Handout #6 - The Elasticities of Traded Goods and the BOP Accounts

It is often assumed that changes in a country’s $ will move its CA in the opposite direction. For example, a rise in $ will make its exports look more expensive to foreigners causing X to fall, while foreign imports now look less expensive to domestic residents and M rises, both of which reduce the CA. Whereas this is the rule, there are important exceptions to the rule that people trying to understand the CA need to know. This handout is dedicated to explaining how and when the exceptions occur. The first step is to establish that the CA is not the number of exported goods, services, and factor services minus the number of imported goods, services, and factor services. Instead, it is the $ value of the exports minus the $ value of the imports. Keeping this distinction in mind, as simple as it sounds, will greatly simplify understanding what this handout is trying to communicate.

6.1 The Domestic Import Market

We first consider the domestic import market for goods and services made in the foreign country (which we could equivalently label the foreign export market for goods and services purchased in the domestic country). To simplify the notation, assume that the domestic country is the US and the foreign country is England. It is possible to depict this same market in two different ways. It is possible to think of the price in the market in terms of the domestic currency (e.g., $’s), or it is just as reasonable to consider the price in terms of £’s. Given that the good is demanded by Americans, they undoubtedly value the good relative to other goods they might buy which are all priced in $.

Therefore, the relationship between the price in $ and the quantity demanded represented by the demand curve is the standard demand curve, which is the demand shown in Figure 6.1. Given that the good is supplied by British producers, the quantity they supply depends on how many £’s they receive for the good (or service). This standard relationship between the quantity supplied and the price in £’s is shown in Figure 6.2.

Now, the first trick is to figure out what the appropriate supply curve looks like in Figure 6.1 where the price is in terms of $’s instead of £’s. Since it is £’s that the British producers of the goods are responding to (as shown in Figure 6.2), translating that information into $ terms requires knowing e. For example, in figure 6.2 it can be seen that at a price of £6 that 6 goods will be supplied. If e=1, then a price of $6 corresponds to the £6 that induces the 6 goods to be produced. If e = 2, then a price of $3 translates to the £6 that produces 6 goods, and if e = ½, then it will take $12 to purchase the £6.

Figure 6.1 shows three alternative supply curves derived from the same supply curve that is in 6.2, differing only in their assumption of the level of e.

The intersection of this supply (that depends on e) and demand in Figure 6.1 indicates the equilibrium quantity of US imports. But the number of imports is not important in determining the CA, what does matter is the $ value of the US imports. The $ value is found by multiplying the equilibrium number of US imports by their equilibrium price. Whereas a decrease in supply will always cause the number of imports to fall, a decrease in supply can cause the $ value of imports to rise, stay the same, or fall, depending on the elasticity of demand between the two points where the initial and decreased supply curve intersect the demand curve.
One can measure an elasticity of demand between any two points on a demand curve that reports valuable information regarding how the $ value of the transacted goods differs between the two points. Since an increase in price causes the quantity demanded to fall, the net effect on the product of the price and quantity – i.e., the $ value of the traded goods – can rise or fall depending on which change is more powerful. Specifically, the elasticity of demand between the two points is defined as:

\[ \varepsilon = \frac{\% \Delta Q}{\% \Delta P} \]  

\hspace{1cm} (6.1)

An “elastic demand” is when \( \varepsilon > 1 \) or, equivalently the \( \% \Delta Q > \% \Delta P \) and therefore, for any change in \( P \) and corresponding change in \( Q \), the $ value will follow \( Q \). For example, if \( \varepsilon > 1 \) then an increase in \( P \) will cause \( Q \) to fall sufficiently to cause the $ value of the goods to fall with it.

This can be seen in Figure 6.1. When the price of the good falls from $8 to $6 (due the shift in the supply caused by the rising of \( e \) from \( \frac{1}{2} \) to 1), the $ value of the traded goods rises from $32 to $36 (please verify this in Figure 6.1). Also note that if the price of good were $11, then American consumers would be willing to spend $11 on the imports, as the price drops to $10 they want to spend more ($20), and as the price drops to $9 they would buy $27 of imports. Since the $ value followed \( Q \) in these three cases, the demand between these sets of points are evidently all elastic as well.

