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We argue that there are inconsistencies in Eqs (5), (6) and (8) in Zhang (2009, p.555) and suggest revisions to Eqs (6) and (8) to rectify the inconsistencies.

The discount rates in Eq. (5) and Eq. (6) in Zhang are not consistent. Eq. (5) was the formula for calculation of the net present value of the total project construction cost, and was expressed by Zhang as

$$NPV_c = \sum_{i=1}^{T_c} \frac{C_i}{(1+R)^{i-1}} \tag{5}$$

where NPV_c is net present value of the total project construction cost, C_i is the project construction cost in year i, R is discount rate, T_c is the project's construction completion time, C_i is the project construction cost in year i. The discount factor for cash flow in year i is $1/(1+R_a)^{i-1}$, which means that the reference year for discounting is the starting year of construction of the project.

Eq. (6) was the formula for calculation of the net revenues in the operation period and was expressed by Zhang as

$$NPV_o = \sum_{j=T_c+1}^{T_c+T_o} \frac{NCF_j}{(1+R)^j} = \sum_{j=T_c+1}^{T_c+T_o} \frac{Q_j P_j - OM_j}{(1+R)^j} \quad (6)$$

where NCF_j is the net cash flow (NCF) in operation year j, NPV_o is the net present value of $NCFs$, T_o is the project franchise operation period, Q_j is the service/product demanded in year j during the operation period, P_j is the price of a unit of service/product in year j during the operation period, OM_j is the operation and maintenance cost in year j during operation.

Since the reference year for discounting in Eq. (5) is the starting year of construction of the project, in order to be consistent with Eq. (5) on the reference year for discounting, Eq. (6) in Zhang (p.555) thus should be modified as

$$NPV_o = \sum_{j=T_c+1}^{T_c+T_o} \frac{NCF_j}{(1+R)^{j-1}} = \sum_{j=T_c+1}^{T_c+T_o} \frac{Q_j P_j - OM_j}{(1+R)^{j-1}} \quad (6)^{revised}$$

The discount rates in Eq. (8) in Zhang (p.555) are also inconsistent. Eq. (8) was developed based on the principle that the franchise operation period should be long enough to enable the concessionaire to recoup his investment and earn a reasonable return over the period. The concession period is the sum of the project construction period plus its franchise operation period. Eq. (8) in Zhang was

$$\sum_{j=T_c+1}^{T_c+T_o} \frac{Q_j P_j - OM_j}{(1+R_a)^j} = \sum_{i=1}^{T_c} \frac{C_i}{(1+R_a)^{i-1}} \quad (8)$$

where T_o is the minimum length of the project franchise operation period acceptable by the concessionaire, P_j is lower than the maximum public affordable price for protecting the public interest, R_a is an internal rate of return (IRR) on equity agreed by the host government and the concessionaire.

The discount factor for cash flow in year i is $1/(1+R_a)^{i-1}$, again, this means that the reference year for discounting is the starting year of construction of the project. In order to be consistent on the reference year for discounting, the discount factor for cash flow in year j during the operation period thus should be $1/(1+R_a)^{j-1}$, rather than $1/(1+R_a)^{j}$. Hence, Eq. (8) in Zhang (2009) should be modified as:

$$\sum_{j=T_c+1}^{T_c+T_o} \frac{Q_j P_j - OM_j}{(1+R_a)^{j-1}} = \sum_{i=1}^{T_c} \frac{C_i}{(1+R_a)^{i-1}} \qquad (8)^{revised}$$

To summarize, in order to be consistent on the reference year for discounting, Eq. (6) and Eq. (8) in Zhang have to be modified.

Reference:

Zhang, X.Q. (2009). "Win-Win concession period determination methodology." *J. Constr. Eng. Manage.*, 135(6), 550–558.