



Munich Personal RePEc Archive

## **Retirement savings guidelines for residents of emerging market countries**

Meng, Channarith and Pfau, Wade Donald

National Graduate Institute for Policy Studies, Japan

17 June 2011

Online at <https://mpra.ub.uni-muenchen.de/31682/>  
MPRA Paper No. 31682, posted 18 Jun 2011 15:37 UTC

# Retirement Savings Guidelines for Residents of Emerging Market Countries

by

Channarith Meng

Ph.D. Candidate, National Graduate Institute for Policy Studies (GRIPS)

7-22-1 Roppongi, Minato-ku, Tokyo 106-8677, Japan

[channarithmeng@yahoo.com](mailto:channarithmeng@yahoo.com)

and

Wade Donald Pfau

Associate Professor, National Graduate Institute for Policy Studies (GRIPS)

7-22-1 Roppongi, Minato-ku, Tokyo 106-8677, Japan

[wpfau@grips.ac.jp](mailto:wpfau@grips.ac.jp)

## Abstract

Most literature about retirement planning treats the working (accumulation) and retirement (decumulation) phases separately. The traditional approach decides on safe withdrawal rate, uses it to derive a wealth accumulation target, and then calculates the savings rate required to achieve this wealth target. Because low sustainable withdrawal rates tend to occur after bull markets, such a formulation will push individuals toward unnecessarily high savings rates to attain their desired retirement spending goals, reducing their feasible lifestyle prior to retirement. By jointly considering both phases of retirement planning, this study provides savings rate guidelines for individuals in 25 emerging market countries. The savings rates calculated here are those which provide an adequate success rate in financing desired retirement expenditures using bootstrapped Monte Carlo simulations. For many emerging market countries, these savings rates will be high, given the high volatility of returns for savings instruments and the inflationary environment. Starting to save early and using a relatively low stock allocation, a finding that contrasts with studies about the United States, provide the lowest necessary savings rate for a given probability of success.

**JEL Codes:** C15, D14, G11, G17, J26

**Keywords:** safe withdrawal rates, retirement planning, savings and wealth accumulation targets, asset allocations, emerging market countries

## **Introduction**

Retirement planning is a challenging issue for people around the world. In developed countries, demographic changes and the looming insolvency of pension systems have been widespread, and these countries are moving forward to reform their pension systems away from defined-benefit and toward defined-contribution pensions. This shifts to individuals the risks of retirement income volatility and sustainability, as well as responsibility for managing retirement portfolios. In less developed and emerging market countries, the trend toward defined-contribution pension systems is also becoming more apparent as well. But the trend is less important as emerging market pension systems cover only a relatively small fraction of the population, and often the amount of pension promises is small and inadequate. Annuity markets are also of limited availability in many of these emerging market countries. These issues underscore the increasing importance of individual responsibility and reliance for retirement planning.

Much retirement planning research at the individual level is about the United States. Importantly, a main focus of this literature is exploring methods and guidelines to help retirees manage their retirement wealth by choosing a sustainable withdrawal rate (For example, see Bengen, 1994, 2006; Guyton and Klinger, 2006; Spitzer, Strieter and Singh, 2007; Tezel, 2004). These studies provide various decision rules about safe withdrawals that retirees can use to make withdrawal decisions. An example of these guidelines is the popular 4 percent withdrawal rule, which suggests that retirees can safely sustain their retirement withdrawals without outliving their wealth, if they initially withdraw 4 percent of their savings and adjust this amount for inflation in subsequent years. However, the recommendations from these studies do not capture the whole retirement planning process. This becomes apparent in a situation where individuals unknowingly over-consume during their working lives and end up with small accumulated savings at retirement. In such a case, they will be forced to dramatically reduce their living standard after retirement. Saving too

much, or not withdrawing enough are two possibilities that could also lead to an undesired reduction in living standards. The retirement planning process and guidelines are more important and meaningful if they involve smoothing lifetime consumption rather than retirement consumption.

Ibbotson, Xiong, Kreitler, Kreitler, and Chen (2007) create savings guidelines for individuals who want to sustain their pre-retirement lifestyle to smooth their lifetime consumption in to their retirement. They use a Monte Carlo simulation approach to project how much savings are necessary for individuals to maintain their pre-retirement lifestyle with 80 percent of pre-retirement net income. Ervin, Faulk, and Smolira (2009) also use a Monte Carlo simulation approach to examine the savings rates required for individuals to sustain their pre-retirement income levels of 80 and 100 percent replacement rates. They assume a specified income level for the individual at retirement (\$100,000 in their study) and investigate how much savings rates need to be adjusted when varying the saving and retirement periods, varying investment portfolio weights, and excluding Social Security income. These studies are based on past U.S. data, which covers a fortuitous period for any country in world history with high stock returns and low volatility. Such a record is not likely to be obtainable in other countries or even in the future U.S. (see, for example, Bogle, 2009; Dimson, Marsh, and Staunton, 2004; Krugman, 2005; Pfau, 2010).

