

National accounts and model consistency

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1.1 National accounts

1.1.1 GNE, GDP and GVA

$$GNE = P_C C + P_K I + P_G G \quad (1)$$

$$GDP = P_Y Q = P_C C + P_K I + P_G G + P_X X - P_M M \quad (2)$$

$$TB = P_X X - P_M M \quad GVA = GDP - T_i = P_V Q \quad (3)$$

T_i = Indirect taxes minus subsidies to production

The price deflator of GDP is determined given the GVA price deflator (P_V):

$$P_V = P_Y \left(1 - \frac{T_i}{P_Y Q} \right) \quad (4)$$

GVA is the sum of Gross Operating surplus and wages

$$GVA = WN + GOS \quad (5)$$

1.1.2 Balance of payments

The Current account is defined as

$$CA = TB + e_i i^* B_{t-1}^* + NUT \quad (6)$$

The term $i^* e B^*$ corresponds to the Primary Income account of the Balance of Payments (NFIA). The term NUT denotes for Net Unilateral Transfers from abroad. In the national accounts, it is labelled the Secondary Income Account.

Net International Investment Position

$$B_t^* = B_{Pt}^* + B_{Ct}^* - D_{Gt}^* \quad (7)$$

Balance of payments identity (we ignore Capital Account):

$$e \Delta B^* = CA = P_X X - P_M M + e i^* B_{t-1}^* + NUT \quad (8)$$

1.1.3 Disposable incomes

Of the Nation:

$$GNDI = P_Y Q + e_t i^* B_{t-1}^* + NUT \quad (9)$$

Implying that

$$GNDI = GNE + CA \quad (9a)$$

Disposable income of the private Sector: nonfinancial sector plus banks (P=NF+B):

$$P_C Y_{dt}^P = GNDI - T - NUT^G - i^* (B_{C,t-1}^* - D_{G,t-1}^*) + i D_{G,t-1}^P$$

$$P_C Y_{dt}^P = P_Y Q + e_t i^* B_{P,t-1}^* - T + NUT^P + i D_{G,t-1}^P \quad (10)$$

For simplicity, we use a single item, T, to describe all taxes minus subsidies: more precisely, T refers to the sum of indirect taxes, direct taxes, and social security contributions, minus government transfers (such as unemployment benefits) and subsidies to production. The term NUT_p refers to the net secondary income received by the private sector from abroad (emigrants remittances, for instance).

1.1.4 Private sector savings

Consolidated private sector: gross savings

$$P_Y S_t^P = P_Y Q + e_t i^* B_{P,t-1}^* - T + NUT^P + i D_{G,t-1}^P - P_C C \quad (11)$$

Because we are pooling together households and non-financial corporations, the model hides the fact that part of the savings of the non-financial private sector consists in earnings retained by corporations to finance their investment (corporate savings). For the purposes of macro-modelling, it is however more important to split the private sector into financial and non-financial sectors.

The banks savings are equal to the respective disposable income, which is the difference between the interest charged on loans and the interest paid on resources (we assume that banks pay no interest to central bank). Splitting the private (P) into non-financial private sector (NF) plus banks (B), we get:

$$P_Y S_t^{NF} = P_Y S_t^P - i D_{G,t-1}^B - i L_{B,t-1}^{NF}$$

$$P_Y S_t^{NF} = P_Y Q + e_t i^* B_{P,t-1}^* - T + NUT^P + i D_{G,t-1}^{NF} - P_C C - i L_{B,t-1}^{NF} \quad (12)$$

$$P_Y S_B = iD_{G,t-1}^B + iL_{B,t-1}^{NF} \quad (13)$$

1.1.5 Government savings

Savings of the Consolidated Government sector (including central bank) are equal to the difference between the government disposable income and government consumption:

$$P_Y S_t^G = T - iD_{G,t-1}^P + i^* e (B_{C,t-1}^* - D_{G,t-1}^*) + NUT^G - P_G G \quad (14)$$

NUT^G refers to the component of NUT that involves the government (official transfers, like international assistance). The Consolidated government sector can be split into general government (GG) and central bank (C). In the consolidated accounts, interest payments on government debt held by the central bank cancel out.

