

# Should the Indonesian pension funds invest abroad?

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## Abstract

Currently, the Indonesian pension fund is prohibited from investing in international assets. In this paper, I quantitatively investigate the benefit and/or the cost, if any, caused by this constraint. Standard mean-variance techniques will be used along with Monte Carlo simulation to check the robustness of the findings. Under various assumptions, including international assets in the pension fund's portfolio could potentially aid pension funds to have higher returns and accumulated wealth. Accordingly, the findings suggest possible reform to lessen these restrictions. Given the controversy over international diversification, a reasonable compromise that would help capture many of the potential benefits for risk-averse investors could be to create a ceiling of 20 percent for international assets.

**Keywords**: *Pension Fund, International Diversification, Asset Allocation, Hypothetical Worker, Indonesia*.

## Introduction

Asset allocation strategy plays a most significant role in determining the performance of pension funds. Brinson, Hood, and Beebower (1986) found that more than 90 percent of the variation of fund returns could be explained by the asset allocation strategy. Later studies such us Ibbotson and Kaplan (2000) and Drobetz and Kohler (2002) tend to support this finding.

An asset allocation strategy requires two decisions: selecting asset classes and determining the weight for each class. In modern portfolio theory, investment managers should consider investment objectives and constraints as well as how assets interact to determine expected returns and risks. The characteristic of assets that factor into the portfolio performance include their returns, the standard deviation of these returns, and the correlations among the assets in the portfolio.

The pioneering work of modern finance theory, Markowitz (1952), argued that broadening portfolio diversification across low correlated assets enables investors to achieve a higher expected return for a given level of risk. His argument implies that broadened asset choice will improve the investment manager's capability to maximize investment returns and/or minimize risk.

As asset class choices are broadened, international financial assets become a clear option. Many studies suggest that pension fund performance could be improved by investing abroad. Dreasen and Laeven (2006) find that international portfolio diversification will benefit investors and that investors from developing countries would receive more benefits than those in developed countries. Segot and Lucey (2007) argue that international diversification in small markets such as those in the Middle East and North Africa could also bring benefits to international investors. In the case of pension funds in Asian countries, Pfau (2009) finds that international diversification could improve the sustainability Pakistan's pension fund by simultaneously increasing expected returns and lowering investment risks. Kumara and Pfau (2010) suggest that international diversification in Sri Lanka, which has an underdeveloped bond market and whose pension assets are bigger than its stock market capitalization, could better serve pension fund participants with risk attitudesranging from aggressive to conservative.

When a domestic economy experiences a recession, returns from domestic financial markets may be low. The pension fund's investment return will also be low if the fund is invested only domestically. If government guarantees the benefits for a mandatory pension plan, it may need to subsidize the pension plan to offset the low returns. In this case, the government budget deficit will be amplified

as governments usually otherwise run fiscal deficits to boost an economy during recession. International diversification under these circumstances will bring greater benefits to the extent that these returns will be less correlated with domestic financial markets. As well, to the extent that weak economic performance is associated with capital outflows, exchange rate depreciation during bad economic conditions will provide relief by boosting the returns earned in foreign currencies.

However, many governments still impose tight regulations to limit the number of investable asset groups and prohibit pension funds from investing abroad. There are potential justifications for this decision. The World Bank (2001) reported two main reasons including the responsibility to protect pension fund members by ensuring that the fund could deliver decent returns without excessive risks. The second reason is the implicit and explicit guarantees of pension values, especially when participation is mandatory, which motivates governments to ensure that government contingent liabilities will not materialize. Furthermore, Bodie and Merton (2002) provide other reasons for the prohibition of investing pension funds globally. These include a need to reduce the risk of capital outflows, to promote domestic employment in order to increase pension fund membership, and because there is a common perception that global investment is risky and costly.

To join in the discussion regarding the merits of pension fund global investment, this paper will quantitatively investigate the benefits and costs of international diversification for the case of Indonesia. A standard mean-variance technique will be used along with Monte Carlo simulation to check the robustness of the estimates. Under various assumptions, we find that international diversification can increase expected returns and accumulated fund wealth for given portfolio risks. Even for the most conservative investors, optimal portfolios will include international assets.

**Indonesian Pension Fund**

On the basis of membership, there are two types of pension funds in Indonesia: mandatory and voluntary. Mandatory pensions cover government employees and formal workers. Voluntary pension membership is open to any workers, but, commonly the members are private workers. Table 1 provides a detailed portrait of the pension funds in 2008.

