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Fakultät
Faculty of Economics and
Management Science

Working Paper, No. 159

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The Low Interest Policy and the Household Saving Behavior in Japan

März 2019

ISSN 1437-9384

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Abstract

This paper scrutinizes the role of prolonged, expansionary monetary policy on the savings behavior of Japanese households, focusing on the dramatic change of the household savings behavior since 1998, from high to low savings. Existing literature generally attributes this behavioral change to the country's shift from a high-growth to a low-growth economy and its demographic change. In contrast, this paper empirically examines changes in the incentives for saving and the ability to save connected to monetary policy. It finds that monetary policy has had a significant impact on Japan's household behavior via three channels: the interest rate channel, the redistribution channel, and the wealth channel.

JEL-Code: E210, E520.

Keywords: Household saving, interest-rate elasticity of saving, Japanese household savings, Bank of Japan, low interest rate policy.

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1. Introduction

The Japanese household saving behavior has undergone a dramatic change over the past 60 years. Until 1975, Japanese household savings have been among the highest in the industrialized world, when households saved nearly one quarter of their disposable incomes (OECD, 2018). Since 1990, however, household savings have dropped significantly. In December 2014, net household savings as percent of GDP and of disposable income turned negative, reaching -0.2% and -0.4%, respectively. In 2017, Japanese household savings were amongst the lowest within the OECD, with 1.8% of GDP and 3.1% of disposable income.

Empirical research shows that the main determinants of the initially high household savings until the 1980s were Japan's rapid post-war economic growth, the subsequently increasing household incomes, and institutional factors (Komiya, 1966; Mizoguchi, 1970; Modigliani and Sterling, 1983; Hayashi, 1986). Moreover, owing to an under-developed social security and welfare system, young Japanese households saved for their retirement, instead of relying on institutional retirement benefits (Komiya, 1966; Hayashi, 1986). Tax alleviations (*maruyū*) also incentivized private precaution (Komiya, 1966; Horioka, 2009). As private credit provision was constrained, households relied on savings to increase current and future consumption (Modigliani and Sterling, 1983).

Since 1998, Japanese household savings as share of GDP and of disposable income have fallen significantly. To explain this phenomenon, the literature focuses on the country's aging society and the effect of such demographic change on the household saving behavior. As the large group of elderly households has begun dissaving, the aggregate household saving rate has started to decline (Koga, 2006; Horioka et al., 2007; Braun et al., 2007; Horioka, 2009; Sheng and Mu, 2012). Owing to demographic change, the mounting pressure on the sustainability of the country's social security system has aggravated the negative trend of household savings (Koga, 2006; Horioka, 2007, 2009; Saito, 2015).

The decline in Japanese household savings has come along with a fall of the main interest rate set by the Bank of Japan towards zero since 1998. Monetary policy makers admit that prolonged expansionary monetary policy, particularly a low nominal and real interest rate, may have a negative impact on savings (Cœuré, 2012; Mersch, 2014; Draghi, 2015). Cœuré (2012) stresses that an unexpected fall in the nominal interest rate and the simultaneous increase in inflation hurts savers, but benefits borrowers. Draghi (2015) is concerned that "very low rates

for a prolonged period might penalize savers to the benefit of debtors". Nevertheless, the literature has not yet explained the impact of prolonged expansionary monetary policy on the household saving behavior in a systematic way.

Therefore, this research aims to further scrutinize the role of prolonged, increasingly expansionary monetary policy on the savings behavior of Japanese households, including the impact of monetary policy on real incomes. In contribution to the existing literature, the paper distinguishes changes in the incentives for saving and the ability to save. On the one hand, low nominal and real interest rates are a disincentive for saving (interest rate channel). On the other hand, expansionary monetary policy influences real income negatively (labor income channel) and has potential distributional wealth effects, hampering the ability of many households to save (redistribution channel).

2. Theoretical determinants of household saving

Net household savings constitute that portion of the disposable income of households which is not used for final consumption, including the change in net equity of households in pension funds (OECD, 2018). Household saving behavior depends on a household's preference and ability to save. Theoretical models diverge with respect to the factors that alter both savings preference and ability, and hence determine changes in household savings.

2.1 Classical, Keynesian and neoclassical determinants of household saving

Classical economic theory postulates that households save a portion of their disposable income according to their preference for private profit – a gradual increase of income over time – and their time preference (Smith, 1789). In order to maximize their total profit, households save in time t in order to consume more in $t+1$. The main determinant of their saving behavior is the real interest rate. Given a rising real interest rate, the opportunity cost of current consumption rises and households save more (Smith, 1789; Ricardo, 1821). As household savings depend positively on the real interest rate it holds that

$$S = S(r), \qquad (1)$$

where S represents household savings, r represents the real rate of interest, and $\frac{\partial S}{\partial r} > 0$ so that S is an increasing function of r.

Keynesian economic theory suggests that a household's propensity to save depends on one or multiple saving motives. Keynes (1936) identifies eight motives, including the classical preference for private profit (*improvement motive*) and time preference (*intertemporal substitution motive*). Moreover, households safeguard themselves against expected labor income decreases after retirement (*life-cycle motive*), or unexpected future income losses (*precautionary motive*). They may strive for (financial) independence (*independence motive*) or participation in potential business projects (*enterprise motive*), leave bequests (*bequest motive*), or save out of greed (*avarice motive*). Keynes (1936) assumes that saving motives change only slowly so that the propensity to save is relatively stable over time.

Keynes (1936) suggests that a household's ability to save depends positively on the level of current disposable income. Thus, the impact of saving ability and saving motive on total household savings can be approximated by the linear relationship

$$S_t = a + bY_t + \varepsilon, \qquad (2)$$

where $a < 0$, $0 < \mathrm{b} < 1$, and ε is the residual. S_t represents the saving level in period t, and Y_t represents the disposable income in the same period. The negative intercept a indicates that households dissave when their level of disposable income is zero. The marginal propensity to save (b) represents a household's motivation to save, indicating that an increasing income corresponds to increasing household savings. The average propensity to save $(\frac{a}{Y_t} + b)$ indicates that household savings rise with the level of disposable income.

A household's preference for liquidity affects the way that households save (Keynes, 1936). Households with a high preference for liquidity hoard cash, those with a low preference deposit their savings at a bank. The liquidity preference depends on the degree of precaution and preference for private profit (Keynes, 1936). At times of great economic uncertainty, precautious households may have a high liquidity preference. At times of economic certainty, rising real interest rates encourage households to deposit their savings at a bank due to the interest profit. Thus, Keynes (1936) acknowledges that household savings also depend on the real rate of interest as households strive for private profit (*improvement motive*).

Neoclassical economic models treat household savings exogenously or endogenously. In the Solow growth model, households save a portion of their disposable income according to an exogenously imposed, fixed saving rate s (Solow, 1956 and 1957; Swan, 1956). Lacking a behavioral component to household savings, the model does not permit conclusions regarding

a household's savings motives and ability. Economic policies, such as tax policies, are the only possible determinant of s. If policy makers know that there is a saving rate s^* $(0 < s^* < 1)$ that maximizes steady-state consumption (golden rule savings), they may introduce tax incentives for household savings at s^* to maximize savings and investment.[1]

In neoclassical models that endogenize household savings, households face an intertemporal optimization problem. Households save to maximize their lifetime utility, subject to their constraints (Ramsey, 1928; Cass, 1965; Koopmans, 1965). Their savings preferences correspond to the life-cycle and permanent income hypotheses (Modigliani and Brumberg, 1954; Friedman, 1957). Both resemble Keynes' (1936) life-cycle motive of saving, according to which households bridge income differences over their life-cycles. In contrast to Keynes, however, the hypotheses postulate that households also consider their expected life-time income growth for their savings decisions.

When households know their point of retirement, they save according to their finite life-cycle so that consumption is stable, but not smooth (Modigliani and Brumberg, 1954). Assuming a constant real interest rate, individual household savings depend on the current life stage, the initial wealth endowment, and lifetime income. Households borrow when young (given their initially low income), repay their debts and save during their working age, but dissave and run down their assets after retirement (Ando and Modigliani, 1963). Thus, population growth pushes the aggregate saving rate up if there are relatively more working-age households than retired households in society. However, households may also save to leave bequests, so that retired households may still have a high saving rate (Modigliani, 1970, 1986). An initially low wealth endowment also affects the household saving rate positively as households save more to accumulate wealth for their retirement (Ando and Modigliani, 1963).

The effect of lifetime income on household savings is twofold since total household income consists of two observable components: labor income and the value of assets. On the one hand, household savings depend positively on the life-time labor income, defined as the current level and the expected growth rate of labor income (Ando and Modigliani, 1963). A household's labor income rises with growing labor productivity. Owing to the wage bargaining involved in this increase, the household anticipates the rising income and expects future consumption to

[1] Yet, as savings are exogenous, it is unclear whether households value present or future consumption so that $s*$ may not be optimal from a welfare perspective.

rise along with it. In order to accommodate for this, household savings increase (Ando and Modigliani, 1963). On the other hand, household savings depend on the value of assets. Similar to an initially low level of wealth endowment, a currently low asset value encourages households to increase their savings for retirement (Ando and Modigliani, 1963).

However, the effect of lifetime income on household saving is ambiguous if the real interest rate changes. For example, a falling interest rate decreases the opportunity cost of current consumption relative to future consumption so that current saving is less profitable than future saving. Thus, households would want to save less at a given labor income (*substitution effect*). In contrast, the present discounted value of expected future consumption rises, making future consumption more expensive and encouraging households to save more (*income effect*). An interest-rate decrease also changes the present discounted value of assets. Accordingly, future income, such as pension earnings or capital income, rises, encouraging households to currently save less (*wealth effect*) (Ando and Modigliani, 1963; Elmendorf, 1996).

