Cross-border DCF valuation in a nutshell

Andreas Schueler*

The papers deals with cross-border DCF valuation. It focusses on key choices the valuator has to make: should the foreign currency (FC) or the home currency (HC) approach be used? How should a valuator deal with the covariance between cash flows and exchange rates? In doing so, the paper addresses inter alia the prerequisites and consequences of using forward exchange rates, reveals a tax effect on repayments, and questions the use of constant discount rates.

1. Introduction

It is common knowledge that flexible exchange rates vary over time. It is also clear that conducting business abroad is relevant for many firms. As shown in Table 1, there are a large number of household names in the corporate world which engage in significant business.

Table 1. Relevance of business abroad; Transnationality Index (TNI): average of foreign assets/tot. assets, foreign sales/tot. sales and foreign employment/tot. employment; 2019; Source: UNCTAD: United Nations Conference on Trade and Development, https://unctad.org/node/29280

Corporation	Home economy	Assets ($MM)		Sales ($MM)		Employment		TNI in %
		Foreign	Total	Foreign	Total	Foreign	Total	
Royal Dutch Shell plc	UK	376 417	402 681	276 518	331 684	59 000	83 000	**82.6**
Toyota Motor Corporation	Japan	307 538	485 422	187 768	275 390	227 787	359 542	**65.0**
BP plc	UK	259 860	295 194	215 203	278 397	58 900	72 500	**82.2**
Softbank Group Corp	Japan	253 163	343 306	29 286	56 910	55 272	74 953	**66.3**
Total SA	France	249 678	273 865	137 438	175 985	71 456	107 776	**78.5**
Volkswagen Group	Germany	243 469	548 271	227 940	282 776	374 000	671 000	**60.3**
Anheuser-Busch InBev NV	Belgium	192 138	237 142	44 352	52 251	148 111	171 915	**84.0**
British American Tobacco PLC	UK	184 959	186 194	25 232	32 998	31 196	53 185	**78.2**
Daimler AG	Germany	179 506	339 742	163 875	193 357	124 842	298 655	**59.8**
Chevron Corporation	USA	172 830	237 428	75 591	140 156	22 800	48 200	**58.0**
Exxon Mobil Corporation	USA	169 719	362 597	123 801	255 583	35 058	74 900	**47.4**
Vodafone Group Plc	UK	168 394	184 253	42 530	49 971	58 429	68 724	**87.2**
EDF SA	France	155 021	340 692	30 625	79 827	34 381	165 790	**34.9**
CK Hutchison Holdings Ltd	Hong Kong, China	143 367	155 523	32 556	38 163	279 000	300 000	**90.2**
Honda Motor Co Ltd	Japan	143 180	188 541	116 150	137 382	153 215	219 722	**76.7**

* Professor of Finance, Universitaet der Bundeswehr Muenchen, Germany.

Companies with business abroad, or more generally, cash flows denominated in foreign currency (FC) must be valued occasionally or on a regular basis due to - for example - M&A-activities, taxation, transfer pricing, impairment tests, or restructuring.

Cross-border valuation of companies has been analyzed extensively - for example - regarding the expected rate of returns for shareholders (cost of equity), and a number of textbooks address cross-border valuation: Bekaert and Hodrick (2018), Chapters 15 & 16, Berk and DeMarzo (2020), Chapter 31, Brealey et al. (2019), Chapter 27, Holthausen and Zmijewski (2020), Chapter 17, and Koller et al. (2020), Chapter 27. However, when it comes to be specific and comprehensive on how to link the literature on company valuation with that on macroeconomics in order to come up a with a DCF framework that works for cross-border valuation, the literature thins out considerably (see Schueler 2021 for a more extensive literature review).

This paper will provide an overview of the key considerations or inputs in cross-border valuation.[1] I would like to point out some conceptual choices faced by the valuator (Section 2), and present some recommendations regarding the DCF framework using two numerical examples (Section 3). Section 4 concludes.

