CHAPTER 4

Policy Implication

Almost two decades before the financial crisis. Thailand enjoyed rapid economic growth with stable internal and external exchange rate. In August 1995. the economy suffered a setback caused mainly by shrinking export. An adjustment of government's loan project incline to create more debt. undertaken with the support of the International Monetary Fund. For such performance or issuing other loans. it should be considered both financial constraints and risk of debt. At present. it becomes impossible to avoid all risks from the depreciation of baht. We will later discuss how the government should respond such problems.

4.1 Loss from Uncontrollable Exchange Rate Stability

We first talk about effects of rapid increase in the external debt due to change in the exchange rate system from a basket of currencies to a managed floating system. Causes of change in the expected present values of the external debt on July 1,1997 and on September 8,1997, will be taken into account.

Causes of change in the maximum present values of the external debt resulting from the tremendous change in the exchange rates and their price return with an assumption that a debt normally paid on July 1,1997 is deferred to be paid on December 31,1997 for having a similar outstanding principal on both dates. This is because we want to only analyze the effect of change in exchange rate system without dealing with other effects of having the different principal on both dates.

Table 4.1 The expected present value and the maximum present value of the external direct debt with holding period a day , a month , a year calculated by Analytical method and Monte carlo method before and after using managed floating system (in baht)

A day holding period	Expected value	VaR	Max. payment
1 7 97 Analytical Method	**114.25**	**2.20**	**116.46 (Billion Bht)**
Monte carlo Method	**114.25**	**1.89**	**116.15**
8 9 97 Analytical Method	**168.65**	**3.84**	**172.50**
Monte carlo Method	**168.65**	**3.34**	**172.00**
increase after before using managed floating system			
Analytical Method	47.61	74.65	48.12
Monte carlo Method	47.61	76.80	48.08

A month holding period	Expected value	VaR	Max. payment
1 7 97 Analytical Method	**114.25**	**10.35**	**124.61(Billion Bht)**
Monte carlo Method	**114.25**	**11.66**	**125.92**
8 9 97 Analytical Method	**168.65**	**19.14**	**187.80**
Monte carlo Method	**168.65**	**17.22**	**185.87**
increase after before using managed floating system			
Analytical Method	47.61	84.91	50.71
Monte carlo Method	47.61	47.68	47.62

A year holding period	Expected value	VaR	Max. payment
1 7 97 Analytical Method	**114.25**	**33.11**	**147.37(Billion Bht)**
Monte carlo Method	**114.25**	**35.67**	**149.93**
8 9 97 Analytical Method	**168.65**	**62.53**	**231.19**
Monte carlo Method	**168.65**	**67.72**	**236.37**
increase after before using managed floating system			
Analytical Method	47.61	88.87	56.88
Monte carlo Method	47.61	89.85	57.66

Having shown in table 4.1, an expected present value of external debt on July 1,1997 (the present value denominated in foreign currencies* exchange rate on July 1,1997) is equal to 114 billion baht comparing to, on September 8, 1997, 169 billion baht increases 55 billion baht or 47.61% . Moreover if we combine the risk caused from the extreme fluctuation of exchange rates together, rise in a change of the

maximum present value is up to 48.12%, 50.17%, 56.88% and VaR is up to 74.65%, 84.91%, 89.85% with a day, a month, a year holding period respectively by using two methods, Analytical and Monte-carlo, That give the similar results. As soon as on September 8,1997, the two major exchange rates, 31.44 THB/US and 0.287 THB/yen, rose from on July 1,1997 , 24.45 THB/US and 0.212 THB/yen up to 28.6% and 35.4% respectively. These showed that the increasing rates of the expected value and the maximum present value of the external debt were higher than the increasing rates of the two major exchange rates. Currently, given severe fluctuations in both currencies, the government is unable to diversify risks associates with external debts. For example, in the past, when the baht against US dollar was weaker, the baht against Japanese Yen was stronger.But, the managed floating system made the depreciation of baht value against all currencies borrowed from abroad move on the same direction of any price returns of exchange rates. For example, if baht against Japanese Yen go up, bath against dollar will go up too.

