the domestic economy, leads to an increase in domestic capital demand. Because domestic funds are needed to finance investments abroad, the real interest rate should increase in theory. In the regression model, we find a positive and statistically significant coefficient for the net capital outflow. An increase in the ratio of net capital outflow to gross domestic product by one percentage point increases the real interest rate on average by 0.214 percentage points.

We did not include the net capital outflow in the savings function, because it is already part of the economy's savings. For the investment function, we find a positive and statistically significant relationship between the net capital outflow and investment, indicating that the investment of funds abroad also leads to investments in the domestic economy. This complementarity can be due to required investments in the domestic headquarters of firms that are investing abroad.

Within the loanable funds model, a public deficit leads to a higher real interest rate and a crowding out of private investment. However, in the regression models, we find a negative and statistically significant relationship between the public deficit and the real interest rate. Moreover, we find a positive and statistically significant relationship between the public deficit and private investment. This positive relationship is in contrast to the loanable funds model's predictions and it may be due to complementarities between public and private investment not covered in the model. Public investment in public infrastructure, like broadband internet, enables private companies to increase their investment, which can rationalise the positive coefficient. The complementarities between public and private investment are emphasized in the discussion about secular stagnation, so the regression model results support the secular stagnation hypothesis.

In a growing economy, the increasing incomes enable higher savings, while companies are more confident in their investment decisions if the economy is performing. Therefore, we expect a positive relationship between the growth rate of gross domestic product with savings and investment, while the effect of the growth of gross domestic product on savings and investment determines whether the effect on the real interest rate is positive or negative. If investment grows stronger than savings, the effect on the real interest rate is positive, while it is negative if savings increase more than investment. In the regression models, we find for savings as well as for investment positive and statistically significant coefficients, with a higher coefficient for savings. While one percentage point additional GDP growth leads to an increase in the investment rate by 0.175 percentage points, it leads to an increase in the savings rate by 0.775 percentage points. The effect of economic growth on the real interest rate is not statistically significant.

An increase in life expectancy leads to a longer expected retirement period, if the retirement age stays the same. For all the OECD countries, we find that the retirement age stayed constant, while life expectancy increased. If households have a high preference to maintain the level of their old-age consumption, they should save more in response to increasing life expectancy. If

this increases capital supply, but not capital demand, the real interest rate should fall as a response to the higher life expectancy. We find a negative and statistically significant coefficient for the real interest rate as implied by this hypothesis. Every additional year of life expectancy decreases the real interest rate by 1.036 percentage points. Although this effect seems to be very high, one can see in the data that life expectancy increased by 5.7 years from 1990 to 2016, while the real interest rate fell by 4.1 percentage points. Thus, during this time span the real interest rate fell by 0.72 percentage points for each year of additional life expectancy, which is in line with the size of the coefficient in the regression model. We also find a positive coefficient for savings. However, the estimate is not statistically significant. Nonetheless, we find that a higher life expectancy leads to lower investment. The coefficient is negative and statistically significant. The negative coefficient might be due to a third factor. As economies mature, the life expectancy of their citizens increases due to progress in medicine. At the same time investment decreases, because of diminishing catch-up effects. This coincidence could lead to the statistically significant coefficient in the regression model, although there is no causality running from life expectancy to investment.

The growth rate of the labour force should be positively linked to savings and investment, because a higher growth rate of the labour force indicates a stronger economy. While the higher incomes cause additional savings, companies are more in favour of investment decisions if the economy is strong. The effect on the real interest rate depends on the reaction of savings and investment. When savings increase more than investment, the real interest rate falls. The estimated regression models indicate a negative coefficient for the real interest rate and positive coefficients for savings and investment. All coefficients are statistically significant. Moreover, the effect on savings is higher than the effect on investment. While an additional percentage point of growth in the labour force causes the savings rate to increase by 1.302 percentage points and the investment rate by 0.462 percentage points, it causes the real interest rate to fall by 0.469 percentage points.

The old age dependency ratio and the young age dependency ratio describe the composition of young and old people in relation to the labour force. Since young and old people have lower savings rates than the labour force, a smaller dependency ratio means a higher savings rate. The baby boomers have contributed to the fall in the dependency ratios and thereby to the increase in the savings rates. The effect of the retirement of the baby boomers depends on how much they reduce their savings rates. We find negative and statistically significant effects of the two dependency ratios on investment. Moreover, the effect of the dependency ratios on the real interest rates is negative, but only statistically significant for the young age dependency ratio. Thus, when the ratio of young people to the labour force decreases by one percentage point, real interest rates rise by 0.485 percentage points.

