# Notes on The Framework of Macroeconomic Analysis

1. Introduction

- The framework presented here is the skeleton of a macroeconomic model. Models are necessary for economic analysis because the details of real world economies obscure the fundamental forces that determine economic outcomes. Like a road map, an economic model is only useful because of its simplifications. The ideal model is one that is just complicated enough to capture the fundamental relationships that determine economic outcomes, but no more so.

- In this lecture, the framework of an open macro economy is developed step-by-step, starting with the simplest possible model and then introducing real world complications one-by-one.

2. Robinson Crusoe Model

- In macroeconomics the focus is on the economy as a whole, but some disaggregation is necessary. Consider an economy decomposed into two sectors: (1) the business sector where goods and services (GDP) are produced with inputs of land (T), labor (L) and capital (K), and (2) the household sector which owns and earns income from selling the services of the factors of production. The household sector expends all its income on goods and services produced in the business sector.

- Such an economy is illustrated in the following diagram, consisting of two concentric circles: the inner circle, illustrating the exchange of real inputs for real outputs, and the outer circle, illustrating the financial counterpart of the real exchange, the flow of income and consumption (C) spending

**Macro Framework of a Robinson Crusoe Economy**
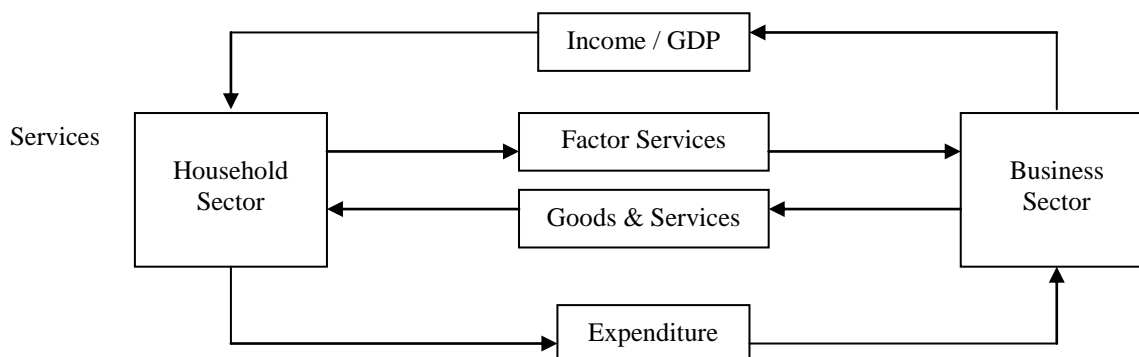
- This model is called "Robinson Crusoe" because households live, in effect, from hand to mouth (i.e., no saving, no investment), there is no government (hence no taxation of household income and no government spending), and the country exists as an island unto itself (no economic relations with the outside world). The main thing about this model is

that there are no macroeconomic issues. Like a closed hydraulic system, it is always in balance. Aggregate output (GDP), by definition, is equal to aggregate income, which in this model is identical with aggregate expenditure. Aggregate supply equals aggregate demand, automatically. Thus, the model implies "Say's Law"—supply creates its own demand.

3. Modern Closed Economy

- In modern economies, households do not consume currently all income, but instead save (postpone consumption) for the future. In addition, businesses are not static, but continually invest to maintain and expand their productive capacity. In addition, in a modern economy government plays a major role, taking income from households through taxation and buying goods and services produced in the business sector.

- These complications are illustrated in the following diagram. Note: S is private saving flowing into the capital market, I is private investment financed by borrowing in the private capital market, T is government tax revenue and G is government spending. When the government budget is not balanced, (T-G)≠0, the government must borrow or lend in the private capital market. In addition, the central bank in a modern economy influences the capital market by changing the stock of money, one kind of financial asset available in the capital market.