In contrast to the life-cycle hypothesis, the permanent income hypothesis suggests that households save according to an infinite life-cycle (Friedman, 1957). Since they do not know their time of death, households wish to smooth their consumption pattern in a stable manner over time. Assuming a constant real interest rate, they consume according to their average lifetime income, which is based on the moving average of their previous income (permanent income). One-off income fluctuations (transitory income), such as bonus payments, are saved (Friedman, 1957). Changes in the real interest rate alter the permanent part of household lifetime income and thus do not affect household saving behavior (Friedman, 1957).

In the presence of uncertainty, neoclassical models predict that household savings diverge from the predictions of the life-cycle as well as permanent income hypotheses, and that households save out of precaution. If inflation in an economy is unstable, rational households become uncertain about their job security and future income. This induces precautionary household saving against unexpected income losses (Leland, 1968).

Precautious households do not borrow when faced with income uncertainty (Carroll, 1997). Instead, they match their consumption and savings with their current incomes, even if they expect their income to grow over time. Thus, savings of precautious households depend on current income, similar to the Keynesian (1936) model. The same applies to households that are severely liquidity or credit constraint, and hence cannot borrow (Deaton, 1991; Carroll,

1997).[2] Changes in household saving behavior may only materialize gradually, suggesting the presence of inertia due to habits or customs.[3]

2.2 Savings in business cycles, under financial repression and during secular stagnation

According to Austrian theory, a household's time preference determines their savings. Therefore, similar to classical theory, households save according to the interest paid on savings. Household savings depend on the central bank and capital market interest rates vis-à-vis the natural interest rate, which is the equilibrium interest rate balancing supply (savings) and demand (investment) on capital markets. If the central bank and capital market interest rates equal the natural interest rate, savings equal investment ($I = S$) (Hayek (1976 [1929]), Wicksell (2005 [1898]) and Mises (1998, [1949]).

If the central bank and capital market interest rates fall below the natural interest rate, a business cycle emerges and household savings evolve in an anti-cyclical way (Hayek (1976 [1929]), Wicksell (2005 [1898]) and Mises (1998, [1949]). The fall of the central bank interest rate below the natural interest rate triggers an overinvestment boom. Previously risky investments appear more profitable as their financing costs have decreased. Bank credit grows and firms channel capital and labor into these investments, causing a misallocation of resources. They bid up nominal wages to attract additional labor. Aggregate demand and prices rise.

Owing to the deviation of the capital market interest rates from the natural interest rate, households reduce their savings and increase their current consumption (Hayek (1976 [1929]), Wicksell (2005 [1898]) and Mises (1998, [1949]). They may also increase their credit-financed consumption and purchase capital goods, such as mortgage-financed real estate. Given that resources are moved to the investment goods sector and consumption increases, prices have to rise. Since nominal wages increase faster than prices, real wages increase so that consumption rises further.

As inflation accelerates, the central bank has to increase its policy rate. The misallocation of resources becomes apparent and investment projects with low returns have to be dismantled.

[2] Gourinchas and Parker (2002) show that precautionary household saving can be consistent with the life-cycle hypothesis. Households that do not wish to borrow may prefer to postpone their consumption as they expect little income growth. Young households that are not able to borrow, may still be able to accrue savings in the course of their working age.

[3] This so-called habit persistence may increase precautionary savings as households with persistent habits tend to dislike income fluctuations (Brown, 1952).

At the turning point of the investment boom, a ‘cleansing effect’ sets in (Schumpeter, 1983 [1912]). Investments fall until the excess stock of physical capital is worked off. Firms release capital and labor from investments that are no longer profitable, and prices decline. Workers accept lower wages in return for job security. This allows nominal wages to decline faster than prices so that real wages fall (Hayek, 1976 [1931]).

The rising interest rate during a recession is an incentive for households to increase their savings. Moreover, households save now in order to repay the debt accrued during the investment boom, such as their previously credit-financed consumption. Real estate owners suffer from falling property prices during the bust as their mortgage debt grows relative to the underlying value of the asset. In this case, they curtail current consumption and increase savings to redeem their high debt. Moreover, falling real incomes impede savings for the purpose of future consumption.

McKinnon (1973) and Shaw (1973) postulate that households save according to their time preference so that their savings depend positively on the real interest rate. Under financial repression, the real interest rate falls below its market equilibrium, affecting the quantity and quality of household savings (Gemech and Struthers, 2003). On the one hand, a government may keep interest rates artificially low to allow cheap refinancing of government debt. This discourages household savings, with a negative impact on the household saving rate, investment and economic growth (Stulz, 1999; Mishkin, 2001). On the other hand, if a government prevents the interest rate from clearing the market, non-market-based forms of saving will emerge, such as the rationing of available credit via auctions or quantitative restrictions on the credit volume by the government. This fosters the rise of investment projects with low profitability, resulting in an inefficient allocation of household savings (Obstfeld, 1998; Gemech and Struthers, 2003; Galindo et al., 2007).

While Shaw (1973) and McKinnon (1973) originally analyzed the effects of financial repression in developing economies, their conclusions may also apply to advanced economies. Reinhart and Tokatlidis (2005) show that advanced economies under a repressed financial system, characterized by government interventions to lower the interest rate, have relatively low household savings. Schnabl (2018) shows that prolonged expansionary monetary policies in advanced economies are equivalent in their effect to that of financial repression in emerging

economies since such policies undermine the allocation function of interest rates and the incentive for household savings.

Despite theoretical grounds for a positive interest rate elasticity of savings, Komiya (1966) points out that a household may have multiple savings motives so that the interest elasticity of household saving must not necessarily be positive. A higher rate of real interest would not necessarily induce higher savings if the household had a strong preference for current consumption, or if the household were content with the interest paid on the principal. Giovannini (1983) and Elmendorf (1996) review empirical evidence for a positive interest elasticity of savings (in developing economies) and find that the sign and magnitude of this elasticity may differ for each country case.

The concept of 'secular stagnation' abandons the idea of the interest rate elasticity of saving, arguing that long-run structural changes, particularly demographic change, determine household savings in industrialized economies (Hansen, 1939; Bernanke, 2005; Summers, 2014; von Weizsäcker, 2014; Laubach and Williams, 2015). In line with the life-cycle model, households in aging societies are more prone to save for retirement than to consume during their working-age stage of life.

Accordingly, households in the aging industrialized economies have high saving rates, causing a 'savings glut' (Summers, 2014; von Weizsäcker, 2014). As household savings rise, they drag down expected aggregate demand and corporate investments. Owing to slowing technological progress over time, the propensity of enterprises to invest further decreases, which pushes up corporate savings (Hansen, 1939; Bernanke, 2005). Given this household and corporate savings glut, the capital stock declines and the cutback on investments weakens labor productivity. Over time, this causes real wages to fall, which in turn diminishes the ability of households to save.

Visco (2002) suggests that demographic change may have an impact on the structure of a household savings portfolio. As a household's risk aversion depends negatively on their age, they are expected to shift away from risky assets, such as equity. This change in household's savings portfolio structures ultimately depends on institutional factors that influence the provision of retirement income flows (Visco 2005).

In contrast, Chen (2016) argues that globalization can affect household saving behavior in the long run. The globalization of social interactions induces changes in historically grown cultural values, although the direction of such changes would remain an empirical question. The growth of global trade gives households easier access to status goods, thus stimulating consumption instead of saving. Financial globalization reduces credit constraints and thus allows households to save less.

3. Household saving in Japan

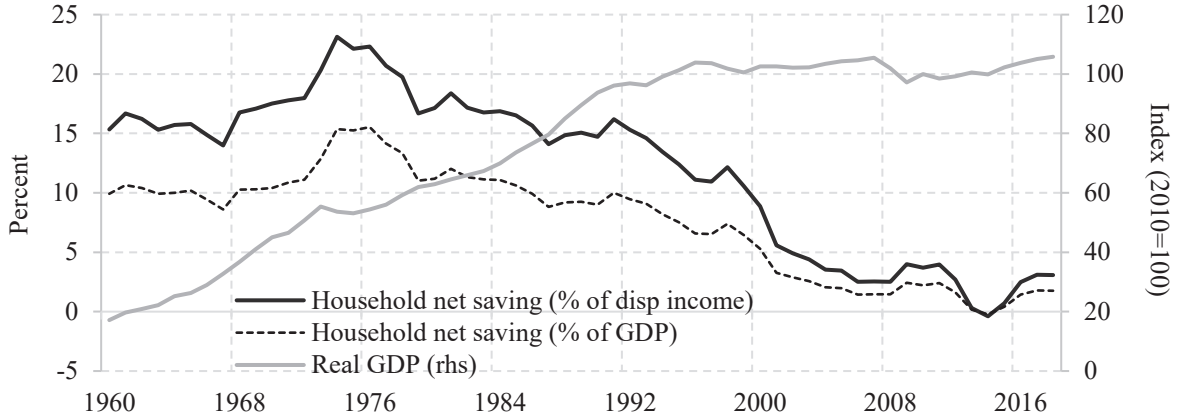
Research on Japanese household savings dates back to the 1960s, and assesses determinants of the absolutely and relatively high saving rate since 1955. Empirical studies until the 1990s mainly test whether households saved according to their life-cycle or due to precaution. Recent research analyzes the significant drop in the saving rate, focusing on the impact of demographic change on life-cycle savings ('secular stagnation') and the impact of institutional changes on precautionary savings. The effect of monetary policy on household savings via the policy interest rate and via the monetary impact on household income has remained under-researched.

