Case Study Series
Cross Rates in Foreign Exchange

Halil D. Kaya

Abstract
This case deals with the calculation of cross rates given the rates between foreign currencies and the dollar. Students will first learn about the direct and indirect quotations. They will learn how to convert a direct quotation into an indirect quotation, and an indirect quotation into a direct quotation. Then, given a currency dealer's bid and ask rates for two foreign currencies (stated in U.S. dollars), they will learn how to compute the bid and ask cross rates between those two foreign currencies. They will first compute the bid and ask rates for one foreign currency stated in the other foreign currency. They will then do the same calculations for the other foreign currency. This case is a hands-on experience for students who want to learn the direct-indirect quotations and cross rates in the real world where we have two prices (i.e. bid and ask) for currencies.
Keywords: currency, direct quotation, indirect quotation, cross rate
JEL classifications: F30, F31

Introduction
Nick has just started working for an import/export company. He has started learning everything about the exchange rates. Nick is thinking about buying/selling foreign currencies for the purpose of making profit. His friend Jonathan is also interested in learning about exchange rates. Nick called his friend and they met at a café.

"Hey, thanks for coming. I didn't know that you were interested in international markets."

Jonathan responds "I am, my friend. In fact, I want to invest in a foreign currency, like the British Pound. The people at my place are talking about a possible jump in the pound over the next few months. That would be a perfect opportunity for me to make some money."

Nick responds "I have some pounds actually. But, I am not too hopeful about it. I may sell them in the future. I have waited long enough. It didn't bring me any profit."

Jonathan adds "My company, on the other hand, wants to buy lots of euros. They need those euros to make a payment to their suppliers in Europe. Do you know anything about the euro? What are the prospects? If it goes up and my company doesn't buy it now, it will hurt them a lot."

Nick responds "My Company actually wants to sell some euros that they just received from their sales in Europe. Maybe they should sell those euros to your firm. This is getting interesting…"

Jonathan continues "Nick, anyways, I think if we need to invest in foreign markets or currencies, we need to learn more about exchange rates. What do you think? I don't want to limit my investments to the U.S. There are more opportunities outside the country."

"I agree. We may even be late in considering foreign markets. But, it is never too late, I guess" Nick adds.

Halil D. Kaya, Northeastern State University, USA, kaya@nsuok.edu

Case Study Series

"I agree. We need to think "outside the box." Late or not, I want to explore this." Jonathan concludes.

Cross Rates

"Investopedia.com" explains cross rates as follows:

"A cross rate is the currency exchange rate between two currencies when neither are official currencies of the country in which the exchange rate quote is given. Foreign exchange traders use the term to refer to currency quotes that do not involve the U.S. dollar, regardless of what country the quote is provided in.

An exchange rate between the euro and the Japanese yen is considered a cross rate in the market sense because it does not include the U.S. dollar. In the pure sense of the definition, it is considered a cross rate if it is referenced by a speaker or writer who is not in Japan or one of the countries that uses the euro. While the pure definition of a cross rate requires it be referenced in a place where neither currency is used, the term is primarily used to reference a trade or quote that does not include the U.S. dollar."

Another website, "xplained.com", explains cross rates as follows:

"The cross rate is the exchange rate between currency A and currency C derived from actual exchange rate between currency A and currency B and between currency B and currency C. Sometimes cross rate is referred to an exchange rate between two currencies not involving the US dollar. Currency vendor provides quotes for only the most liquid currencies such as the US dollar, Euro, Pound Sterling, Swiss Franc, etc. Exchange rates between other currencies is normally calculated as the cross rates using the quotes for major currencies."

An example for a simple cross rate calculation is given below. This example assumes that there is only a single rate (i.e. price) between the currencies (in real world, we have two prices for currencies: the bid price and the ask price. The bid price is when you are selling a currency and the ask price is when you are buying a currency):

The €/$ spot exchange rate is €0.6/$ and the Yen/$ is Yen89/$. What is the €/Yen cross exchange rate?

€/Yen = (€/$) / (Yen/$) = 0.6 / 89 = 0.00674

Cross Rates with Bid-Ask Prices

An exchange rate table for the euro (versus the dollar) and for the yen (versus the dollar) looks like below:

	American Terms (in $)		European Terms (per $)	
	Bid	Ask	Bid	Ask
Euro	1.20	1.21	1/1.21	1/1.20
Yen	0.010	0.011	1/0.011	1/0.010

Halil D. Kaya, Northeastern State University, USA, kaya@nsuok.edu

Case Study Series

So, the third column (the bid rate for the $) is the reciprocal of the second column (the ask rate for the euro in the first row or for the yen in the second row), and the fourth column (the ask rate for the $) is the reciprocal of the first column (the bid rate for the euro in the first row or for the yen in the second row).