It is possible that retirement planning in pursuit of lifetime consumption smoothing can be accomplished with safe withdrawal rules by deriving a wealth accumulation target for retirement (obtained by dividing the desired income replacement rate by the withdrawal rate that a retiree feels comfortable using), and then calculating the savings rate needed during the working years to obtain the wealth accumulation target. For example, a person who follows the 4 percent safe withdrawal rule and desires an 80 percent replacement of their final pre-retirement income for their retirement expenditures will need 20 times their final income as accumulated wealth at retirement if no other pensions or income sources are available.

Knowing this target, they can plan their savings during their working period to reach it. However, such an approach that considers the accumulation phase and decumulation phase separately misses out on incorporating mean reversion (Pfau, 2011). A worst-case accumulation period will rarely be followed by a worst-case retirement period. This means saving more than was necessary in many cases. Instead, both the accumulation and decumulation phases should be combined into one integrated whole, providing guidelines in terms of safe savings rates for individuals to follow which are sufficient to finance their planned retirement expenditures.

Moreover, this research on providing savings guidelines is very important to induce more awareness and knowledge for people to prepare for their retirement planning, as surveys conducted across OECD countries and worldwide consistently show disturbingly low and insufficient knowledge of individuals to prepare savings for their retirement (Baldwin, 2008). Such trends could also be expected for individuals in emerging market countries as well. Our objective is to consider the retirement planning process by integrating the working and retirement phases and to provide savings guidelines for individuals in 25 emerging market countries.

## **Data and Methodology**

This study uses data from a variety of sources available through the end of 2009. Firstly, returns on domestic stocks for the 25 countries are obtained from the MSCI Stock Indices. They are calculated as the annual percentage change at year end for the MSCI Standard Core Gross Indices. We use domestic currency deposit rates, taken from the International Monetary Fund's International Financial Statistics (IFS), to represent the local fixed income returns. Some exceptions are that we use the central bank discount rate for India and Jordan in 1988-89 and the call money rate for Pakistan. Also, for Poland, there was a change in the methodology for reporting deposit rates in 2002 and we make adjustments so that rates remain consistent after this. Inflation rates are also taken from the IFS. We exclude

the period of hyperinflation occurring in Argentina and Brazil, which were extraordinary and would severely affect the realism of our simulation results. The analysis will be conducted in real terms. Even though we would also like to consider short-term and long-term government debt instruments, such data is not available for many of the emerging countries.

Our approach starts from the point where an individual chooses a fixed proportion of their income to save each year for retirement. These savings are invested in a portfolio with domestic stocks and fixed income. Given the accumulated savings at retirement, the individual starts to take inflation-adjusted withdrawals that are fixed in real terms each year from the savings portfolio for a certain number of retirement years. A particular savings rate is considered successful if it provides enough wealth at retirement to sustain the desired withdrawals for the retirement duration without exhausting wealth.

In order to determine the savings rates, we need to define initial parameters during the individual's working and retirement life, including initial wealth, career length, income path, replacement rate, retirement duration, and portfolio asset allocation. We consider a hypothetical individual who starts with an arbitrary value of salary. The salary grows at 1 percent in real terms every year for a 30-year career length. The individual contributes to the retirement savings portfolio at the end of each year with a constant proportion of their salary. Estimating an appropriate savings rate is the objective. Our analysis does not incorporate other pension or income sources, which would reduce the necessary replacement rate from savings as well as the necessary savings rate accordingly. Even though we do not consider social security benefits, our results will still provide a useful guide for those who are covered by it, since necessary withdrawal amounts from savings can be reduced by the amount of other income sources.

After saving for 30 years, the individual begins retirement and takes withdrawals from their accumulated wealth. We consider fixed withdrawals amounting to 60, 80, and 100 percent replacement rates from pre-retirement net income, which is defined as gross income

less savings for retirement. An 80 percent replacement rate is considered because there is widespread agreement that the retirement income needed to maintain a person's living standard is less after retirement (for example, see Munnell, 2005) due to the elimination of some taxes and costs such as mortgage payments and children's schooling. We consider a 60 percent replacement rate for some individuals who might receive social security benefits or income from other sources, and a 100 percent replacement rate for those wishing to maintain the same expenditures. As mentioned by Ibbotson et al. (2007), using net income is a realistic approach and helps retirees avoid dramatic changes in lifestyle. Basing the retirement income target on gross income could confuse an individual into saving more unnecessarily. We assume a 20-year retirement duration in which fixed withdrawal amounts (in real purchasing power) are made at the beginning of each year as an amount equal to the defined replacement rate of pre-retirement net income.

We consider the case where individuals self-manage their savings and retirement portfolio. They invest in domestic assets and remain responsible for all risks related to investment returns and longevity. This self-management of the retirement portfolio, in particular, should reflect the current and future trend in emerging market economies where pension reforms from defined-benefit towards defined-contribution pension plans have been extensive, while the annuity markets are still underdeveloped or non-existent.

