Withdrawal strategy in Japan

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There is a risk of longevity i.e., the self-funds after retirement may deplete before the end of life. What is needed after retirement is to spend out of self-funds in addition to public pensions while investing self-funds over lifetime without depleting. We analyze a safe withdrawal rate based on varying self-funded amounts every month due to fluctuation in the market. According to this method, there is no longevity risk that self-funds are depleted throughout lifetime.

1. Introduction

It is a matter of concern whether it is possible to compensate for living expenses, including medical and nursing expenses, by public pension and self-funds after retirement[1]. There is a risk of longevity, i.e., the self-funds accumulated during working years may deplete before the end of life.

The purpose of this paper is to verify by using simulation analysis whether living costs after retirement including medical and nursing expenses can be maintained throughout lifetime with self-funds accumulated during working years. With this analysis, we can estimate the amount of self-funds to be spent every year.

According to the 'Family Income and Expenditure Survey (Fiscal Year 2019) published by the Ministry of Internal Affairs and Communications in Japan, the average expenditure of two-person households whose members are aged 60 years or above is about 270,000 yen. Average income such as monthly public pension for a household of elderly couple is 210,000

1) In this paper, "self-funds" is a portfolio consisting of domestic stocks and bonds.

yen. Hence, the shortage is 60,000 yen. It is necessary to supplement this shortage with self-funds which accumulated during working years. Simply put, it amounts to 720,000 yen (12 x 60,000 yen) in one year. Assuming the remaining lifetime after retirements is 30 years, the pensioner needs at least 21.6 million yen. Needless to say, the costs are not limited to living expenses. There may be unanticipated expenditures, and it goes without saying that it is necessary to save more in the case of inflation.

What is needed in the future is to spend out of self-funds, which were accumulated during working years, in addition to public pensions while investing self-funds over lifetime without depleting. For example, let's say you saved up little by little over 30 years from 35 to 65 years old and saved 30.9 million yen. If you spend 1.2 million yen each year for 30 years while managing this fund at an annual interest rate of 1%, the cash on hand will be zero at the end of the 30-year period. However, this calculation does not take inflation into account. Also, we assume that 1% interest rate remains unchanged for 30 years after retirement[2)]. Most of the studies in the literature about lifetime financial planning have been done in the United States because the burden of medical expenses is higher than in Japan.

According to Bengen (1994), a representative paper in this literature, annual withdrawal by 4% every year is safe while investing self-funds in stocks and bonds after the retirement. This is called Bengen's 4% rule.

2. Previous Studies

Cooley et al. (2003, hereafter CHW) reaffirmed the validity of the findings in Bengen (1994) using US data from 1946 to 2001. Pfau (2010) is the empirical study to test the validity of Bengen's 4% rule using Japanese data.

2) A certain withdrawal amount every year can be calculated using EXCEL's PMT function.

This study showed that Bengen's 4% rule is not valid for Japan, while 3 to 3.5% is valid. In addition, Shiroshita and Kinoshita (2013) showed using the method in CHW (2003), as used by Pfau (2010), that the safe withdrawal rate in Japan is lower than in the USA because the stock/bond performance is lower than in the USA.

We propose a safe withdrawal rate based on varying self-funded amounts every month due to fluctuations in the market rather than a fixed withdrawal rate from the original self-funds. According to this method, although the withdrawal amount received each year is different, there is no longevity risk that self-funds are depleted throughout lifetime. We also run additional tests and get the same result.

3. Simulation Analysis

3.1. Data

First, based on the method in CHW (2003), using Japanese data, we calculated the safe withdrawal ratio[3)] of self-funds and the accompanying ratio of bonds and stocks that enables it. This analysis is an extension of Shiroshita and Kinoshita (2013). We assume that the future rates of return are calculated based on historical data.

3) The probability of success for the safe withdrawal rate is not necessarily 100%. It is supposed to be around 75% in the USA. To illustrate, assume that the success probability of 3% for the withdrawal rate of self-funds is 75%. In general, it is considered that retirees live on public pensions and self-funds. Even if the probability of the depletion of self- funds is somewhat high, this may not pose a problem for people with high risk tolerance, because public pension can be reliably received. For example, it can be calculated by the success probability of the retiree's safe withdrawal rate = the public pension ratio multiplied by the success probability + the self-funds ratio multiplied by the success probability. If the public pension ratio and the self-funds ratio is 0.6:0.4 and the success probability of the withdrawal rate of the self-funds is 75%, the success probability of the retiree's safe withdrawal rate is 0.6 × 100% + 0.4 × 75% = 90%.