3.1 Empirical determinants of Japanese household saving in the past and now

In post-war Japan, high net household saving rates coincided with rapid economic growth until the 1990s (*Figure 1*). In line with the Solow-Sawn growth model, the literature generally agrees that economic growth pushed up aggregate household savings as households continued saving a high portion of their rising disposable incomes (Komiya, 1966; Mizoguchi, 1970; Hayashi, 1986, 1989a,b; Shibuya, 1987). Accordingly, policy shocks affected the household saving behavior. Komiya (1966), for example, shows that tax breaks for private savings (*maruyū*) introduced in 1963 encouraged household savings to avoid higher income taxation ("tax evasion effect").[4]

[4] The *maruyū* system exempted a limited amount of private savings from taxation, including the interest income on bank and postal deposits or on government bonds.

Figure 1: Japanese net household saving rates and real GDP



Source: OECD Economic Outlook, DG ECFIN Ameco, IMF – International Financial Statistics, 2018.

Literature that follows the life-cycle and permanent income hypotheses argues that Japan's continuously high economic growth increased current and expected household income, and thus raised the household saving rate (Komiya, 1966; Mizoguchi, 1970; Hayashi, 1986, 1989a,b; Shibuya, 1987; Horioka, 1990). In line with the life-cycle model, the literature finds that Japan's post-war working-age population growth pushed the aggregate saving rate up (Okita, 1957; Shibuya, 1987; Modigliani and Sterling, 1983; Horioka, 1990). Hayashi (1989) shows that the initially low level of household wealth also incentivized households to save. In line with the permanent income hypothesis, Komiya (1966) and Mizoguchi (1970) find that the saving rate rose due to the growth of bonus payments (transitory income).

While Japanese household savings and economic growth remained high, the empirical literature since the 1970s re-examines the explanatory power of the two hypotheses. However, few studies go beyond the neo-classical explanations (Shinohara, 1968, 1970; Williamson and de Bever, 1978). While Shinohara (1968, 1970) also relates high household savings to bonus income growth, he finds that this positive relationship is only enabled by investment booms. Similarly, Williamson and de Bever (1978) argue that monetary expansions lower the price of capital for enterprises significantly, which promotes a capital investment boom that in turn pushes up bonus incomes and leads to a household savings boom.

A large strain of the literature considers precautionary savings as a determinant of high Japanese household savings, additionally to life-cycle and permanent income saving motives (Yoshihara, 1972; Odaka, 1974; Hayashi, 1986; Tachibanaki, 1986; Sato, 1987). Yoshihara (1972) finds increasing precautionary savings due to habit persistence in the saving behavior. Tachibanaki (1986) argues that households complemented their life-cycle savings with

additional precautionary savings as life-cycle wealth accumulation was not high enough to maintain high consumption after retirement. Sato (1987) proposes that the Japanese economy had transitioned from a neoclassical to a Keynesian model economy by the mid-1970s. Thus, the level of current household income would have determined household savings, in line with a precautionary saving motive (instead of saving motives in line with the life-cycle and permanent income hypotheses).

Institutional and structural factors may potentially have increased precautionary savings and suspended dissaving of elderly households. The relatively underdeveloped post-war social security system as well as limited consumer and mortgage finance may have encouraged precautionary household savings (Shinohara, 1959; Komiya, 1966; Mizoguchi, 1970; Hayashi, 1989; Anderson, 1990).[5] Given the increase in average life expectancy in Japan as well as the lack of institutional retirement provision, elderly households increased their labor force participation and continued saving (Modigliani and Sterling, 1983; Shibuya, 1987; Ishikawa, 1988). Moreover, Ogawa (1991) argues that income uncertainty during the first oil crisis (1974-1976) was a significant driver for precautionary savings.

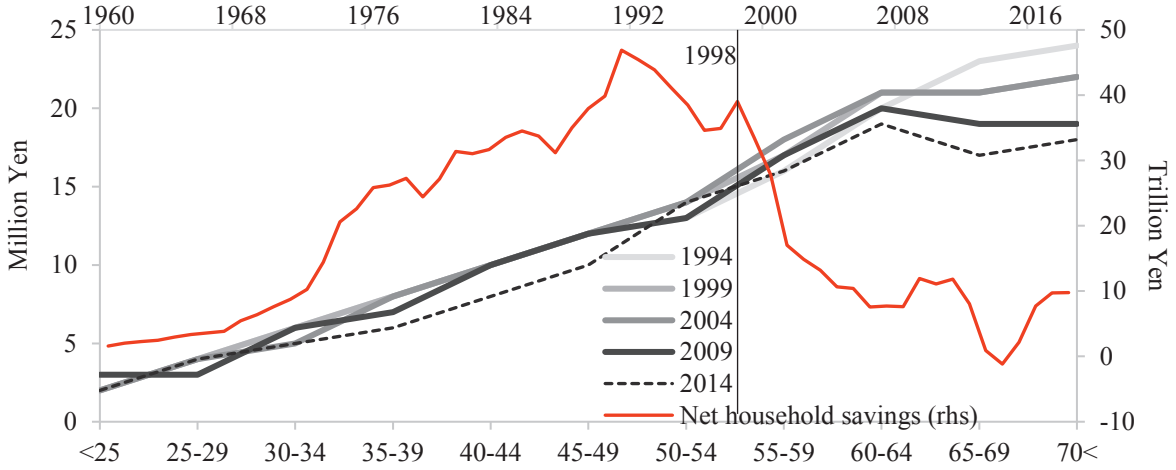
Despite institutional changes over time, such as a strengthened social security system including improved public pension schemes, Japanese precautionary household savings remained relatively high throughout the 1980s and 1990s (*Figure 2*).[6] During the 1980s, elderly households maintained a high saving rate despite their slowly decreasing labor force participation (Ishikawa, 1988; Ito, 1992). This lack of dissaving may also suggest saving for bequests at the time (Hayashi, 1986; Dekle, 1990; Ito, 1992). Barthold and Ito (1991) find that the magnitude of intergenerational, (un)intentional transfers between households were large in Japan (see also Hayashi et al., 1988; Ito and Kitamura, 1994).[7].

[5] Shinohara (1959) argues that the early high aggregate saving rate in Japan was due to precautionary saving of the high portion of self-employed, who could not rely on public pension benefits. Mizoguchi (1970) shows that self-employment had an increasingly marginal effect on Japanese household savings over time (see also Horioka, 1990); instead, he stresses that precautionary savings rose for all households due to the lack of institutional social security provision.

[6] Hayashi (1986, 1989a,b) finds that Japanese household savings were exceptionally high between 1965 and 1975, but that measurement errors biased them upward later on. Christiano (1989) shows that savings in Hayashi's model do not correspond to the Japan's actual saving path. Dekle and Summers (1991) argue that measurement adjustments were exaggerated. Horioka (1995) confirms measurement errors in the data, but shows that they were mutually offsetting (also Campbell, 2004). Iwamoto (1996) reaffirms Hayashi's view, arguing that the saving rate was even lower when correcting for measurement errors.

[7] Some studies on Japan's high household savings in the 1980s also link savings to slumping investment and balance of payments surpluses at the time, but without considering determinants of savings (Feldstein and Horioka, 1980; Schnabl, 2001).

Figure 2: Japanese total net household savings and by age group



Source: Ministry of Internal Affairs and Communications (MIC), OECD Economic Outlook, 2018.
Note: Household savings by age group are for workers' households, defined as households whose heads are employed as clerks or wage earners by public or private enterprises.

In the early 1990s, shortly after the burst of Japan's bubble economy, economic uncertainty (including income uncertainty and uncertainty about future government expenditure) may still have evoked a brief period of precautionary savings, although not equally across income and age groups (Zhou, 2003; Murata, 2003). Anderson (1990) suggests that, according to the Ricardian equivalence, the rising fiscal deficit triggered precautionary savings of all households as they expected higher taxes and lower government expenditure in the future.[8] Contrary to the life-cycle model, Takayama and Kitamura (1994) show that precautionary savings rose with income and age, as affluent elderly households saved in anticipation of a strained social security system. Nakagawa (1999) finds that income uncertainty motivated precautionary savings of low- and middle-income households and confirms that elderly households saved to accommodate for their increased life-expectancy and economic uncertainty, but not bequests.

However, increasing economic uncertainty in the 1990s appears to have affected household portfolio choices. Precautious households tended to choose physical assets, particularly houses, instead of financial assets in their early stage of wealth accumulation (Noguchi, 1990; Hayashi, 1992; Ito and Kitamura, 1994; Tachibanaki, 1994). Such house purchases were potentially linked to the desire to leave them as bequests in the future (Ito and Kitamura, 1994; Tachibanaki, 1994). However, owing to the high house prices, young households needed to accumulate

[8] As households anticipate future tax increases they save if the government deficit rises or taxes are cut (Ricardo, 1821)

relatively more savings to buy real estate, which pushed up the saving rate and increased the average age of first-time house buyers to around 40 (Moriizumi, 2003; Tokuoka, 2010).