2. Conceptual choices

I am assuming a two-country-setting, relevant currencies are the home (domestic) currency (HC) and the foreign currency (FC). Direct quotation is used, i.e. the price for one unit of FC is quoted in HC. The valuation is done from the perspective of a domestic investor, and company value is to be denominated in HC. Risk is priced according to the global CAPM. This requires the relative purchase price parity to hold (see Koller et al. 2020, p. 514, Bekaert and Hodrick 2018, p. 569, Stulz 1995, p. 12). Covered interest parity and the international Fisher hypothesis are assumed to hold as well. Domestic and foreign corporate income is subject to a constant and identical corporate tax rate. Neither personal income taxes nor barriers to repatriation of cash flows are considered here.

First, the valuator must choose between the FC approach and the HC approach. Applying the former require cash flows in FC to be discounted by the risk-adjusted discount rate (RADR) in FC. The resulting company value in FC (V_{FC}) is then to be converted into HC by the spot exchange rate at the valuation date (S_0) to get to the company value in HC (V_{HC}). The latter requires the cash flows in FC to be converted into HC by the expected spot exchange rates before they are discounted by the RADR in HC, leading to the company value in HC at the valuation date.

The second and the third choice apply only to the HC approach:

Secondly, the valuator must decide how to address the covariance between the cash flows in FC and the exchange rates. The amount and timing of cash flows in FC depend on the foreign exchange rate on a regular basis. Just consider the case of an exporter in a foreign country. If the valuator derives the RADR HC from the RADR FC, the covariance of the RADR FC and the exchange rates has to be taken into account as well. These covariances do not occur if the FC approach is used and cash flows in FC are discounted by RADR in FC. There are (at least) three options for the HC approach: (a) neglect the covariance of the cash flow with the exchange rates, justified by a deliberate estimate of its (negligible) relevance, and use the RADR in HC; (b) neglect the covariances in both the cash flows and the RADR which can be shown algebraically, or (c) consider the covariance in the cash flows while converting them into HC and use the RADR in HC. The proof that (b) is indeed possible, can be found in Schueler (2021). Please note that option (b) requires the use of the RADR FC multiplied by the expected change in the exchange rate. There is a fourth option (d): use forward exchange rates as the certainty equivalent of the expected spot exchange rates. Covariances are not relevant for (d), too. Since (d) needs to be elaborated in greater detail, I am covering it within the following discussion of the third conceptual choice.

Third, the valuator must decide how to determine future exchange rates for converting the cash flows in FC into HC. Theory has taught us that for valuing risky cash flows for risk averse investors we could use either expected values or certainty equivalents. This applies to exchange rates, too. We can use either expected exchange rates or forward exchange rates, because forward exchange rates are the certainty equivalents of expected exchange rates. The choice affects the RADR to be used. How can we determine expected exchange rates? As exchanging major currencies is a multi-billion business, we should refrain from guessing these rates nor accepting the guesses of others, like managers, bankers, or analysts. The international parity conditions provide a solution: the relative purchasing power parity (rPPP) establishes the link between the expected inflation rates in both countries

[1] It is based on a presentation by the author at the EACVA conference on business valuation in March 2021, and another paper of the author (Schueler 2021) that contains a more fundamental and technical discussion of the topic. The author wishes to thank the participants of the conference and especially the reviewers of Schueler (2021).

and the expected exchange rate. Therefore, if we could obtain reliable estimates of the expected inflation rates over the forecast horizon, we could derive the expected exchange rates. However, the expected inflation rates might be difficult to find, particularly for a long-term forecast horizon. The uncovered interest parity (UIP) together with the unbiasedness hypothesis (UH) establish a link between the risk-free interest rates in both countries and the forward exchange rates that are set equal to the expected forward exchange rates. There exists intense discussion about whether we can assume the UIP to be valid. We cannot answer that question here. I would rather point out that we could either use the forward exchange rate as a starting point to estimate the expected exchange rate by adding a risk premium, because the certainty equivalent plus the risk premium equals the expected value in general. Then, one needs to come up with an estimate of the risk premium, if it is not negligible. Or, one could treat the forward exchange rates as certainty equivalents. Then, the appropriate discount rate is the RADR in FC multiplied by the ratio of the risk-free interest rates in both countries (1 added to each of both).

To summarize, the use of forward exchange rates can be justified in several ways. The valuator must make clear which reasoning applies to the valuation at hand because this affects the definition of the RADR to be used. In this context, a table shown in Ruiz de Vargas (2018) is helpful, since it illustrates that data on forward exchange rates is readily available (Table 2).

