

An issue raised by Peter Reekie's evidence on 7th December:
Weighted Average Cost of Capital as an indicator of hub interest rates.

Jim Cuthbert
April 2018.

At the meeting of the Public Audit Committee on 7th December, Peter Reekie of SFT said the following about the cost of finance for SFT's hub and NPD projects:-
"The average senior debt rate is 4.09 per cent and the average for junior debt is 10.8 per cent which leads to an all-in weighted cost of capital of 4.74 per cent."

What Peter Reekie is talking about here is a measure known as the weighted average cost of capital, (WACC): this is defined as the weighted average of senior and subordinate, (that is junior), debt interest rates, weighted together by the proportions of capital raised from the two sources. Given that senior debt accounts for 90% of capital in hub and NPD projects, this implies that the WACC, on Peter Reekie's figures, is

$WACC = 4.09 \times 0.9 + 10.8 \times 0.1 = 4.76$, which, give or take rounding, is the figure quoted by Peter Reekie.

While WACC is indeed one method quite commonly used to measure the overall cost of borrowing, it is important for the Committee to realise that it does not necessarily provide an accurate representation of the overall interest rate the public sector is paying for the finance of SFT projects. To provide an accurate measure of the overall interest rate actually being paid, the weighting factor for pooling the senior and sub debt interest rates has to take account, not just of the proportions of overall capital being funded from both sources, but of the projected profiles of payments on senior and sub debt. If these profiles are significantly different, then the WACC can be a very misleading indicator.

The purpose of this note is three-fold.

- (i) to provide a simple explanation of why WACC is potentially misleading, and to suggest what measure should be used.
- (ii) to assess available evidence on whether the WACC is likely to be significantly misleading in the case of hub projects. The evidence suggests that WACC may well significantly understate the true cost of hub finance.
- (iii) to suggest what needs to be done.

How the WACC can mislead.

The main part of this section is a simple example illustrating how the WACC can mislead. But before that, it is necessary to introduce some notation, and some standard background on interest rates and discounting.

Any financial transaction can be represented as a stream of positive and negative numbers, where negative numbers represent borrowing, and positive numbers represent payments.

Suppose, for example, that I borrow 90 in year 0, and pay this loan back over 10 years using an equal instalment of principal scheme, at an interest rate of 4%: (what this means is that

each year I pay one tenth of the original sum borrowed, plus interest on the outstanding principal.)

Then this transaction can be represented as follows:

year	0	1	2	3	4	5	6	7	8	9	10
payment	-90	12.6	12.24	11.88	11.52	11.16	10.8	10.44	10.08	9.72	9.36

For any interest rate, $x\%$, the discount factor at interest rate x in year j is defined as $(1 + x)^{-j}$ (in calculating this expression, x is expressed as a fraction: so if $x = 5\%$, the discount factor at rate x in year 6 is $(1.05)^{-6}$)

The internal rate of return, (IRR), of the transaction is that discount rate which is such that the sum of the discounted values of the whole transaction is equal to zero. For transactions of the common type, where negative terms precede positive terms, there will be one, and only one, IRR. And the IRR is just the interest rate at which money is being borrowed in the transaction.

So, for the example above, where the interest rate is 4%, it can indeed be seen that the sum of the payments, discounted at 4%, is zero. This is shown in the following table.

year	0	1	2	3	4	5	6	7	8	9	10	sum
payment	-90	12.6	12.24	11.88	11.52	11.16	10.8	10.44	10.08	9.72	9.36	
discount factor at 4%	1	0.962	0.925	0.889	0.855	0.822	0.790	0.760	0.731	0.703	0.676	
discounted payment	-90.00	12.12	11.32	10.56	9.85	9.17	8.54	7.93	7.37	6.83	6.32	0.00

Now consider a project where there are two forms of finance: senior debt, and subordinate debt. The senior debt component is assumed to be a loan of 90 over 10 years, under an equal instalment of principal scheme, at an interest rate of 4%, as illustrated in the above example.

The subordinate debt component is assumed to be a loan of 10, borrowed as a 10 year bond, at an interest rate of 10.5%: (what this means is that, each year from 1 to 9, interest is paid on the outstanding loan, but there is no repayment of principal: in year 10, the entire principal is repaid, plus that year's interest.)

The payment scheme for subordinate debt is shown below: and, again, it can be seen that the sum of the discounted stream of payments, discounted at 10.5%, is indeed zero.