Under this new system, several extreme circumstances hamper the ability of predicting correctly the later burden of the debt , however, for a good choice , we can later assume scenarios for early warnings and other policy implications.

4.2 Application of Value-at-Risk Improvement

At present, some would wonder what kinds of bonds or loans that we should issue next time, under short or long periods with currencies or where the optimal choice to decrease Value-at-Risk for paying debts would be. If we can freely issue bonds at the same amount of debt, with minimized risks, we should issue them.

So, we will discuss the mathematical basis of the DelVaR[1] constructed for this purpose. Generally, the portfolio VaR is given as:

$$VaR(p) = (p^T Q\ p)^{\wedge} 1/2$$

p = a (column) vector of cash flow amounts

Q = a confidence level-scaled variance-covariance matrix describing the covariance structure of standard vertices

p^T = transpose of p

After Thai government issue a new bond , we evaluate VaR of augment debt R_i=P+A_i , where A_i is a new debt consisting solely of ith issue and the DelVaR quantity is calculated, being:

$$DelVaR(p) = \nabla VaR(p) = p^T Q / p^T Qp$$

Where it notes that this quantity is independent of the index i or a say that the DelVaR vector depends only upon the current debt, and not upon the new issue of bond .The incremental effect of any new issue is, as follows:

$$\text{Incremental VaR} = \text{DelVaR} * a_i = [p^T Q/VaR(p)] * a_i$$

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[1] Please see details in Improving on VaR , Mark Garman

Where a_i is a (column) vector of cash flow amounts for the year(i) issuing bond, hence a_i is always positive. Decrease in VaR will occur by DelVaR of a (column) vector with a negative sign. The value of each column of DelVaR matrix will indicate how much improvement (negative sign) or degrade (positive sign) of VaR so as to indicate proper currencies for bond issue.

4.3 Value-at-Risk Increment Result

Change from basket system pegged with US dollar to managed floating system on economic crisis at present time makes the severe fluctuation of the price return of exchange rates THB/Yen and THB/US dollar. In particular, magnitudes of covariance of the price returns are bigger and at positive. This makes the government unable to diversify bonds denominated in foreign currencies for risk reduction.to However, we can minimize the risk by using Del VaR model.

Table 4.3shows that in 1996 and 1997, if the government issues a loan or bond denominated in Deutsche Mark and Saudi Riyal respectively, it could diversify bonds denominated in foreign currencies in prder to minimize risks. Since the last quarter of 1997 until 2031, given an assumption of an unstable exchange rate, the government cannot decrease the risk but it can choose to borrow the debt denominated in a currency minimizing increase in the risk. For example, issuing the debt denominated in Austrian Schilling in value of 1 baht will increase the value at risk 15.8 satangs. That is an optimal choice for minimize the risk better than choosing other currencies having never been borrowed.

Table 4.2 The covariance and corelation of yearly price return (dp/p) of any exchange rate risk vertices on scenario of unstable exchange rate

	asy	cSy	sfy	dmy	dky	bfy	pdy	yy	sry	usy
asy	0.048818	0.047745	0.051366	0.051291	0.051586	0.050636	0.054961	0.011593	0.045056	0.045121
cSy	0.047745	0.05912	0.053143	0.05134	0.051139	0.05895	0.060491	0.016149	0.055181	0.055228
sfy	0.051366	0.053143	0.061545	0.05636	0.05673	0.055229	0.062406	0.01423	0.049708	0.049796
dmy	0.051291	0.05134	0.05636	0.055716	0.05524	0.052883	0.058914	0.01011	0.048059	0.048129
dky	0.051586	0.051139	0.05673	0.05524	0.057792	0.056521	0.059582	0.010903	0.047837	0.047873
bfy	0.050636	0.05895	0.055229	0.052883	0.056521	0.07439	0.062943	0.019217	0.055587	0.055642
pdy	0.054961	0.060491	0.062406	0.058914	0.059582	0.062943	0.071535	0.019425	0.056586	0.056651
yy	0.011593	0.016149	0.01423	0.01011	0.010903	0.019217	0.019425	0.076046	0.017373	0.017376
sry	0.045056	0.055181	0.049708	0.048059	0.047837	0.055587	0.056586	0.017373	0.05228	0.052341
usy	0.045121	0.055228	0.049796	0.048129	0.047873	0.055642	0.056651	0.017376	0.052341	0.052406