1.1.6 National savings

The sum of private savings (11) and government savings (14) is equal to national savings:

$$P_Y (S_t^P + S_t^G) = [P_Y Q + i^* e (B_{P,t-1}^* + B_{C,t-1}^* - D_{G,t-1}^*) + NUT] - P_G G - P_C C$$

$$P_Y S_t = P_Y Q + e_i i^* B_{t-1}^* + NUT - P_C C - P_G G \quad (15)$$

Using (2), the main identity of the national accounts follows

$$P_Y S_t = P_K I + (P_X X - P_M M + e_i i^* B_{t-1}^* + NUT) = P_K I + CA \quad (16)$$

Or, in alternative:

$$P_Y S - P_K I = CA \quad (16a)$$

This identity shows that, underlying a current account, one may have an excess investment over savings in the private sector, in the government sector, or both. A situation in which a current account deficit is basically matched by a government deficit is labelled “twin deficit”.

1.2 Consistency tables

In what follows, we disaggregate the private sector into non-financial and financial.

1.2.1 Balance sheets

Figure 1 – Balance sheets of 5 institutional sectors

NF Private sector (NF)		Depository banks (B)		External sector (*)	
M_2	L_B^{NF}	R	D	eD_G^*	eB_C^*
D_G^{NF}		D_G^B	L_C^B	$NHIP$	eB_P^*
eB_P^*	NW_{NF}	L_B^{NF}	NW_B		
$P_K K_P$					

General Government (G)		Central bank (C)	
$P_K K_G$	$D_G^P = D_G^{NF} + D_G^B$	eB_C^*	M_B
	D_G^C	D_G^C	NW_C
	eD_G^*	L_C^B	
	NW_G		

1.2.2 Capital stock

$$\Delta K_t^P = I_t^P - \delta K_{t-1}^P \quad (16)$$

$$\Delta K_t^G = I_t^G - \delta K_{t-1}^G \quad (17)$$

Where K_G stands for the public capital stock

1.2.3 Non-Financial Private sector

The non-financial private sector comprises households and non-financial corporations. The balance sheet identity of the private sector is defined as follows¹:

$$NW_{NF} = P_K K_P + M_2 + B_p, \quad (18)$$

Where NW_{NF} denotes for the Net Worth of the NF private sector, K_P for the stock of real assets held by the private sector, P_K for the price of capital goods, M_2 for monetary assets and B_p for financial assets (equity, bonds) net of liabilities. The later can be decomposed into government bonds held by the private sector (D_G^P), external assets net of external liabilities (eB_p^*), minus credit from commercial banks (L_B^P). Thus,

$$B_p = eB_p^* + D_G^{NF} - L_B^{NF}. \quad (19)$$

The net accumulation of real, monetary and financial assets by the private sector (first column in Table 1):

$$P_Y S_t^{NF} = P_K I_{P,t} + \Delta M_2 - \Delta L_B^{NF} + e\Delta B_p^* + \Delta D_G^P \quad (20)$$

By definition, the balance-sheet of the private sector (26) gives the stocks of assets, liabilities, and net worth of that sector at a moment in time. By taking the change in stocks between two balance-sheets we get the net flows over the corresponding time spam, which defines the *sources-and-use-of-funds* statement:

$$\Delta NW_{NF} = (P_K \Delta K_P + \Delta P_K K_P) + (\Delta M_2 + \Delta D_G^P - \Delta L_B^{NF} + e\Delta B_p^*) + \Delta eB_p^* \quad (21)$$

$$\Delta NW_{NF} = (P_K \Delta K_P + \Delta P_K K_P) + (P_Y S_t^{NF} - P_K I_{P,t}) + \Delta eB_p^*$$

Using (16)

$$\Delta NW_{NF} = (P_Y S_t^{NF} - P_K \delta K_{t-1}) + (\Delta P_K K_P + \Delta eB_p^*) \quad (22)$$

¹ Private agents rely on equity and on lending from each other as a source of finance, but these transactions cancel out in the private sector aggregate.

That is, the change in net worth is equal to net savings plus valuation changes (first column in Table 2).

1.2.4 Commercial banks

Commercial banks are a special kind of financial institution, because they are authorised to issue deposits. With the funds raised by deposits and loans obtained from the central bank, L_C^B , commercial banks engage in their main activity: granting credit to the non-financial sector. The balance sheet of the commercial banking sector obeys to the following identity²:

$$NW_B = R + L_B^{NF} + D_G^B - L_C^B - D \quad (23)$$

where L_B^P denotes for banks' loans to the private sector, D_C^G for government securities, NW_B for the net worth of commercial banks, D for private deposits in the banking system, and the remaining variables are defined as before. Reserves of commercial banks, R , comprehend cash holdings in banks' vaults plus deposits held at the central bank.