With the data, we use a bootstrapping approach, in which the annual in-sample returns are randomly selected with replacement by year to form a variety of hypothetical asset paths over the lifecycle. We simulate 10,000 hypothetical return sequence paths for each country. For each return sequence in each country, we optimize across the two domestic assets, finding the fixed asset allocation that allows for the lowest savings rate to meet the retirement spending goals. In so doing, we assume that individuals have perfect foresight to choose the fixed asset allocation that would achieve the lowest savings rates for sustaining 20 years of withdrawals in retirement. We will relax this assumption as well by showing how the savings

rates change for various asset allocations. We consider 21 possibilities for fixed asset allocations, ranging in 5 percentage point increments from 0 to 100 percent stocks, with the remainder of assets in fixed income. We assume that the investment portfolio will be rebalanced without considering tax implications and transaction costs at the end of the year to maintain the targeted asset allocation.

## **Results**

*// Table 1 About Here //*

Table 1 provides summary statistics for 25 emerging market countries. The statistics are provided for the available period in real terms after removing the effect of inflation. Stocks provide double-digit average returns for most countries, except China, Israel, Jordan, Morocco, and Poland. However, their volatility, as measured by standard deviation, is also very high. The standard deviation of stock returns for most countries is more than twice as high as the mean and even more than thrice as high for some countries. This demonstrates the high risks prevailing in the stock markets of emerging market countries. On the other hand, fixed income assets, in general, provide relatively low average returns in these countries, compared to stocks. Fixed income assets provide less than 5 percent average real returns, except in Brazil, and even negative returns for some countries. However, the lower returns for most countries are also accompanied by less volatility and risk, compared to stocks. Inflation rates are also high with an average of more than 6 percent for many countries. Brazil, Columbia, Hungary, Indonesia, Mexico, Russia, Sri Lanka, and Turkey experienced an average double-digit inflation rate. Table 1 also provides the correlations between stocks and fixed income assets. As seen, the correlation coefficients are small for most countries and negative for some countries, implying potential diversification benefits.

*// Table 2 About Here //*

Table 2 shows the minimum necessary savings rates calculated from the integrated approach, which jointly considers both the working and retirement phases, and the minimum

necessary savings rates calculated from the isolated approach, which are the savings rates needed to achieve the retirement wealth target that was calculated to provide the necessary wealth for the estimated safe withdrawal rate at the same percentile. The table is based on a 30-year work period, 20-year retirement period, 1 percent annual real wage growth, a 30/70 percent asset allocation to stocks and fixed income assets during the entire 50-year period, and an 80 percent replacement of pre-retirement net income. For the 90, 95, and 99 percent success rates (in other words, 90<sup>th</sup>, 95<sup>th</sup>, and 99<sup>th</sup> percentiles of the simulations), the minimum necessary savings rates obtained from the isolated approach are higher than those obtained from the integrated approach. The difference between the savings rates from both approaches varies across countries, ranging from 2 percentage points to more than 10 percentage points. This difference is larger for higher percentiles as well. The reason for these differences is because the isolated approach is doubly pessimistic. First, a safe withdrawal rate is chosen with a particular success rate. Separately, the savings rate needed to provide enough wealth to sustain this withdrawal is calculated for the same percentile. This is too pessimistic because the chances of experiencing a bad luck scenario both before and after retirement are not related in this way. In fact, for U.S. data, Pfau (2011) shows the opposite to be the case due to mean reversion in stock returns and market valuations. The integrated approach here provides a lower savings rate for a particular level of confidence because it allows for independence between the pre- and post-retirement periods. This is why it is more appropriate to consider the accumulation and retirement phases together.

// Table 3 About Here //

Table 3 provides results for the minimum necessary savings rates over 30 years of work and 20 years of retirement required to attain 60, 80 and 100 percent replacement rates of pre-retirement net income with 90, 95, and 99 percent success rates. This table incorporates the perfect foresight assumption, using the asset allocation for each simulation that provides the lowest savings rate. Figure 1 will show more about the results for varying asset

allocations. By looking at the minimum necessary savings rates for the 80 percent replacement rate, the results show that individuals in most of the countries need high savings rates to smooth their lifetime consumption. If we allow for a 90 percent success rate, only individuals in 3 out of 25 countries (Chile, Brazil, and Peru) experiences sustainable savings rates of less than 10 percent. Individuals in 17 countries would need more than 20 percent savings rates, and 7 countries (Czech Republic, Pakistan, Jordan, Sri Lanka, China, and particularly Russia) need 30 percent or higher. The impossibly high savings rates needed in Russia result from the very high volatility of stock returns and the extraordinarily high inflation rate. If we focus on improved chances for success, higher savings rates are necessary. For example, with a 99 percent chance for success, individuals in 13 countries need more than a 30 percent savings rate. The table also considers a 60 percent replacement rate and a 100 percent replacement rate. Naturally, savings rates and replacement rates are positively related, and this additional information provides more perspective about their relationship. The results show that necessary savings rates increase by between 20 and 25 percent of the current savings rates for many countries when the desired replacement rate (of pre-retirement net income) increases from 60 to 80 percent, and between 15 and 20 percent when the desired replacement rate increases from 80 to 100 percent.

