Asset-Liability Management 2018

Project – some hints

As I said in the project description, this is a new project with new data, and I could not guarantee that the numbers selected would "behave well" in the sense of giving reasonable results. Indeed, the numbers have turned out to be a bit troublesome.

Here are some hints regarding the results.

1. Term structure modelling

The regression method for estimating the model parameters for Vasicek / CIR does not perform well. On the other hand, you probably also noticed that the yield curves over the estimation period were very unstable. Expecting a purely statistical model to make sense of the mess the financiers and politicians created, is asking too much.



Just using the regression method, I get this in question 1 (c), obviously quite unsatisfactory:



In an attempt to address the problem, I forced b=6% and $a = \alpha/(b\Delta)$. A long-term rate of 6% may be "about right" for NOK under normal economic conditions. In that case the fit looks like this:



It's still a poor fit, but at least the curves meet.

In your project you could discuss the fitting issue briefly. You're free to look for a better fit by adjusting the parameters, but I don't know if the Vasicek / CIR models are able to provide a better fit.

2. Exchange rate modelling and MVA

There seems to be some confusion on how to calculate the covariance matrix. It is, indeed, spelt out in the project. The underlying (simplistic) assumption is that the month-to-month <u>differences</u> of the 10 currency rates are i.i.d. over time, and that there are correlations across the set of currencies for any monthly change. That there must be correlations is really obvious: if the NOK drops/rises in value from one month to the next under otherwise stable conditions, all of the 10 currencies are likely to rise/drop to some extent. I also assume that the expected monthly change is zero, and force that assumption into the estimation formula. Because of the independence assumption you can just multiply the monthly variances by 12 to get annual variances. <u>So please, don't just run a "Corr" function on the raw exchange rates</u>.

To allow you to check your results, here are μ , Σ and the portfolios.

