SOVEREIGN WEALTH FUNDS: STATISTICAL ANALYSIS OF ASSET ALLOCATIONS IN 2013

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Abstract:

The paper explores the proportions of asset allocations of observed Sovereign Wealth Funds in 2013. Portfolios include: savings funds, stabilization/savings funds, pension reserve funds and reserve investment funds. First, we determine confidence interval of the proportion of alternative assets in 11 observed portfolios at a 99 percent probability level. Second, we determine confidence interval of the proportion of fixed income in 13 observed asset allocation of SWFs at a 99 percent probability level. Third, we determine determine confidence interval of proportion of cash figure in 7 observed portfolios at 95 percent probability. Finally, we determine confidence interval of the proportion of public equities in 13 observed asset allocations at a 99 percent probability level. In this context, proportions of each of these classes are provided through statistical analysis and illustrations.

Keywords: Sovereign Wealth Fund, Portfolio, Asset Allocations.

JEL classification: C12, F21, G11.

1 Introduction

Sovereign Wealth Funds (SWFs) are long-term investments that follow either a strategic approach to ensure the supply of natural resources and technology or that transfer wealth to future generations through transformation or accumulation of assets. Fundamentally, SWFs are seeking four things. First, high returns, motivated by the opportunity cost of excess official reserves invested in risk-free assets. Second, the funds save wealth for future generations, when the natural sources will be exhausted, meaning no surplus revenues for the country. Third, countries dependent on commodity exports set up funds for absorbing the shock of fluctuations in global market prices of oil, indicating a stabilization function. Fourth, these funds promote domestic industries through their investments.

Viewed in this light, SWF activities can be summarized in the following two points. First, SWF motives can be strategic rather than purely financial as SWFs may seek to gather ownership rights in sensitive sectors such as telecommunications, media, energy, seaport, financial services and dual use industries and later use these assets to support the domestic economy in the case of war. Second, SWFs may acquire proprietary information only available to corporate insiders and transfer this corporate intelligence to

a rival company in their own country. As a result, SWF´s investments have received increasing attention due to the drastic increase in their size and visibility and due to their potential to threaten the stability of firms.

Exempli gratia, according to International Monetary Fund (IMF) estimates, SWFs are growing at a rate of USD 800–900 billion p.a. In other words, since 2008, assets under management of SWFs rose by 76 percent to USD 5.4 trillion in October 2013. This is as a result of the investment activities of these funds. Moreover, the sheer size of SWF is also obvious from the comparison with top stock exchanges worldwide. According to the International Sovereign Wealth Fund Institute 2012 report, comparing the assets under management of these funds with the market capitalization of the top 16 stock exchanges of the world suggests that the AUM of SWFs are more than that of all the exchanges except NYSE Euronext (US) with the market capitalization of USD 12.6 trillion. On the other hand, the USD 5.4 trillion of AUM of SWFs is more than twice the market capitalization of the Indian National Stock Exchange (NSE) and the Bombay Stock Exchange (BSE) put together according to the data of the World Federation of Exchanges in 2012.

It is important to mention a number of studies on the subject of SWFs since 2007. In particular, Beck, R. and Fidora, M. (2008) provided a background on the impact of sovereign wealth funds (SWFs) on the global financial markets and the impact of a transfer of traditional foreign exchange reserves to SWFs on global capital flows. Baptista, A. M. (2008) presented that portfolios lie away from the mean–variance frontier under fairly general conditions. More to the point, he found that the composition and location of such portfolios can differ notably from those on the mean–variance frontier. Miracky et. al. (2009) studied investment patterns and performance of SWFs.

Bernstein, S., Lerner, J. and A. Schoar (2009) provide the direct private equity investment strategies across SWFs and their relationship to the funds' organizational structures. Brown, A., Papaioannou, M. and Petrova, I. (2010) examined some basic macrofinancial linkages of an SWF's strategic asset allocation (SAA) strategies with regard to the government budget, monetary policy and exchange rate movements. Kunzel, P., Lu, Y., Petrova, I. and Pihlman, J. (2011) argued for the continued importance of SWFs as a stabilizer in international capital markets for regular macro-risk assessments of the sovereign.

Johan, S., Knill, A.M. and Mauck, N. (2013) examined the investments of 19 SWFs around the world from 1991 through 2010. They found that investments are similar to other institutional investors and are less likely to invest in private equity versus public equity internationally. Al-Hassan, A., Papaioannou, M., Skancke, M. and Chih Sung, Ch. (2013) described in a systematic (normative) manner the salient features of a SWF's governance structure in relation to its objectives and investment management that can ensure its efficient operation and enhance its financial performance.