Since 1998, Japan's net household savings have significantly decreased in absolute and relative terms (*Figure 1* and *Figure 2*). In comparison to their peak at 46.9 trillion yen in 1991, net household savings declined by 80% to 9.7 trillion yen in 2017.[9] The household saving rate fell from 16.2% to 3.1% of disposable income (10.0% to 1.8% of GDP) during the same time, reaching its peak at 23.1% (15.4%) in 1974 and its trough at -0.4% (-0.2%) in 2014. While Japanese household savings were amongst the highest in the industrialized world in the 1970s, they have been amongst the lowest within the OECD since 2010 (OECD, 2018).

In line with the life-cycle and permanent income hypotheses, demographic change, a high wealth accumulation, and decreasing (bonus) income growth may have driven the decline of household savings over time (Horioka, 2009; Braun et al., 2007; Sheng and Mu, 2012; Saito, 2015). Literature in line with the life-cycle model argues that the fall of the productive population (ages 15-64) and the rising number of retired households since 1993 has had a negative impact on the household saving rate (Koga, 2006; Braun et al., 2007; Horioka, 2009; Sheng and Mu, 2012; Saito, 2015; Curtis et. al, 2017). Moreover, the rapid increase of household wealth until 1990 and the decreasing labor income growth since 1992 possibly discouraged household savings (Koga, 2006; Horioka, 2006, 2009). In line with the permanent income hypothesis, Horioka (2009) suggests that the decline of the ratio of bonus payments to labor income (for regular employees) since 1992 has lowered household savings.

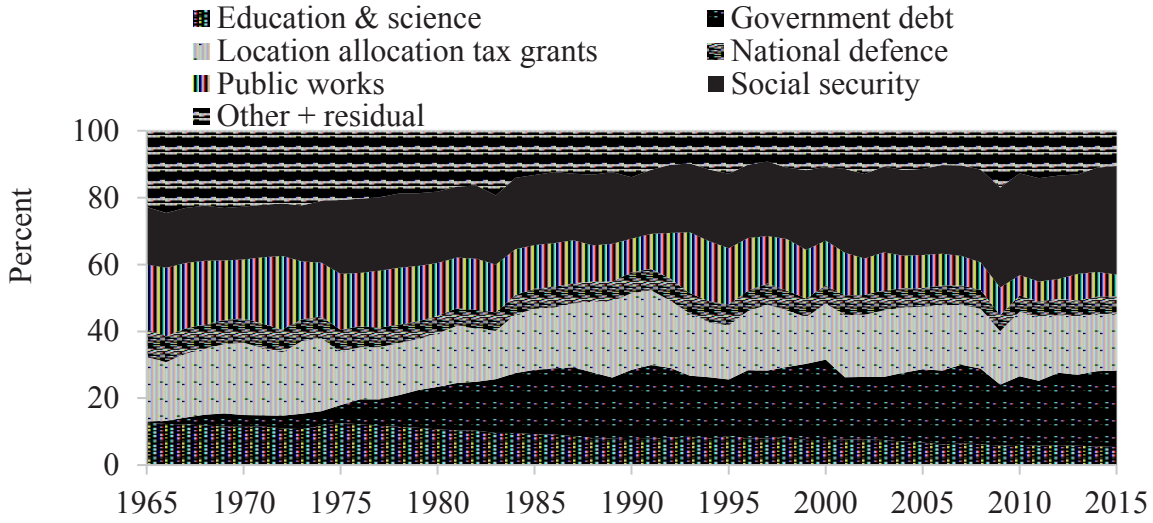
Institutional factors, including changes to the tax system as well as consumer and mortgage finance options may have decreased household savings over time. Horioka (2009a) argues that household savings decreased due to the abolition of the *maruyū* tax breaks for saving in 1988 as well as the dwindling saving promotion activities of the government. Moreover, improvements in consumer credit options since 1990 may have led households to reduce their precautionary savings as this would have allowed households to cover unexpected income losses with credit instead of private savings (Horioka, 2006, 2009a).

Lastly, savings may have sharply decreased due to significant improvements of public pension benefits (Horioka et al., 2007; Horioka, 2009a). Due to Japan's intergenerational

[9] Note that net household savings are a flow variable.

transfer system, a pay-as-you-go public pension system, young households bear the immediate costs of the transfer system. Given an aging population, the burden on young households increases. Accordingly, Horioka et al. (2007) illustrate that post-baby-boom households (born after 1960) maintained their precautionary savings until the early 2000s, anticipating a strain on the system. However, the introduction of a public long-term care insurance program in 2000 and the 2004 public pension reform, which essentially increased the expected net benefits of households born after 1970 (see *Figure 3*), decreased household savings of the working-aged (Takayama, 2003; Horioka et al., 2007; Horioka, 2009a,b). Thus, household saving behavior may have become less Ricardian, as household savings declined despite increasing government expenditures and debt (Saito, 2016).

Figure 3: Japanese government expenditures as a share of the general account budget



Source: Ministry of Finance, 2018.
Note: Complete data are only available until 2015.

Figure 3 illustrates the increase in social security subsidies of the government as a share of the general account budget since 1990. These subsidies include payments to the public pension system.[10] While the share of social security subsidies in the government's general account expenditure was 15.6% in 1960 it had doubled to 32.5% in 2015. This is equivalent to an average increase by 25.3 % from 1990 until 2015, whereas the share had only increased by 19.3% on average in the previous years since 1960.

[10] The mandatory social security pension program for private sector employees is the Kosei Nenkin Hoken (KNH, Employees Pension Insurance). In 1954, the KNH shifted from an earnings-related pension to a two-tier benefits system, of which one tier consists of flat-rate basic benefits and the other of an individual flat-rate contribution. One-third of the KN benefits are financed by subsidy through the general account budget (Takayama, 2003).

3.2 Monetary effects on Japanese household saving

The literature on Japanese household savings leaves a gap as it is mainly confined to the impact of demographic change on life-cycle savings, despite economic theory offering alternative explanations. Thus, existing empirical evidence on Japan's household saving behavior may suffer from omitted variable bias. For example, Iwaisako and Okada (2012) argue that the nonlinear movement in the Japanese saving rate clearly challenges research that relies on the monotonic trend of population aging, suggesting that other determinants of household saving behavior need to be accounted for.

In particular, there is limited research on the link between monetary policy and household savings, which may be important for three reasons. First, the persistently expansionary monetary policy warrants a review of the interest rate elasticity of savings (interest rate channel). Secondly, the prolonged low-interest rate policy may affect real labor income negatively via its negative impact on labor productivity, further hampering a household's ability to save (labor income channel). Thirdly, unconventional monetary expansions may have redistributive consequences, which could deter household savings (redistribution channel).

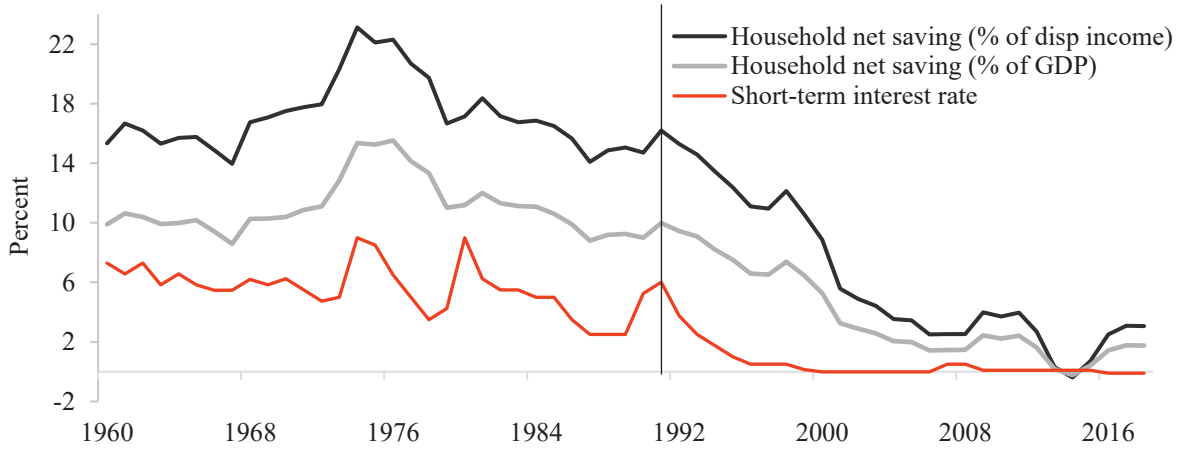
First, monetary policy may affect household savings via changes in the interest rate, particularly a prolonged zero policy rate (interest rate channel). Classical, neoclassical, and Austrian economic theory as well as the theory of financial repression agree that a household's motivation and ability to save are positively related to the interest rate (see *section 2*). Accordingly, a falling interest rate discourages saving and would tempt households to withdraw savings from deposits whose profitability depends on interest payments. Theoretical ambiguity of the interest elasticity of saving only exists in the life-cycle model so that the total effect of interest rate changes on household savings in this model remains an empirical question.

In the case of Japan, the sparse empirical evidence regarding the interest elasticity of savings is mixed and does not include evidence on the elasticity given the recent prolonged low interest rate policy. Nakagawa (1999) does not find a significant relationship between real interest rate changes and the aggregate household saving rate.[11] However, *Figure 4* illustrates that the decrease of Japanese net household savings as a share of disposable income and GDP coincides with the falling policy rate of the Bank of Japan. Until 1991, the year-on-year change

[11] An earlier study by Komiya (1966) of post-war Japan also does not find evidence for the interest elasticity of the average Japanese saver to changes in the interest.

in net savings as a share of disposable income and GDP was on average 0.028 and 0.003 percentage points p.a., respectively, while the policy rate decreased by 0.042 percentage points p.a. on average. Since 1992, the policy rate fell rapidly to the zero-lower bound in 1999 (with on average 0.731 percentage points p.a.), where it has remained until 2018. This has accelerated the decrease of net household savings, with a fall of 0.470 and 0.296 percentage points p.a., respectively, until 2018.