The corresponding sources-and-use-of-funds statement is:

$$\Delta NW_B = (\Delta L_B^{NF} + \Delta D_G^B - \Delta L_C^B) + \Delta R - \Delta D \quad (24)$$

Assuming away valuation changes³, the accumulation of assets by the banking sector must obey to (fourth columns in Table 1 and in Table 2):

$$P_Y S_B = \Delta NW_B \quad (25)$$

Consolidating the non-financial and financial private sector, we obtain

² For simplicity, we are ignoring funds raised by banks through the capital market, such as long-term bonds. Note that individual banks also rely on lending from each other as a source of finance, but when considering the banking system as a whole, these inter-bank loans cancel out

³ This looks a quite strong assumption. However, losses by banks on private credit correspond to gains in the non-financial private sector, in the aggregate non-performance loans cancel out.

$$\Delta NW_P = \Delta NW_{NF} + \Delta NW_B = (P_Y S_t^P - P_K \delta K_{t-1}) + (\Delta P_K K_P + \Delta e B_P^*)$$

1.2.5 General Government

The Net Worth of the general government is defined as follows:

$$NW_G = P_K K_G - D_G^P - D_G^C - e D_G^* \quad (26)$$

The general government *sources-and-use-of-funds* statement is:

$$\Delta NW_G = (P_K \Delta K_G + \Delta P_K K_G) - (\Delta D_G^P + \Delta D_G^C + e \Delta D_G^* + \Delta e D_G^*) \quad (27)$$

The net borrowing of the general government is:

$$P_Y S_G - P_K I_G = \Delta D_G^P + \Delta D_G^C + e \Delta D_G^* \quad (28)$$

Using (27), (28), and (17), we get:

$$\Delta NW_G = (P_Y S_G - \delta P_K K_{t-1}^G) + (\Delta P_K K_G - \Delta e D_G^*) \quad (29)$$

That is, the change in the net worth of the government sector is the sum of net current savings, and capital gains or losses on physical capital and foreign debt.

1.2.6 Central bank

The central bank balance sheet obeys to the following identity:

$$NW_C = e B_C^* + (D_G^C + L_C^B) - M_B \quad (30)$$

where, NW_C denotes for the net worth of the central bank, $e B_C^*$ for net foreign assets held by the central bank expressed in domestic currency, D_G^C for government debt held by the CB, L_C^B for loans to commercial banks, and M_B for the Monetary Base. It is assumed that the central banks charge no interest on commercial banks.

The money base (M_B) is the most relevant liability of the central bank. It comprehends notes and coins held by the public (M_0) and reserves held by commercial banks, R :

$$M_B = R + M_0 \quad (31)$$

Since the central bank savings are zero (any income is transferred to the government and interest on banks is zero), its balance sheet only changes via valuation changes. The central bank' sources-and-use-of-funds statement is:

$$\Delta NW_C = (e\Delta B_C^* + \Delta L_C^B + \Delta D_C^G + \Delta eB_C^*) - \Delta M_B = \Delta eB_C^* \quad (32)$$

Given the definition of net external wealth (7), another way of looking at the change in the central bank reserve assets is:

$$\Delta B_C^* = \Delta B^* - \Delta B_P^* + \Delta D_G^* \quad (33)$$

Given the balance of payments identity (8)

$$\Delta B_C^* = CA - \Delta B_P^* + \Delta D_G^* \quad (34)$$

This equation, showing the balance of payments “overall balance” as the sum of the current account plus the non-reserve financial account (“net capital inflow”) is a key equation in traditional monetary programming.

Consolidating the net worth of the central bank and of the general government, we obtain

$$\Delta NW_{G+C} = (P_Y S_G - \delta P_K K_{t-1}^G) + (\Delta P_K K_G + \Delta e(B_C^* - D_G^*)) \quad (35)$$

1.2.7 Consolidated monetary sector

Taking together the central bank and the commercial banks balance sheets (23) and (30), one obtains the consolidated balance sheet of the monetary sector:

$$NW_{B+C} = eB_C^* + (D_G^B + D_G^C + L_B^{NF}) - D - M_0 \quad (36)$$

The specific feature of bank deposits is that they are so liquid that they can serve as means of payment. Because of this, bank deposits are part of what we call “money”, together with currency in circulation (M_0). The money supply is, therefore: ⁴

$$M_2 = M_0 + D \quad (37)$$

equation (36) can be rearranged as:

$$M_2 = eB_C^* + (L_B^P + D_B^G + D_C^G) - NW_{B+C} \quad (36a)$$

Equation (36a) reveals that the counterparts of money supply are the reserve assets of the central bank and total domestic credit (to the government and to the private sector).