Bodie, Z. and Briere, M. (2013) addressed the management of sovereign wealth from the perspective of the theory of contingent claims; moreover, in the sovereign's balance sheet, they framed sovereign fund management as an asset-liability management (ALM) problem. Lee, B. S. and In, F. H. (2013) investigated that sovereign wealth funds' poor performance is partly due to their poor information about the target firms. They applied Granger-causality tests. Gilligan, G., O'Brien, J. and Bowman, M. (2014) focused on the role that they might play in domestic investment in order to stimulate the growth of social capital and nation building in their home country as well as progress made by SWFs themselves in the improvement of the standards and processes of governance.

Gelb, A., Tordo, S., Halland, H., Arfaa, N. and Smith, G. (2014) proposed some basic elements of a conceptual framework to create a system of checks and balances to help ensure that the SWFs do not undermine macroeconomic management. Al-Kharusi, Q. A, Dixon, A. D. and Monk, A. H. B. (2014) pointed out that SWFs are expanding geographically, moving their organizations into the markets they found appealing, rather than waiting for intermediaries to come to them, reflecting a broader trend towards the professionalization of pension and sovereign fund investment organizations.

The research objectives of this paper are presented as follows: What are the current proportions of each asset allocation of SWFs? What is the mean of reliability of the following classes: alternative assets, fixed income, cash and public equties in portfolios of SWFs?

1.2 Data and Methodology

This paper examines the proportion of each class of portfolio of SWFs. We provide statistical analysis of 11 observed alternative assets, analysis of 13 observed fixed income, analysis of 7 observed cash figures and finally we analyze public equties of 13 observed portfolios in 2013. Observed portfolios of SWFs include savings, stabilization/savings, pension reserve and reserve investment funds. This has been done by illustrations using available data from official websites of funds and over fifty annual and quarterly reports and author´s calculations due the fact that most of the funds do not provide data to the public. In addition, we present the estimates using the 'Student' t-test distribution with (N−1) degrees of freedom and determination of the left-hand interval. The methods to be deployed in this paper are qualitative and quantitative analysis and comparative research that requires active intervention by the researcher.

2 Literature Review

There are many different definitions of a SWF. On the one hand, the EU Commission (2008) describes SWFs as state-owned investment vehicles which manage a diversified portfolio of domestic and international financial assets. On the other hand, McKinsey & Company (2007) presents that SWFs are funded by the Central Bank's reserves, aimed to maximize the returns within manageable risk bands. The technical definition of SWFs is that they are government-owned and controlled (directly or indirectly), have no outside beneficiaries or liabilities and that they invest their assets, either in the short or long-term, according to the interests and objectives of the sovereign sponsor, argued Monk (2009).

2.1 Asset Allocations

More to the point, strategic asset allocation is based on long-term risk and return objectives as well as investor expectations regarding asset class returns, volatility and correlations. In addition to this, the principal factors driving these allocation are as follows. First, *Asset Class Diversification*, meaning allocations to a wide range of asset classes, which diversifies away the risk to the portfolio of individual asset classes that underperform. Second, *Geographic Diversification*, meaning allocations to a wide range of different geographic regions, which diversifies away the risk to the portfolio of different regions and countries that underperform. Third, *illiquidity premium*, meaning allocations to asset classes that are illiquid in nature but are expected to generate superior returns over a long-term horizon. Fourth, *growth*, meaning allocations to asset classes expected to capture economic growth including emerging markets equity, small cap equity and private equity. Fifth, *inflation protection*, meaning allocations to assets that are more likely to protect against longer term inflation including inflation-linked bonds, commodities and infrastructure.

In the case of strategic investment, the SWFs' strategy will be very opportunistic and will also involve opaque transactions using Sovereign Wealth Enterprises. On the other hand, asset management for wealth accumulating SWFs is more comparable to that of endowment funds. More to the point, both investor types share some common characteristics such as the long-term perspective and the obligation to increase or at least to preserve the capital stock. Nevertheless, SWFs differ in terms of their exposure to funding risk, stemming from the price uncertainty of natural resources. To sum up, to account for this dependency, the SWF sponsor has two options: hedging or diversification. However, the portfolio shall be diversified in order to reduce concentration risk among government money market funds and managed accounts.