The goodness of fit measure is very high in this model, indicating possible multicollinearity between the regressors. If there is multicollinearity, regressors should be insignificant while the goodness of fit measure should be high. In our regression model, the coefficients are significant, which does not support multicollinearity. In fact, the high goodness of fit measure in the regression model is due to the fixed effects in the model. If the model is estimated without fixed ef-

fects, i.e. as a pooled regression, the goodness of fit measure falls significantly. Moreover, multicollinearity would not be a problem here, because we are less interested in identifying causal relationships, but more interested in forecasting interest rates with all the available information in order to determine whether the evolution of real interest rates is driven by a persistent cycle or by a longer-term trend.

Table 6-2: Estimated regression models

Regression coefficients, t-statistics in parenthesis, * / ** indicates statistical significance on the 5 percent / 1 percent level.

Coefficient	Real rate	Savings	Investment
Country fixed-effects			
Real rate		-0.022 (-0.28)	-0.441** (-8.29)
Total factor productivity	0.043 (1.77)	-0.561 (-0.72)	-2.837** (-10.36)
Capital intensity	0.006* (0.77)	-0.125** (5.43)	-0.072** (-8.96)
Age of capital stock	-0.010 (-0.81)	-0.682 (-1.71)	0.172 (1.23)
GDP per capita	-0.0004 (-7.07)	0.0006** (3.36)	0.0007** (10.95)
Life expectancy	-0.089 (-0.75)	0.506 (1.34)	-0.105 (-0.79)
Labour force growth	-0.350* (-2.19)	1.352** (2.63)	0.445** (2.48)
Age dependency old	-0.139** (-3.74)	0.141 (1.17)	-0.210** (-4.98)
Age dependency young	-0.126* (-2.26)	0.578** (-3.23)	0.024 (0.38)
Goodness-of-fit	0.885	0.969	0.996
F-statistic	138.8**	534.4**	4513**
Observations	468	468	468

Sources: Own calculations based on Bergeaud/Cette/Leat (2016), OECD, World Bank

The second set of regression models contains additional variables, like total factor productivity, the age of capital stock, capital intensity or per capita GDP, in order to explain real interest rates, savings and investment. The results are reported in Table 6-2. The shortcoming of this data is that it covers fewer countries.

In contrast to Rachel and Smith (2015), Fischer (2016, 2017), and Yi and Zhang (2017), we do not find that the slowdown of productivity has contributed to lower interest rates. In the regression model, the coefficient that ties total factor productivity to the real interest rate is not statistically significant. The same result applies when we use labour productivity instead. However, we find that the growth in total factor productivity is associated with a decline in the investment rate, while it does not show any statistically significant effect on savings. The negative effect between the investment rate and total factor productivity is surprising, because technological progress should normally lead to more profitable investment opportunities.

When production becomes less capital-intensive, investment rates should decline. We find a negative and statistically significant coefficient here. Moreover, we find a negative and statistically significant effect on savings as well. Although we would have expected a negative effect on real interest rates, we find a positive and statistically significant coefficient here. The reason might be that a change from capital-intensive investment to intangible investments changes the financing of these investments. Because capital-intensive investment could be used as collateral, intangible assets could not be used as collateral, so banks would demand a higher risk premium.

The age of capital stock could be a factor behind a decline in investment. However, we do not find that the age of capital stock has any statistically significant effect on real interest rates, savings and investment.

Per capita GDP is associated with higher incomes that will enable higher savings. Moreover, the level of GDP should be related to the level of investment, because companies will predominantly invest when the economy is strong. For both savings and investment, we find a positive and statistically significant coefficient here. However, we do not find any statistically significant effect of per capita GDP on the real interest rate. One reason might be that the level of per capita GDP is higher for mature economies, while the interest rate is lower because of the lower investment demand of mature economies.

In this regression model, life expectancy is not related to the real interest rate, savings and investment. In contrast to the regression models of Table 5-1, all three coefficients are not statistically significant.

The growth rate of the labour force should have a positive effect on savings and investment. In the regression models, we can find positive and statistically significant effects of the growth rate of the labour force on savings and investment. The fact that the effect is stronger on savings than on investment contributes to a decline in real interest rates. The coefficient in the regression model for the real interest rate is negative and statistically significant.

For the old-age dependency ratio and the young-age dependency ratio, we find negative and statistically significant coefficients in the regression model for the real interest rate. The reason for this can be that young and old people have lower savings rates than the labour force. However, we do not find a positive and statistically significant effect of these two variables on savings.