	asy	cSy	sfy	dmy	dky	bfy	pdy	yy	sry	usy
asy	1	0.888734	0.937099	0.983463	0.971201	0.840264	0.93003	0.190264	0.891857	0.892075
cSy	0.888734	1	0.881006	0.894544	0.874877	0.888919	0.930159	0.240852	0.992561	0.992215
sfy	0.937099	0.881006	1	0.962464	0.951221	0.816236	0.940521	0.207999	0.876317	0.876825
dmy	0.983463	0.894544	0.962464	1	0.973481	0.821437	0.933186	0.155323	0.890473	0.890693
dky	0.971201	0.874877	0.951221	0.973481	1	0.862027	0.926651	0.164465	0.870291	0.869887
bfy	0.840264	0.888919	0.816236	0.821437	0.862027	1	0.862834	0.255501	0.891361	0.891162
pdy	0.93003	0.930159	0.940521	0.933186	0.926651	0.862834	1	0.263369	0.9253	0.925251
yy	0.190264	0.240852	0.207999	0.155323	0.164465	0.255501	0.263369	1	0.275526	0.275255
sry	0.891857	0.992561	0.876317	0.890473	0.870291	0.891361	0.9253	0.275526	1	0.99997
usy	0.892075	0.992215	0.876825	0.890693	0.869887	0.891162	0.925251	0.275255	0.99997	1