An “inelastic demand” is when \( \varepsilon < 1 \) or, equivalently the \( \% \Delta P > \% \Delta Q \) and therefore, for any change in \( P \) and corresponding change in \( Q \), the $ value will follow \( P \). For example, if \( \varepsilon < 1 \) then a decrease in \( P \) will cause \( Q \) to rise, but not enough to keep the $ value of the goods from falling with the price.

Again, this can be seen in Figure 6.1. When the price of the good falls from $6 to $4 (due the shift in the supply caused by the increase in \( e \) from 1 to 2), the $ value of the traded goods falls from $36 to $32 (please verify this in Figure 6.1). Also note that if the price of the good were $4, then American consumers would be willing to spend $32 on the imports, as the price drops to $3 they want to spend less ($27), and as the price drops to $2, the amount spend drops further to $20. Since the $ value followed \( P \) in these three cases, the demand between these sets of points are evidently all inelastic.

Figure 6.1 shows how a change in \( e \) affects the supply of US imports when it is expressed in terms of $ and, therefore, affects the $ value of the imports. For an increase in \( e \), the $ value of the imports will rise if the relevant section of the demand curve is elastic, whereas an increase in \( e \) will cause the $ value of imports to fall when the demand is inelastic.

In this discussion, the focus has been on the $ value of the imports. But note that the $ value of imports directly corresponds to the quantity of $ supplied by Americans in the foreign exchange markets to purchase those imports. Figure 6.1 effectively reveals the relationship between \( e \) and the quantity of $ supplied in the foreign exchange, but in a different way than a foreign exchange market diagram. But if one takes the information from Figure 6.1 and plots it in a diagram with \( e \) on the vertical axis and quantity of the domestic currency on the horizontal axis, then something very interesting occurs.

As can be seen in Figure 6.1, a rise in \( e \) causes the supply curve to rotate clockwise, pivoting from the origin. Imagine that \( e = 0 \) to begin with and then starts to increase towards 1, therefore, the initially vertical supply curve rotates clockwise as \( e \) increases. It can be seen in Figure 6.1 that as \( e \) rises, the supply intersects the demand at lower and lower points on the demand curve. But note that as the equilibrium price
moves from $12, to $11, and then $10, that the supply of $ to purchase imports is rising. But, at some level of e the $ valued of the imports will be maximized (in Figure 6.1 this occurs when e = 1), and any further increase in e causes the $ value to drop. In Figure 6.1, as e increases such that the supply intersects the demand at $4, then $3, and then $2, the $ value of imports is falling. This relationship between e and the quantity of the $ supplied for the purchase of the imports is presented in Figure 6.3.

The supply curve presented in Figure 6.3 includes the familiar lower half of the supply curve corresponding to the lower levels of e, as well as the less-familiar backward bending portion of the supply curve where increases in e, as shown in Figure 6.1, actually reduce the quantity of $’s supplied for the purpose of buying imports. A common technique to motivate the backward bending half of a supply curve is to consider an individual’s labor supply curve. Although an increase in someone’s hourly wage may induce them to work more hours/week when wages increase from $20 to $30 per hour, but after a certain point, higher wages afford the luxury of having more leisure time. For example, someone able to make $30,000 per hour whenever they choose to work would probably work few hours per week than someone earning $20/hr. The backward bending half of the supply of domestic currency to pay for imports exists by similar reasoning: after a point increases in the value of the domestic currency enable one to buy all they want of foreign goods for less of their own currency.

The Domestic Export Market

The market for domestic exports (or, equivalently, the market for the foreign country’s imports) also depends on an exchange rate for the domestic producers and foreign buyers to negotiate an equilibrium price. Again it is wise to consider this market when the price is in terms of the domestic currency ($’s, as shown in Figure 6.4) as well as in terms of the foreign currency (£’s, as shown in Figure 6.5). The quantity supplied by the American producers is determined by the price of the exported good in terms of $’s and, according, the supply capturing that relationship is provided in Figure 6.4. The quantity demanded by the British customers depends on the price they face in terms of £’s. This demand relationship is illustrated in Figure 6.5.