Table 2. Data on forward exchange rates; CCY - currency; ECB - European Central Bank; B - Bloomberg, spot rate; C - Bloomberg, contributed or cross-calculation; IN - Bloomberg, interpolated; CIP - Bloomberg, calc. through covered interest parity ; D - Datastream; CIP stands for covered interest parity, i. e. forward exchange rates calculated by multiplying the current spot exchange rate by the ratio of the risk-free interest rates in both countries (1 added to each of both); Ruiz de Vargas (2018)

CCY	Spot rate	Forward exchange rates														
		6M	1Y	2Y	3Y	4Y	5Y	6Y	7Y	8Y	9Y	10Y	15Y	20Y	25Y	30Y
AUD	ECB/B/D	C,D	C,D	C,D	C	C	C,D	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP
DKK	ECB/B/D	C,D	C,D	C,D	C	C	C,D	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP
HKD	ECB/B/D	C,D	CIP, D	CIP, D	CIP	CIP	CIP, D	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP
ILS	ECB/B/D	C,D	C,D	C,D	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP
JPY	ECB/B/D	C,D	C,D	C,D	C	C	C,D	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP
CAD	ECB/B/D	C,D	C,D	C,D	C	C	C,D	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP
NZD	ECB/B/D	C,D	C,D	C,D	C	C	C,D	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP
NOK	ECB/B/D	C,D	C,D	C,D	C	C	C,D	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP
SEK	ECB/B/D	C,D	C,D	C,D	C	C	C,D	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP
CHF	ECB/B/D	C,D	C,D	C,D	C	C	C,D	IN	IN	IN	IN	C	CIP	CIP	CIP	CIP
SGD	ECB/B/D	C,D	C,D	C,D	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP
GBP	ECB/B/D	C,D	C,D	C,D	C	C	C,D	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP
USD	ECB/B/D	C,D	C,D	C,D	C,D	C,D	C,D	C	C	C	C	C	CIP	CIP	CIP	CIP
CNY	ECB/B/D	C,D	C,D	C,D	IN	IN	C,D	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP
INR	ECB/B/D	C,D	C,D	C,D	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP
RUB	ECB/B/D	C,D	C,D	CIP,D	CIP	CIP	CIP,D	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP	CIP

3. DCF framework

There are some requirements for implementing cross-border DCF valuation by one of the three major variants of DCF (Adjusted Present Value APV, Flow-to-equity FtE, WACC). Due to the necessity to exchange cash flows in FC into HC and to define the RADR accordingly, especially the HC approach is affected by them.

For both FC and HC approach it should be noted that tax effects due to debt financing not only consist of the well-known *tax shield on interest expenses* generated by subtracting interest expenses from taxable income, but also, a tax effect related to the repayment (RP) of debt that must be considered as well if a domestic company is using debt denominated in FC. Depending upon the development of the exchange rate between the point of time the debt was received (period s) and it has to be repaid (period t), taxable income might be reduced if the repayment of FC-debt

converted into HC exceeds the amount of initial debt financing in HC, or taxable income might be increased if the repayment in HC is lower than the initial amount of debt in HC. Calculating this *tax shield on repayments* starts with the HC approach, but also needs to be considered for the FC approach. It might look a bit awkward to first compute the effect by converting debt-related cash flows originally denominated in FC into HC and then back to FC. But it is necessary, because the cash impact of that tax shield would be overlooked in the FC approach otherwise. Table 3 shows an example for a domestic company that uses debt denominated in foreign currency. We assume that the domestic tax regime requires the currency effects of repayments to be considered in the taxable income.

Table 3. Tax shields on debt denominated in FC employed by a domestic company; corporate tax rate 30%

Year (t)		**0**	**1**	**2**	**3**	**Sum**
Exchange rate (HC/FC)	HC/FC	0.95	0.90	0.80	0.70	
Exchange rate in t vs. 0.95	HC/FC		0.05	0.15	0.25	
Debt	FC	90.00	60.00	30.00	0.00	
	HC	85.50	54.00	24.00	0.00	
Interest (4 %)	FC		3.60	2.40	1.20	7.20
	HC		3.24	1.92	0.84	6.00
Tax shield on interest expenses	HC		0.97	0.58	0.25	1.80
Repayments	FC		30.00	30.00	30.00	90.00
	HC		27.00	24.00	21.00	72.00
Applied to repayment = increase in taxable income	HC		1.50	4.50	7.50	13.50
Tax shields on repayments	HC		-0.45	-1.35	-2.25	-4.05
Total tax shields	HC		0.52	-0.77	-2.00	-2.25