Macro Framework of a Modern Closed Economy
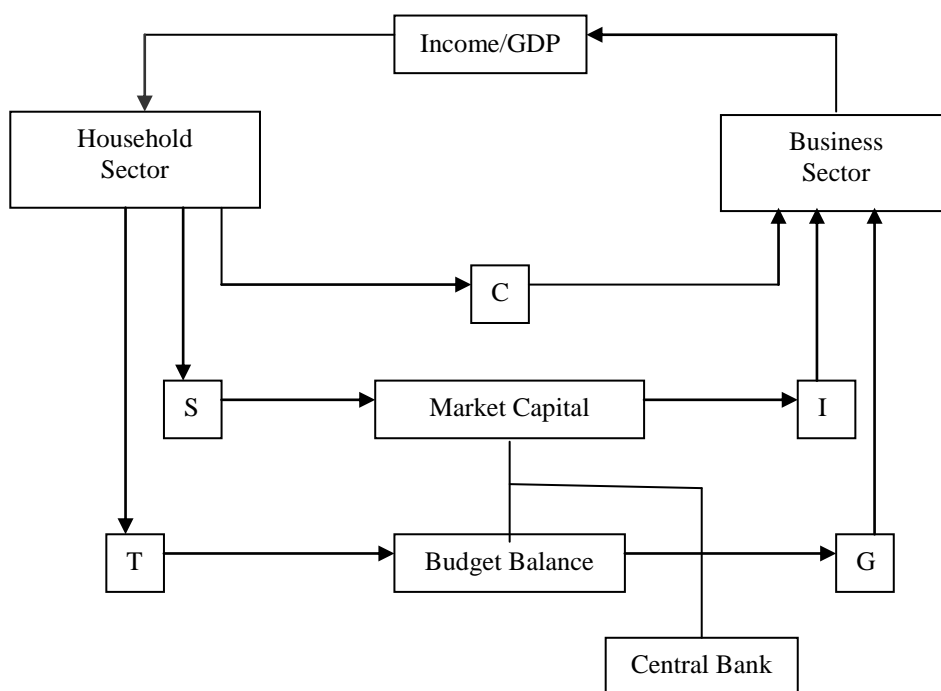
- These real world complications make the model interesting for macroeconomic analysis, for macro equilibrium is no longer assured. Macro equilibrium, where aggregate supply equals aggregate demand, holds only when the *leakages* from the income stream (S and T) equal the *injections* to the income stream (I and G). This is shown algebraically from the two identities: one, which equates GDP with the sum of aggregate spending by households (C), businesses (I) and government (G); the other, which equates GDP with aggregate income, which is disposed of by consumption (C), saving (S) and taxation (T):

(1) $GDP = C + I + G$

(2) $= C + S + T$

(3) $S - I + T - G = 0$ *or* $S + T = I + G$ *or* $S - I = T - G$

- How is this equilibrium established and maintained? That is the question economic theory attempts to explain. Before explaining how this is done, it is useful to introduce another important complication, openness to the world economy.

4. **Framework of an open macro economy**

- Openness introduces many complications to the framework: Firstly, there is no longer any identity between GDP (the value of goods and services produced domestically) and the income the nation earns selling its factor services (GNP). Households may earn income from abroad, if in the past they have invested abroad (i.e., if they sell the services of their capital to the foreign businesses). In addition, the business sector may buy the services of capital from the foreign sector. The difference between GDP and GNP is the interest earnings of domestic residents on net foreign assets (iNFA), NFA being the net difference between domestic holdings of foreign assets (FA) and foreign liabilities (FL), which may be positive or negative.

(4) $GNP = GDP + iNFA$ *where* $NFA = FA - FL$

- Openness also offers households the opportunity to spend their income on foreign goods and services (import, M), as well as on domestic goods and services. Openness also provides an additional source of demand for GDP, foreign demand (exports, X). Imports constitute an additional leakage from the income stream, while exports constitute an additional injection.

- The national income accounting identity and condition for macroeconomic balance for an open economy is thus:

(5) $GDP = C + I + G + X - M$

(6) $GNP = C + S + T$

(7) $S - I + T - G + M - X - iNFA = 0$ *or* $S + T + M = I + G + X + iNFA$

Note: In (5), imports (M) are netted out because C, I, and G, as they are measured in practice, include spending on imports as well as on domestically produced goods and services (GDP).