1.2.8 National wealth

Summing the net worth of all national units, one gets the net worth of the economy as a whole:

$$NW = NW_P + NW_G + NW_C + NW_B = e[B_C^* - D_G^* + B_P^*] + P_K K \quad (38)$$

The last member of (38) shows the country’ International Investment Position (7). Hence:

$$NW = eB^* + P_K K \quad (38a)$$

A country’ total wealth is composed by the country stock of non-financial assets (K) and the net holdings of financial assets (NIIP).

Changes in National Wealth are accounted for by net acquisitions of assets and capital gains and losses:

$$\Delta NW = \Delta eB^* + e\Delta B^* + P_K \Delta K + \Delta P_K K \quad (39)$$

⁴ In the real world, central banks monitor wider monetary aggregates, including short term securities held by the public (e.g. treasuries). For convenience, we ignore this complication.

The item $P_K \Delta K$ corresponds to net investment. This, in turn, is equal to gross investment minus depreciation, as stated in equations (16) and (17). Using these and the BP identity (26), we get:

$$\Delta NW = (P_Y S - \delta P_K K) + (\Delta e B^* + \Delta P_K K) \quad (40)$$

That is, a country' Net Worth changes over time driven by its net savings (gross savings minus depreciation), and capital gains or losses on real and in financial assets.

Table 1 – Flow of funds entire economy

	Non-Fin. Private Sector	Government	Central Bank	Commercial Banks	Total
Gross Savings	$P_Y S_{NF}$	$P_Y S_G$		$P_Y S_B$	$P_Y S$
(-) Investment	$P_K I_P$	$P_K I_G$			$P_K I$
(+) Other Capital (net)	-	.			-
(=) Net Lending (+) or Borrowing (-)	$P_Y S_{NF} - P_K I_P$	$P_Y S_G - P_K I_G$		$P_Y S_B$	CA
(=) Money	ΔM_2		$-\Delta M_B$	$\Delta R - \Delta D$	0
(+) Domestic Credit	$-\Delta L_B^P$		ΔL_C^B	$\Delta L_B^P - \Delta L_C^B$	0
(+) Securities placed at home	ΔD_G^{NF}	$-\Delta D_G^P - \Delta D_G^C$	ΔD_G^C	ΔD_G^B	0
(+) Cross-border asset transactions (net)	$e \Delta B_P^*$	$-e \Delta D_G^*$	$e \Delta B_C^*$		$e \Delta B^*$

Table 2 – Changes in net worth

	Non-Fin. Private Sector	Government	Central Bank	Commercial Banks	Total
Gross Savings	$P_Y S_{NF}$	$P_Y S_G$		$P_Y S_B$	$P_Y S$
(-) Capital depreciation	$\delta P_K K_{P,t-1}$	$\delta P_K K_{G,t-1}$			$\delta P_K K$
(=) Net Savings	$P_Y S_{NF} - \delta P_K K_P$	$P_Y S_G - \delta P_K K_{G,t-1}$			
(+) Capital Transfers					
(+) Valuation changes	$\Delta e B_P^* + \Delta P_K K_P$	$\Delta P_K K_G - \Delta e D_G^*$	$\Delta e B_C^*$		$\Delta e B^* + \Delta P_K K$
(=) Change in NW	ΔNW_{NF}	ΔNW_G	ΔNW_C	ΔNW_B	ΔNW

Further reading

Agenor, P. R., Montiel, P., 2008. *Development Macroeconomics*, 3rd ed. Princeton. [Chapter 2.1].

Agenor, J.P., 2000, *The Economics of Adjustment and Growth*, Academic Press, [Chapter 8]

European Commission, Eurostat, 2013. *European System of Accounts 2010 (ESA 2010)*, Luxembourg: Publications Office of the European Union.

International Monetary Fund, 2009. *Balance of Payments and International Investment Position Manual*, sixth edition (BPM6).