The question is: What is the purpose of diversification? More to the point, diversification is to provide reasonable assurance that no single fund has a disproportionate exposure to the SWFs' assets that may adversely impact the aggregate results of the SWF or impede its liquidity. Viewed in this light, diversification is an important tool of risk management and can mitigate the volatility and uncertainty inherent in substantial exposure to risk assets and as such, the SWF will seek to be diversified.

If we look at determinants in the setting up of an appropriate investment, the first determinant is the objective of the SWF and the second determinant is the risk-bearing capacity of the SWF. In this regard, the longer a fund's investment horizon is, the higher its capacity to take on investment risks. On the other hand, a short investment horizon signals a lower scope for exposure to risky assets. To sum up, investment funds with a strong intergenerational savings orientation tend to view their long horizon and ability to ride through

market downturns as a key competitive advantage. For instance, risk objectives are typically determined by the owner or the governing body of the SWF.

3 Hypotheses

Based on data analyzed for the paper, we developed four main hypotheses and preliminary results are demonstrated in this section. Presented calculations are the author´s best estimation.

3.1 Testing Hypothesis I.

First, we use data of 11 observed asset allocations, especially allternative assets, in 2013 as illustrated in Table 1 below. Second, we determine the reliability at a 99% confidence level and determine confidence interval of proportion of alternative assets in observed asset allocations of SWFs. Third, funds include: savings funds, stabilization/savings funds, pension reserve funds and reserve investment funds.

Table 1: Variables, N=11

Z	Alternative Assets %
The Government Pension Fund Global - Norway	1.2
Nigeria Sovereign Investment Authority	15
Alberta Heritage Savings Trust Fund	27
Alaska Permanent Fund Corporation	44
National Development Fund of Iran	77.6
Ireland, National Pensions Reserve Fund	20.8
Australia Future Fund	34.7
New Zealand Superannuation Fund	30
China Investment Corporation	45
Government of Singapore Investment Corporation	26
Korea Investment Corporation	16
AVERAGE	30.663
STDEV	20.159
TINV for α/2	2.763
TINV for α	2.228
MEDIAN	27
SKEW	1.120
KURT	2.268

Source: Author´s calculations, available data from SWFs websites, reports.
Notes: 1) Alternative assets includes private equity, infrastructure, real estate, return; 2) Government Pension Fund Global - Norway - 1Q 2014; Alberta Heritage Savings Trust Fund - 1Q 2013; Alaska Permanent Fund Corporation – 2013; Nigeria Sovereign Investment Authority - 2012; National Development Fund of Iran – 2013; Ireland, National Pensions Reserve Fund - 1Q 2014; Australia Future Fund - 1Q 2014; New Zealand Superannuation Fund - 2Q 2013; China Investment Corporation - 2012; Government of Singapore Investment Corporation - 2013; Korea Investment Corporation - 2012

We use the TINV function that returns the value of t Student's t-distribution as a function of the probability and the degrees of freedom; in our case the number of degrees of freedom = N-1 where N is the number of values, and probability $\alpha = 0.01$. The two-sided confidence interval can be determined from the relation:

$$\left(\bar{x} - t_{1-\frac{\alpha}{2}} \frac{s_1}{\sqrt{n-1}} \le \mu \le \bar{x} + t_{1-\frac{\alpha}{2}} \frac{s_1}{\sqrt{n-1}}\right) = 1-\alpha \qquad (1)$$

$$\left(30.66 - 2.76\frac{20.16}{\sqrt{10}} \le \mu \le 30.66 + 2.76\frac{20.16}{\sqrt{10}}\right) = 1-\alpha$$

$$(13.06 \le \mu \le 48.27) = 99\%$$

Results of this formula show an acceptable range for levels of significance. On the other hand, it explains with at 99 percent probability level that the proportion of alternative assets in asset allocations of the 11 observed SWFs is between 13.06 and 48.27 percent of the total portfolio. To determine the left-hand interval, confidence interval of alternative assets, we use the following relationship:

$$P\left(\mu \ge \bar{x} - t_{1-\alpha} \frac{s_1}{\sqrt{n-1}}\right) = 1-\alpha$$

$$P\left(\mu \ge 30.66 - 2.23\frac{20.16}{\sqrt{10}}\right) = 0.95 \qquad (2)$$

$$P(\mu \ge 16.5) = 95\%$$

According to the results of this formula, the proportion of alternative assets in asset allocation of 11 SWFs will be more than 16.5 percent at a 95 probability probability level. We then formulate the hypothesis as follows:

H_0: These are random deviations due to the selection of elements in the file Z, m= μ .