Including a demand curve in Figure 6.4 requires representing the value that the British customers put on the goods in terms of $’s. Because they are actually valuing the goods in terms of £’s, translating the valuation into $’s requires an exchange rate, and for every different exchange rate, the British demand in terms of $’s is different. Figure 6.4 depicts three different demand curves, each associated with a different e. Note that as e increases, the valuation in terms of $ falls because £’s the British use to value are worth less.

Figure 6.6 shows the domestic export market again in terms of the domestic currency and depicts the demand for the domestic exports by the foreign buyers in two ways: one with a smaller e, and another with a larger e. The diagram also depicts two supply curves, of course neither of which would be affected by a change in e, but they merely represent two types of supply curves that could exist: One (S1) intersects the demand curves in the elastic portion of the demand curve in the elastic portion of the demand curve, while the other (S2) intersects the demand in its inelastic range. Irrespective of which supply curve one assumes to exist, a decrease in e that causes the demand (in terms of the domestic currency) to pivot out, increases the domestic currency
value of the exports (i.e., the gray box, whose area represents the $ domestic currency value of exports, is larger). But note how the degree to which the domestic currency value of exports changes actually differs depending on whether the relevant demand is elastic (i.e., where S₁ intersects the demand) or inelastic (i.e., where S₂ intersects the demand). What one observes in Figure 6.6 is not deceiving: the more elastic the demand for domestic exports (where it is intersected by the supply), the more a decrease in e increases the domestic currency value of exports (i.e., the more the gray box grows) and, therefore, increases the demand for the domestic currency in the foreign exchange market.

6.3 The Marshall-Lerner Condition

Thus far in this handout it has been shown that:

1) If the demand for domestic imports is inelastic, then a decrease in e will raise the domestic currency value of the imports and, therefore, increase the supply of domestic currency sold in the foreign exchange markets. The fact that the decrease in e will reduce the number of goods imported while increasing the domestic currency value of those goods may be odd, but, as demonstrated above, possible.

2) The more inelastic the demand for exports, the less a fall in e increases the domestic currency value of the exports and, therefore, the less of the domestic currency demanded in the foreign exchange markets.

Now, these two effects beg the question: Is it possible that a depreciation of the domestic currency (i.e., the decrease in e) could cause the domestic currency value of the country’s imports to rise (due to the inelastic demand for imports) by more than the increase in the domestic currency value of its exports. If so, then the depreciation of the domestic currency would cause the country’s net exports (i.e., the domestic currency value of exports minus imports) to fall.

The answer to this question is yes if, as indicated by the discussion above, the elasticity of demand for imports is inelastic and the elasticity of demand for exports is sufficiently inelastic as well. In fact, it can be shown that for a country initially with balanced trade, that if

$$|\varepsilon_X| + |\varepsilon_M| < 1$$  \hspace{1cm} (6.2)

then a fall in e will decrease X – M.

Be sure to note how counterintuitive this result is: A decrease in e will increase the number of exported goods and decrease the number of imported goods will, when the two elasticities sum to less than one, cause the country’s net exports to fall. Again, the reason is that it is the domestic currency value of the exports minus the imports that matters, and not their numbers.

When

$$|\varepsilon_X| + |\varepsilon_M| > 1$$  \hspace{1cm} (6.3)

a decrease in e will increase in the country’s net exports. Equation 6.3 is called the Marshall-Lerner Condition (MLC). Therefore, when the MLC holds, a change in e precipitates a change in net exports that we would intuitively expect.

Since the effect of a change in e on net exports depends on demand elasticities, it is valuable to understand what determines demand elasticities. The demand elasticity for a particular good is a positive function of the availability of other goods that could serve
as a substitute for that good. If the price of a good goes up, what other options do consumers have? If there are no substitutable goods that can be turned to, then even if the price is raised, consumers will not reduce the quantity they purchase by much: the \( \%\Delta Q \) will be small and the demand is inelastic. But as the number of substitutes increase, the more likely it is that a consumer will respond to an increase in price of the good by buying a substitute good instead: the \( \%\Delta Q \) in response to increases in \( P \) will grow and the demand will become more elastic.