- Openness offers households the opportunity to put their savings in foreign capital markets as well as in the domestic capital market. Likewise, the business sector can finance investment

in the foreign as well as the domestic capital market. Consequently, in any given year the stock of foreign assets and liabilities held by domestic residents is likely to change. The change in net foreign assets (ΔNFA=ΔFA-ΔFL), shows the net outflow of savings to the foreign sector (or, net inflow of savings from abroad if ΔNFA<0).

- Foreign assets are held not only by the private sector, but also by the central bank. When held by the central bank they are known as "official reserve assets" or simply "reserves" (R). Reserves play a key role in open economy macroeconomics because they constitute one component of the monetary base. As reserves go up and down, other things equal, the money supply goes up and down, which in turn has important implications in financial markets and for macroeconomic activity.

  The link between official reserves of the central bank and money supply is illustrated in the following stylized version of a modern financial system.

Central Bank		**Commercial Banks**		**Household & Firms**	
Assets	Liabilities	Assets	Liabilities	Assets	Liabilities
Reserves (R)	Currency in Circulation (CC)	Loans	Deposits	Deposits	Loans
Claims on the Government, known as Domestic Credit (D)	Commercial Bank Required Reserves (RR)	RR	Equity	CC

Other Assets | Other Liabilities |

- One (narrow) definition of the money supply (M^S) is the sum of currency in circulation (CC) and deposits in the banking system. A fraction of deposits (rr = RR/deposits, the required reserve ratio) is held with the central bank. The assets of the central bank (R+D) constitute, therefore, the base of the money supply, and are variously known as "base money," "high-powered money," or as "reserve money."

$$M^S = CC + Deposits = CC + \frac{RR}{rr} = h(CC + RR) = h(R + D)$$

  Note: h is the ratio of the money supply to base money and depends on the share of currency in the money supply and the reserve requirement ration.

- These complications are built into the framework of a modern open economy is illustrated below:

Macro Framework of an Open Economy

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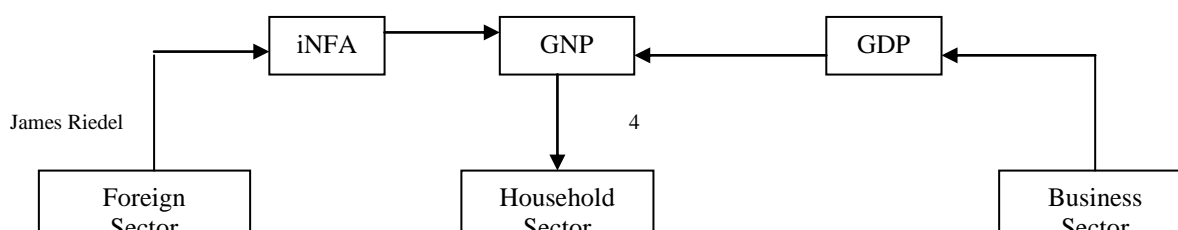
5. Theorizing about Macroeconomic Equilibrium and Adjustment

- The main purpose of economic theory is to explain how markets achieve equilibrium and adjust to on-going changes that disrupt equilibrium. Theorizing almost always proceeds as follows:

  Step one: State the condition for equilibrium. This is generally no more than stating that supply equals demand, *ex ante*. Of course, *ex post*, supply always equals demand by definition. Any thing that was supplied must have been demanded, *ex post*, otherwise it would not have been supplied. Equilibrium, however, requires that supply equal demand, *ex ante*, before the fact. That is, that the *desired* level of supply matches the *desired* demand. Only when this condition is met is the market is in equilibrium.

  Step two: Theorize about the behavior of supply and demand. Here the theorist hypothesizes about what determines supply and demand. For example, it is common to hypothesize that supply of a good (S) depends positively on its price (P), negatively on the variable costs of production (W), positively on the capacity of the industry (K) and other determinants. Demand (D) on the other hand is commonly assumed to depend negatively on the price (P), positively on the level of income of consumers (Y), negatively on any taxes (t) that apply, and so on. The standard notation for writing this theory of supply and demand algebraically is:

$$(9) \quad S = S(\underset{+}{P}, \underset{-}{W}, \underset{+}{K}, ...) \quad and \quad (10) \quad D = D(\underset{-}{P}, \underset{+}{Y}, \underset{-}{t}, ...)$$

Step three: <u>State which variables are endogenous and which are exogenous</u>. In a free market economy it is usually assumed that the price and quantity supplied and demanded are endogenous, the other determinants being treated as exogenous, i.e., determined outside the market.