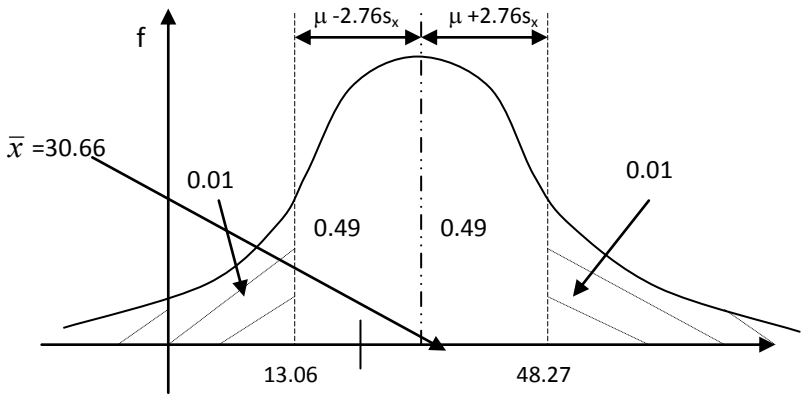
H_1: These are NOT random deviations due to the selection of elements in the file Z, m≠ μ .

$$t = \frac{|\bar{x} - \mu|}{s}\sqrt{n} = \frac{30.66 - 16.5}{20.16}\sqrt{11} = 2.33 \qquad (3)$$

$t_{crit} = 2.23$

The significance level of 0.05 and 10 degrees of freedom, the inverse two-sided t-distribution is calculated by TINV (0.05; 10) is 2.23. Ergo, $t > t_{crit} \rightarrow$ we accept the alternative hypothesis, 30.66≠16.05 and there are no random deviations due to the selection of observed funds, in short, resluts are statistically significant.

Figure 1: Illustration of the proportion of alternative assets



Source: Author's analysis.

Figure 1 above shows that the measured value 30.66 is located inside the acceptable range and therefore we accept the alternative hypothesis. To sum up, results using the formula show at a 95 percent

probability level that the proportion of alternative assets in asset allocations of observed SWFs is between 13.06 percent and 48.27 percent of the total portfolio and that by determining the left-hand interval we may say it is more than 16.05 percent of the funds‘ portfolios.

3.2 Testing Hypothesis II.

We observe data of 13 asset allocations in 2013 as illustrated in Table 2 below. More to the point, we determine the reliability of at a 99% probability level and we determine confidence interval of the proportion of fixed income in observed asset allocation of SWFs. In this context, funds include: savings funds, stabilization/savings funds, pension reserve funds and reserve investment funds.

Table 2: Variables, N=13

Z	Fixed Income %
The Government Pension Fund Global - Norway	37.7
Botswana - Pula Fund	25.77
Alberta Heritage Savings Trust Fund	20
Alaska Permanent Fund Corporation	20
Timor Leste Petroleum Fund	65
National Development Fund of Iran	16.6
Ireland, National Pensions Reserve Fund	14.7
Hong Kong Monetary Authority Investment Portfolio	74
Australia Future Fund	11.8
New Zealand Superannuation Fund	9
China Investment Corporation	19.1
Government of Singapore Investment Corporation	21
Korea Investment Corporation	38.8
AVERAGE	28.728
STDEV	20.166
TINV for □ /2	2.680
TINV for □	1.782
MEDIAN	20
SKEW	1.470
KURT	1.296

Source: Author´s calculations, available data from SWFs websites, reports.
Notes: 1) Botswana - Pula Fund - 2Q 2013; Government Pension Fund Global - Norway - 1Q 2014; Alberta Heritage; Savings Trust Fund - 1Q 2013; Ireland, National Pensions Reserve Fund - 1Q 2014; Australia Future Fund - 1Q 2014; New Zealand Superannuation Fund - 2Q 2013; China Investment Corporation – 2012; Korea Investment Corporation – 2012