We calculated the monthly market rate of return on investments using domestic stock price and bond price from January 1966 to December 2018. To compute the monthly market rate of return, we used monthly stock data from the Japan Stock Exchange from January 1966 to December 2011, and market stock prices from Nikkei Media Marketing's Financial Quest from January 2012 to December 2018. Our monthly bond data consist of monthly data from Encorr of Ibotson from January 1966 to December 2011, and monthly bond data from Nikkei Media Marketing's Financial Quest from January 2012 to December 2018. To calculate the inflation rates for the same period, we used monthly consumer price index obtained from Encorr from January 1966 to December 2011 and the official inflation rates published by the Ministry of Internal Affairs and Communications Statistics Bureau from January 2012 to December 2018.

3.2. Fixed Withdrawal Ratio

We assume that the amount of self-funds is 10 million yen[4] in retirement. While investing self-funds in stocks and bonds, we withdraw up to 10% yearly from a certain withdrawal period (30 years), with an annual withdrawal rate ranging from 0.5% to 10% in increments of 0.5% on a yearly basis. However, the withdrawal rate is fixed for the original self-funds amounting to 10 million yen during the withdrawal period.

Suppose that the withdrawal rate is 3%. The annual withdrawal amount for 10 million yen is 300,000 yen. On a monthly basis, it is 25,000 yen of 0.25% every month. We withdraw a certain ratio while investing self-funds (10 million yen) in stocks and bonds for 30 years. In that case, we use the following asset allocations as combinations of stocks and bonds to invest

4) Since the simulation results depend on the withdrawal rate, the same result is obtained even if the amount of self-funds is 1 million yen, 100 million yen, or 1000 million yen.

the self-funds: (1) 100% stocks (2) 75% stocks, 25% bonds (3) 50% stocks, 50% bonds (4) 25% stocks, 75% bonds (5) 100% bonds. Asset allocation is rebalanced[5)] to the same rate as the first monthly asset allocation. Monte Carlo simulation[6)] is used to calculate the probability of success without depleting self-funds during the period. Monte Carlo simulation generates lognormal random numbers given the average and standard deviation of each rate of return and inflation rate and derives the rate of return on stocks and bonds and the inflation rate.

3.3. Methodology

The calculation is essentially the same as in Shiroshita and Kinoshita (2013).

$$V_t = V_{t-1} \times (1 + R_t) - W(1 + I_t)$$

where V_t: the amount of self-funds at the end of month t

V_{t-1}: the amount of self-funds at the end of month $t-1$

R_t: return on securities (stocks and bonds) in month t

W: nominal withdrawal amount

I_t: inflation rate at the end of month t

$W(1+I_t)$: real withdrawal amount at the end of month t

The empirical analysis is performed using Monte Carlo simulations as

5) Rebalancing means is selling financial instruments whose prices have risen, buying ones whose prices have fallen and maintaining a constant ratio for a fixed period. For example, suppose that the ratio of stocks and bonds in a portfolio of 10 million yen is 50:50, i.e., the initial values of the stocks and bonds are 5 million yen each. Then, assume that the value of the stocks rises to 6 million yen while value of the bonds does not change. In that case, we will sell stocks in the amount of 500,000 yen and buy bonds in the amount of 500,000 yen. Subsequently, after this change, the value of the stocks will be 5.5 million yen and that of bonds will be 5.5 million yen.

6) For the sake of brevity, we calculate only the real probability of success.

follows.

① Fix the withdrawal ratio, asset allocation, and period.

② Derive the returns of stocks and bonds and the inflation rate by generating third-log normal random numbers given the average values and standard deviations of stock and bond returns and the inflation rates.

③ Calculate the amounts of self-funds at the end of the month.

④ Derive the rate of return on stocks and bonds and the inflation rate in the following month.

⑤ Derive the amount of self-funds at the end of the month.

⑥ Repeat ④ and ⑤ until the final period.

⑦ Repeat this 1,000 times

⑧ If the amount of self-funds in the last month of the 1,000 trials is positive, the procedure succeeds, and if it goes to zero during the trial periods, it fails.

⑨ Calculate the probability of success based on the number of successes out of 1,000 trials. For example, if we succeed 800 times out of 1,000 trials, the probability of success is 80%.