Figure 4: Net household saving and the short-term interest rate



Source: OECD Economic Outlook, IMF – International Financial Statistics, Bank of Japan, 2018.
Note: Household net savings are a flow variable.

The co-movement of Japanese net household savings and the interest rate may reflect a monetary policy effect on the motivation and ability of households to save. On the one hand, the falling interest rate has rendered savings deposits unprofitable, dampening the motivation of households to save. On the other hand, aggregate net household savings may have declined as households maintained their preference for savings in currency and deposits since 1995. Yoshino and Mizoguchi (2013) show that households have continuously kept around 50% of their total financial assets in currency and deposits. Yet, the constantly declining interest rates have dampened the return from saving in currency and deposits in Japan, and thus depressed the ability of households to increase their savings.

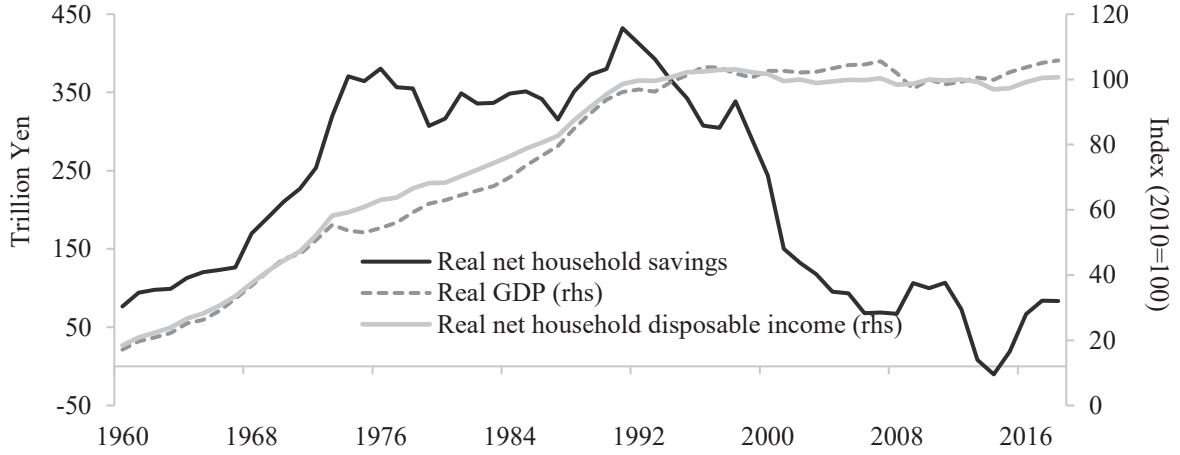
Secondly, monetary policy may affect household savings via the effect of prolonged monetary expansions on real wages (labor income channel). Economic theory agrees that household savings would decline as a response to falling real wages (see *section 2*). Moreover, theory postulates that the trend decline of real wages may be a result of expansionary monetary policy. In New Keynesian models, the negative effect is due to sticky nominal wages (Evans, 2001; Christiano et al., 2005), whereas it is due to surprise inflation in the Barro-Gordon model

(Barro and Gordon, 1983). In the Austrian Business Cycle model, real wages decline during a business cycle downswing, after a low-interest rate induced economic boom (Hayek, 1976 [1929]); Wicksell, 2005 [1898]; Mises, 1998 [1949]).

Empirical evidence for Japan agrees on the relationship between falling (real) income and decreasing household savings, although the literature has not yet connected this to Japan's expansionary monetary policy. Horioka (2009b) and Iwaisako and Okada (2012) argue that, in the late 1990s and early 2000s, declining real income growth and income losses due to higher tax deductions and social insurance premiums as well as temporary reductions in social security benefits had a significantly negative impact on household savings of retired and working-age households at advanced ages. Chen et al. (2007) link negative changes in total factor productivity growth to the decline of the saving rate.

Figure 5 shows that trends in Japanese real net household savings, real GDP and real net household disposable income have evolved in a parallel way since 1960. Until 1991, increasing real net household savings coincided with high real GDP growth, which was on average at 5.8% p.a. Real disposable income growth was on average at 5.6% p.a. In contrast, Japan's low-growth phase starting in 1992, with real GDP and real disposable income growing on average at 0.9% and 0.7% p.a., was accompanied by a remarkable fall of real net household savings by 80.6%, from 432.1 trillion yen in 1991 to 84.0 trillion yen in 2017.

Figure 5: Real net household savings, GDP and net household disposable income



Source: OECD Economic Outlook, IMF – International Financial Statistics, DG ECFIN AMECO, 2018.
Note: Net household savings, GDP and net household disposable income are deflated using the CPI. Net households savings are a flow variable.

The parallel trends of real net household savings and economic growth in Japan may indicate an effect of the prolonged low-interest environment on the household's *ability to save*.

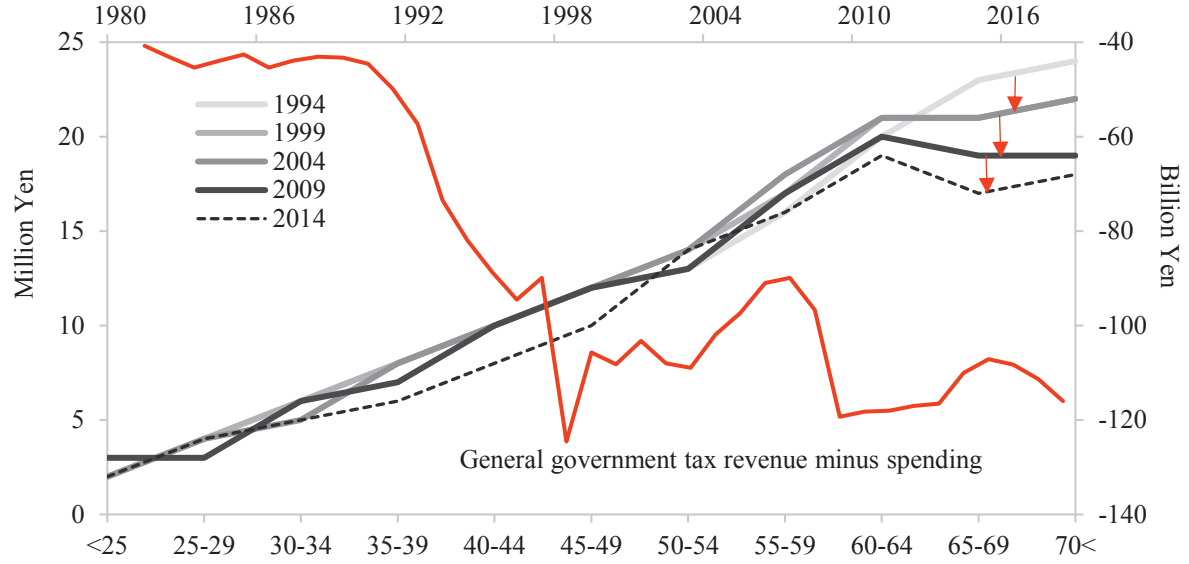
During the bubble economy, a low-interest-rate triggered investment boom helped raise real wages, which enabled households to increase their savings to a historical high. After the burst of the bubble economy (1985-1990), however, real wages declined alongside falling interest rates. Real income growth has stagnated since the mid-1990s, which further depressed net household savings. While earlier research by Shinohara (1970) relates high Japanese household savings to bonus income growth that was enabled by investment booms, current research has yet to relate falling household savings to the shrinking investment and declining (bonus) incomes triggered by the burst of the bubble economy.

Thirdly, monetary policy may affect the household saving behavior as it redistributes resources from young to elderly households as well as from the private (household) to the public sector (redistribution channel). On the one hand, the life-cycle accumulation of savings assumes an inequal distribution of wealth across generations, whereby young working-age households tend to have relatively little physical or financial assets (see *section 2*). Given unconventional expansionary monetary policy, low interest rates diminish incomes from savings deposits of young households. In contrast, unconventional monetary expansions increase asset prices, which raise the existing wealth of elderly households (Saiki and Frost, 2014), thus redistributing financial resources across generations.

On the other hand, unconventional expansionary monetary policy allows a government to exert financial repression by keeping the interest rate on government bonds artificially low. This allows the government debt to remain sustainable, but redistributes resources from the private to the public sector (see *section 2*). Moreover, enabled by unconventional monetary expansion and motivated by demographic change, a government may redistribute resources in the form of social transfers to elderly households as an increasing group of retirees is a potent electoral group.

Yoshino and Mizoguchi (2013) provide empirical evidence for the redistribution effects of monetary policy on household savings in Japan. The authors examine changes in the Japanese flow of funds and show that private savings are directed to elderly households via government transfers as well as to the public sector via government bond purchases and reduced interest payments on such bonds. Yoshino and Mizoguchi (2013) also find that private firms do not invest and capital formation does not occur as private savings generally flow to the government.

Figure 6: Japan's general government balance and net household savings by age group



Source: Oxford Economics, DG ECFIN AMECO, 2018.