	mu		one							
Australia	1.8910 %		1							
Canada	2.0570 %		1							
Switzerland	-0.7460 %		1							
Denmark	-0.3570 %		1							
Euro	-0.3470 %		1							
United Kingdom	0.8780 %		1							
Japan	-0.0650 %		1							
Poland	1.2650 %		1							
Sweden	-0.4110 %		1							
United States	2.5180 %		1							
Sigma	Australia	Canada	Switzerland	Denmark	Euro	nited Kingdc	Japan	Poland	Sweden	Inited State
Sigma Australia	Australia 0.1716614	Canada 0.1025506	Switzerland 0.0536457	Denmark 0.0084125	Euro 0.062471	nited Kingdo 0.1100509	Japan 0.0006578	Poland 0.021518	Sweden 0.0086996	Inited State 0.0813717
Sigma Australia Canada	Australia 0.1716614 0.1025506	Canada 0.1025506 0.1743418	Switzerland 0.0536457 0.0624204	Denmark 0.0084125 0.0103224	Euro 0.062471 0.0759231	nited Kingdo 0.1100509 0.1675834	Japan 0.0006578 0.001168	Poland 0.021518 0.0143404	Sweden 0.0086996 0.007572	Inited State 0.0813717 0.162829
Sigma Australia Canada Switzerland	Australia 0.1716614 0.1025506 0.0536457	Canada 0.1025506 0.1743418 0.0624204	Switzerland 0.0536457 0.0624204 0.2253393	Denmark 0.0084125 0.0103224 0.0206562	Euro 0.062471 0.0759231 0.1538199	hited Kingdo 0.1100509 0.1675834 0.1971268	Japan 0.0006578 0.001168 0.001874	Poland 0.021518 0.0143404 0.025546	Sweden 0.0086996 0.007572 0.0102227	Inited State 0.0813717 0.162829 0.1557803
Sigma Australia Canada Switzerland Denmark	Australia 0.1716614 0.1025506 0.0536457 0.0084125	Canada 0.1025506 0.1743418 0.0624204 0.0103224	Switzerland 0.0536457 0.0624204 0.2253393 0.0206562	Denmark 0.0084125 0.0103224 0.0206562 0.0043108	Euro 0.062471 0.0759231 0.1538199 0.0321512	hited Kingdc 0.1100509 0.1675834 0.1971268 0.0331334	Japan 0.0006578 0.001168 0.001874 0.0002331	Poland 0.021518 0.0143404 0.025546 0.0056598	Sweden 0.0086996 0.007572 0.0102227 0.0021711	Inited State 0.0813717 0.162829 0.1557803 0.021198
Sigma Australia Canada Switzerland Denmark Euro	Australia 0.1716614 0.1025506 0.0536457 0.0084125 0.062471	Canada 0.1025506 0.1743418 0.0624204 0.0103224 0.0759231	Switzerland 0.0536457 0.0624204 0.2253393 0.0206562 0.1538199	Denmark 0.0084125 0.0103224 0.0206562 0.0043108 0.0321512	Euro 0.062471 0.0759231 0.1538199 0.0321512 0.2400187	hited Kingdc 0.1100509 0.1675834 0.1971268 0.0331334 0.2472601	Japan 0.0006578 0.001168 0.001874 0.0002331 0.0017286	Poland 0.021518 0.0143404 0.025546 0.0056598 0.0424945	Sweden 0.0086996 0.007572 0.0102227 0.0021711 0.0161793	Inited State 0.0813717 0.162829 0.1557803 0.021198 0.1574015
Sigma Australia Canada Switzerland Denmark Euro United Kingdom	Australia 0.1716614 0.1025506 0.0536457 0.0084125 0.062471 0.1100509	Canada 0.1025506 0.1743418 0.0624204 0.0103224 0.0759231 0.1675834	Switzerland 0.0536457 0.0624204 0.2253393 0.0206562 0.1538199 0.1971268	Denmark 0.0084125 0.0103224 0.0206562 0.0043108 0.0321512 0.0331334	Euro 0.062471 0.0759231 0.1538199 0.0321512 0.2400187 0.2472601	ited Kingdc 0.1100509 0.1675834 0.1971268 0.0331334 0.2472601 0.7173998	Japan 0.0006578 0.001168 0.001874 0.0002331 0.0017286 0.0022358	Poland 0.021518 0.0143404 0.025546 0.0056598 0.0424945 0.0470987	Sweden 0.0086996 0.007572 0.0102227 0.0021711 0.0161793 0.0205899	Inited State 0.0813717 0.162829 0.1557803 0.021198 0.1574015 0.3053748
Sigma Australia Canada Switzerland Denmark Euro United Kingdom Japan	Australia 0.1716614 0.1025506 0.0536457 0.0084125 0.062471 0.1100509 0.0006578	Canada 0.1025506 0.1743418 0.0624204 0.0103224 0.0759231 0.1675834 0.001168	Switzerland 0.0536457 0.0624204 0.2253393 0.0206562 0.1538199 0.1971268 0.001874	Denmark 0.0084125 0.0103224 0.0206562 0.0043108 0.0321512 0.0331334 0.0002331	Euro 0.062471 0.0759231 0.1538199 0.0321512 0.2400187 0.2472601 0.0017286	ited Kingdc 0.1100509 0.1675834 0.1971268 0.0331334 0.2472601 0.7173998 0.0022358	Japan 0.0006578 0.001168 0.001874 0.002331 0.0017286 0.0022358 4.912E-05	Poland 0.021518 0.0143404 0.025546 0.0056598 0.0424945 0.0470987 9.046E-05	Sweden 0.0086996 0.007572 0.0102227 0.0021711 0.0161793 0.0205899 0.0001009	Inited State 0.0813717 0.162829 0.1557803 0.021198 0.1574015 0.3053748 0.0028802
Sigma Australia Canada Switzerland Denmark Euro United Kingdom Japan Poland	Australia 0.1716614 0.1025506 0.0536457 0.0684125 0.062471 0.1100509 0.0006578 0.021518	Canada 0.1025506 0.1743418 0.0624204 0.0103224 0.0759231 0.1675834 0.001168 0.0143404	Switzerland 0.0536457 0.0624204 0.2253393 0.0206562 0.1538199 0.1971268 0.001874 0.025546	Denmark 0.0084125 0.0103224 0.0206562 0.0043108 0.0321512 0.0331334 0.0002331 0.0056598	Euro 0.062471 0.0759231 0.1538199 0.0321512 0.2400187 0.2472601 0.0017286 0.0424945	ited Kingdc 0.1100509 0.1675834 0.1971268 0.0331334 0.2472601 0.7173998 0.0022358 0.0470987	Japan 0.0006578 0.001168 0.001374 0.002331 0.0022358 4.912E-05 9.046E-05	Poland 0.021518 0.0143404 0.025546 0.0056598 0.0424945 0.0470987 9.046E-05 0.0263811	Sweden 0.0086996 0.007572 0.0102227 0.0021711 0.0161793 0.0205899 0.0001009 0.00044282	Inited State 0.0813717 0.162829 0.1557803 0.021198 0.1574015 0.3053748 0.0028802 0.0115222
Sigma Australia Canada Switzerland Denmark Euro United Kingdom Japan Poland Sweden	Australia 0.1716614 0.1025506 0.0536457 0.0084125 0.062471 0.1100509 0.0006578 0.021518 0.0086996	Canada 0.1025506 0.1743418 0.0624204 0.0103224 0.0759231 0.1675834 0.001168 0.0143404 0.007572	Switzerland 0.0536457 0.0624204 0.2253393 0.0206562 0.1538199 0.1971268 0.091874 0.025546 0.0102227	Denmark 0.0084125 0.0103224 0.0206562 0.0043108 0.0321512 0.0331334 0.0002331 0.0056598 0.0021711	Euro 0.062471 0.0759231 0.1538199 0.0321512 0.2400187 0.2472601 0.0017286 0.0424945 0.0161793	ited Kingdc 0.1100509 0.1675834 0.1971268 0.0331334 0.2472601 0.7173998 0.0022358 0.0470987 0.0205899	Japan 0.0006578 0.001168 0.001374 0.002331 0.0022358 4.912E-05 9.046E-05 0.0001009	Poland 0.021518 0.0143404 0.025546 0.0056598 0.0424945 0.0470987 9.046E-05 0.0263811 0.0044282	Sweden 0.0086996 0.007572 0.002277 0.0021711 0.0161793 0.0205899 0.0001009 0.00044282 0.0024687	Inited State 0.0813717 0.162829 0.1557803 0.021198 0.1574015 0.3053748 0.0028802 0.0115222 0.0094107