Many governments in the past have reduced the value of their currency, intending to bring about an increase in its net exports that will simulate the economy. Governments need to be careful because, as just described, if the MLC does not hold the policy will backfire. Governments also need to be aware of the elasticities for those imported goods that are particularly important to an economy. For example, there are many countries that depend on imported oil (for gasoline, etc.). Oil is a very important source of energy for which there are few good substitutes: the demand for oil is inelastic. Therefore, if the value of one of these countries’ currencies were to fall, the domestic currency value of its imported oil would increase.

### 6.4 The Marshall-Lerner Condition and the J-Curve

The reaction by consumers to changes in relative prices usually grows with time. One reason is that they may be unaware of possible substitutes at first, but an increase in the price of something provides new incentive to take the time to investigate other possible substitutes. For example, a manufacturer buying component parts from a firm may not seriously consider possible substitutes until the current supplier raises its price. Similarly, when a firm’s price falls it can take time before people notice and switch their spending to the good. A second reason is that an increase in the price of a good can make it profitable for new entrants to the market with substitutable goods. At the old price such firms could not compete, but the higher price of the good now increases the incentive to start making substitutable goods. These new businesses rarely arise immediately after the rise in price; it takes time for the substitutes to appear on the market. These first two reasons are relevant in any setting, but there is a third reason applicable to international trade. Domestic firms may have contracts with foreign suppliers to deliver specific quantities on specific dates, for specified amounts of the foreign currency. If the domestic currency depreciates, the price in terms of the domestic currency rises, yet the quantity purchased is dictated by the contract and unchanged. In this case, the elasticity of demand is “infinitely inelastic” (i.e., \( \varepsilon_D = 0 \)). But in time, the contracts expire allowing the firm to purchase substitute products and, accordingly, the elasticity of demand grows.

The fact that elasticities are smaller in the short run and grow with time, and the fact that the MLC (Equation 6.3) requires the elasticities of demand for exports and imports to add up to a certain size, together suggest the possibility that the MLC may not hold initially after a change in \( e \) (that affects the price of exports and imports as shown in Figures 6.1 and 6.3), but then with time, the elasticities grow and the MLC begins to hold. Figure 6.7 relates precisely this story. As shown in the Figure, the CA initially falls due to \( e \) falling because the MLC does not hold. But then as the domestic consumers of imports and foreign consumers of the domestic exports find substitutes the two elasticities increase and the MLC begins to hold and the CA begins to rise. Because
the plot of the CA over time as shown in Figure 6.7 is in the shape of the letter “J”, the initial fall and then rise in the CA due to a decrease in e is referred to as the J-Curve effect.

6.5 Pass-through

If an appreciation of the domestic currency causes the price of imports to fall and the price of exports (to the foreign consumers) to rise, then the change in e has been “passed through” to the prices of the exported and imported goods. If an appreciation of the domestic currency by X% causes import prices to fall by X% and export prices (to the foreign consumers) to rise by X%, then “complete” or “100%” pass-through has occurred. The more competitive the markets, the more pass-through has to occur. But to the extent that firms which sell in other countries are not completely forced by competition to set a particular price for their good, they can choose a “markup” by which the price exceeds their costs of production. The higher the markup, the more profit they make per good sold but, of course, the fewer goods they sell.

It is often the case that firms with the power to do so, prevent pass-through from occurring in order to maintain their market share. For example, in the late 1980’s when the $ was falling against the ¥, the price of cars made in Japan should have been rising to US customers if pass-through had taken place. But the Japanese sellers prevented the pass-through in order to maintain their market share: they sacrificed profit in the short run to maintain their market share and, in theory, their long term profits. More generally, firms may have a practice of preventing pass-through to absorb the exchange rate risk so that their foreign customers will not have to.

Key Terms

elasticity of demand
J-curve effect
Marshall-Lerner condition
pass-through
Figure 6.4
US EXPORTS/UK IMPORTS

Figure 6.5
US EXPORTS/UK IMPORTS
Figure 6.6
US EXPORTS/UK IMPORTS

Figure 6.7
The J-Curve