*// Table 4 About Here //*

Table 4 shows the minimum necessary savings rates to attain an 80 percent replacement of pre-retirement net income for varying career lengths and success rates. Longer savings periods produce a remarkable effect in lowering safe savings rates. At a 90 percent success rate, individuals who save for only 20 years will require in some countries a more than doubling of the 30-year savings rate. Individuals in only 2 countries, Brazil and Chile, can afford an 80 percent replacement rate with a less than 20 percent savings rate, while 18 countries need 30 percent or higher savings rates. On the other hand, with 40 years of saving, individuals in 16 countries may save less than 20 percent. Among them, 7 countries need

lower than 10 percent savings rates. As the replacement rate is calculated as a percentage of pre-retirement net income, lower necessary savings rates also mean higher absolute retirement income. Looking at higher probabilities for success, the results are more terrifying for the individuals who do not start to save early enough. Overall, given the high savings rates needed for most emerging markets due to the high volatility of saving instruments and inflation, the results suggest that individuals should start saving as early as possible.

// Figure 1 About Here //

Figure 1 shows the optimal asset allocations to achieve the minimum necessary savings rates shown in Table 3 for various success rates. Interestingly, the results from Figure 1 reveal that for most countries, the optimums occur with a low proportion of stocks. This is in contrast to many previous studies about the U.S., a country which is characterized by quite favorable market conditions and a well-developed financial system. Between the 90 percent and 99 percent success rates, the optimums occur at points with a less than 40 percent stock allocation for most countries except Chile, Peru, and Mexico at the 90, 95 and 99 percent success rates, Egypt and Czech Republic at the 90 and 95 percent success rates, and Colombia, South Africa, and Hungary at the 90 percent success rate.

// Figure 2 About Here //

Finally, Figure 2 illustrates the distribution of the minimum necessary savings rates with a 95 percent chance of success across stock allocations for each country. The smallest savings rate is labeled with the country's name code. The figure shows that the optimal stock allocation is low in many countries, and that savings rates often slope upward above about 30 percent stocks. Allocating a high proportion to stocks tends to increase necessary savings rates in these emerging markets.

## **Conclusion**

While much retirement planning literature focuses on finding ways for retirees to safely withdraw their accumulated wealth so that they smooth their consumption during

retirement, these studies capture only a part of retirement planning. The full retirement planning process involves both the accumulation and decumulation phases. It is possible that from the concept of safe withdrawal rates, individuals can work to achieve a wealth target. However, such an approach is doubly pessimistic, and to capture a necessary savings rate with a particular chance for success, we recommend connecting the entire lifecycle and determining the savings rate required to finance retirement expenditures without regard for the actual implied withdrawal rate. Savings rates calculated in this manner are lower and more reflective of the intended risk level.

Even though the savings rates necessary to attain a desired replacement rate vary across the 25 emerging market countries, our results show that the situation in most of these countries would require high savings rates to safely provide for planned retirement expenditures. The savings rates, of course, are higher for individuals who desire higher success probabilities or higher income replacement rates. Individuals in emerging market countries should start saving early, as longer savings periods can dramatically reduce the required savings rate, given the high volatility of saving instruments and the inflationary environment in these countries. With regard to asset allocation for the saving and retirement portfolios, our study indicates that stocks do not play a large role in the optimal allocation for most emerging market countries.

## **References**

- Baldwin, B. (2008). The shift from DB to DC coverage: A reflection on the issues. *Canadian Public Policy*, 34, 29-37.
- Bengen, W. P. (1994). Determining withdrawal rates using historical data. *Journal of Financial Planning*, 7, 1, 171-180.
- Bengen, W. P. (2006). *Conserving Client Portfolios During Retirement*. Denver: FPA Press.
- Bogle, J. C. (2009). *Enough: True measure of money, business, and life*. New Jersey: John Wiley and Sons.

- Dimson, E., Marsh, P., & Staunton, M. (2004). Irrational optimism. *Financial Analysts Journal*, 60, 1, 15-25.
- Ervin, D. M., Faulk, G. K., & Smolira, J. C. (2009). The impact of asset allocation, savings and retirement horizons, savings rates, and social security income in retirement planning: A Monte Carlo Analysis. *Financial Services Review*, 18, 313-331.
- Guyton, J. T. & Klinger, W. J. (2006). Decision rules and maximum initial withdrawal rates. *Journal of Financial Planning*, 19, 3, 49-57.
- Ibbotson, R., Xiong, J., Kreitler, R. P., Kreitler, C. F., & Chen, P. (2007). National savings rate guidelines for individuals. *Journal of Financial Planning*, 20, 4, 50-61.
- Krugman, P. (2005). Confusions about social security. *The Economist's Voice*, 2, 1, 1-8.
- Munnell, A. H. (2005). *Trends and issues: Do people save enough for retirement?* (TIAA-CREF Institute Report 05/05).
- Pfau, W. D. (2010). An international perspective on safe withdrawal rates from retirement savings: The demise of the 4 percent rule? *Journal of Financial Planning*, 23, 12, 52-61.
- Pfau, W. D. (2011). Safe savings rates: A new approach to retirement planning over the lifecycle. *Journal of Financial Planning*, 24, 5, 42-50.
- Spitzer, J. J., Strieter, J. C., & Singh, S. (2007). Guidelines for withdrawal rates and portfolio safety during retirement. *Journal of Financial Planning*, 20, 10, 52-59.
- Tezel, A. (2004). Sustainable retirement withdrawals. *Journal of Financial Planning*, 17, 7, 52-57.