3.4. Empirical Results

Table 1 presents descriptive statistics of our data. The monthly average and standard deviation of Japan's data we used are as follows. The monthly average return on stocks (bonds) is 0.45% (0.20%), and the standard deviation of the stock (bond) returns is 5.07% (1.09%). Average inflation rate is 0.23% and its standard deviation is 0.63%. Stocks have high average return and standard deviation compared to bonds. However, the average rate of return of bonds is slightly lower than average inflation rate while the standard deviation is higher.

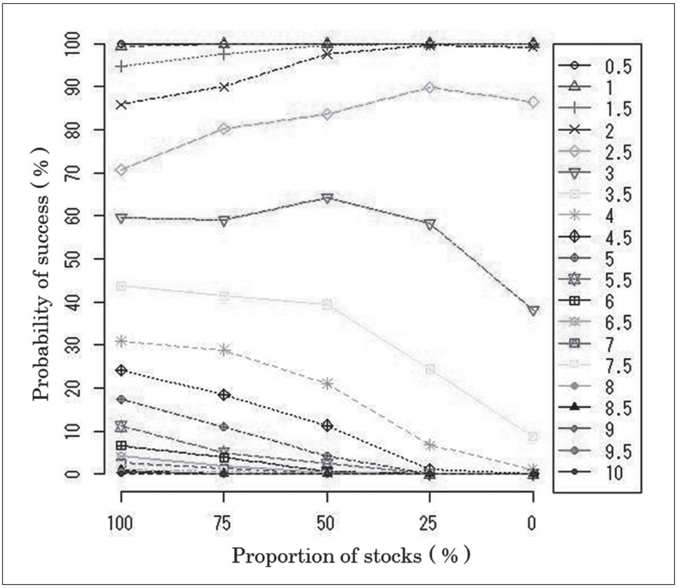
According to Figure 1, if we increase the weight of 30-year bonds and set the withdrawal ratio to 2%, the probability of success is almost 100%.

Table 1 Monthly average data

	1966－2018
Rate of stock return	0.45% (5.07)
Rate of bond return	0.20% (1.09)
Inflation rate	0.23% (0.63)

※Standard deviation in the brackets.

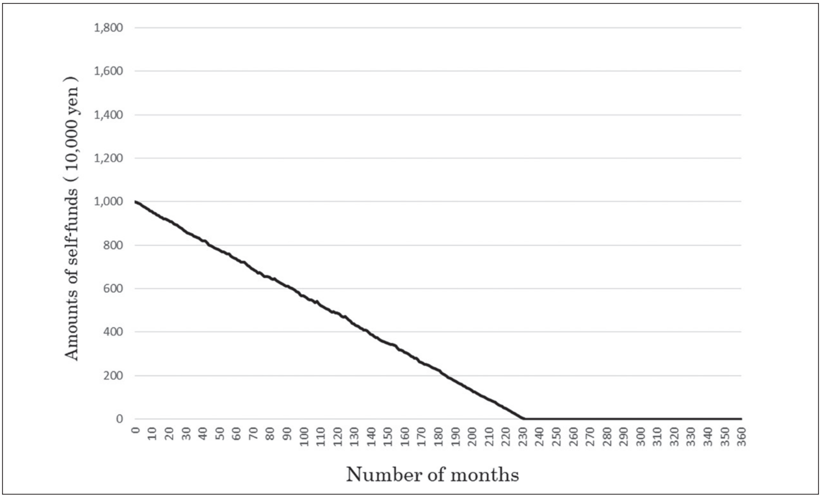
Figure 1 Real withdrawal and probability of success (30 years)



However, the probability of success decreases greatly as the withdrawal rate increases. If we withdraw 4%, the probability of success is only 30% even if the stock ratio is 100%. The withdrawal rate with success probability exceeding 80% is 2.5%, and the stock allocation ranges from 25% to 50%. This is lower than Bengen's safe withdrawal rate of 4%.

In Figure 2, the vertical axis represents the amount of self-funds and the horizontal axis represents the number of months. The further to the right in the horizontal axis, the more time elapses. If you withdraw 4%