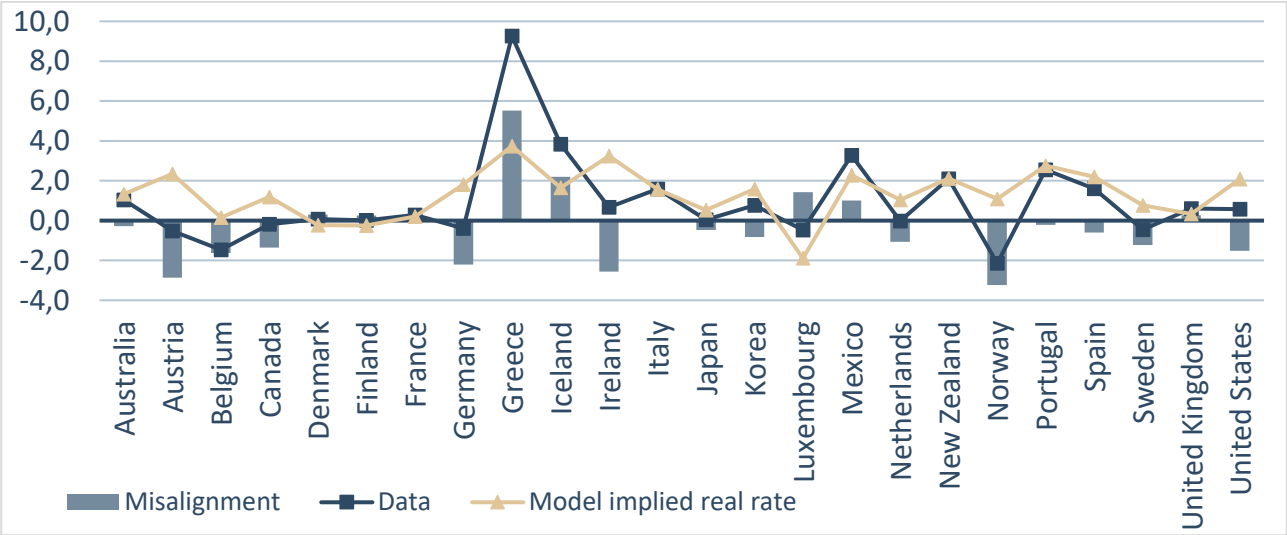
6.2 Interest rate misalignments

The regression model for the real interest rate can be used to calculate the real interest rate that is determined by economic fundamentals. This model-implied interest rate can then be compared to the data in order to detect misalignments. The detection of misalignments is important for our forecasting exercise, because the correction of the misalignment back to a trend could be confused with an interest rate cycle. We use model one for detecting these misalignments.

In Austria, Germany, Ireland and Norway, interest rates are more than two percentage points lower than indicated by the model (Figure 6-1). One reason may be the accommodative monetary policies in these countries. Although the United States are also characterized by excessively low interest rates compared to the model predictions, the misalignments are smaller, in part because the Federal Reserve Bank has already started its interest rate normalisation policy. The correction of the misalignment could mask a declining trend in real interest rates if the forecast horizon is too small. It can then be confused with a cyclical movement of interest rates. We therefore use the demographic variables, for which long-term forecasts are available for forecasting real interest rates by means of model 1.

Figure 6-1: Interest rate misalignments

Current interest rate level minus the interest rate level predicted by economic fundamentals, in percentage points



Sources: Own calculations based on World Bank

6.3 Forecasts

The regression model for real interest rates can be used to make predictions about the future level of real interest rates. For the long-term net capital outflow, the public deficit and the growth rate of gross domestic product, we assume the latest available values for the forecasts, while we use the demographic forecasts by the OECD and the United Nations to forecast life expectancy, labour force growth and the change in the dependency ratios.

Table 6-3: Real interest rate forecasts

In percent

Country	2016	2025	2035	2050
Australia	1.0	0,4	0.2	-0.7
Austria	-0.5	1.3	-0.1	-1.6
Belgium	-1.5	-1.1	-1.9	-3.5
Canada	-0.2	-0.4	-1.0	-2.3
Denmark	0.1	-1,2	-3.3	-4.5
Finland	0.0	-1.3	-1.6	-2.2
France	0.3	-0.1	-0.4	-1.3
Germany	-0.4	1.3	0.5	0.0
Greece	9.3	3.6	3.5	1.3
Iceland	3.8	0.9	0.7	-0.3
Ireland	0.7	4.3	4.9	2.8
Italy	1.6	1.5	1.1	-1.0
Japan	0.1	1.2	2.0	1.6
Korea	0.8	1.6	1.1	1.2
Luxembourg	-0.5	-2.8	-4.2	-4.8
Mexico	3.3	3.7	4.1	3.7
Netherlands	-0.0	0.3	-1.3	-2.5
New Zealand	2.1	2.1	1.3	0.6
Norway	-2.1	0.4	-0.6	-1.3
Portugal	2.5	3.5	3.1	0.9
Spain	1.6	3.7	4.6	3.0
Sweden	-0.5	-0.7	-1.0	-2.3
United Kingdom	0.6	-1.0	-1.7	-3.5
United States	0.6	0.7	-0.4	-1.9