The pension program for government employees is run by two state-owned enterprises (SOE): PT Asabri for the army and police and PT Taspen for the civil servants. These cover all 4.8 million government employees in 2008. The pension scheme provides defined benefits (DB), which implies that the government should inject funds into the system if providers could not pay the promised

benefits. The World Bank (2006) reports that both funds suffered cash flow deficits and needed a government injection of 1.3 trillion rupiah in 2002. Further needed injections are expected. The pension contribution is 8% of basic salary with generous benefits: a lump sum payment at retirement and a current salary-indexed payment for life that covers 70% of basic salary at retirement.

The mandatory pension program for formal workers is run by another SOE, PT Jamsostek. In terms of membership, Jamsostek is the biggest pension plan in Indonesia, covering 8.2 million workers. Even though the program is mandatory, the participation rate was only 31 percent due to weak enforcement. The scheme works on a defined-contribution (DC) basis, and the contribution rate is 5.7 percent of wages. The benefit (total contribution plus return on investment) is paid as a lump sum at retirement.

Two types of voluntary pension funds exist: the Employer Pension Fund (EPF) and the Financial Institution Pension Fund (FIPF). There are 265 companies that operate a pension program for their employee under the EPF. In terms of assets, the EPF is the biggest pension plan in Indonesia, with 79 trillion rupiah held in 2008. The scheme, contributions, and benefits for each plan vary. In 2008, there were 216 defined-benefit plans (DB) and 39 defined-contribution plans (DC) operating under EPF.

The fastest growing pension plan is the FIPF, but its asset size is still the smallest. From 2004 to 2008, the average annual asset growth was 22.4 percent. The FIPF providers are banks and life insurance companies. FIPF schemes are operated as DC with benefits equal to total contributions plus investment returns provided as a lump sum payment at retirement.

In total, the pension programs cover 27 percent of Indonesian workers in 2008, which is still a very low coverage rate. In 2004, the House of Representatives (DPR) enacted Law number 40/2004 which tackled the national social security system (SJSN) in an effort to provide social security (including pensions) to all Indonesians. Currently, the DPR is preparing the law regarding SJSN providers. However, concerns about the enforcement of the program and its sustainability are growing because of Indonesia's lack of enforcement for the existing social security law (Jamsostek).

The combined assets of pension programs reached 3.6 percent of GDP in 2008. This is quite low compared with neighboring countries. The World Bank (2006) reports that in 2003, the pension fund asset to GDP ratio was 8.4 percent in Thailand, 57.1 percent in Malaysia, and 75.1 percent in

Australia. The current size of pension fund assets will allow the Indonesian financial market to absorb pension fund investments. In 2008, the bond and stock market capitalization to GDP ratio was 34 percent (much lower than in 2007, which was 64 percent, due to the global financial crisis). The banking asset to GDP ratio was 47 percent.

The Indonesian pension fund is currently prohibited from investing in international assets. All investments are made domestically. As to investment allocation, the pension investment in 2008 was placed mainly in government bonds, followed by time deposits and corporate bonds. Investment in the stock market was low. Only PT Jamsostek invested significantly in the stock market. Compared with the investment in 2000, that in 2008 was much more diversified. In 2000, time deposits dominated pension fund investment accounting for more than 60 percent of the total investment for pension programs (PT Taspen/Asabri allocated 94 percent of its investment to time deposits). With improved pension fund management, improvement of asset diversification was also promoted by developing the government bond market where trading begin in 2002.

In the DC scheme, investment performance, which is mainly determined by the asset allocation strategy, is very important to pension fund participants. Asset returns determine how much retirement income he or she will obtain. In DB schemes, investment performance matters for the providers/guarantors, because it impacts their level of contributions and or subsidies required to keep the program sustainable. Therefore, promoting better investment performance is important for all stakeholders and it warrants classification as the main goal for pension reforms in Indonesia.

**Methodology**

Following Kumara and Pfau (2010), we used two different methodologies to calculate the optimal asset allocation strategy, taking into account the pension fund member's characteristics, portfolio return, and portfolio risk. We compare expected returns and risks for the optimal allocations when international diversification is allowed and when it is prohibited in order to estimate the impacts of such existing restrictions.

The first method we consider is standard mean-variance portfolio analysis, which is widely used in modern finance. In this model, investors will select a portfolio to maximize their expected utility ($U_p$) as defined in the following equation:

$$U_p = r_p - 0.5A\sigma_p^2$$

where $r_p$ is portfolio's expected return, $\sigma_p$ is portfolio's standard deviation, which represents the risk of the portfolio, and A is the investor's risk aversion coefficient. For risk aversion, zero means risk neutrality, and an increasing value of A means greater risk aversion. Typically, an aggressive investor has a value of 1 or 2, a moderate investor has a value of 3 or 4, and a conservative investor will have values ranging from 5 to 10, or even higher. In this study, we consider values of A from 1 to 10, representing a variety of investor types. Pension funds usually behave with risk aversion, and we assume that a value of 5 is representative.