Subordinate debt: 10.5% per annum bond												
year	0	1	2	3	4	5	6	7	8	9	10	sum
payment	-10	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	11.05	
disc. factor at 10.5%	1	0.905	0.819	0.741	0.671	0.607	0.549	0.497	0.450	0.407	0.368	
discounted payment	-10.00	0.95	0.86	0.78	0.70	0.64	0.58	0.52	0.47	0.43	4.07	0.00

Now consider the overall funding for the project: this is the sum of the senior and sub debt project streams, as follows:-

Total project											
year	0	1	2	3	4	5	6	7	8	9	10
senior debt payment	-90	12.6	12.24	11.88	11.52	11.16	10.8	10.44	10.08	9.72	9.36
sub debt payment	-10	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	11.05
total project payment	-100	13.65	13.29	12.93	12.57	12.21	11.85	11.49	11.13	10.77	20.41

What is the IRR of the total project payment stream? A small amount of calculation, (not shown here), shows that the IRR of the total project payment stream, (the “project IRR”), is actually 5.02964%: let’s say, 5.03%. This is illustrated in the following table:-

year	0	1	2	3	4	5	6	7	8	9	10	sum
total project payment	-100	13.65	13.29	12.93	12.57	12.21	11.85	11.49	11.13	10.77	20.41	
disc. factr at 5.02964%	1	0.952	0.907	0.863	0.822	0.782	0.745	0.709	0.675	0.643	0.612	
discounted total paym	-100	13.00	12.05	11.16	10.33	9.55	8.83	8.15	7.52	6.92	12.49	0.00

So for this project as a whole, the public sector is actually borrowing at 5.03%. But what is the WACC of this project? Well, the WACC is easily calculated as

$$WACC = 4*0.9 + 10.5*.1 = 4.65\%$$

So in this example, the WACC , at 4.65%, understates the true cost of capital, (that is, the project IRR), of 5.03%.

The reason for the difference between the WACC and the project IRR is that the payment profiles of the senior and subordinate debt streams are different: the sub debt borrowing is, on average, outstanding for longer than the senior debt borrowing. So to correctly calculate the overall interest rate for the project involves giving more weight to the sub debt component than in the WACC approach.

Only if the outstanding debt profiles of the senior and sub debt components are the same can the WACC be taken as an accurate estimate of the true project interest rate. In real life public procurement projects, this is very unlikely to happen, since senior debt lenders will normally insist that their loans are largely repaid before significant repayments of sub debt take place.

In the absence of explicit confirmation that the outstanding debt profiles of the constituent spending streams are the same, the project IRR, as defined above, rather than the WACC, should be used as the appropriate measure of the overall cost of capital.

Does this matter in practice for hub projects?

As explained at the end of the preceding paragraph, for projects like hub projects, the profile of payments on sub debt is likely to be delayed relative to the payment profile for senior debt, so there is every reason on a-priori grounds to expect that the WACC may significantly understate the true cost of capital.

But what does the evidence say? Given the secrecy surrounding hub funding arrangements, the evidence on this is sparse. There is only one hub project for which I currently have access to the detailed financial model. For that project, (and subject to obscurities in interpreting the financial model), the relevant figures from the model are:-

$$\text{Average senior debt interest rate} = 4.47\%$$

Shareholder IRR = 10.5%

Percentage of funding raised by senior debt = 90.7%.

Project IRR = 6.37%.

But calculating the WACC implies

$$\text{WACC} = 4.47 * 0.907 + 10.5 * 0.093 = 5.03\%.$$

On this basis, it appears that, for this project, the WACC actually understates the true cost of capital to the public sector by 1.34 percentage points. If my interpretation of this financial model is correct, therefore, this provides strong evidence that use of the WACC may very seriously understate the true cost of finance to the public sector in hub projects.

What needs to be done.

- a) Since it was SFT who quoted to the Committee an estimate of the cost of borrowing based on the WACC, SFT should be asked either to justify the use of WACC, on the basis that the profiles of senior debt and sub debt are the same: or
- b) to produce an alternative version of the cost of capital quoted to the Committee, based on project IRRs rather than WACC.
- c) If SFT is not in a position to do b), they should be asked why – since surely knowledge of project IRRs should be part and parcel of SFT’s stewardship of the hub programme.
- d) Finally, the Committee, and the public, will wish to monitor the behaviour of hub project IRRs, and whether the differential between the WACC and the project IRR is tending to increase over time. In doing this, it would be unsatisfactory to be subject to the considerable lag in the availability of information, implied by SFT’s policy on when project finance information ceases to be commercial in confidence. (SFT’s current policy is that financial information ceases to be commercial in confidence two years after the relevant facility has become operational.) This policy means that, in principle, the financial models for just four hub revenue projects might be available just now. I put forward a proposal to SFT some time ago that a useful partial indicator, which would not cross any thresholds of commercial confidentiality, should be published for each hub project. The suggested indicator is the weighting factor between sub debt and senior debt implicit in the correct calculation of the project IRR. SFT should be encouraged to pursue this idea.