What are the meanings of these numbers?

The first two columns show the value of the euro (in the first row) and the value of the Yen (in the second row).

> If I sell €1, I will get $1.20.
> If I buy €1, I have to pay $1.21.
> If I sell Y1, I will get $0.010.
> If I buy Y1, I have to pay $0.011.

The last two columns show the value of the dollar in euros (in the first row) and the value of the dollar in yens (in the second row).

> If I sell $1, I will get (1/1.21) euros.
> If I buy $1, I have to pay (1/1.20) euros.
> If I sell $1, I will get (1/0.011) yens.
> If I buy $1, I have to pay (1/0.010) yens.

The question is what is the cross rate between the euro and the yen? There are four different cross rates here:

1) $S^b(Y/€)$ is the bid (selling) price of €1 in yens. First we need to sell €1 and receive some dollars, then we need to sell those dollars to get yens. As shown above, when we sell €1, we will get $1.20. When we sell each dollar, we will get (1/0.011) yens. So, it is a two-step process. Therefore, $S^b(Y/€)$ is the multiplication of these two rates:
$S^b(Y/€) = 1.20*(1/0.011) = 109.09$ yens

2) $S^b(€/Y)$ is the bid (selling) price of Y1 in euros. First we need to sell Y1 and receive some dollars, then we need to sell those dollars to get euros. As shown above, when we sell Y1, we will get $0.010. When we sell each dollar, we will get (1/1.21) euros. So, it is a two-step process. Therefore, $S^b(€/Y)$ is the multiplication of these two rates:
$S^b(€/Y) = 0.010*(1/1.21) = 0.00826$ euros

3) $S^a(Y/€)$ is the ask (buying) price of €1 in yens. To find this rate, first we need to answer this question: "how many dollars should we pay to buy €1?" If I buy €1, I have to pay $1.21. Then, the second question to ask is: "how many yens should we pay to buy each dollar?" If I buy $1, I have to pay (1/0.010) yens. Therefore, $S^a(Y/€)$ is the multiplication of these two rates:
$S^b(Y/€) = 1.21*(1/0.010) = 121$ yens

4) $S^a(€/Y)$ is the ask (buying) price of Y1 in euros. To find this rate, first we need to answer this question: "how many dollars should we pay to buy Y1?" If I buy Y1, I have to pay $0.011. Then, the second question to ask is: "how many euros should

Halil D. Kaya, Northeastern State University, USA, kaya@nsuok.edu

Case Study Series

we pay to buy each dollar?" If I buy \$1, I have to pay (1/1.20) euros. Therefore, $S^a(€/Y)$ is the multiplication of these two rates:

$S^a(€/Y) = 0.011*(1/1.20) = 0.00917$ euros

The Decision

Nick is trying to answer the following questions:

1. What does "cross rate" mean?
2. What is the difference between direct quotation and indirect quotation?
3. Is direct quotation the same as "American terms" or "in \$"? Is indirect quotation the same as "European terms" or "per \$"?
4. If a direct quotation is given, how can we find the corresponding indirect quotation? If an indirect quotation is given, how can we find the corresponding direct quotation?
5. A currency dealer gave Nick the following rates. He gave Nick the value of £1 in dollars in the first row, and the value of €1 in dollars in the second row. What are the meanings of these rates (1.600, 1.620, 1.250, 1.260)?

	American Terms	
	Bid	Ask
Pound	1.600	1.620
Euro	1.250	1.260

6. Nick wants to find the "European terms" in each row. In other words, he wants to find the value of \$1 in pounds (both bid and ask prices in the first row), and he also wants to find the value of \$1 in euros (both bid and ask prices in the second row). How can he find these rates? What are these rates?

	American		European	
	Bid	Ask	Bid	Ask
Pound	1.600	1.620	?	?
Euro	1.250	1.260	?	?

7. Nick wants to sell 250,000 pounds. How many euros will he get?
8. If his company sells 5 million euros, how many pounds will they get?
9. Nick's friend Jonathan wants to buy 1 million pounds. How many euros will he pay?
10. Jonathan's firm wants to buy 2 million euros. How many pounds will they pay?

References

"Cross Rate Definition | Investopedia" http://www.investopedia.com/terms/c/crossrate.asp
"Cross Rate | Definition | Formula | Example - XplainD" http://xplaind.com/555662/cross-rate

Author

Halil D. Kaya
Associate Professor of Finance, Department of Accounting and Finance, College of Business and Technology, Northeastern State University, USA, kaya@nsuok.edu

Halil D. Kaya, Northeastern State University, USA, kaya@nsuok.edu