Figure 2　4% withdrawal rate from original self-funds



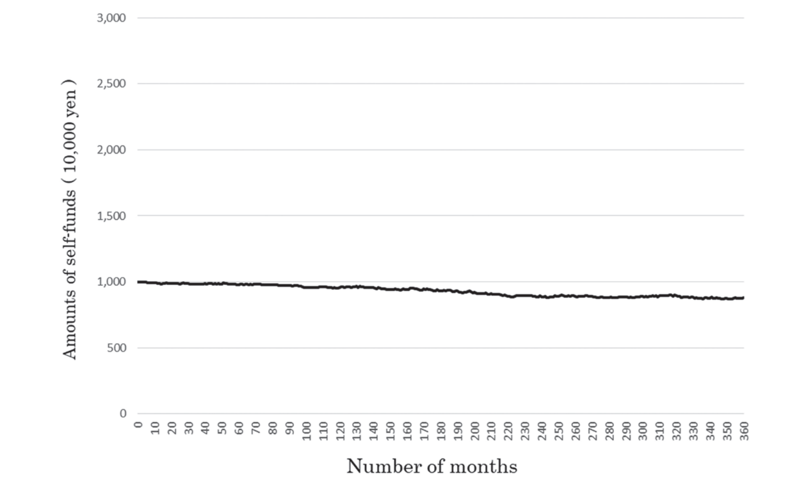
every year (i.e., 0.33% every month) while investing self-funds at a ratio of 50% of stocks and 50% of bonds, looking at the median, the self-funds will deplete after 230 months (nearly 19 years).

4. Additional Evidence

In this section, we assume that the withdrawal rate of self-funds of the previous month is constant. This calculation follows Shiroshita and Kinoshita (2013). What is different from the aforementioned assumption is that we do not withdraw a fixed amount of money from the original self-funds (10 million yen), but withdraw a fixed ratio of self-funds in the *previous* month. However, if the amount of self-funds in the previous month increases, more will be withdrawn even at the same ratio. Likewise, if the amount of self-funds decreases in the previous month, less will be withdrawn at the same ratio.

Figure 3 shows the monthly amount of self-funds (median) when we

Figure 3 4% withdrawalo f self-funds from previous month



withdraw 0.33% per month (4% every year) while investing with an asset allocation of 50% stocks and 50% bonds for a period of 30 years. Even if time passes, the amount of self-funds is not equal to zero. It is almost the same as the original self-funds, i.e., the probability of success is 100%.

Table 2 shows the real withdrawal rate, the probability of the success of withdrawal rate with an asset allocation of 50% of bonds and 50% of stock, the amount of self-funds (final portfolio values[7)]) and the amounts of self-funds according to various proportions of stocks.

As you can see from the table, in all cases, the probability of success is 100%. In the initial assumption, as the withdrawal rate from the original self-funds increases, the probability of success goes to zero. But if we withdraw from the self-funds of the previous month, the probability of success after 30 years becomes 100%. The amount of self-funds (median) of 14% will remain even if we withdraw 10% every year for 30 years. This is due to

7) The final portfolio value refers to the median value.

Table 2　Final portfolio value

Real withdrawal rate	Probability of success	Final portfolio value	Quintile of f inal portfolio value				
			95%	75%	50%	25%	5%
0.5%	100%	2.51	6.18	3.59	2.51	1.79	1.12
1.0%	100%	2.04	4.78	2.95	2.04	1.50	0.88
1.5%	100%	1.79	4.07	2.54	1.79	1.26	0.76
2.0%	100%	1.56	3.52	2.20	1.56	1.11	0.71
2.5%	100%	1.35	3.13	1.96	1.35	0.95	0.60
3.0%	100%	1.19	2.77	1.70	1.19	0.86	0.50
3.5%	100%	0.99	2.34	1.40	0.99	0.69	0.44
4.0%	100%	0.88	1.94	1.24	0.88	0.62	0.39
4.5%	100%	0.77	1.83	1.09	0.77	0.55	0.35
5.0%	100%	0.64	1.56	0.91	0.64	0.46	0.27
5.5%	100%	0.53	1.19	0.76	0.53	0.38	0.24
6.0%	100%	0.47	1.11	0.68	0.47	0.33	0.21
6.5%	100%	0.41	0.93	0.56	0.41	0.29	0.18
7.0%	100%	0.35	0.81	0.49	0.35	0.24	0.15
7.5%	100%	0.30	0.75	0.42	0.30	0.22	0.13
8.0%	100%	0.27	0.61	0.38	0.27	0.19	0.12
8.5%	100%	0.23	0.51	0.30	0.23	0.16	0.10
9.0%	100%	0.18	0.45	0.26	0.18	0.13	0.08
9.5%	100%	0.16	0.36	0.23	0.16	0.12	0.08
10.0%	100%	0.14	0.34	0.20	0.14	0.10	0.06