The second method uses Monte Carlo simulation. Since mean variance analysis is static, it cannot incorporate the dynamic aspects of wealth accumulation. Monte Carlo simulation captures thousands of possible future scenarios as they evolve over time. Here, we forecast a range of possible outcome by generating thousands of scenarios from the inputs of means, standard deviation, and correlation, using a lognormal distribution for asset returns.

To simulate the situation for pension fund participants, let worker X be a representative worker who contributed to the pension fund for n years and then retired. Pension contributions are a constant rate μ of his wage w. The wage will grow annually at the rate of g. If there is no principal agent problem, the pension fund objective is to maximize the expected utility of each pension member.

We define utility as a standard constant relative risk aversion (CRRA) utility function as follows: [1]

$$E[U(W_i)] = \sum_i^N (\frac{1}{1-A} {W_i}^{1-A})$$

where $W_i$ is the terminal wealth accumulation or delivered lump-sum pension benefit at retirement in simulation ($i$), A is worker risk aversion, and N is the total number of simulations.

The evolution of wealth is determined by:

$$W_t = [W_{t-1} + \mu(1+g)^{t-1} w_1](1+r_t)$$

where $W_t$ is the wealth at time t, $\mu$ is contribution rate, g is the rate of wage growth, $w_1$ is the initial wage, and $r_t$ is the net portfolio return after deducting investment costs.

**Data and Calibration**

[1] When A=1, the utility function is the logarithm of wealth.

We use data from 1986 to 2008. Domestic assets include bank time deposits and stocks. We did not consider T-bills because data on T-bills (central bank certificates/SBI) are only available since 1996 with the first issuance of SBI, and because their returns are strictly dominated by time deposit returns. We also did not use bonds because government bonds that could provide a benchmark for bond market returns have just became available in 2002. As well, the investment allocation of the Indonesian pension fund was dominated by time deposits before the introduction of government bonds. Until recently, some pension funds still place the majority of their investments in time deposits.

The domestic bank time deposit return data are represented by annualized 3-month time deposit interest rates. The data come from the International Monetary Fund's International Financial Statistics (IMF IFS). Domestic stock returns are represented by the percentage change in the Jakarta Stock Exchange/Indonesia Stock Exchange index. The stock index data were obtained from the Indonesian Capital Market and Financial Institutions Supervisory Agency (Bapepam-LK).

For international assets, we chose three assets: world bills, world bonds, and world stocks. The original data are measured in U.S. dollars. World assets are defined as an index of 17 developed market countries, weighted by country size. The world asset data is provided by Morningstar as an updated dataset first described in Dimson, Marsh, and Staunton (2002).

To make international assets comparable with domestic assets, we convert the dollar value of the international assets into rupiah using the exchange rate at year end. We assume that funds do not hedge currency risk. We use inflation data to calculate real asset returns. Both exchange rate and inflation are available in the IMF IFS.

Table 2 provides descriptive statistics. All returns are in Indonesian rupiah. In the domestic asset category, Indonesian stocks experienced a much higher expected return and risk than bank time deposits. In the international asset category, world bills have the lowest expected return and the lowest risk. Meanwhile, world bonds strictly dominate because world bonds have a higher expected return with a lower risk than world stocks during this time period.

Domestic assets have low correlations and high diversifying potential. Meanwhile, international assets are strongly correlated. However, correlations between domestic assets and international assets are very low, suggesting the possibility of asset diversification.

Table 2 also shows that Indonesia suffered from high inflation during the 1986-2008 periods. The average inflation rate was 13.7 percent, the lowest rate was 5.5 percent and the highest was 75.5 percent. The Indonesian rupiah also depreciated steadily with an average depreciation rate of 12.7 percent. Domestic currency depreciation boosts the returns on foreign assets.

For calibration, we considered values of A between 1 and 10, which represent a broad range of investors. Pension funds are perceived to be risk-averse, with a risk aversion value of about 5. Therefore, in our discussion, we will give more focus to A with a value of 5.

Initial annual wage ($w_1$) is Rp 30,000,000, meaning the worker's starting monthly salary is Rp 2,500,000. The assumed real annual wage growth (g) is 3 percent which is the average real GDP per worker growth from 1986 to 2008. To simulate pension wealth accumulation, we assume a career length (n) of 35 years, from age 21 to retirement at 56 (the current retirement age for Indonesian public servants).

We assume an annual domestic investment cost of 3 percent of total investment. According to Government Regulation No. 22/2004, the maximum operational cost that could be deducted by PT Jamsostek for DC pension fund management is 2 percent. As well, we assume that the cost of investment charged by external bodies is about 1 percent. For international investment, we assume that the annual investment cost is 5 percent. This consists of a 2 percent fee charged by thepension fund, a 1 percent loss from the difference of buying and selling rate of foreign currencies, and a 2 percent fee charged by external bodies. The investment cost was assumed to reflect the maximum of possible expenses.