Source: Own calculations based on OECD, United Nations, World Bank

For Germany, we find a rebound from currently -0.4 percent to 1.3 percent by 2025 due to the elimination of the misalignment when the ECB starts to normalise its monetary policy. After the normalisation of this interest rate cycle, the negative trend in the real interest rates goes on, leading to a real interest rate of 0.5 percent in 2035 and a real interest rate of 0.0 percent in 2050 (table 6-3). This result stands in contrast to the hypothesis of a cyclical behaviour in real

interest rates and supports the hypothesis of a negative longer-term trend in real interest rates, as implied by the global savings glut hypothesis and the secular stagnation hypothesis.

Japan will experience an increase in interest rates from currently 0.1 percent to 1.2 percent in 2025 and to 2.0 percent in 2035. This effect is driven by the shrinking labour force in Japan. The shrinking labour force reduces savings more than investment, which causes an upward pressure on the interest rates. Moreover, the ageing of society as indicated by the old-age dependency ratio causes the savings rate to fall, which causes additional upward pressure in interest rates. The expected increase in the young-age dependency ratio, which has a negative effect on interest rates, causes the real interest rate to fall to 1.6 percent by 2050.

In the United States, real interest rates will increase from currently 0.6 percent to 0.7 percent in 2025. However, they will fall to -0.4 percent by 2035 and to -1.9 percent by 2050. Again, the results indicate a negative trend in real interest rates that dominates the evolution of interest rates even after monetary policy has normalised.

Negative real interest rates will be likely in many countries. However, the largest decline will materialise in Denmark and Luxembourg, where real interest rates will decline to -4.5 percent and -4.8 percent.

The results indicate a rebound of the real interest rate towards a longer lasting downward trend rather than a rebound of a persistent interest rate cycle.

7 Conclusions

The analysis indicates that the current low interest rate levels are not solely caused by the accommodative monetary policies of central banks, but are also the outcome of a longer-term downward trend. Although interest rates are currently lower than indicated by macroeconomic factors and, thus, are likely to increase when central banks start to toughen their monetary policies, in the long run real interest rates will decline predominantly because of demographic factors. This trend will be persistent, because demographic factors will presumably not alter.

However, it is likely that declining real interest rates will trigger additional investments in the medium-term or will induce adjustments in savings, so that the forecast cannot be interpreted as an exact prediction. The forecast describes more the expected trend in real interest rates conditional on demographic factors.

In general, lower interest rates are not bad news for countries and market participants. Interest rates are part of the financing costs of households, companies and governments, hence offering the possibility to lend at lower costs. Thus, low interest rates ease the financing of public and private investments and reduce burden on households, companies and governments, therefore offering more leeway for improving infrastructure and individual lives.

However, adjustments are necessary given these prospects. For instance, policy-makers are well-advised to adjust pension systems to cope with lower interest rate levels. Pension systems often favour fixed-income assets as these are perceived to be less risky compared to stocks and real estate. However, with yields tending to zero, this advantage vanishes. Therefore, it would be better to allow for a broader diversification of assets. Anglo-Saxon countries are thus better prepared for even lower interest rates as their pension systems already allow for greater diversification. In addition, postponing retirement ages would help to reduce the necessity to save even more money to secure old-age living standards.

Low interest rate levels also have an impact on the financial system, specifically on banks. Business models relying on the margin between lending rates and borrowing rates will turn out to be less profitable with interest rates tending to zero. Thus, new business models are necessary, for instance models that focus on fees. Furthermore, the regulatory privileges for sovereign bonds in banking regulation will turn out to be costly for banks if this asset class is trending to even lower or even negative yields.

Adjustments are also necessary in monetary policy. As interest rates are close to zero or even negative, classical monetary policy faces limits. Therefore, alternative measures – like quantitative easing – will become more common. The current monetary policy, consequently, will not be an exception but rather the forerunner of a change in monetary policy.

The change in interest rates will affect more institutions and policy areas. Market participants are thus well-advised to review the impacts of falling real interest rates on their business models and to take precautions for the future.

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