**Table 1: Summary Statistics**

Country	Start year (End year is 2009 in all cases)	Real Stocks Returns		Real Fixed Income Returns		Inflation		Correlation between Stocks and Fixed Income assets
		Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	
Argentina	1992	11.5	37.8	3.6	6.4	7.2	8.1	-0.15
Brazil	1995	19.1	47.8	9.5	7.3	11.0	15.6	0.30
Chile	1988	18.0	29.5	3.4	3.4	8.4	6.9	-0.09
China	1993	4.7	45.9	-0.2	3.8	4.9	7.3	0.31
Columbia	1993	18.7	41.3	4.4	3.4	11.6	7.2	-0.59
Czech Republic	1995	11.7	30.4	-1.0	1.6	4.5	3.4	0.56
Egypt	1995	30.0	62.6	1.3	5.3	7.3	5.0	0.09
Hungary	1995	18.4	47.6	0.8	2.7	10.4	7.6	-0.23
India	1993	13.9	39.8	1.2	2.6	6.8	3.0	0.04
Indonesia	1988	23.9	67.3	4.6	5.9	11.2	11.1	0.09
Israel	1993	8.9	30.2	2.8	2.8	5.0	4.3	0.34
Jordan	1988	6.7	29.6	1.0	5.2	5.5	6.1	0.20
Korea	1988	10.7	37.4	2.8	1.9	4.6	2.2	0.04
Malaysia	1988	12.0	35.1	1.8	1.5	2.9	1.3	0.06
Mexico	1988	18.6	34.6	-1.2	7.2	17.7	23.7	0.26
Morocco	1998	7.9	22.8	2.6	1.6	1.9	1.1	-0.30
Pakistan	1993	16.5	53.6	0.3	3.3	8.6	4.6	0.16
Peru	1993	21.0	38.0	-0.4	7.0	8.3	11.9	0.04
Philippines	1988	10.8	44.1	1.7	2.4	7.4	3.6	-0.08
Poland	1994	2.0	34.3	2.1	2.2	9.4	9.9	-0.14
Russia	1995	14.4	60.0	-9.9	11.5	34.2	49.4	0.19
South Africa	1993	10.4	22.8	3.7	2.4	6.9	2.5	-0.06
Sri Lanka	1993	12.7	55.8	-0.1	4.1	10.3	4.7	0.45
Thailand	1988	15.1	51.0	2.5	2.9	3.8	2.3	0.07
Turkey	1988	39.1	120.6	2.0	8.4	52.1	31.2	0.04

*Source: Own calculations using data described in Data and Methodology section*

**Table 2: Minimum Necessary Savings Rates under Integrated and Isolated Approaches**

Country	90 <sup>th</sup> percentile		95 <sup>th</sup> percentile		99 <sup>th</sup> percentile	
	Integrated Approach	Isolated Approach	Integrated Approach	Isolated Approach	Integrated Approach	Isolated Approach
Brazil	8.4	10.7	10.4	13.8	14.8	21.9
Columbia	13.2	15.6	15.0	18.4	19.0	24.8
Chile	13.6	15.7	15.1	18.0	18.0	22.8
Indonesia	15.9	20.7	19.3	26.7	26.6	39.4
Egypt	17.2	22.3	21.1	29.4	30.5	44.7
South Africa	19.0	20.9	20.4	23.1	23.5	27.7
Argentina	23.8	28.2	27.1	33.7	34.7	45.7
Peru	24.4	29.0	27.7	34.0	34.7	44.4
Morocco	24.6	26.9	26.1	29.3	29.2	34.4
Hungary	25.2	30.4	29.0	35.8	36.1	46.9
Korea	26.5	30.8	29.2	35.5	35.6	44.4
Turkey	26.5	38.7	34.2	51.1	50.5	71.9
Malaysia	26.5	30.5	29.3	34.7	34.4	43.2
Thailand	26.7	32.3	30.6	38.8	38.2	50.4
Israel	27.1	31.1	29.8	35.4	35.7	43.9
India	28.7	33.6	32.0	39.0	38.2	50.6
Mexico	30.6	35.9	34.4	42.2	41.9	54.4
Philippines	32.1	37.6	36.0	43.0	42.9	53.3
Pakistan	34.4	41.8	39.7	49.8	49.2	64.0
Czech Republic	36.0	40.6	39.5	45.4	45.7	54.6
Jordan	37.5	42.6	40.8	47.5	47.8	57.9
Poland	40.9	46.1	44.8	51.4	51.8	60.6
Sri Lanka	42.9	50.3	47.9	57.5	56.9	70.3
China	53.2	60.6	58.2	67.2	66.6	77.1
Russia	85.1	89.8	88.9	93.4	94.1	97.3
Mean	29.6	34.5	33.1	39.8	39.9	49.9
Median	26.5	31.1	29.8	35.8	36.1	46.9
Minimum	8.4	10.7	10.4	13.8	14.8	21.9
Maximum	85.1	89.8	88.9	93.4	94.1	97.3

