ECON 463/663

Macro definitions for standard and intertemporal trade models:

Two goods: exportable good *x* and importable good *m*.
Y = national output, defined as $Y = P_x Q_x + P_y Q_y$.
Z = domestic purchases of final goods and services, defined as $Z = P_x Z_x + P_y Z_y$, and also defined as Z = C + I.
C = Consumption purchases.
I = Investment purchases.
$S_D$ = Domestic Savings, defined as $S_D = Y – C$.

In a <u>one-period model</u>, there is no savings or investment, so C = Z.

If we also assume there are thus no international transfers of savings, then Z = Y.

Thus, $P_x Q_x + P_y Q_y = P_x Z_x + P_y Z_y$, which can be rewritten as $P_x (Q_x - Z_x) = P_y (Z_y - Q_y)$, or exports equal imports, and trade is thus balanced.

This can also be written as $P_x (Q_x - C_x) = P_y (C_y - Q_y)$, since we are assuming C = Z.

If we instead assume that there is a <u>transfer of savings from a foreign country</u> – perhaps a gift, since there is no reason to invest, or perhaps a war reparation – then we shall call this movement of savings into our country $S_F$ (I just called this *F* elsewhere).

In this case, we can purchase more goods and services, so $Z = Y + S_F$.

This implies that we will have a trade deficit, since $P_x Z_x + P_y Z_y = P_x Q_x + P_y Q_y + S_F$, or $P_x (Q_x - Z_x) - P_y (Z_y - Q_y) + S_F = 0$, or exports minus imports equals the negative of foreign savings. Of course, if some of our savings are transferred to a foreign country, then $S_F<0$ and we will have a trade surplus.

In a two-period model, with periods 1 and 2, current output $Y_1 = f(K_1,L_1)$ is already predetermined, but future $Y_2$ depends on how much we choose to set aside for investment.

Future capital $K_2 = K_1(1-\delta) + I_1$, where $\delta$ is the depreciation rate and $I_1$ is current investment.  So future output $Y_2 = f(K_2,L_2)$, and if we assume that labor supply is not an endogenous variable then we can write this in short form as $Y_2 = f(I_1)$.  We assume that the marginal product of capital is positive but diminishing, so $f' > 0$ and $f'' < 0$.

Also, $f' = (1+R)$, where R is the marginal rate of return on investment (i.e., the interest rate plus the rate of depreciation), and usually $R > 0$.  So $f' > 1$ usually.

Since having a future gives us reason to invest now, $Z_1 = C_1 + I_1$.  If we finance this entirely from domestic savings, then $I_1 = S_D$ and since $S_D = Y_1 - C_1$, we know that $Y_1$ must equal $Z_1$.  Remember that $S_D$ only refers to domestic savings in the first period.

In a two-period model, we invest now in order to produce more in the future.  But if there is no third period, then history ends and there is no reason to invest in the second period. In this case, then, $I_2 = 0$ and $Z_2 = C_2$.

Having two periods is of course merely a simplifying assumption.  Having an infinite future does not really change the model, it only complicates it in two ways.  First, we can imagine that in the second period we are again faced with the choice of whether to invest, but the two-period model is used for periods 2 and 3.  Then in the third period, we do it again for periods 3 and 4, and so on and forth.  We can thus link the two period models into a many-linked chain into the infinite future.  The second complication, however, is that our current investment may last for many years, since depreciation rates are usually less than 100% per year.  Both these complications can be addressed with more complex models, but the simpler model works pretty well for our purposes.

If we now combine the two-period model with a transfer of foreign savings into our country, then $Z_1 = Y_1 + S_F$, and thus $Z_1 = C_1 + I_1 > Y_1$.  This can be shown to imply two conditions.

First, $I_1 = S_D + S_F$, so investment equals the sum of domestic and foreign savings.

Second, let us define $NX_1$ as net exports, or exports minus imports.   Since we know already that exports minus imports equals the negative of foreign savings, then $C_1 + I_1 + NX_1 = Y_1$.

This should look like the familiar equation $Y = C + I + G + NX$, though here we are ignoring government purchases (actually, we can separate government purchases into consumption and investment, and think of the above equation as $Y = C_p + I_p + G + NX = C_p + I_p + (C_g + I_g) + NX = (C_p + C_g) + (I_p + I_g) + NX$, where p and g represent the private and government sectors of the economy).

In the two-period model, then, if $S_F > 0$, then $C_1 + I_1 > Y_1$, and $NX_1 < 0$.

Next period, however, things change. Since we have in effect borrowed foreign savings, we have to repay them at rate R. Thus $Z_2 + S_F(1+R) = Y_2$, so we must spend less than we produce to repay our debts. This then means that we will run a trade surplus in the second period, as $NX_2 + (-S_F(1+R)) = 0$.

Remember that $S_F$ and $S_D$ refer to savings in the first period. In the second period, we will only save to repay foreign savings, since $I_2 = 0$. Also, because it is only a two-period model we can assume that $C_2 = Z_2$, which is implied by $I_2 = 0$.

In the intertemporal trade model, you have two countries in two time periods. Assume they may be trading goods and services, but initially suppose that they are autarkic in savings, so that each country must use domestic savings to finance their investment. The autarky R may differ in the two countries for reasons of supply or demand. One country may have a higher rate of return on capital in general, because it currently has less capital, because it has better growth prospects, or because its economy is more efficient. One country may simply have consumers who prefer current consumption over future consumption, and so are unwilling to save as much as another country. Either way, if the autarky R differs then there are potential gains from trade.