Question 1 (b)

Question 1 (c)

	w_min		w_ref		w_tan
Australia	0.0253 %	Australia	0.0229 %	Australia	0.0248 %
Canada	-0.1317 %	Canada	-0.1627 %	Canada	-0.1384 %
Switzerland	-0.1008 %	Switzerland	-0.0383 %	Switzerland	-0.0873 %
Denmark	96.4131 %	Denmark	113.4862 %	Denmark	100.1025 %
Euro	-12.9616 %	Euro	-15.1863 %	Euro	-13.4423 %
United Kingdom	0.0354 %	United Kingdom	0.0245 %	United Kingdom	0.0331 %
Japan	16.6548 %	Japan	1.6457 %	Japan	13.4115 %
Poland	0.2983 %	Poland	0.0874 %	Poland	0.2527 %
Sweden	-0.1559 %	Sweden	0.1277 %	Sweden	-0.0946 %
United States	-0.0770 %	United States	-0.0071 %	United States	-0.0619 %

Question 1 (d)

Assume that

Required return	2.20 %
Funding ratio	100.00 %

I assumed quite simply, that the liability behaves like SEK but with a different expected return.

Liability-Asset			w_gamma
Correlation	Sweden	Australia	0.0000 %
Australia	42.2602 %	Canada	0.0000 %
Canada	36.4988 %	Switzerland	0.0000 %
Switzerland	43.3429 %	Denmark	0,0000 %
Denmark	66.5541 %	Euro	0.0000 %
Euro	66.4673 %	Euro	0.0000 %
United Kingdom	48.9265 %	United Kingdor	n 0.0000 %
Japan	28.9873 %	Japan	0.0000 %
Poland	54.8723 %	Poland	0.0000 %
Sweden	100.0000 %	Sweden	100.0000 %
United States	30.9532 %	United States	0.0000 %

Optimal portfolio that includes a liability hedge and risk-free NOK and gives an expected asset return of 2.2%:

nu	100.0000 %
1-w_0	-81.46 %
w_0	181.46 %

In your project, please give me evidence that you've actually done the calculations.