*Note: Results are based on a 30-year working period, 20-year retirement period, 1 percent annual real wage growth, 30/70 asset allocation of stocks and fixed income assets, and 80 percent replacement rate for pre-retirement net income*

**Table 3: Minimum Necessary Savings Rates with Perfect Foresight Assumption  
(30 working and 20 retirement years)**

Country	60% of Pre-retirement Net Income			80% of Pre-retirement Net Income			100% of Pre-retirement Net Income		
	90% success rate	95% success rate	99% success rate	90% success rate	95% success rate	99% success rate	90% success rate	95% success rate	99% success rate
Chile	5.3	7.7	12.9	7.0	10.0	16.5	8.6	12.2	19.8
Brazil	6.1	7.0	8.8	8.0	9.2	11.5	9.8	11.2	13.9
Peru	7.7	12.4	23.9	9.9	15.9	29.5	12.1	19.1	34.4
Mexico	7.9	11.6	22.0	10.3	14.9	27.3	12.5	18.0	32.0
Egypt	9.8	14.8	24.7	12.7	18.8	30.5	15.4	22.4	35.4
Columbia	9.9	11.7	13.6	12.8	15.0	17.4	15.5	18.1	20.8
Indonesia	12.4	14.8	18.8	15.9	18.8	23.6	19.1	22.5	27.8
South Africa	14.5	16.1	17.9	18.5	20.4	22.5	22.1	24.3	26.6
Argentina	18.3	20.2	23.6	23.0	25.2	29.2	27.2	29.6	34.0
Hungary	19.0	23.4	28.0	23.8	28.9	34.1	28.0	33.7	39.3
Morocco	19.6	20.3	21.3	24.5	25.4	26.5	28.9	29.8	31.1
Korea	19.8	20.6	21.6	24.8	25.7	26.9	29.1	30.2	31.5
Thailand	20.6	22.0	23.8	25.7	27.3	29.4	30.1	32.0	34.3
Turkey	20.8	25.4	33.3	25.9	31.3	40.0	30.5	36.3	45.5
Israel	20.9	21.9	23.4	26.0	27.3	28.9	30.6	31.9	33.7
Malaysia	21.2	23.2	25.0	26.4	28.7	30.8	31.0	33.5	35.7
India	23.1	25.7	28.7	28.6	31.6	34.9	33.4	36.6	40.1
Poland	23.9	24.4	25.4	29.5	30.1	31.2	34.4	35.0	36.2
Philippines	24.3	25.4	27.0	30.0	31.2	33.1	34.8	36.2	38.2
Czech Republic	24.7	31.1	38.5	30.4	37.5	45.5	35.3	42.9	51.0
Pakistan	28.0	31.1	35.0	34.1	37.6	41.8	39.3	43.0	47.3
Jordan	30.5	32.9	37.3	37.0	39.6	44.2	42.3	45.0	49.8
Sri Lanka	34.7	37.3	40.9	41.5	44.3	47.9	47.0	49.8	53.5
China	37.0	38.2	41.1	43.9	45.2	48.2	49.4	50.8	53.8
Russia	81.0	85.6	91.1	85.0	88.8	93.2	87.7	90.8	94.5
Mean	21.6	24.2	28.3	26.2	29.1	33.8	30.2	33.4	38.4
Median	20.6	22.0	24.7	25.7	27.3	30.5	30.1	32.0	35.4
Minimum	5.3	7.0	8.8	7.0	9.2	11.5	8.6	11.2	13.9
Maximum	81.0	85.6	91.1	85.0	88.8	93.2	87.7	90.8	94.5