For this example, we assume a decreasing expected HC/FC-exchange rate. This leads to negative tax shields on repayments that results in negative total tax shields. The sum of the repayments in HC (72) is smaller than the debt in t=0 denominated in HC (85.5), representing the cumulated (13.5) effects on taxable income.

If the HC approach is to be applied, the RADR must fit to the decision of the valuator about how to convert the cash flows in FC into HC, as we discussed in section 2. For the sake of simplification, I am only focusing on the case that cash flows are converted by forward exchange rates here, treating them as certainty equivalents. Thus, we neither assume exchange risk premia to be negligible nor the UIP to hold. In this case, the RADR to be used, labelled RADR*, is the RADR in FC adjusted by the risk-free interest rates i (plus 1) of both countries:

$$RADR^* = \left(1 + RADR_{FC}\right)\frac{1+i_{HC}}{1+i_{FC}} - 1 \quad (1)$$

Table 4 illustrates this for a simple valuation of an unlevered company, i. e. a company that is financed by equity only.

Table 4. FC approach and HC approach for valuing an unlevered company with a lifespan of 3 years using forward fx rates and RADR*; constant yield curves in both countries (i_{FC} = 1%; i_{HC} = 2%)

Year (t)		0	1	2	3
FC approach					
FCF	FC		100.00	110.00	120.00
RADR	FC	7.0%			
Value	FC	287.49			
Spot fx rate	HC/FC	0.95			
Value	HC	273.1			

HC approach					
Forward fx rate	HC/FC		0.9407	0.9315	0.9223
FCF	HC		94.07	102.46	110.68
RADR =					
$RADR_{FC}$ x $(1+i_{HC})/(1+i_{FC})$		5.95%			
Value	HC	273.1			

This simple example illustrates that even if the HC approach is used, the RADR has to be adjusted starting from the RADR in FC. One could argue that the valuator should simply stick with the FC approach. If a RADR in HC is derived first (or top-down), one has to keep in mind that it implies a premium for exchange rate risk and might not be applied to cash flows converted by forward exchange rates in every case. Rather, it requires the exchange rate risk premium to be negligible or the UIP to hold.

The example is also simple in that regard that we assume the risk-free rates in both countries to be constant over time. If they were not, the risk-free rates used for deriving the RADR in both countries would need to be based upon forward interest rates. Otherwise, the reconciliation between FC and HC approach would be impossible. The reason for that being that the forward exchange rate F for periods $t > 0$ depend upon the forward interest rates (S_0 being the current spot exchange rate):

$$F_t = S_0 \frac{\prod_{\tau=1}^{t}\left(1+i_{HC|\tau-1,\tau}\right)}{\prod_{\tau=1}^{t}\left(1+i_{FC|\tau-1,\tau}\right)} \quad (2)$$

Finally, the example is simplified, because the company is assumed to have a life-span of only 3 years. In practice, companies are assumed to exist forever, unless we know that their lifespan is limited. Therefore, I would like to point out that the growth rate to be used for deriving the terminal value needs to be derived while keeping the change of the exchange rate in mind. If forward exchange rates are used to convert the cash flows in FC into HC, for example, we could split up the growth rate g to be applied to the converted cash flows (HC approach) as follows:

$$g_{FCF,HC,F} = \left(1+g_{FCF,FC}\right)\frac{1+i_{HC|T-1,T}}{1+i_{FC|T-1,T}} - 1 \quad (3)$$

If a levered company is to be valued the relation shown in (1) can be applied to the RADR needed for the DCF variant chosen. For the WACC (FCF) approach, the WACC in FC has to be adjusted accordingly. For the FTE approach, the levered cost of equity has to be adjusted. The principle remains the same. Unfortunately, things can quickly become complicated, because the financial risk, the risk of default and the risk of the tax effects induced by debt financing. All three would need to be addressed properly. These issues are discussed in Schueler (2021), but are beyond the scope of this paper.