However, we use the TINV function that returns the value of t Student's t-distribution as a function of the probability and the degrees of freedom. Especially, the number of degrees of freedom = N-1 where N is the number of values and probability $\alpha = 0.01$. According to the what is mentioned above, we determine the two-sided confidence interval using the following relationship:

$$\left(\bar{x} - t_{1-\frac{\alpha}{2}} \frac{s_1}{\sqrt{n-1}} \le \mu \le \bar{x} + t_{1-\frac{\alpha}{2}} \frac{s_1}{\sqrt{n-1}}\right) = 1-\alpha \qquad (4)$$

$$\left(28.73 - 2.68\frac{20.17}{\sqrt{12}} \le \mu \le 28.73 + 2.68\frac{20.17}{\sqrt{12}}\right) = 0.99$$

$$(13.11 \le \mu \le 44.35) = 99\%$$

Results using this formula show an acceptable range for levels of significance. On the other hand, it explains at a 99 percent probability level that the proportion of fixed income in asset allocations of the observed 13 SWFs is between 13.11 and 44.35 percent of the total portfolio. To determine the left-hand interval, the average of fixed income, we use the following relationship:

$$P\left(\mu \ge \bar{x} - t_{1-\alpha} \frac{s_1}{\sqrt{n-1}}\right) = 1-\alpha \qquad (5)$$

$$P\left(\mu \ge 28.73 - 1.78\frac{20.16}{\sqrt{12}}\right) = 0.90$$

$$P(\mu \ge 18.36) = 90\%$$

According to the results using the formula above, the proportion of fixed income in the asset allocation of 13 SWFs will be more than 18.36 percent at 90 percent probability. We then formulate the hypothesis as follows:

H_0: These are random deviations due to the selection of elements in the file Z, m= μ .

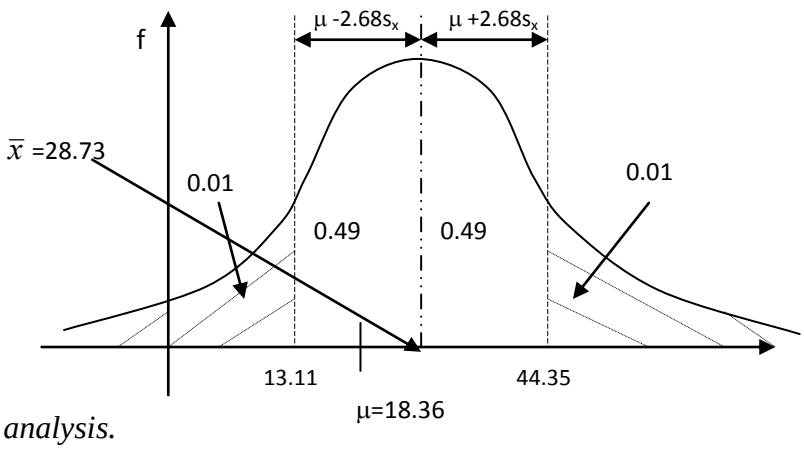
H_1: These are NOT random deviations due to the selection of elements in the file Z, m≠ μ .

$$t = \frac{|\bar{x} - \mu|}{s}\sqrt{n} \quad = \frac{28.73 - 18.36}{20.16}\sqrt{13} = 1.85 \qquad (6)$$

$t_{crit} = 1.78$

The significance level of 0.10 and 12 degrees of freedom and the inverse two-sided t-distribution is calculated using TINV (0,1; 12) is 1.78. Ergo, $t > t_{crit} \rightarrow$ we accept the alternative hypothesis, 28.73≠18.36 and there are no random deviations due to the selection of observed funds, in short, results are statistically significant.

Figure 2: Illustration of the proportion of fixed income



Source: Author's analysis.

As revealed by Figure 2 above, the measured value 28.73 is located inside the acceptable range and therefore, we accept the alternative hypothesis. To sum up, results show that there is a 90 percent probability that the proportion of fixed income in asset allocations of observed SWFs is supposed to be between 13.11 percent and 44.35 percent of the total portfolio and by determining the left-hand interval we may say that it is supposed to be more than 18.36 percent of the funds‘ portfolios.

3.3 Testing Hypothesis III.

At this section, we observe data of 7 asset allocations of cash classes in 2013 as illustrated in Table 3 below. In other words, we determine the reliability at a 95% probability level and we want to determine confidence interval of the proportion of cash in observed asset allocations of SWFs. Clearly, funds include: savings funds, stabilization/savings funds, pension reserve funds and reserve investment funds.