We assume that asset weights vary in 5 percentage point increments from 0 to 100 percent. There will be 21 asset allocation strategies for domestic investments and 9,113 asset allocation strategies when international diversification is allowed.

We conduct 10,000 simulations, which means that we estimate a probability distribution with 10,000 outcomes for W. Despite the actual number of possible scenarios being much larger,[2] 10,000 scenarios are sufficient to get stable result.

**The optimal asset allocation strategy**

[2] Total possible scenarios (N) are equal to the length of data set powered by the working period or $23^{35}$

Table 3 shows the optimal asset allocation strategy for the mean variance analysis using nominal data. The first part of table shows the optimal asset allocation when world assets are prohibited. The latter part explains the optimal asset allocation and the cost/benefit with international diversification.

When international assets are prohibited, the most aggressive investor, whose risk aversion coefficient is 1, could earn higher returns by accepting more risk and this would increase their utility. The optimal portfolio will consist of 25 percent Indonesian stocks and 75 percent bank time deposits. This portfolio will provide expected return of 15.7 percent with a standard deviation of 21.8 percent. The more conservative investor will hold more bank time deposits and less Indonesian stocks. A typical pension fund investor with a risk aversion coefficient of 5 will build a portfolio consisting of 95 percent bank time deposits and 5 percent Indonesian stocks. The portfolio return will be 13.6 percent with a 10 percent standard deviation. This finding justifies the phenomenon of low stock investment in the pension fund industry. On average, pension funds put less than 7 percent of their assets in the stock market.

If international assets are allowed, the optimal asset allocation for an aggressive investor with a risk aversion coefficient of 1 will be 30 percent Indonesian stocks and 70 percent world bonds. The proportion of domestic investments will increase proportionally with increases in the risk aversion coefficient. For instance, when an investor has a risk aversion coefficient of 2, his optimal portfolio will consist of 30 percent bank time deposits, 20 percent Indonesian stocks, and 50 percent world bonds.

The optimal portfolios for Indonesian investors do not include world bills and world stocks. This is because world bills are strictly dominated by bank time deposits and world stocks are strictly dominated by world bonds.

The typical pension fund investor with a risk aversion coefficient of 5 will build a portfolio that consists of 70 percent bank time deposits, 10 percent Indonesian stocks, and 20 percent world bonds. This portfolio return will be 15.6 percent with 18.1 percent standard deviation. International diversification could generate an increased return for a typical pension fund investor of 1.9 percentage points, representing an increase of 14 percent. This magnitude of increase of the expected return decreases when increasing the risk aversion coefficient. For example, investors whose risk aversion coefficient is 10 will generate an additional return of only 0.4 percentage points with the optimal portfolio including international assets. However, the increased return experienced

a trade off with increased risk. The typical pension fund portfolio with risk aversion of 5 will generate volatility of 18 percent which is 81 percent higher than the volatility when international assets are prohibited. Overall, investors will be better off when international assets are allowed because this was a utility maximizing decision.

Table 4 shows the optimal asset allocation strategy from the mean variance analysis using real data. Bank time deposits have become more important in this optimal portfolio. When international assets are prohibited, the aggressive investor with a risk aversion coefficient of 1 will build his portfolio with 75 percent time deposits and 25 percent stocks. The portfolio will have an expected return of 5.35 percent and a risk of 21.24 percent. This expected return is much lower than the nominal return due to the high inflation rate in Indonesia. However, in both cases, portfolio risk is about the same.

The optimal strategy for a typical pension fund investor is to hold 95 percent bank time deposits and 5 percent stocks. This strategy is similar to the strategy computed using nominal data. Indonesian stocks will not have any role in building the portfolio of the investor who is more conservative than the typical pension fund investor. The conservative investor's portfolio will only consist of bank time deposits.

When international assets are allowed, the most aggressive investor will allocate 70 percent to international assets and the most conservative investor will allocate only 20 percent. All types of investors could potentially earn additional returns when international assets are allowed. The typical pension investor with a risk aversion coefficient of 5 will build a portfolio consisting of 60 percent time deposits, 10 percent Indonesian stocks, and 30 percent world bonds. This portfolio will earn an expected real return of 6.02 percent with a portfolio risk of 18.45 percent. It means that international diversification could bring 4.28 percentage points of additional return, an increase of 80 percent. However, portfolio risk will also increase by 76 percent compared to when the investor only invests domestically.

To check the robustness of the computation, we employed Monte Carlo simulations for a hypothetical worker. We simulated 10,000 scenarios using asset returns, standard deviations, and correlations as described previously in the methodology.