Figure 6 shows that the rising government deficit in Japan, expressed as the difference between general government tax revenue and spending, has coincided with decreasing net household saving of elderly households. Traditionally, Japanese elderly households maintained their household savings instead of engaging in life-cycle dissaving until the early 1990s. However, starting with the dramatic increase in general government spending in 1990, which includes social security spending for public pensions, and the rise of the deficit from 44.6 to 116.0 Trillion yen, these households reduced their savings gradually. While in 1994, the average elderly household (ages 65+) held net household savings of about 23.5 million yen, this declined to 17.5 million yen in 2014. This appears to support Saito's (2016) argument that household saving behavior has become less Ricardian over time.

4. Empirical estimation framework and results

Up to the present, the literature on Japanese household savings has not scrutinized the effect of the low interest rate policy on the household saving behavior. Moreover, the empirical literature on Japanese savings behavior is divided along the growth path of the Japanese economy. While recent literature examines the low-growth phase of the economy since the 1990s, other papers discuss the high growth phase of the past. Therefore, this paper tests the relationship between Japan's monetary policy and the household saving behavior, using a large data sample from 1960 to 2018, while emphasizing the low interest rate policy starting in 1991.

4.1 Data and estimation framework

The data span from 1960 to 2018. This long sample period accounts for the shift of the Japanese economy from a high-growth to a low-growth phase. All data are of annual frequency, as this is the only frequency consistently available for such a long time span. The observation period starts in 1960, with the beginning of Japan's post-war high-growth phase, when reliable data for most necessary variables is accessible. Due to missing values for some time series, a shorter observation period ranges from 1980 to 2018. The shorter sample still incorporates the end of Japan's high-growth phase and thus also allows modeling the shift of the Japanese economy from a high-growth to a low-growth phase in 1998. *Table 1* offers a detailed description of the data, including data sources.

Table 1: Data Description

Acronym	Description	Sample period	Source
Bonus	Average bonus payments (of regular employees in enterprises with more than 30 employees).	1970 – 2017	Ministry of Health, Labour and Welfare, Japan.
currdep	Currency and deposits as share of total financial assets of households.	1980 – 2014	Annual National Accounts, OECD.
depend_adj	Adjusted old-age dependency ratio (unemployed old-age as share of total employees).	1968 – 2017	Ministry of Internal Affairs and Communication (MIC), Japan.
govdef_GDP	Government deficit, calculated as the difference between general government tax revenue and spending, as share of GDP.	1981 – 2018	Oxford Economics; DG ECFIN AMECO.
labprod	Labor productivity, calculated as output (GDP) per employee in yen.	1960 – 2017	International Financial Statistics (IFS), International Monetary Fund (IMF); OECD Economic Outlook.
ncWage	Nominal average cash wage (per employee) in million yen.	1960 – 2018	OECD Economic Outlook.
nGDP	Nominal gross domestic product in trillion yen.	1960 – 2018	IFS, IMF.
nIR	Nominal Bank of Japan short-term main policy rate (percent).	1960 – 2018	Bank of Japan.

nNHHDI	Nominal net household disposable income in trillion yen.	1960 – 2018	OECD Economic Outlook.
nNHHS	Nominal net household savings in trillion yen.	1960 – 2018	OECD Economic Outlook.
NHHS_GDP	Net household savings (as share of GDP).	1960 – 2018	OECD Economic Outlook; IFS, IMF.
NHHS_NHHDI	Net household savings (as share of net household disposable income).	1960 – 2018	OECD Economic Outlook.
NHHW_GDP	Net household wealth (as share of GDP).	1970 – 2016	OECD Economic Outlook; IFS IMF.
rGDP	Real GDP (Index 2010 = 100).	1980 – 2018	IFS, IMF; DG ECFIN AMECO.
rIR	Real short-term interest rate (percent).	1961 – 2018	Bank of Japan; DG ECFIN AMECO.
rNHHDI	Real net household disposable income in trillion yen.	1960 – 2018	OECD Economic Outlook.
rNHHS	Real net household savings (Index 2010 = 100).	1960 – 2018	OECD Economic Outlook.
Sharequ	Shares (and other equity) as a share of total financial assets of households.	1980 – 2014	Annual National Accounts, OECD.
socsec_GDP	Social security government expenditure as share of GDP.	1966 – 2017	Ministry of Finance, Japan.

The saving behavior of Japanese households can be modelled using aggregate net household savings (*nNHHS*) as well as aggregate net household savings as share of GDP (*NHHS_GDP*) and of disposable income (*NHHS_NHHDI*). Nominal net household savings are deflated using the *CPI* to obtain real net household savings (*rNHHS*). The net household saving rates are calculated by dividing nominal net household savings by GDP (*nGDP*) as well as net disposable income (*nNHHDI*).

Based on the analysis in section 3, important determinants of the Japanese household saving behavior are household income and wealth, as well as monetary policy. Household income includes current level and expected income as well as bonus income. Current level income is provided by the nominal average cash wage per employee (*ncWage*) and deflated by the CPI to obtain real average cash wages per employee (*rcWage*). Current level income in the form of transitory income (*bonus*) is approximated by average bonus payments for regular employees since data for average bonuses of all employees are not available. Expected income is approximated by labor productivity growth (*labprod*), which is calculated dividing GDP data

by the total number of employees. The positive relationship between real income and labor productivity permits such approximation as workers expect their real wages to rise with their rising labor productivity.[12] Japanese household wealth is modelled using net household wealth as share of GDP (*NHHS_GDP*). The impact of monetary policy on household saving behavior is measured via the nominal (short-term) policy rate (*nIR*). CPI inflation is subtracted to obtain the real interest rate (*rIR*).

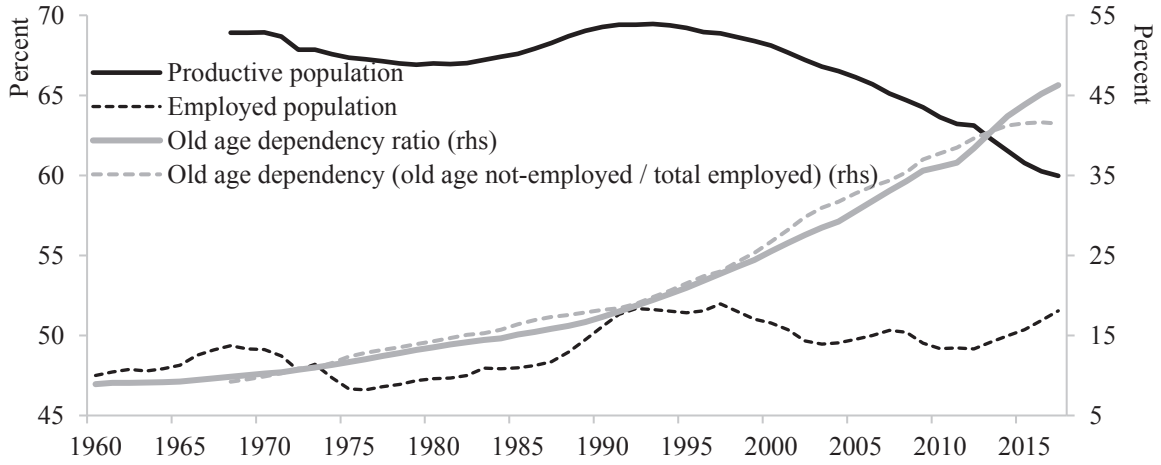
Structural factors, such as the social security system or the government deficit, savings preferences, and the demographic structure of an economy may also determine household saving behavior. Social security expenditure of the government is taken as share of GDP (*socsec_GDP*). The government deficit is calculated as the difference between general government tax revenues and general government spending as share of GDP (*govdef_GDP*). Savings preferences are represented by currency and deposits as a share of total household financial assets (*currdep*) or shares and other equity as a share of total household financial assets (*sharequ*).

The demographic structure is typically represented by the old-age dependency ratio and the productive population ratio. However, the ratios are downward- and upward-biased, respectively, as they do not include elderly employees aged 65+ (*Figure 7*). The productive population as a share of the total population fell from 68.9% in 1968 to 60.0% in 2017, peaking at 69.5% in 1993 but decreasing steadily ever since. Similarly, the old age dependency ratio increased from 8.8% in 1960 to 43.9% in 2016.[13] Yet, the employed population as a share of the total population has remained at around 50% since 1990, displaying a recent upward trend which is significantly driven by increasing old-age employment. Thus, the adjusted old age dependency ratio, which measures only the *"de facto not employed"* old age as a share of total employees, has stagnated since 2010 currently remaining at 41.5%.

[12] See Blanchard and Katz (1999) and Mankiw (2009) for a discussion of the relationship between real wages and labor productivity.

[13] The productive population measures the working age population (ages 15-64) as a share of total population, whereas the employed population measures all employees as a share of total population. The old age dependency ratio measures the old age (65+) as a share of the working age population, whereas the adjusted old age dependency ratio measures the not-employed old age as a share of total employees.

Figure 7: Japanese productive and employed population as well as old age dependency



Source: World Bank WDI, MIC, OECD.

Table 2 shows the descriptive statistics for the overall sample of the year-on-year rates of change of the data, after removing two outliers for the real interest rate driven by the high CPI inflation in 1973 and 1974. The descriptive statistics indicate that Japan experienced a high- and a low-growth phase. Nominal and real GDP, net household disposable income, aggregate net household savings as well as the two household savings rates display a high degree of variability over the sample period (see *Table 2*). For example, nominal GDP (*nGDP*) ranges from 16.01 to 555.61 trillion yen, with a mean of 335.69 trillion yen and a standard deviation of 197.57. Net household disposable income (*nNHHDI*) ranges from 10.34 to 321.14 trillion yen, with a mean of 203.40 trillion yen but with a standard deviation of 115.06. Similarly, nominal net household savings (*nNHHS*) range from -1.17 to 46.90 trillion yen, with a mean of 19.26 trillion yen and a standard deviation of 14.22.