Table 3: Variables, N=7

Z	Cash %
Nigeria Sovereign Investment Authority	5
Botswana - Pula Fund	7.86
National Development Fund of Iran	5.8
Ireland, National Pensions Reserve Fund	39.7
Australia Future Fund	10.9
China Investment Corporation	3.8
Government of Singapore Investment Corporation	7
AVERAGE	11.437
STDEV	10.669
TINV for □ /2	1.943
TINV for □	1.446
MEDIAN	7
SKEW	2.472
KURT	6.277

Source: Author´s calculations, available data from SWFs websites, reports.
Notes: Nigeria Sovereign Investment Authority - 2012; Botswana - Pula Fund - 2Q 2013; Ireland, National Pensions Reserve Fund - 1Q 2014; Australia Future Fund - 1Q 2014; China Investment Corporation - 2012

First of all, we use the TINV function that returns the value of t Student's t-distribution as a function of the probability and the degrees of freedom. In other words, the number of degrees of freedom = N-1 where N is the number of values, and probability $\alpha = 0.05$.

Secondly, we determine the two-sided confidence interval by using et sequentes relationship:

$$\left(\bar{x} - t_{1-\frac{\alpha}{2}} \frac{s_1}{\sqrt{n-1}} \le \mu \le \bar{x} + t_{1-\frac{\alpha}{2}} \frac{s_1}{\sqrt{n-1}}\right) = 1-\alpha \qquad (7)$$

$$\left(11.44 - 1.94\frac{10.67}{\sqrt{6}} \le \mu \le 11.44 + 1.94\frac{10.67}{\sqrt{6}}\right) = 0.95$$

$$(3 \le \mu \le 19.89) = 95\%$$

As a result of the formula above, we see an acceptable range for levels of significance, more to the point, that explain at a 95 percent probability level that the proportion of cash class in asset allocations of the observed 7 SWFs is between 3.00 and 19.89 percent of the total portfolio. Thirdly, to determine the left-hand interval, the average of the cash figure, we use the following relationship:

$$P\left(\mu \geq \bar{x} - t_{1-\alpha}\frac{s_1}{\sqrt{n-1}}\right) = 1-\alpha \qquad (8)$$

$$P\left(\mu \geq 11.44 - 1.44\frac{10.67}{\sqrt{6}}\right) = 0.95$$

$$P(\mu \geq 5.17) = 95\%$$

In short, results shows that the proportion of the cash figure in the asset allocation of 7 SWFs will be more than 5.17 percent at a 95 percent probability level. At this point, we formulate another hypothesis as follows:

H_0: These are random deviations due to the selection of elements in the file Z, m= μ .

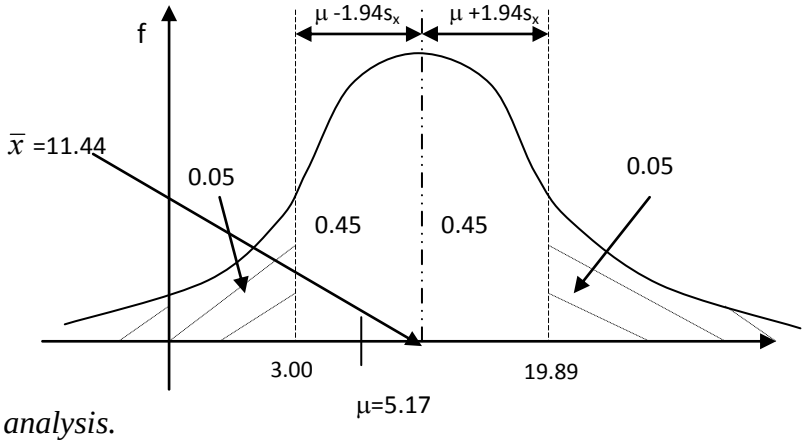
H_1: These are NOT random deviations due to the selection of elements in the file Z, m≠ μ .

$$t = \frac{|\bar{x}-\mu|}{s}\sqrt{n} = \frac{11.44-5.17}{12.67}\sqrt{7} = 1.31 \qquad (9)$$

$t_{crit} = 2.44$

In this context, the significance level of 0.05 and 7 degrees of freedom and the inverse two-sided t-distribution calculated using TINV (0.05; 6) is 2.44. Ergo, $t < t_{crit} \rightarrow$ we accept the null hypothesis, 11.44=5.17 and the deviation is caused by random selection of funds in file Z, which *is not* statistically significant. The following Figure 3 presents the proportion of cash.

Figure 3: Illustration of the proportion of cash



Source: Author's analysis.

Figure 3 above highlights that the measured value 11.44 is located inside the acceptable range and therefore, we accept the null hypothesis. On the one hand, results show that there is a 95 percent probability that the proportion of cash in asset allocations of observed SWFs is supposed to be between 3.00 percent and 19.89 percent of the total portfolio. Id est, determining the left-hand interval, we arrived at the result that the figure of cash is more than 5.17 percent in the fund´s portfolios.