Table 5 shows the results for the Monte Carlo simulations with nominal data. When international assets are prohibited, the optimal asset allocation for the aggressive investor with a risk aversion coefficient of 1 includes 30 percent time deposits and 70 percent Indonesian stock. The most

conservative investor with a risk aversion coefficient of 10 will include 90 percent time deposits and 10 percent. Meanwhile, a typical pension fund investor holds 85 percent time deposits and 15 percent Indonesian stocks. This strategy will generate a median wealth of 16.9 billion rupiah at retirement. The standard deviation of wealth is 5.6 billion rupiah with a minimum wealth of 8.2 billion rupiah and a maximum wealth of 84.3 billion rupiah. The distribution of accumulated wealth is skewed to the right as a log normal distribution. The reason is the asymmetric nature of the return. 100 percent gain followed by 50 percent loss will put the investor back to the starting wealth.

If international assets are allowed, the optimal portfolio will consist of 35−75 percent domestic assets. This optimal asset allocation strategy will increase expected wealth by up to 62 percent and reduce the wealth standard deviation by up to 67 percent.

The optimal asset allocation strategy for a typical pension fund investor with a risk aversion of 5 will consist of 30 percent bank time deposits, 25 percent Indonesian stocks, and 45 percent world bonds. This strategy will earn a median wealth of 24.5 billion rupiah at retirement with a standard deviation of 17.5 billion rupiah. The minimum wealth is 6.8 billion rupiah, the $5^{th}$ percentile wealth is 12.6 billion rupiah, and the maximum possible wealth is 293.6 billion rupiah. Compared with the optimal portfolio when international assets are prohibited, a typical pension investor could increase his expected wealth by 45 percent.

Table 6 shows the results of Monte Carlo simulation with real data. When international assets are prohibited, the optimal asset allocation for the most aggressive investor with a risk aversion coefficient of 1 consist of 75 percent bank time deposits and 25 percent Indonesian stocks. The proportion of time deposits will increase with the increase in the risk aversion coefficient. A typical pension fund investor is to hold 85 percent bank time deposits and 15 percent stocks which will generate expected wealth of 210 million rupiah.

If international assets are allowed, the optimal portfolio will consist of 30−55 percent domestic assets. This optimal asset allocation strategy will increase expected wealth by 40-57 percent and reduce the wealth standard deviation by up to 8 percent. Compared with the analysis using nominal data, real data analysis tends to amplify the benefits of international diversification. The reason is that the return of domestic assets has a strong negative correlation with inflation, but international asset returns have almost no correlation with domestic inflation. Therefore, international

diversification in the Indonesian case can extract the benefit of portfolio diversification, which is lowering the risk.

In this scenario, the optimal asset allocation strategy for a typical pension fund investor consists of 15 percent time deposits, 25 percent Indonesian stocks, and 60 percent world bonds. This strategy will earn an expected wealth of 327 million rupiah at retirement with a standard deviation of 267 million rupiah. The minimum possible wealth is 68 million rupiah, the $5^{th}$ percentile of wealth is 156 million rupiah, and the maximum possible wealth is 4.2 billion rupiah. Compared with the optimal portfolio when international assets are prohibited, the typical pension investor could increase his expected wealth by 56 percent.

**Conclusions**

The mean-variance analysis and Monte Carlo simulations show evidence of benefits from international diversification for Indonesian pension funds. We find that, under various assumptions, including international assets in pension fund portfolios could increase returns and wealth accumulations. The most conservative optimal portfolio will consist of at least 5 percent of world assets and the most aggressive portfolio will consist of at least 60 percent of international assets. For a typical pension fund risk level, the portfolio will consist of at least 20 percent of international assets. Accordingly, our findings suggest the need for possible reforms in pension fund investment regulations. Given the controversy over international diversification, a reasonable compromise that would help capture many of the potential benefits for risk-averse investors could be to create a ceiling of 20 percent for international assets. This, however, should not be interpreted as a final recommendation for asset allocation inasmuch as we did not include all possible assets that could be accommodated in the pension fund portfolio. The main goal of our paper is to demonstrate the effect of international diversification and not to give a final recommendation for asset allocation.