Table 2: Descriptive Statistics (1960 – 2018)

Variable	Obs.	Mean	Std. Dev.	Min	Max
Bonus	46	-0.32	7.30	-26.07	18.22
Currdep	35	52.07	3.25	45.23	59.08
depend_adj	50	23.08	10.60	9.22	41.63
govdef_GDP	38	0.02	0.00	0.01	0.02
labprod	57	-4.32	5.19	-16.07	5.30
ncWage	59	3.02	1.47	0.26	4.55
nGDP	59	335.69	197.57	16.01	555.61
nIR	59	3.24	2.91	-0.10	9.00
nNHHDI	59	203.40	115.06	10.34	321.14
nNHHS	59	19.26	14.22	-1.17	46.90
NHHS_GDP	59	7.64	4.42	-0.23	15.53
NHHS_NHHDI	59	12.07	6.67	-0.39	23.13
NHHW_NHHDI	47	716.36	148.82	427.65	948.14

prodpop	50	66.79	2.54	59.97	69.46
rGDP	59	75.87	29.13	17.15	105.80
rIR	56	0.44	1.55	-3.20	3.69
rNHHDI	59	217.25	84.25	48.28	311.63
rNHHS	59	220.62	129.85	-10.22	432.14
rcWage	59	91.32	21.92	35.07	111.89
sharequ	35	13.77	4.17	7.75	24.02
socsec	52	22.31	4.59	15.60	32.50

All time series are tested for unit roots. While it has been common practice in the literature to use augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests to determine potential non-stationary behavior of time series, it is preferable to use the Dickey-Fuller-General-Least-Squares (DF-GLS) unit root test instead because it has a statistically significantly greater power than previous versions of the ADF test and the PP test (Elliott, Rothenberg and Stock, 1996; Baum, 2000).[14] The DF-GLS test has a null hypothesis postulating that the time series is a non-stationary random walk, possibly with drift. Alternatively, the time series is either stationary about a linear time trend, or with a possibly nonzero mean but without a linear time trend. The null hypothesis is tested against both alternative hypotheses to account for the possibility of a time trend. The optimal lag length for each unit root test is specified in accordance with the Ng-Perron criterion (Baum, 2000).[15]

Caution is warranted with regard to the identification of unit root processes. First, type I and II errors can occur when time series exhibit large outliers or structural breaks. Outliers can cause a type I error when the null hypothesis of a unit root is falsely rejected so that the time series is not differenced (Hamilton, 1994). Structural breaks can cause a type II error as unit root tests are generally biased towards not rejecting a unit root although the true process may be stationary within each regime (Perron, 2015). The failure to reject the null hypothesis of a unit root leads to mistakenly differencing a time series. Secondly, misspecification of unit root tests in terms of the null and alternative hypotheses also leads to false identification. Depending on the inclusion of deterministic or stochastic terms in the regression, the asymptotic distribution of the test statistic differs, leading to varying conclusions about the tested times series (Hamilton, 1994).

[14] The test proposed by Elliott, Rothenberg and Stock (1996) initially transforms the time series via a generalized least squares (GLS) regression before performing the unit root test. Thus, the DF-GLS test fits a regression analogous to that of the ADF test, but uses GLS-detrended data for the regression (Stock and Watson, 2011).

[15] All augmented Dickey-Fuller-type unit root tests are sensitive to lag length (Elliott, Rothenberg and Stock, 1996).

Following Greene (2012), graphs and summary statistics for each time series enhance the identification of potential biases of unit root tests as well as the potential type of non-stationary behavior. Consequently, two outliers for *rIR* are removed as well as outliers for the year-on-year percentage change of net household savings in the years 2013-2016. The latter outliers are a result of a temporary drop of net household savings into negative territory. In accordance with the high- and low-growth phases of Japan's economy, a structural break can be identified for the year 1998, marking the outbreak of the Japanese financial crisis. Moreover, a structural break can be identified for all real variables in 1973/4, when CPI inflation in Japan sparked. The Chow test confirms these identifications for all variables at high levels of significance (Greene, 2012).

DF-GLS unit root tests around the structural breaks do *not* reject the null hypothesis (the time series is a non-stationary random walk, possibly with a drift) at high levels of significance (against the alternative that the time series is trend stationary) for all variables, except for the year on year percentage change in real net household savings growth, in real household income (*rcWage*), and in labor productivity. The results are robust for optimal lag lengths according to the Ng-Perron criterion. Thus, *NHHS_GDP*, *NHHS_NHHDI*, *nIR*, *rIR*, *bonus*, *NHHW*, *depend_adj*, *socsec_GDP*, *govdef_GDP, currdep*, and *sharequ* are first differenced. The Newey-West estimator consistent with autocorrelation and heteroscedasticity and with an optimal lag length of 3 is used for all regressions.[16]

In line with the empirical literature on household saving behavior and taking into account the transmission channels of monetary policy, the following equation is estimated:

$$HHsavings_t = \alpha_t + \beta_1 nIR_t + \beta_2 rcWage_t + \beta_3 bonus_t + \beta_4 labprod_t + \beta_5 NHHW_t + \beta_6 depend\_adj_t + \beta_7 socsec\_GDP_t + \beta_8 govdef\_GDP_t + \beta_9 savings\_pref_t + \varepsilon_t, \quad (3)$$

where the regressand $HHsavings_t$ is either the year on year change in real net household savings ($rNHHS$) or the differenced household savings rate as percent of GDP ($NHHS\_GDP_t$) or as percent of net household disposable income ($NHHS\_NHHDI_t$). In line with the life-cycle model and permanent income hypothesis, the regressors include household income and wealth.

[16] Newey and West (1987, p. 705) show that their estimator for the covariance matrix is consistent if the lag length m grows with the sample size T so that $\lim_{T\to\infty} T = +\infty$, and if m grows at a slower rate than $T^{1/4}$ so that $\lim_{T\to\infty}[m(t)/T^{1/4}] = 0$. Accordingly, m is set to the integer part of $T^{1/4}$ (Greene, 2012, p. 960).

The coefficients for current labor income (β_2 and β_3) as well as expected labor income (β_4) should have a positive sign as households save to accommodate expected rising future consumption alongside rising lifetime income. In contrast, a negative sign is expected for a household's wealth endowment (β_5) since households save less with a rising wealth endowment. Moreover, the aging of the society as well as the extent of the social security system (β_6 and β_7) are both expected to have a negative sign. Economic theory suggests that an aging economy is characterized by dissaving and a well-developed social security system renders precautionary household savings unnecessary. According to the Ricardian equivalence, the coefficient for the government deficit (β_8) is expected to have a positive sign as household saving rates increase with rising government deficit (as percent of GDP). The savings preference (β_9) is approximated either by currency and deposits as a share of total household financial assets (*currdep*) or shares and other equity as a share of total household financial assets (*sharequ*), with an expected positive sign. Households with an increasing share of equity or currency and deposits in their savings portfolio would increase their saving rate.

In order to identify the impact of monetary policy on household savings, the interest rate (*interest rate channel*), real income (*labor income channel*), and the government deficit as percent of GDP (*redistribution channel*) are added to the regression. The expected signs for all these regressors are positive (coefficients β_1, β_2, and β_7, respectively). Accordingly, households should decrease their savings as a declining interest rate lowers their incentive to save. They should also decrease their savings along their decreasing ability to save, when their real income falls. Lastly, they should increase their (precautionary) savings alongside a rising fiscal deficit as they expected higher taxes and lower government expenditure in the future (Ricardian equivalence).

4.2 Estimation results

Table 3 and *Table 4* report the estimation results for the household saving rate as percent of GDP (*NHHS_GDP*) and of net household disposable income (*NHHS_NHHDI*), respectively, for the sample period from 1960 until 2018. The regression results do not change for the small sample, which runs from 1980 until 2018. Moreover, changing the regressand to a measure of real aggregate net household savings also does not change the results in terms of signs and significance of the coefficients. For reason of parsimony, these results are not reported here.

Models (1) through (6) capture the potential effects of monetary policy on the household saving rate. Models (1) through (3) test the benchmark, which only includes measures for the three monetary transmission channels as well as household income and wealth. Models (4) through (6) also include structural factors, such as measures for economic and financial uncertainty as well as measures for the saving preference of households and the demography of the economy.

Table 3 and *Table 4* show that monetary policy has a highly significant and positive effect on the household saving rate via the *interest rate channel* in all of the six models and for both regressands. The coefficient for the nominal interest rate (*nIR*) is significant at the 1% level. Accordingly, a one percentage point cut in the interest rate reduces the household saving rate as percent of GDP by 0.43 percentage points on average, whereas it reduces the saving rate as percent of net household disposable income by 0.65 percentage points on average (models 6). This is in line with economic theory that predicts a positive relationship between the policy rate set by a central bank and the household saving rate.