date	AS	CS	SF	DM	DK	FF	pd	SR	yn	US
29/12/95	-0.00344	0.003965	-0.00137	-0.00429	-0.01701	0.022331	-0.0028	0.001157	0.033505	0.000844
31/12/96	0.005781	0.007034	-0.00697	-0.00105	0.005823	0.030732	-0.00101	-0.00184	0.046689	0.000716
31/12/97	0.158044	0.197885	0.17967	0.167732	0.163286	0.1964	0.206913	0.192365	0.189175	0.192629
31/12/98	0.14912	0.187343	0.17019	0.157714	0.153463	0.186419	0.196838	0.182886	0.203414	0.183134
31/12/99	0.147991	0.185945	0.168959	0.156371	0.152236	0.185248	0.195572	0.181625	0.20575	0.181871
31/12/00	0.157464	0.197041	0.178987	0.16691	0.16271	0.19621	0.206318	0.19162	0.192098	0.191882
31/12/01	0.161961	0.202275	0.183659	0.171921	0.167667	0.201473	0.211307	0.196338	0.184533	0.196609
31/12/02	0.154108	0.193155	0.175235	0.163049	0.158945	0.19296	0.202442	0.188216	0.197549	0.188474
31/12/03	0.15097	0.18958	0.171851	0.159391	0.155522	0.189808	0.198985	0.185001	0.203065	0.185252
31/12/04	0.141743	0.17865	0.162168	0.149117	0.145476	0.179111	0.188586	0.175037	0.215744	0.17527
31/12/05	0.129774	0.164399	0.149435	0.135921	0.132409	0.165011	0.17475	0.162009	0.228524	0.162222
31/12/06	0.114831	0.146519	0.133451	0.119478	0.11624	0.147237	0.157254	0.145499	0.241376	0.145683
31/12/07	0.117503	0.149671	0.136468	0.122296	0.119337	0.150471	0.160632	0.148264	0.240846	0.148448
31/12/08	0.120052	0.152657	0.139284	0.125047	0.122106	0.153608	0.163859	0.151031	0.239763	0.151221
31/12/09	0.122316	0.155414	0.141626	0.127469	0.124643	0.157146	0.1666	0.153588	0.238827	0.153782
31/12/10	0.129931	0.164524	0.149684	0.135553	0.132971	0.16666	0.17564	0.161944	0.233889	0.16215
31/12/11	0.137928	0.174211	0.158225	0.144074	0.141933	0.177038	0.185271	0.170728	0.227436	0.170941
31/12/12	0.145215	0.182922	0.166014	0.152032	0.150017	0.185943	0.193841	0.178622	0.219824	0.178846
31/12/13	0.091483	0.118885	0.10797	0.092889	0.091669	0.123279	0.130551	0.119721	0.261428	0.119854
31/12/14	0.094215	0.122127	0.110897	0.095759	0.094697	0.126856	0.133882	0.122695	0.260725	0.122832
31/12/15	0.096905	0.125324	0.113795	0.098626	0.097649	0.130246	0.137148	0.125636	0.259783	0.125775
31/12/16	0.100926	0.130111	0.118156	0.103018	0.102027	0.135104	0.141958	0.130044	0.257859	0.13019
31/12/17	0.111247	0.142407	0.129382	0.114387	0.113168	0.147061	0.154218	0.141395	0.251704	0.141558
31/12/18	0.127781	0.162085	0.147323	0.132692	0.131136	0.166143	0.173688	0.159442	0.238926	0.159631
31/12/19	0.142975	0.180002	0.163741	0.149589	0.147732	0.183259	0.191326	0.175728	0.223527	0.175941
31/12/20	0.170653	0.212206	0.193402	0.181002	0.178259	0.21305	0.222376	0.204512	0.179415	0.20477
31/12/21	0.183069	0.226108	0.20645	0.195484	0.192252	0.225383	0.235406	0.216476	0.147186	0.216754
31/12/22	0.195933	0.239077	0.218868	0.211842	0.207676	0.235002	0.245664	0.226128	0.067573	0.226432
31/12/23	0.196542	0.239522	0.219487	0.212435	0.208462	0.23594	0.246358	0.226452	0.067651	0.226754
31/12/24	0.197152	0.239944	0.220046	0.212983	0.209212	0.236967	0.247027	0.226789	0.067661	0.227091
31/12/25	0.197774	0.240402	0.220574	0.213503	0.210054	0.238259	0.247674	0.227131	0.067526	0.227431
31/12/26	0.198478	0.240788	0.221218	0.214109	0.210953	0.239183	0.248349	0.227388	0.067177	0.227686
31/12/27	0.199505	0.24099	0.222328	0.215252	0.212295	0.23986	0.249216	0.22737	0.066086	0.227664
31/12/28	0.200766	0.241073	0.223765	0.216841	0.213921	0.240176	0.250152	0.227102	0.064559	0.227391
31/12/29	0.20569	0.239842	0.229655	0.223433	0.220407	0.238727	0.253144	0.224215	0.056332	0.224476
31/12/30	0.205807	0.240193	0.229675	0.223315	0.220739	0.239814	0.253454	0.224471	0.055986	0.224728
31/12/31	0.205841	0.240213	0.229699	0.223326	0.220803	0.23993	0.253495	0.224481	0.055916	0.224738

Table 4.3 The incremental value at risk of issuing a new bond or loan by DelVaR method on scenario of unstable exchange rate (in baht)

However, such a condition will be correct if an amount of cash flow from issuing such loan has not been too much changing significantly variance, covariance of any price returns of risk vertices at a level of confident (whether we can use F-test to decide variances change or not). If the government issues a loan denominated in Japanese Yen or US dollar in value of 1 baht, it would add more value at risk up to 18.9 , 19.3 satangs respectively. Why? We can explain by analyzing percent of bunching of the debt denominated in Austrian Schilling and Deutsche Mark equal to 0.32% , 0.73% are significantly less than that denominated in Japanese Yen and US dollar equal to 35.41% , 62.18% respectively. Nevertheless, the covariances of the price return of exchange rates between THB/AS and THB/yen equal to 4.56×10^{-5} and that between THB/AS and THB/US equal to 16.5×10^{-5} , and the covariance (THB/DM, THB/US) equal to 17.1×10^{-5} are significantly less than the covariance (THB/Y, THB/US) equal 17.3×10^{-3} and variance (THB/US) equal 5.2×10^{-2}or variance (THB/Y) equal 7.6×10^{-2}that we can write in a simple form as follows