Step four: <u>Solve the model for the endogenous variables (price and quantity) in terms of the given values of the exogenous variables</u>. For example setting (9) equal to (10), the condition for equilibrium, solve for P as a function of the exogenous variables (W, K, Y, t,…)

(11) $P = P(\underset{+}{W}, \underset{-}{K}, \underset{+}{Y}, \underset{-}{t},...)$

Then, substitute (11) into (9) and (10) to get

(12) $S = D = Q(\underset{-}{W}, \underset{+}{K}, \underset{+}{Y}, \underset{-}{t},...)$

Note: changes in exogenous supply variables (W and K) cause changes in price and quantity in opposite directions, while changes in exogenous demand variables (Y and t) cause changes in price and quantity in the same direction.

- It is often useful to illustrate supply and demand determination diagrammatically. In the following diagram, the P and Q that satisfy the condition S=D are determined for given values of the exogenous variables. As the exogenous variables change, the S and D curves shift and the equilibrium P and Q change.

- Macroeconomic analysis follows this same four-step procedure, however, as the macroeconomic framework shows, it is necessary to consider several interconnected markets simultaneously:

   (i)   <u>The market for goods and services (GDP)</u>. The equilibrium condition (supply equals demand) is written: GDP=C+I+G+X-M. GDP is generally assumed to either be fixed at the full employment level, or to be determined by aggregate demand (C+I+G+X-M).   The heart of macroeconomics is theorizing about the determinants of the components of aggregate demand. This is where the big controversies lay between the Keynesians and the New Classical macroeconomists. They also disagree about which variables are endogenous and exogenous, the Keynesians giving much less

importance to price adjustment (price endogeneity) than the New Classical macroeconomists.

(ii)   <u>The market for foreign exchange</u>: All transactions between domestic residents and the foreign sector go through the foreign exchange market. Some transactions (earning income abroad, exporting, borrowing) generate a supply of foreign exchange, others (making income payments abroad, importing, lending) generate a demand for foreign exchange. The condition for equilibrium (supply equals demand) is X-M+iNFA-ΔNFA-ΔR=0. This holds *ex post* as the balance of payments accounting identity, but for equilibrium it must hold *ex ante*. The theory of the foreign exchange market hypothesizes about the determinants of each component of the balance of payments. Which variables are treated as endogenous and which as exogenous depends mainly on the foreign exchange regime (i.e., whether the exchange rate is free to float in the market or pegged at a fixed rates by the central bank).

(iii) <u>The market for domestic financial assets</u>: Since equilibrium in both goods and services market and the foreign exchange market depend on the domestic interest rate, it is necessary to consider the domestic financial asset market, which for purposes of theory we simplify to the market for money and bonds. Again, the procedure follows the four steps laid out above. State the condition for equilibrium, theorize about the determinants of supply and demand, identify the endogenous and exogenous variables, and solve the model.

6. Two Key Concepts

- *Ex ante* versus *Ex Post*. Supply is always equal to demand *ex post*, since by definition anything that was sold in the market was bought. That, however, does not mean the market is always in equilibrium. For example, when a firm can not sell all that it produces, it must add the excess production to inventory, in effect buying its own product. *Ex post*, every produced is sold (including inventory accumulation), but the firm is not happy. When price fixing leads to a situation of rationing (more people want to buy than sell), *ex post* supply equals demand, but those who are rationed out of the market are not happy, i.e., *ex ante* supply does not equal demand.

- <u>Equilibrium Conditions versus Accounting Identities</u>. Analogous to the ex ante vs. ex post is the distinction between equilibrium conditions and accounting identities. The national income accounts, the balance of payments and the central bank's balance sheet are ex post statements of how much was supplied and demanded. By definition, supply is matched by the demand, GDP equals C+I+G+X-M, the credits match the debits in the balance of payments, but this does not mean these markets are in equilibrium. These statistics are essential for macroeconomic analysis, but only if they are interpreted within a valid theoretical framework.