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## APPENDIX

### Table 1
### Indonesian Pension Fund Industry in 2008

| | Government Employee | Formal Sector Employee | EPF | FIPF |
|---|---|---|---|---|
| Membership | Mandatory | Mandatory | Voluntary | Voluntary |
| Number of providers | 2 | 1 | 265 | 26 |
| Providers | Asabri, Taspen | Jamsostek | Employers | Banks, insurance agencies |
| Scheme | Defined benefit (DB) | Defined contribution (DC) | 216 DB & 39 DC | DC |
| Contribution | 8% | 5.7% | Varies | Varies |
| Benefit | Lump sum payment on retirement & annuity benefit for life | Lump sum payment on retirement as total contribution plus return | Lump sum payment on retirement &/or annuity benefit for life | Lump sum payment on retirement as total contribution plus return |
| Members (million) | 4.8 | 8.2 (31% of formal workers) | 0.95 | 1.1 |
| Assets (trillion rupiah) | 27 | 64 | 79 | 11 |
| Investment (in percent)*: | | | | |
| Time deposit | 27 (94) | 33 (60) | 19 (68) | 56 (68) |
| T bills & money market | 0 (0) | 0 (0) | 0 (1) | 5 (1) |
| Government bond | 59 (0) | 38 (0) | 31 (0) | 19 (0) |
| Corporate bond | 12 (2) | 12 (3) | 27 (10) | 15 (10) |
| Stock | 2 (1) | 14 (24) | 11 (6) | 3 (6) |
| Mutual fund | .05 (0) | 3 (3) | 4 (1) | 2 (1) |
| Others | 0 (3) | 0 (10) | 9 (14) | 0 (14) |

**Data for 2000 follow in parentheses. For 2000, the EPF and FIPF were pooled and an overall asset allocation is provided.*

**Table 2**
**DESCRIPTIVE STATISTICS (%) FOR RETURNS IN RUPIAH**
**1986–2008**

| | Nominal return | | | | Real return | | | |
|---|---|---|---|---|---|---|---|---|
| | **Mean** | **Std. deviation** | **Min** | **Max** | **Mean** | **Std. deviation** | **Min** | **Max** |
| Indonesian time deposit | 16.1 | 7.0 | 6.4 | 39.1 | 2.8 | 1.6 | -20.7 | 12.7 |
| Indonesian stocks | 26.2 | 66.2 | -50.6 | 269.5 | 12.9 | 12.9 | -58.2 | 236.5 |
| World bills | 17.9 | 28.0 | -12.6 | 105.4 | 3.6 | 4.5 | -19.0 | 82.5 |
| World bonds | 25.3 | 32.7 | -16.7 | 108.4 | 10.1 | 5.3 | -27.0 | 85.1 |
| World stocks | 23.9 | 39.0 | -30.4 | 126.4 | 9.0 | 6.7 | -41.1 | 101.1 |
| Inflation | 13.7 | 13.9 | 5.5 | 75.3 | | | | |
| Exchange rate movement | -12.7 | 26.1 | -95.1 | 14.0 | | | | |

**CORRELATION MATRIX**

| | **Indonesian time deposit** | **Indonesian stocks** | **World bills** | **World bonds** | **World stocks** | **Inflation** | **Exchange rate** |
|---|---|---|---|---|---|---|---|
| Indonesian time deposit | 1 | 0.27 | 0.05 | 0.05 | 0.16 | -0.77 | 0.38 |
| Indonesian stocks | -0.04 | 1 | -0.27 | -0.28 | 0.03 | -0.27 | 0.38 |
| World bills | 0.42 | -0.32 | 1 | 0.93 | 0.81 | 0.01 | -0.85 |
| World bonds | 0.39 | -0.33 | 0.95 | 1 | 0.80 | 0.02 | -0.79 |
| World stocks | 0.45 | -0.04 | 0.84 | 0.83 | 1 | 0.00 | -0.67 |
| Inflation | 0.66 | -0.15 | 0.52 | 0.51 | 0.42 | 1 | -0.53 |
| Exchange rate | -0.39 | 0.33 | -0.997 | -0.95 | -0.83 | -0.53 | 1 |

** The upper triangle of the correlation matrix represents real return correlation and the lower triangle represents nominal return correlation.*