COV (THB/AS,THB/US) and COV (THB/AS,THB/Y)

< COV (THB/DM, THB/US) and COV (THB/AS,THB/Y)

<< COV (THB/Y, THB/US) and Var (THB/US)

<< COV (THB/US, THB/Y) and Var (THB/Y)

So, issuing a loan denominated in Austrian Schilling would increase the least value at risk opposite to that denominated in Pound Sterling which would maximize the value at risk. Although there is little percentage of bunching in this currency, the covariances of the price return between Pound Sterling and the two major currencies, Japanese Yen and US dollar, have the substantial magnitudes and show the positive sign. In other word, if US dollar or yen against baht appreciate, Pound Sterling against baht would appreciate too, that makes the highest risk.

However, if the government can control exchange rate stability, it will benefit from risk management and the burdens for debt servicing will drop. At least, the government should estimate the value of a possible profit received by such management, so, in later scenario, we assume the government can control boundary of change in baht currency against other currencies within the coming years. This approach will enable the government to derive proper criteria for bond issue in proper currencies to reduce maximum present values. The following part will show how much the present value can be reduced in different currency denomination.

Having been able to keep scenario of unstable exchange rate is good result for issuing a new loan or bond shown in table 4.4 about Improvement VaR by considering decrease in the margins of value at risks in any currencies. Since the end of 1997 till 2020, issuing a loan denominated in Swiss France, Deutsche Mark, Pound Sterling, Saudi Riyal or US dollar would reduce total value at risk and diversify.

However, an optimal choice is that the government should choose issuing a new loan which are denominated in Swiss France at year-end because creating such a debt in value of 1 baht would decrease total maximum present value of external debt by 0.09 satang.

Comparison of both scenarios will show practical and flexible policy implications for the government in different situations. Issuing a debt denominated in Pound Sterling would increase the highest risk and issuing a debt denominated in Austrian Schilling would make the lowest risk in the first scenario or unstable exchange rate.Controversially, in the second scenario or stable exchange rate similar to the past time such debt denominated in Austrian Schilling makes higher risk which is not a good choice, but that denominated in Pound Sterling betters off decreasing total risk.

In the first scenario adding the US dollar debt more, the risk is higher, absolutely controversially , in the second scenario such an addition helps decrease the risk since the negative sign of a correlation between the price return of THB/US dollar exchange rates and that of THB/yen exchange rates is the diversification of the debt in to two major currencies that have a contrary direction of their price returns.