3.4 Testing Hypothesis IV.

At this point, data of observed 13 public equities of asset allocations in 2013 are presented in Table 4 below. Furthermore, we determine the reliability of 99 percent and we want to determine confidence interval

of proportion of public equties in observed asset allocations of SWFs. However, this data also includes five types of funds as follows: savings funds, stabilization/savings funds, pension reserve funds, reserve investment funds.

Table 4: Variables, N=13 (continued on the next page)

Z	**Public Equities %**
The Government Pension Fund Global - Norway	61.1
Botswana - Pula Fund	66.37
Nigeria Sovereign Investment Authority	80
Alberta Heritage Savings Trust Fund	53
Alaska Permanent Fund Corporation	36
Timor Leste Petroleum Fund	35
Hong Kong Monetary Authority Investment Portfolio	26
Ireland, National Pensions Reserve Fund	24.8
Australia Future Fund	42.6
New Zealand Superannuation Fund	61
China Investment Corporation	32
Government of Singapore Investment Corporation	46
Korea Investment Corporation	45.2
AVERAGE	46.851
STDEV	16.688
TINV for □ /2	2.680
TINV for □	2.178
MEDIAN	45.2
SKEW	0.502
KURT	-0.473

Source: Author´s calculations, available data from SWFs websites, reports.
Notes: 1) Government Pension Fund Global - Norway - 1Q 2014; Botswana - Pula Fund - 2Q 2013; Nigeria Sovereign Investment Authority – 2012; Alberta Heritage Savings Trust Fund - 1Q 2013; National Pensions Reserve Fund - 1Q 2014; Australia Future Fund - 1Q 2014; New Zealand Superannuation Fund - 2Q 2013; China Investment Corporation - 2012; Korea Investment Corporation - 2012

To begin, we use the TINV function that returns the value of t Student's t-distribution as a function of the probability and the degrees of freedom. In other words, the number of degrees of freedom = N-1 where N is the number of values and probability α = 0.01. Then, we determine the two-sided confidence interval using following relationship:

$$\left(\bar{x} - t_{1-\frac{\alpha}{2}} \frac{s_1}{\sqrt{n-1}} \le \mu \le \bar{x} + t_{1-\frac{\alpha}{2}} \frac{s_1}{\sqrt{n-1}}\right) = 1-\alpha \qquad (10)$$

$$\left(46.85 - 2,.68\frac{16.69}{\sqrt{12}} \le \mu \le 46.85 + 2.68\frac{16.69}{\sqrt{12}}\right) = 0.99$$

$$(33.93 \le \mu \le 59.78) = 99\%$$

According to the results mentioned above, we see an acceptable range for levels of significance, in this context, explaining at a 99 percent probability level that the proportion of public equties in asset allocations of observed 13 SWFs is between 33.93 and 59.78 percent of the total portfolio. Consequently, we determine the left-hand interval, the average of cash figure we use the et sequentes relationship:

$$P\left(\mu \geq \bar{x} - t_{1-\alpha}\frac{s_1}{\sqrt{n-1}}\right) = 1-\alpha$$
$$P\left(\mu \geq 46.85 - 2.17\frac{16.69}{\sqrt{12}}\right) = 0.95 \quad (11)$$
$$P(\mu \geq 36.38) = 95\%$$

To sum up, results show that the proportion of public equities in asset allocation of 13 SWFs will be more than 36.38 percent at 95 percent probability.

At this point, we decided to formulate another hypothesis as follows:

H_0: These are random deviations due to the selection of elements in the file Z, m= μ .

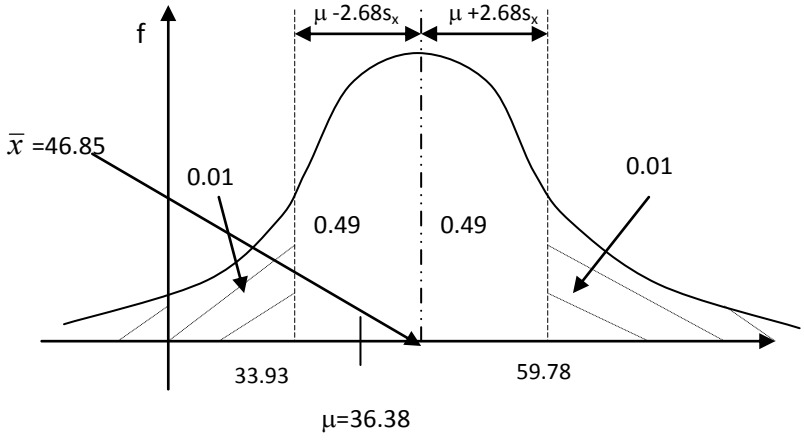
H_1: These are NOT random deviations due to the selection of elements in the file Z, m≠ μ .