**Table 3**
**OPTIMAL ASSET ALLOCATION WITH MEAN-VARIANCE ANALYSIS**
***NOMINAL DATA***

| **INTERNATIONAL DIVERSIFICATION PROHIBITED** | | | | | | |
|---|---|---|---|---|---|---|
| **RISK AVERSION COEFFICIENT** | **1** | **2** | **3** | **4** | **5** | **10** |
| **Portfolio weight (%)** | | | | | | |
| Time deposit | 75 | 85 | 90 | 95 | 95 | 95 |
| Indonesian stocks | 25 | 15 | 10 | 5 | 5 | 5 |
| **Domestic share (%)** | 100 | 100 | 100 | 100 | 100 | 100 |
| | | | | | | |
| **Portfolio return net of fees (%)** | 15.66 | 14.65 | 14.15 | 13.65 | 13.65 | 13.65 |
| **Portfolio risk (%)** | 21.8 | 15.88 | 12.92 | 9.96 | 9.96 | 9.96 |
| | | | | | | |
| **WITH INTERNATIONAL DIVERSIFICATION** | | | | | | |
| **RISK AVERSION COEFFICIENT** | **1** | **2** | **3** | **4** | **5** | **10** |
| **Portfolio weight (%)** | | | | | | |
| Time deposit | 0 | 30 | 50 | 70 | 70 | 90 |
| Indonesian stocks | 30 | 20 | 15 | 10 | 10 | 5 |
| World bills | 0 | 0 | 0 | 0 | 0 | 0 |
| World bonds | 70 | 50 | 35 | 20 | 20 | 5 |
| World stocks | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | |
| **Domestic share (%)** | 30 | 50 | 65 | 80 | 80 | 95 |
| | | | | | | |
| **Portfolio return net of fees (%)** | 21.16 | 18.73 | 17.15 | 15.58 | 15.58 | 14.0 |
| **Portfolio risk (%)** | 42.72 | 31.67 | 24.86 | 18.05 | 18.05 | 11.24 |
| | | | | | | |
| **Benefits of reform** | | | | | | |
| *Additional return (percentage points)* | 5.5 | 4.08 | 3 | 1.93 | 1.93 | 0.35 |
| *Change of return (%)* | 35 | 28 | 21 | 14 | 14 | 3 |
| *Change of risk (%)* | 96 | 99 | 92 | 81 | 81 | 13 |
| | | | | | | |

**Table 4**
**OPTIMAL ASSET ALLOCATION WITH MEAN-VARIANCE ANALYSIS**
***REAL DATA***

| **INTERNATIONAL DIVERSIFICATION PROHIBITED** | | | | | | |
|---|---|---|---|---|---|---|
| **RISK AVERSION COEFFICIENT** | **1** | **2** | **3** | **4** | **5** | **10** |
| **Portfolio weight (%)** | | | | | | |
| Time deposit | 75 | 90 | 95 | 95 | 95 | 100 |
| Indonesian stocks | 25 | 10 | 5 | 5 | 5 | 0 |
| **Domestic share (%)** | 100 | 100 | 100 | 100 | 100 | 100 |
| | | | | | | |
| **Portfolio return net of fees (%)** | 5.35 | 3.84 | 3.34 | 3.34 | 3.34 | 2.83 |
| **Portfolio risk (%)** | 21.24 | 13.16 | 10.47 | 10.47 | 10.47 | 7.77 |
| | | | | | | |
| **WITH INTERNATIONAL DIVERSIFICATION** | | | | | | |
| **RISK AVERSION COEFFICIENT** | **1** | **2** | **3** | **4** | **5** | **10** |
| **Portfolio weight (%)** | | | | | | |
| Time deposit | 0 | 20 | 40 | 55 | 60 | 75 |
| Indonesian stocks | 30 | 20 | 15 | 10 | 10 | 5 |
| World bills | 0 | 0 | 0 | 0 | 0 | 0 |
| World bonds | 70 | 60 | 45 | 35 | 30 | 20 |
| World stocks | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | |
| **Domestic hare (%)** | 30 | 40 | 55 | 65 | 75 | 80 |
| | | | | | | |
| **Portfolio return net of fees (%)** | 10.95 | 9.21 | 7.62 | 6.39 | 6.02 | 4.79 |
| **Portfolio risk (%)** | 36.28 | 29.13 | 23.79 | 19.33 | 18.45 | 13.99 |
| | | | | | | |
| **Benefits of reform** | | | | | | |
| *Additional return (percentage points)* | 5.6 | 5.37 | 4.28 | 4.28 | 4.28 | 1.96 |
| *Change of return (%)* | 105 | 140 | 128 | 91 | 80 | 69 |
| *Change of risk (%)* | 71 | 121 | 127 | 85 | 76 | 80 |
| | | | | | | |