Similarly, fiscal policy has a significantly positive effect on the household saving rate via the *redistribution channel*. This is evidence in favor of the Ricardian equivalence, similar to Anderson's (1990) findings but contrary to Saito (2016). The coefficient for the government deficit (*govdef_GDP*) is significant at the 1% level for all models and for both regressands (*Table 3* and *Table 4)*. The consistently positive sign indicates that the household saving rates increase with rising government deficit (as percent of GDP). In other words, a rising fiscal government deficit triggers precautionary household savings as households expect higher taxes and lower government expenditure in the future. In particular, a one percentage point rise in the government deficit increases net household savings as percent of GDP and of disposable income by 0.181 and 0.286 percentage points on average, respectively (models 6).[17]

Monetary policy does not appear to have a significant impact on the household saving rate via the *labor income channel*. The coefficients for household income (*rcWage*) and labor productivity (*labprod*), which represents expected household income, are insignificant for all models and for both regressands (*Table 3* and *Table 4*). Models (1) – (3) show that the results for the income channel do not change if transitory income (*bonus*) is used as proxy for real income instead of real cash wages (*rcWage*, which excludes overtime, bonus payments and

[17] Note that the government deficit as percent of GDP is on average 0.02 percent.

social transfers), or if both payment measures or only one of the two are included in the regression model. This also holds for models (4) – (6) so that, for reason of parsimony, the results reported for models (4) – (6) only include the real cash wage (*rcWage*) and labor productivity (*labprod*).

Table 3: OLS estimation results – net household savings as percent of GDP 1960-2018

NHHS_GDP	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
nIR	0.33***	0.32***	0.33***	0.33***	0.39***	0.43***
	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.11)
rcWage	-0.01		-0.03	-0.01	-0.07	-0.10*
	(0.07)		(0.07)	(0.08)	(0.07)	(0.06)
bonus		-0.00	-0.01			
		(0.01)	(0.01)			
labprod	0.07	0.07	0.08	0.08	0.11**	0.11
	(0.05)	(0.04)	(0.05)	(0.05)	(0.05)	(0.07)
NHHW	0.04***	0.04**	0.04**	0.04***	0.04***	0.04***
	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
govdef_GDP	173.52***	171.10***	169.62***	174.24***	165.51***	181.02***
	(30.15)	(31.10)	(30.86)	(31.61)	(27.10)	(27.25)
depend_adj	-1.03***	-1.04***	-1.01***	-1.04***	-1.04***	-0.93**
	(0.25)	(0.21)	(0.24)	(0.27)	(0.27)	(0.42)
rGDP				0.01	-0.00	-0.03
				(0.03)	(0.03)	(0.04)
socsec_GDP					-0.10	-0.10
					(0.08)	(0.08)
sharequ						0.03
						(0.03)
Constant	0.60***	0.60***	0.59***	0.61**	0.72***	0.60
	(0.21)	(0.20)	(0.21)	(0.23)	(0.26)	(0.43)
Prob > F	9.84***	10.45***	8.60***	9.72***	9.90***	23.46***
Obs.	36	36	36	36	36	33

Note: Newey-West robust standard errors are reported in parentheses. The significance of coefficients is reported at the 10%, 5%, and 1% level, indicated by *, **, ***, respectively.

Net household wealth (*NHHW*) has a significantly positive effect on the household saving rate as percent of GDP and net household disposable income throughout all model specifications, although the effect is small (*Table 3* and *Table 4)*. The coefficient is significant at the 1% level for all models and both regressands, except for models (2) and (3) where it is significant at 5%. The results concerning the significance of variables remain unchanged for all models and both regressands if household wealth is included as percent of household disposable income or GDP. For reason of parsimony, these results are not reported here. Thus,

the household saving rate as percent of GDP and of disposable income increases with rising household wealth. This is contrary to economic theory, which postulates a negative sign.

Given the significantly positive effect of household wealth on household saving rates (*Table 3* and *Table 4*), it appears that this coefficient captures a household's ability to save (instead of the coefficients of household labor income). This suggests that monetary policy may have affected the household saving behavior via the *wealth channel* instead of the labor income channel. Bordo and Lane (2013) show that monetary easing, particularly unconventional policy, has a positive impact on asset prices, including house, stock and commodity prices, increasing financial household wealth. However, given an unequal distribution of wealth among households, such positive changes do not affect all households equally. For Japan, Saiki and Frost (2014) show that expansionary monetary policy widened inequality, especially after 2008, when quantitative easing became more aggressive.[18]

Table 4: OLS estimation results – net household savings as percent of net household disposable income 1960-2018

NHHS_NHHDI	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
nIR	0.50***	0.48***	0.50***	0.50***	0.59***	0.65***
	(0.16)	(0.14)	(0.16)	(0.15)	(0.16)	(0.17)
rcWage	-0.07		-0.10	-0.06	-0.16	-0.22**
	(0.12)		(0.11)	(0.12)	(0.11)	(0.10)
bonus		-0.00	-0.01			
		(0.02)	(0.02)			
labprod	0.10	0.07	0.10	0.10	0.16	0.14
	(0.08)	(0.08)	(0.08)	(0.09)	(0.10)	(0.13)
NHHW	0.06***	0.06**	0.06**	0.06***	0.06***	0.06***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
govdef_GDP	274.13***	272.72***	267.77***	276.19***	262.43***	286.05***
	(49.55)	(50.38)	(50.00)	(50.83)	(43.67)	(45.73)
depend_adj	-1.57***	-1.64***	-1.54***	-1.61***	-1.61***	-1.29*
	(0.43)	(0.38)	(0.42)	(0.47)	(0.47)	(0.71)
rGDP				0.02	-0.00	-0.04
				(0.04)	(0.04)	(0.06)
socsec_GDP					-0.16	-0.15
					(0.12)	(0.13)
sharequ						0.05
						(0.05)
Constant	0.90**	0.93**	0.89**	0.94**	1.12**	0.79
	(0.37)	(0.35)	(0.37)	(0.41)	(0.47)	(0.72)
Prob > F	9.01***	9.86***	7.90***	8.49***	8.90***	19.69***

[18] The aggregate data on household wealth used in Saiki and Frost (2014) do not capture such heterogenous effects so that future research will have to investigate this aspect of monetary transmission on household saving.

Observations	36	36	36	36	36	33

Note: Newey-West robust standard errors are reported in parentheses. The significance of coefficients is reported at the 10%, 5%, and 1% level, indicated by *, **, ***, respectively.

Regression models that include structural factors (*rGDP* and *socsec_GDP*) mostly yield insignificant results for the coefficients of structural variables, without changing the sign and significance of coefficients of the monetary transmission variables as well as household wealth (*Table 3* and *Table 4*). The coefficient for economic uncertainty, measured by real GDP growth (*rGDP*), has the expected (negative) sign in models (5) and (6), but is insignificant for household saving decisions. These results do not change if unemployment is used as a measure of economic uncertainty. Moreover, the coefficient for financial household uncertainty, measured by the public social security expenditure (*socsec_GDP*), has the expected negative sign, but is also insignificant for the household saving rates.

Similarly, a household's savings preference is also insignificant for its saving behavior, but has the expected sign (*Table 3* and *Table 4*). While insignificant for all models and both regressands, the coefficient for shares and equity as percent of total financial assets (*sharequ*) in model (6) has a positive sign. Although not reported here for reason of parsimony, the coefficient for currency and deposits as percent of total financial assets (*currdep*) has a negative sign, but also remains insignificant for all specifications.

In contrast, the demographic development (*depend_adj*) of the economy has a highly significant and negative coefficient for all models and both regressands (*Table 3* and *Table 4*). The coefficient for the old-age-dependency ratio is significant at 1% for all models, excluding models (6) where it is significant at 5% and at 10% for the regressions with the household saving rate as percent of GDP and of disposable income, respectively. On average, a one percentage point increase in the dependency ratio lowers the household saving rate as percent of GDP and of disposable income by 0.93 and 1.29 percentage points, respectively (models 6). This is in line with the literature that investigates Japanese household saving using the life-cycle model. Life expectancy instead of the old-age-dependency ratio is insignificant but does not change the results for the other variables. It is not reported here for reason of parsimony.

5. Outlook

This paper scrutinizes the role of prolonged, expansionary monetary policy on the savings behavior of Japanese households, focusing on the dramatic change of Japanese household

savings behavior since 1998, from high to low savings. Existing literature generally attributes this behavioral shift to the country's shift from a high-growth to a low-growth economy and its demographic change. This paper adds to the existing literature by examining changes in the incentives for saving and the ability to save connected to monetary policy.

The empirical results of this paper indicate that monetary policy has played a significant role in the change of the Japanese household saving behavior during the investigated time frame. The significant impact of monetary policy on Japan's household saving behavior has been threefold, via the interest rate channel, the redistribution channel, and the wealth channel. In contrast, monetary policy does not appear to have had a significant impact on the household saving rate via the labor income channel.

Future research may extend this analysis for Japan, investigating whether and to what extent the impact of monetary policy on the household saving behavior varies at times of conventional versus unconventional expansionary monetary policy. Moreover, research may apply this analysis to other industrialized economies, such as member states of the European Union, that have experienced similar shifts from a high-growth to a low-growth economy and demographic change, as well as prolonged phases of expansionary monetary policy.

Lastly, while a household's saving preference appears to be insignificant in the empirical analysis at hand, the signs for *sharequ* as well as *currdep* were as expected. At times of persistently low interest rates, households that prefer to save via equity (*sharequ*) would increase their saving rate. In contrast, households that prefers to save via currency and deposits (*currdep*) would decrease their saving rate. Interestingly, Saiki and Frost (2014) find that the saving preference of Japanese households depends on the income and wealth bracket a household belongs to.

Thus, future research may reassess the effect of a household's saving preference on its ability to save. Research may also consider that the potential effect of monetary policy on Japanese household saving behavior may depend on the distribution of household wealth. This is an important research task as household savings can have crucial implications for the economic wealth of households or financial institutions, as well as for household consumption decisions that in turn affect the corporate sector and thus long-term economic growth.

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