

> Appendix

The Math of Currency Trading

News outlets such as the *Financial Times* and the *Wall Street Journal*, as well as online sources, publish bilateral exchange rate tables that list currency values in terms of other currencies. These tables report bid-ask midpoints and so do not represent prices that can actually be traded in the market. Here is an example.

	£	€	¥	\$
U.K. pound (£)	1	0.7333	0.004954	0.5735
Euro (€)	1.3637	1	0.006755	0.7820
Japanese yen (¥)	201.875	148.032	1	115.768
U.S. dollar (\$)	1.7438	1.2787	0.008638	1

The cells above the diagonal contain the number of units of the currency in the left-hand column that equal one of the currencies along the top row of the table (e.g., £0.7333/€). Conversely, the cells below the diagonal contain the number of units of the currency in a particular column of the table that equals the value of one unit of currency from that row (e.g., €1.3637/£).

Rather than trying to remember this convention, it is usually easier to infer the convention used in these tables from the values of your domestic currency. In the example above, Japanese and U.S. residents are likely to know that the dollar/yen price of 115.768 reflects a yen-

per-dollar exchange rate of ¥115.768/\$, rather than a dollar-per-yen price. This is a direct price for a U.S. resident and an indirect price for a Japanese resident. The yen-per-dollar price is then simply the reciprocal of the dollar-per-yen price:

$$1/(\text{¥}115.768/\text{\$}) = \$0.008638/\text{¥}.$$

Note that the values in this table are internally consistent. Thus, the yen-per-pound exchange rate must equal the yen-per-dollar rate times the dollar-per-pound rate:

$$\text{¥}201.875/\text{£} = (\text{¥}115.768/\text{\$}) (\text{\$}1.7438/\text{£}).$$

Alternatively, the yen-per-pound rate can be calculated by dividing the yen-per-dollar rate by the pound-per-dollar rate:

$$\text{¥}201.875/\text{£} = (\text{¥}115.768/\text{\$}) / (\text{£}0.5735/\text{\$}).$$

Keeping track of the currency units ensures that the answer has the correct units.

Exchange rates that do not involve the domestic currency are called **cross rates**. Cross rates for infrequently traded currencies can be calculated by comparing them against an actively traded currency such as the dollar. For example, the cross rate between the Chilean peso (CLP) and Japanese yen can be calculated by combining the CLP-per-dollar rate with the yen-per-dollar rate. If one U.S. dollar is worth 559.51 Chilean pesos, then the CLP-per-yen rate must be

$$(\text{CLP } 559.51/\text{\$}) / (\text{¥}115.768/\text{\$}) = \text{CLP } 4.8330/\text{¥}.$$

Again, it is important to keep track of the currency units to ensure the desired result.