4. Conclusions

We categorize our conclusions into those related to the valuation method, those related to the cash flow to be discounted, and those related to the RADR:

Valuation method

- FC or HC approach: in general, the FC approach avoids most of the challenges imposed by exchange rates, since the exchange rate is only relevant for converting the present value in FC into HC by using the observable current spot exchange rate. Covariances need not be addressed, and future exchange rates need not be estimated. However, there might be valuation cases for which the discount rate (RADR) in FC is not easily derived. Otherwise, it might be easier in practice to convert a stream of cash flows in FC or sporadic FC-cash flows into HC, thereby following the HC approach, and integrate it in the overall cash flow forecast for the cash generating unit, business unit or company. Another practical example for which the HC approach might be easier, is a domestic company that uses debt financing in FC. As previously mentioned, this also enables the valuator to address the tax shields on repayments caused by changes in the exchange rate in a more straightforward manner.
- Choice between different DCF variants: the popularity of the WACC approach, also referred to as FCF approach, stems from the possibility to use constant cost of capital (WACC) if the leverage ratio (capital structure) can be assumed to be constant. For a cross-border valuation, the need to use forward interest rates to establish consistency between FC and HC approach, and the tax shields on repayments question the robustness of this as-

sumption even for the FC approach. The valuator should consider to follow the APV approach.

Cash flow forecast

- Additional tax effect: the repayment of debt in foreign currency used by a domestic firm can lead to a tax effect in addition to the well-known tax shields on interest expenses. This tax shield on repayments occurs, if the exchange rate has changed between the period the debt financing has been received and the period a repayment occurs.
- Covariances: if cash flows in FC are correlated with exchange rates, the covariance between these variables needs to be considered. If it can be assumed to be small, it might not be of relevance for the valuation result and could be neglected. Other than that, there is the possibility to skip it and to use a RADR also without considering the covariance, or to use forward exchange rates.
- Future exchange rates: this problem arises for the HC approach. Forward exchange rates are an important point of reference for estimating future exchange rates. They can be interpreted in general as the certainty equivalent of the unknown future exchange rates. Therefore, they could be treated as certainty equivalents directly, or an exchange risk premium could be added to them resulting in the expected exchange rates. If one assumes the UIP to hold or the exchange risk premium to be neglectable, forward exchange rates serve as a direct proxy for the expected exchange rate. Another possibility to estimate the expected exchange rate is compound the current spot exchange rate by the ratio of the expected inflation rates (1 added to each of them). Although that sounds tempting and is in line with the relative purchase power parity, practitioners might encounter difficulties in coming up with mid and long-term estimates of the yearly expected inflation rates in both countries.
- Growth rate for the terminal value: for the HC approach, the rate of change in exchange rates has to be considered besides the growth in FC-cash flows. If forward exchange rates are used, the latter rate of change is determined by the ratio of one plus the risk-free rates. The valuator should first estimate the growth in FC-cash flows and then consider how to address the change in exchange rates for the terminal value.

RADR

- Risk-free rate: the use of yearly forward interest rates is necessary to ensure the equivalence between the HC and the FC approach. Valuators should not use a "one size fits all" constant risk-free rate.
- RADR depend upon the way to estimate future exchange rates within the HC approach: if the valuator is able to determine expected spot rates, the RADR in HC has to contain a premium for exchange rate risk. If forward exchange rates are used, the "regular" RADR in HC can be used only, if the exchange rate risk premium is assumed to be negligible or the UIP is assumed to hold. If forward exchange rates serve as certainty equivalents, the RADR in FC adjusted by the ratio of interest rates (1 added to each of them) is to be used.
- Interpretation of RADR empirically derived for the company or the peer group: if the RADR in HC is estimated empirically without any risk adjustments, it contains inter alia a premium for the exchange rate risk implicitly. The same is true analogously, if the RADR for the firm to be valued is derived by referring to the beta values for comparable companies (peer group). These beta values contain premia for the exchange rate risk from the perspective of each peer company. The valuator should keep this in mind while implicitly applying these risk premia to the company to be valued.

Although the paper provides only an overview about cross-border valuation, it might be helpful in increasing the awareness regarding the choices, challenges and pitfalls for valuation practitioners.

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