**Table 5**
**OPTIMAL ASSET ALLOCATION WITH MONTE CARLO SIMULATIONS**
***NOMINAL DATA***

| **INTERNATIONAL DIVERSIFICATION PROHIBITED** | | | | | | |
|---|---|---|---|---|---|---|
| **RISK AVERSION COEFFICIENT** | **1** | **2** | **3** | **4** | **5** | **10** |
| **Portfolio weight (%)** | | | | | | |
| Time deposit | 30 | 60 | 75 | 80 | 85 | 90 |
| Indonesian stocks | 70 | 40 | 25 | 20 | 15 | 10 |
| **Domestic share (%)** | 100 | 100 | 100 | 100 | 100 | 100 |
| | | | | | | |
| **Median of terminal wealth (billion rupiah)** | 21.2 | 20.3 | 18.5 | 17.7 | 16.9 | 15.9 |
| **Standard deviation** | 128.1 | 25.9 | 10.8 | 7.9 | 5.6 | 3.9 |
| **Minimum** | 1.9 | 4.2 | 6.3 | 7.5 | 8.2 | 8.4 |
| **5th percentile** | 5.7 | 8.8 | 10.6 | 11.1 | 11.4 | 11.6 |
| **Maximum** | 5,787.6 | 574.2 | 168.5 | 119.9 | 84.3 | 58.5 |
| | | | | | | |
| **WITH INTERNATIONAL DIVERSIFICATION** | | | | | | |
| **RISK AVERSION COEFFICIENT** | **1** | **2** | **3** | **4** | **5** | **10** |
| **Portfolio weight (%)** | | | | | | |
| Time deposit | 0 | 0 | 0 | 15 | 30 | 60 |
| Indonesian stocks | 55 | 40 | 35 | 30 | 25 | 15 |
| World bills | 0 | 0 | 0 | 0 | 0 | 0 |
| World bonds | 45 | 60 | 65 | 55 | 45 | 25 |
| World stocks | 0 | 0 | 0 | 0 | 0 | 0 |
| **Domestic share (%)** | 55 | 40 | 35 | 45 | 55 | 75 |
| | | | | | | |
| **Median of terminal wealth (billion rupiah)** | 30.6 | 30.6 | 30 | 27.2 | 24.5 | 19.6 |
| **Standard deviation** | 86.1 | 46 | 39 | 26.3 | 17.5 | 7.5 |
| **Minimum** | 4 | 5.1 | 5.3 | 6 | 6.8 | 8.7 |
| **5th percentile** | 10.1 | 11.9 | 12.1 | 12.4 | 12.6 | 12.6 |
| **Maximum** | 2,694 | 971.9 | 732.7 | 464.8 | 293.6 | 112.9 |
| | | | | | | |
| **Benefits of reform (%)** | | | | | | |
| *Change of expected wealth* | 44.3 | 50.7 | 62.2 | 53.7 | 44.9 | 23.3 |
| *Change of standard deviation* | -67.2 | 77.6 | 261.1 | 232.9 | 212.5 | 92.3 |

**Table 6**

**OPTIMAL ASSET ALLOCATION WITH MONTE CARLO SIMULATIONS**
***REAL DATA***

| **INTERNATIONAL DIVERSIFICATION PROHIBITED** | | | | | | |
|---|---|---|---|---|---|---|
| **RISK AVERSION COEFFICIENT** | **1** | **2** | **3** | **4** | **5** | **10** |
| **Portfolio weight (%)** | | | | | | |
| Time deposit | 25 | 65 | 75 | 85 | 85 | 95 |
| Indonesian stocks | 75 | 35 | 25 | 15 | 15 | 5 |
| **Domestic share (%)** | 100 | 100 | 100 | 100 | 100 | 100 |
| | | | | | | |
| **Median of terminal wealth (million rupiah)** | 280 | 260 | 240 | 210 | 210 | 190 |
| **Standard deviation** | 6,490 | 350 | 180 | 90 | 90 | 50 |
| **Minimum** | 20 | 40 | 50 | 60 | 60 | 60 |
| **5th percentile** | 58 | 101 | 111 | 119 | 119 | 121 |
| **Maximum** | 422,180 | 9,920 | 3,360 | 1,180 | 1,180 | 480 |
| | | | | | | |
| **WITH INTERNATIONAL DIVERSIFICATION** | | | | | | |
| **RISK AVERSION COEFFICIENT** | **1** | **2** | **3** | **4** | **5** | **10** |
| **Portfolio weight (%)** | | | | | | |
| Time deposit | 0 | 0 | 0 | 0 | 15 | 35 |
| Indonesian stocks | 55 | 40 | 35 | 30 | 25 | 15 |
| World bills | 0 | 0 | 0 | 0 | 0 | 0 |
| World bonds | 45 | 60 | 65 | 70 | 60 | 50 |
| World stocks | 0 | 0 | 0 | 0 | 0 | 0 |
| **Domestic share (%)** | 55 | 40 | 35 | 30 | 40 | 50 |
| | | | | | | |
| **Median of terminal wealth (million rupiah)** | 392 | 385 | 376 | 362 | 327 | 272 |
| **Standard deviation** | 1,418 | 603 | 482 | 398 | 267 | 139 |
| **Minimum** | 44 | 56 | 60 | 64 | 68 | 139 |
| **5th percentile** | 119 | 146 | 151 | 153 | 156 | 155 |
| **Maximum** | 50,997 | 11,621 | 7,562 | 6,754 | 4,189 | 1,939 |
| | | | | | | |
| **Benefits of reform (%)** | | | | | | |
| *Change of expected wealth* | 40 | 48.1 | 56.7 | 72.4 | 55.7 | 43.2 |
| *Change of standard deviation* | -8.2 | 72.3 | 67.8 | 342.2 | 196.7 | 178.0 |