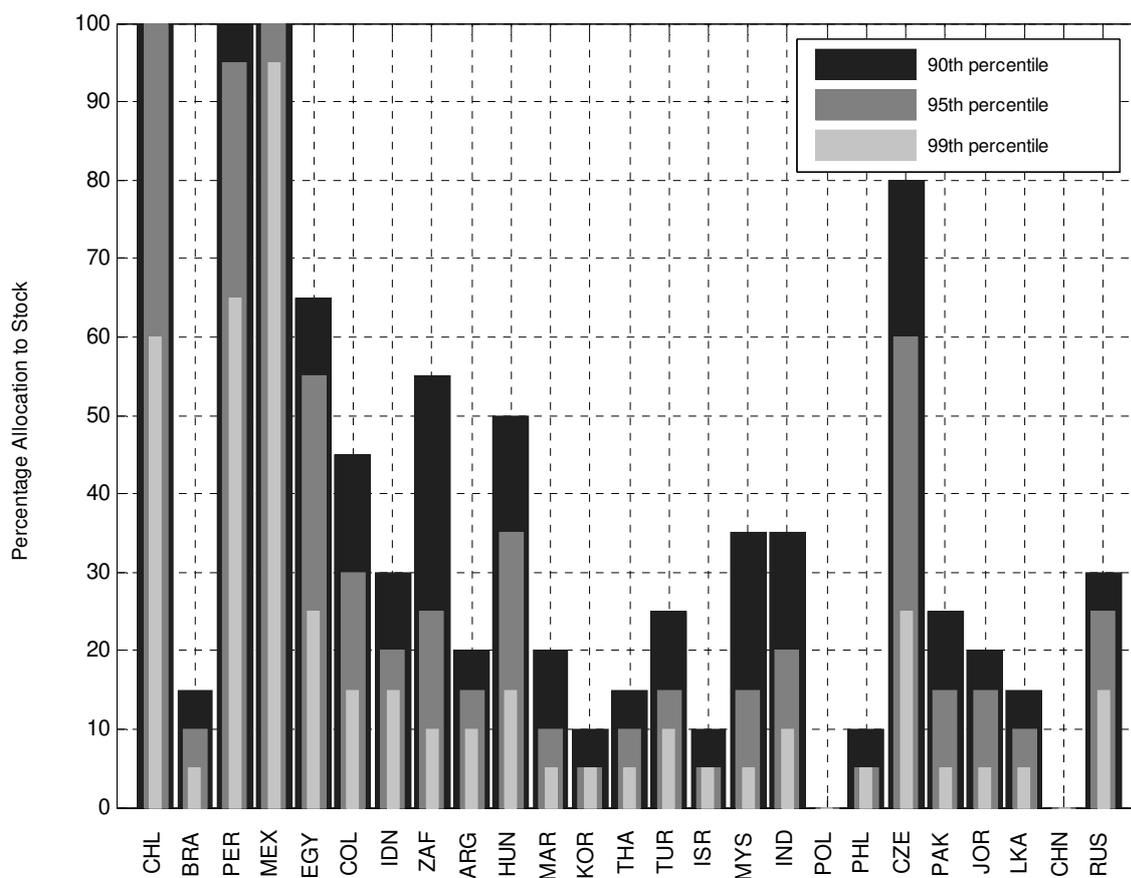
*Note: Assumptions include perfect foresight, a 30-year saving duration, 20-year retirement duration, 1 percent annual real wage growth, no administrative fees, and annual rebalancing*

**Table 4: Minimum Necessary Savings Rates to attain 80 percent of Pre-retirement Net Income**

Country	90% Success Rate			95% Success Rate			99% Success Rate		
	40/20 working/ retirement years	30/20 working/ retirement years	20/20 working/ retirement years	40/20 working/ retirement years	30/20 working/ retirement years	20/20 working/ retirement years	40/20 working/ retirement years	30/20 working/ retirement years	20/20 working/ retirement years
Chile	2.7	7.0	17.8	4.1	10.0	22.6	8.8	16.5	29.9
Brazil	3.6	8.0	17.6	4.3	9.2	19.4	5.8	11.5	22.6
Peru	4.1	9.9	22.8	7.2	15.9	30.6	17.7	29.5	43.0
Mexico	4.3	10.3	23.0	7.0	14.9	29.8	16.0	27.3	45.3
Egypt	5.9	12.7	26.5	10.0	18.8	32.9	20.7	30.5	43.4
Columbia	6.7	12.8	24.1	8.6	15.0	26.3	10.9	17.4	28.7
Indonesia	8.9	15.9	27.7	11.4	18.8	30.8	16.0	23.6	35.9
South Africa	11.5	18.5	30.0	13.6	20.4	31.5	15.6	22.5	33.4
Hungary	15.6	23.8	36.8	20.6	28.9	40.7	27.1	34.1	44.5
Argentina	16.0	23.0	34.3	17.9	25.2	36.5	21.6	29.2	40.5
Turkey	17.4	25.9	39.0	22.9	31.3	44.1	31.8	40.0	51.5
Morocco	17.7	24.5	35.2	18.8	25.4	35.9	19.8	26.5	37.0
Korea	18.1	24.8	35.4	19.0	25.7	36.1	20.2	26.9	37.4
Thailand	18.5	25.7	36.6	20.3	27.3	38.2	22.8	29.4	40.3
Malaysia	19.1	26.4	37.7	21.6	28.7	39.3	24.1	30.8	41.0
Israel	19.3	26.0	36.7	20.4	27.3	37.7	22.1	28.9	39.6
India	20.4	28.6	40.0	24.2	31.6	42.3	28.1	34.9	45.0
Czech Republic	21.3	30.4	43.4	28.9	37.5	48.7	39.2	45.5	54.1
Poland	23.1	29.5	39.6	23.7	30.1	40.2	24.8	31.2	41.4
Philippines	23.4	30.0	40.3	24.7	31.2	41.4	26.3	33.1	43.2
Pakistan	26.7	34.1	44.9	30.6	37.6	47.5	35.9	41.8	51.0
Jordan	30.5	37.0	46.9	33.2	39.6	49.3	38.1	44.2	53.4
Sri Lanka	35.1	41.5	50.9	38.3	44.3	52.9	42.5	47.9	56.3
China	38.7	43.9	52.0	40.2	45.2	53.4	43.2	48.2	56.1
Russia	84.0	85.0	86.9	88.1	88.8	89.9	92.9	93.2	93.9
Mean	19.7	26.2	37.0	22.4	29.1	39.9	26.9	33.8	44.3
Median	18.1	25.7	36.7	20.4	27.3	38.2	22.8	30.5	43.0
Minimum	2.7	7.0	17.6	4.1	9.2	19.4	5.8	11.5	22.6
Maximum	84.0	85.0	86.9	88.1	88.8	89.9	92.9	93.2	93.9