date	AS	CS	SF	DM	DK	FF	pd	yn	SR	US
31/12/97	0.005923	0.005972	-0.00692	-0.00178	0.004948	0.031361	-0.00141	0.051554	-0.00326	-0.00056
31/12/98	0.005989	0.005568	-0.00669	-0.00206	0.004734	0.03197	-0.0014	0.054586	-0.00378	-0.00105
31/12/99	0.005994	0.005505	-0.00666	-0.00208	0.004737	0.03215	-0.00133	0.055383	-0.00385	-0.00113
31/12/00	0.006086	0.005938	-0.00659	-0.00173	0.005128	0.031823	-0.00127	0.053101	-0.00337	-0.00067
31/12/01	0.006205	0.006229	-0.00646	-0.00145	0.005489	0.03166	-0.0012	0.051754	-0.00307	-0.0004
31/12/02	0.006495	0.005808	-0.00611	-0.00153	0.005506	0.03237	-0.00117	0.054406	-0.00353	-0.00087
31/12/03	0.006603	0.005615	-0.00609	-0.00164	0.005455	0.032836	-0.00111	0.055962	-0.00368	-0.00104
31/12/04	0.006492	0.00525	-0.00627	-0.00216	0.00489	0.033208	-0.00119	0.058589	-0.00414	-0.00149
31/12/05	0.006313	0.004891	-0.00639	-0.00264	0.004353	0.033354	-0.00131	0.060732	-0.00461	-0.00193
31/12/06	0.005947	0.004365	-0.00656	-0.00316	0.003646	0.033372	-0.00141	0.062967	-0.00514	-0.00242
31/12/07	0.005444	0.004237	-0.00689	-0.00356	0.003115	0.03326	-0.00143	0.063902	-0.00521	-0.00249
31/12/08	0.005191	0.004557	-0.00726	-0.00409	0.002752	0.033221	-0.00148	0.064747	-0.00509	-0.00243
31/12/09	0.004978	0.004673	-0.00683	-0.00427	0.002786	0.033301	-0.00149	0.065691	-0.00514	-0.0025
31/12/10	0.004504	0.004782	-0.00714	-0.00429	0.00281	0.033435	-0.00115	0.066505	-0.00487	-0.00233
31/12/11	0.004781	0.004906	-0.00701	-0.00434	0.002978	0.034153	-0.00091	0.06777	-0.00458	-0.00216
31/12/12	0.004627	0.005208	-0.00709	-0.00443	0.003029	0.034273	-0.00078	0.06777	-0.00423	-0.00189
31/12/13	0.004583	0.003461	-0.00655	-0.00538	0.001748	0.034258	-0.00111	0.073531	-0.00603	-0.00367
31/12/14	0.004603	0.003467	-0.0064	-0.00538	0.001803	0.03438	-0.00097	0.074167	-0.00599	-0.00368
31/12/15	0.004669	0.003552	-0.00631	-0.00537	0.00188	0.034492	-0.00087	0.07456	-0.00593	-0.00367
31/12/16	0.004776	0.003746	-0.00617	-0.00527	0.002058	0.034595	-0.00081	0.074496	-0.00585	-0.0036
31/12/17	0.004852	0.004281	-0.00629	-0.00508	0.002366	0.034659	-0.00073	0.073539	-0.00554	-0.0033
31/12/18	0.00502	0.005126	-0.00637	-0.00471	0.00289	0.034726	-0.00066	0.071524	-0.00503	-0.00277
31/12/19	0.005045	0.006086	-0.00671	-0.00433	0.003346	0.034587	-0.00052	0.069016	-0.00439	-0.00214
31/12/20	0.004961	0.008792	-0.00756	-0.00325	0.00435	0.032799	-0.00054	0.058192	-0.00252	-0.00021
31/12/21	0.004617	0.01102	-0.00796	-0.00218	0.005045	0.029922	-0.00046	0.046903	-0.00085	0.001431
31/12/22	0.002641	0.015148	-0.00753	0.001564	0.006215	0.015032	-0.00029	0.002556	0.004352	0.0061
31/12/23	0.003028	0.016124	-0.00659	0.002246	0.006975	0.014622	0.000238	0.001296	0.004787	0.006384
31/12/24	0.003931	0.017404	-0.00538	0.003327	0.008311	0.014645	0.001046	0.000251	0.005427	0.006783
31/12/25	0.005409	0.018484	-0.00315	0.00517	0.010348	0.015162	0.00213	-0.0007	0.006044	0.007177
31/12/26	0.0071	0.019385	-0.00106	0.007609	0.012567	0.015554	0.003641	-0.00198	0.006781	0.007625
31/12/27	0.011281	0.020428	0.003818	0.011914	0.016355	0.016816	0.005609	-0.00271	0.007075	0.007681
31/12/28	0.015322	0.021728	0.008911	0.016118	0.020118	0.018151	0.007482	-0.00146	0.006461	0.00698
31/12/29	0.026768	0.023474	0.023162	0.028144	0.029553	0.020556	0.012765	0.00318	0.003383	0.003727
31/12/30	0.029266	0.024039	0.025711	0.030161	0.031493	0.021197	0.013839	0.001982	0.003918	0.003947
31/12/31	0.02962	0.024032	0.026133	0.030506	0.031779	0.021266	0.014001	0.001825	0.003968	0.003962

Table 4.4 The incremental value at risk of issuing a new bond or loan by DelVaR method on scenario of stable exchange rate (in baht)