In the model, the country with the lower R will have foreign savings outflows (so $S_F < 0$, $S_D > I_1$, and $Z_1 < Y_1$). This country will have less investment, so it will have lower $Y_2$ than before, but $Z_2$ (and $C_2$) will be higher than $Y_2$ since it will be repaid for its lending at a higher rate of return than it had in autarky. The other country receiving foreign savings inflows (so $S_F > 0$, $S_D < I_1$, and $Z_1 > Y_1$) will have more investment, and higher $Y_2$ even though some of this future output has to be repaid to the lending country, with interest. Intertemporal trade will occur until the R's equate on the margin.

Both countries will be able to improve their overall utility $U(C_1,C_2)$, and since overall consumption is inherently a normal good, the income effect of having intertemporal trade for both countries will be positive for both periods. The substitution effect will vary, however. In the country with the initially-lower R, the rise in R will have a negative substitution effect on $C_1$, and a positive substitution effect on $C_2$. Combining this with the income effect, we can predict that $C_2$ will rise but the effect on $C_1$ is ambiguous. Thus, the effect on this country's $S_D$ is also ambiguous. In the country with the initially-higher R, the fall in R will have a positive substitution effect on $C_1$, and a negative substitution effect on $C_2$. Combining this with the income effect, we can predict that $C_1$ will rise but the effect on $C_2$ is ambiguous. Thus, this country's $S_D$ will fall.

National Income Accounting with International Transactions

| | |
|---|---|
| GNP | = Gross National Product |
| GDP | = Gross Domestic Product |
| GNI | = Gross National Income |
| C | = Consumption Purchases (p = private, g = government) |
| I | = Investment Purchases (p = private, g = government) |
| G | = Government Purchases (consumption plus investment) |
| NX | = Net Exports of merchandise and services |
| EXP | = Exports (m=merchandise, s=services, f=factor receipts) |
| IMP | = Imports (m=merchandise, s=services, f=factor payments) |
| NFR | = Net Factor Receipts (International Receipts less Payments) |
| UT | = Unilateral International Transfers |
| T | = Net Taxes (less subsidies and domestic transfers) |

1. GDP = market value of final-use goods produced in the home country

$$\begin{aligned} GDP &= C + I + NX \\ &= (C_p + C_g) + (I_p + I_g) + NX \\ &= C_p + I_p + (C_g + I_g) + NX \\ &= C_p + I_p + G + NX \end{aligned}$$

and $NX = (EXP_m + EXP_s) - (IMP_m + IMP_s)$

$$\therefore GDP = C_p + I_p + G + (EXP_m + EXP_s) - (IMP_m + IMP_s)$$

1. GNP = market value of final-use goods produced by the home country

$$\begin{aligned} GNP &= GDP + NFR \\ &= C_p + I_p + G + NX + NFR \end{aligned}$$

and $NFR = EXP_f - IMP_f$ (these are wages, interest, and profits received from foreign countries less payments to foreign countries)

$$\therefore GNP = C_p + I_p + G + (EXP_m + EXP_s + EXP_f) - (IMP_m + IMP_s + IMP_f)$$

3. GNI includes unilateral international transfers. Subtracting taxes gets disposable private (personal + business) income, which is either consumed or saved.

$$GNI = GNP + UT = (C_p + S_p) + T$$

4. Government savings is the combined budget surplus, where interest on government debt is either treated as a domestic transfer or government purchase.

$$S_g = T - G$$

5. So:

$GNP = C_p + I_p + G + NX + NFR = GNI – UT = (C_p + S_p + T) - UT$

$\therefore I_p + G + NX + NFR = S_p + T - UT$

$\therefore I_p = S_p + (T – G) – (NX + NFR + UT)$

$\therefore I_p = S_p + S_g – (NX + NFR + UT)$

6. The Current Account Balance is the sum of net exports of merchandise and services, net factor receipts, and unilateral transfers. This is offset by foreign savings through the capital account and financial accounts, including official reserve or settlement transactions.

$$CAB = NX + NFR + UT = (EXP_m + EXP_s + EXP_f) - (IMP_m + IMP_s + IMP_f) + UT$$
$$= (EXP_m - IMP_m) + (EXP_s - IMP_s) + (EXP_f - IMP_f) + UT$$

and $CAB + S_F = 0$

$\therefore I_p = S_p + S_g – CAB$

$\therefore I_p = S_p + S_g + S_F$

$\therefore I_p = (S_p + S_g) + S_F$

$\therefore I_p = S_D + S_F$

Investment is thus financed through either domestic savings (including private and government savings) or foreign savings.

Foreign savings equals the exports minus the imports of assets, i.e. inflows minus outflows or receipts minus payments. This includes private financial assets and government assets, along with net increases in the official U.S Dollar reserve assets of foreign central banks, less the net increases in foreign currency reserve assets held by the Federal Reserve Bank.

We know that $CAB + S_F = 0$ in theory, but not all transactions are reported to governments due to illegal transactions, tax evasion, and errors. Thus, it is made to balance through a “statistical discrepancy” equal to the sum of all other transactions with the sign reversed.