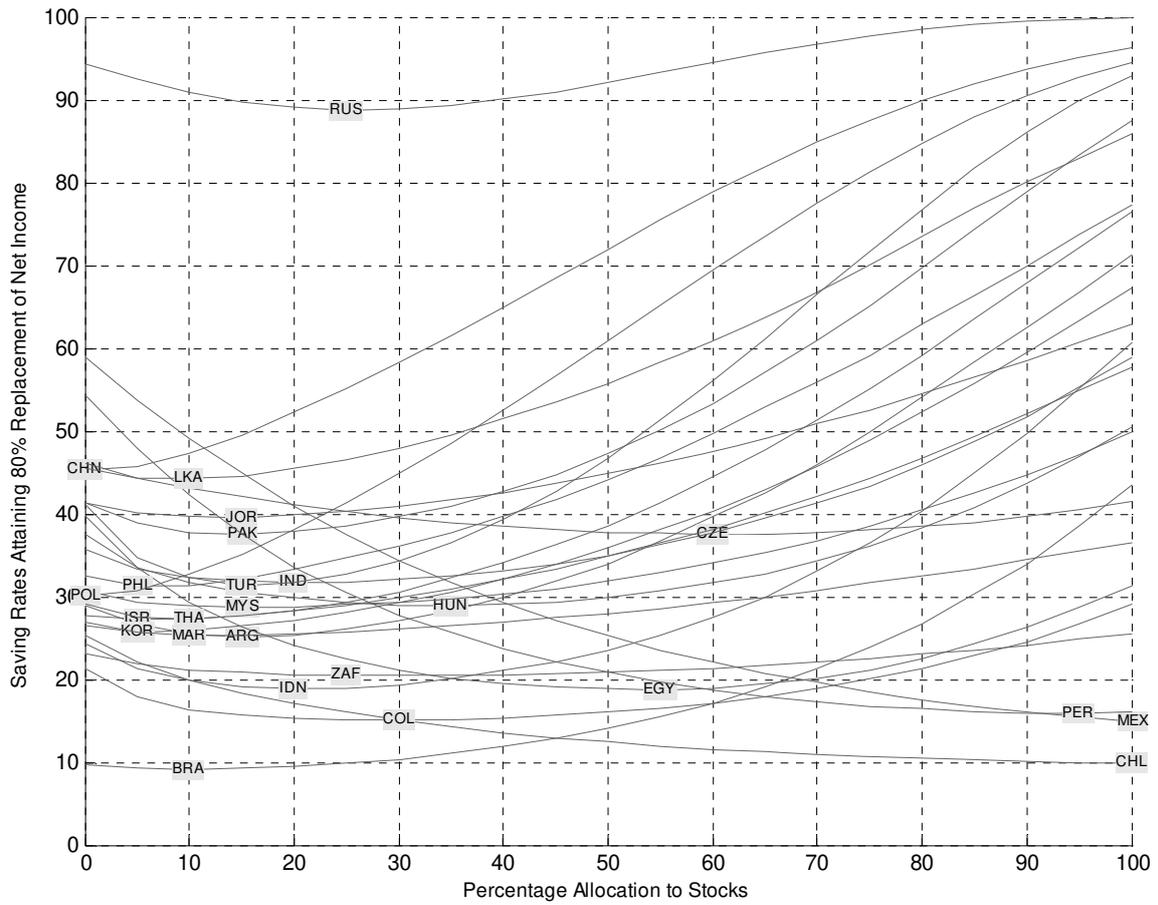
*Note: Assumptions include perfect foresight, a 30-year saving duration, 20-year retirement duration, 1 percent annual real wage growth, no administrative fees, and annual rebalancing.*

**Figure 1: Optimal Stock Allocation for Savings Rates at Various Success Rates**



*Note: Assumptions include perfect foresight, 80 percent replacement of pre-retirement net income, a 30-year saving duration, 20-year retirement duration, 1 percent annual real wage growth, no administrative fees, and annual rebalancing.*

**Figure 2: Savings Rate by Various Stock Allocation at 95 Percent Success Rate**



*Note: Assumptions include 80 percent replacement of pre-retirement net income, a 30-year saving duration, 20-year retirement duration, 1 percent annual real wage growth, no administrative fees, and annual rebalancing..*