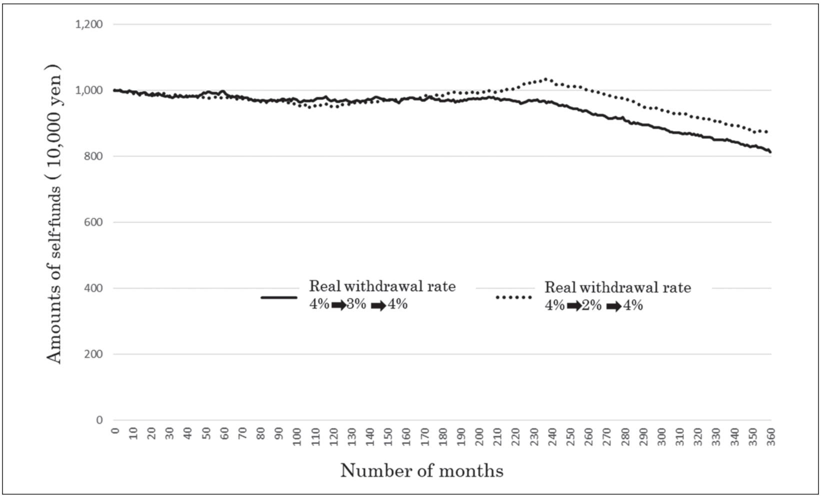
the difference in the amount of withdrawal even if the withdrawal rate is constant. In other words, if the market conditions are favorable, you can withdraw more. Otherwise, you will withdraw only a small amount, and the self-funds will not deplete in 30 years. However, needless to say, the self-funds will run short in the case of an adverse investment performance due to large expenses such as sickness and nursing care.

5. A More Realistic Simulation

Finally, we conduct a more realistic simulation in this section. The 30-year period is divided into three sub-periods as early-retirement, mid-retirement and late- retirement. In the early-retirement sub-period, we are relatively healthy, so expenses such as travel will increase. In the mid-retirement sub-period, we gradually reduce costs related to going out, and total costs will decrease. In the late-retirement sub-period, from the viewpoint of health. we expect medical expenses and nursing care expenses to increase.

In this section, we simulate the 4% annual withdrawal from the previous month's self-funds in early-retirement, annual withdrawal of 2% (3%) in mid-retirement and annual withdrawal of 4% in late-retirement. We also construct an asset allocation in which the ratio of risky assets such as stocks is reduced over time. We carried out a simulation using various asset allocations such as 50% stocks and 50% bonds in early-retirement, 20% stocks 80% bonds in mid-retirement and 0% stocks and 100% bonds in late-retirement. In all other aspects, the method of simulation is the same as in “additional evidence” section above and the withdrawal ratio is for the self-funds of the previous month. Figure 4 shows the trend for the median of self-funds. It can easily be seen that the self-funds never deplete. Over time, we observe that the self-funds decrease only gradually.

Figure 4　Realistic withdrawal rate



6. Conclusion

The probability of success depends on the withdrawal ratio, the composition of the assets, which are a combination of stocks and bonds, and the length of the period. We found in the initial evidence that if we increase the withdrawal rate for the original self-funds, the probability of success decreases. In other words, the risk of longevity increases.

The success probability of the withdrawal rate of self-funds of the previous month is 100% regardless of asset allocation, the withdrawal rate and the length of the period. In other words, self-funds never run out during lifetime. However, the withdrawal amount is not constant and if the market conditions deteriorate, less will be withdrawn even with the same withdrawal rate. In the worst case, there is a possibility that living expenses, including medical and nursing care expenses, may not be covered fully even if public pension is put in.

In order to make the simulation more realistic, we examined the case where the withdrawal ratio and the ratio of stocks/bonds were changed in the early-retirement, mid-retirement, and late-retirement periods. As in the case of the additional evidence, self- funds do not run out over the course of the lifetime. Put differently, the probability of success is 100%. One of the contributions of this evidence is that if the withdrawal rate based on self-funds of the previous month is appropriate, it will be possible to spend at a certain rate without zeroing self-funds during lifetime. In other words, it makes it possible to reduce the risk of living longer. However, the withdrawal amount may be affected by the market conditions, resulting in a shortage of funds for retirement life.

The findings of this study can be enriched and extended in the future by considering transaction costs and taxes. If we take transaction costs and taxes into consideration, the amount of expenditures is expected to decrease.

It will be necessary to conduct a more realistic simulation in the future. In addition, some individuals may withdraw more funds early which may allow them to live only on public pension in late-retirement. A simulation that reflects differences in risk tolerance across individuals will also be necessary.

It is expected that starting age to receive public pension payments will be delayed in the future. It is clear from this empirical research that the accumulation of self-funds during working years is also important to cope with such an uncertainty.

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