$$t = \frac{|\bar{x}-\mu|}{s}\sqrt{n} = \frac{46.85-36.38}{16.69}\sqrt{13} = 2.26 \quad (12)$$

$t_{crit} = 2.17$

In fact, the significance level of 0.05 and 12 degrees of freedom and the inverse two-sided t-distribution is calculated using TINV (0.05; 12) is 2.17. Ergo, $t > t_{crit} \rightarrow$ we accept allternative hypothesis, 46.85≠36.38 and there are no random deviations due to the selection of observed funds, in short, results are statistically significant. For better understanding, we provide the following Figure 4 below that illustrates the proportion of public equities.

Figure 4: Illustration of the proportion of public equities



Source: Author's analysis.

However, Figure 4, representing the measured value 46.85, is located inside the acceptable range and therefore, we accept the allternative hypothesis. Firstly, results show that there is a 99 percent probability that the proportion of public equities in asset allocations of observed SWFs is between 33.93 percent and 59.78 percent of the total portfolio. Secondly, determining the left-hand interval, we arrived to the result that the figure of public equities is more than 36.38 percent of the funds‘ portfolios.

4 Conclusion

First, we observed data of alternative assets in 2013. We identified that at a 99 percent probability level the proportion of alternative assets in asset allocations of the observed 11 SWFs is between 13.06 and 48.27 percent of the total portfolio. Then, we determined the left-hand interval and that the proportion of alternative assets will be more than 16.5 percent at a 95 percent probability level. To sum up, at significance level of 0.05 and 10 degrees of freedom, the inverse two-sided t-distribution is calculated using TINV (0.05; 10) is 2.23. Therefore, $t > t_{crit} \rightarrow$ we accepted the alternative hypothesis, 30.66≠16.05 and there are no random deviations due to the selection of observed funds, in short, results are statistically significant.

Second, we observed data of fixed income in 2013. We examined that at a 99 percent probability level the proportion of fixed income in asset allocations of observed 13 SWFs is between 13.11 and 44.35 percent of the total portfolio. Afterwards, we determined that the left-hand interval, the proportion of fixed income in asset allocation, will be more than 18.36 percent at a 90 percent probability level. In short, at a significance level of 0.10 and 12 degrees of freedom, the inverse two-sided t-distribution is calculated using TINV (0.1; 12) is 1.78. Therefore, t > tcrit → we accepted the alternative hypothesis, 28.73≠18.36 and there are no random deviations due to the selection of observed funds, more to the point, results are statistically significant.

Third, we observed data of cash figures in 2013. We presented that at a 95 percent probability level the proportion of cash class in asset allocations of the observed 7 SWFs is between 3.00 and 19.89 percent of the total portfolio. On the other hand, by determination of the left-hand interval, the proportion of cash figure in asset allocation will be more than 5.17 percent at a 95 percent probability level. In this context, at a significance level of 0.05 and 7 degrees of freedom, the inverse two-sided t-distribution is calculated using TINV (0.05; 6) is 2.44. Ergo, t < tcrit → we accept the null hypothesis, 11.44=5.17 and the deviation is caused by a random selection of funds in file Z, which are not statistically significant.

Fourth, we observed data of public equities in 2013. We described that at a 99 percent probability level the proportion of public equties in asset allocations of observed 13 SWFs is between 33.93 and 59.78 percent of the total portfolio. Then, according to the determination of the left-hand interval, the proportion of public equities in asset allocation will be more than 36.38 percent at a 95 percent probability level. In fact, at a significance level of 0.05 and 12 degrees of freedom, the inverse two-sided t-distribution is calculated using TINV (0.05; 12) is 2.17. Ergo, $t > t_{crit} \rightarrow$ we accept the alternative hypothesis, 46.85≠36.38 and there are no random deviations due to the selection of observed funds, in short, results are statistically significant.

However, since the financial crisis, as investments turned out to have certain effects on fund performance, SWF managers were considerably questioned about their investment decisions and monitoring activities. Id est, changes in SWFs‘ asset allocations will increasingly involve ethical responsibilities in the future.

5 References

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