Chapter 19
The Modelling of Financial Flows

19.1 Introduction

Transactions taking place between economic agents that have been characterized so far in quantitative terms have their financial counterparts. In macroeconometric models they are represented by financial flows, which are obtained by multiplying the quantity flows by the appropriate deflators. This concerns the flows of final demand components, the flows of production and the use of production factors.

On the other hand, autonomous financial flows take place within the secondary distribution of national income, which are related to income creation and the realization of economic agents' expenditures. The emerging savings (mark-up) ensure that the financial wealth of these agents will increase. The expenditures on commodities and services are one of the major channels through which financial flows are transmitted to the real sector (Klein et al. 1999). In general, the following institutional sectors of economic agents are distinguished: households, enterprises, public institutions (including financial ones), and foreign sector (Welfe 1992; Juszczak et al. 1993; Welfe and Welfe 2004).

19.2 The Models of Households' Incomes, Expenditures and Wealth Changes

Personal incomes are important component for households' economic activities. They are the main determinant of their consumption, which was referred to in Chap. 16. Because of this, macroeconometric models devote much attention to the generation of personal incomes, providing quite detailed descriptions of their range and particularly of their sources.

The national accounts distinguish the institutional accounts, which contain the nominal gross disposable incomes of households. The net incomes are obtained by deducting taxes and obligatory social contributions.

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In terms of their sources of origin, personal incomes are heterogeneous aggregates. The following components are usually distinguished: labour incomes, incomes of entrepreneurs, incomes from agriculture, transfers from public institutions (social services) and property incomes. Further decomposition of incomes depends on how complex a model is to be and on the availability of statistical data (Welfe 1993).

Gross labour incomes (i.e. incomes before tax) YP_t^{WB} are obtained when the average wages before tax WP_t^B are pre-multiplied by the number of employees N_t:

$$YP_t^{WB} = WP_t^B \cdot N_t \tag{19.1}$$

In the multisectoral models labour incomes are determined for particular sections and then added up.

The net labour incomes (i.e. after tax) YP_t^W are determined by deducting personal tax T_t^W:

$$YP_t^W = YP_t^{WB} - T_t^W \tag{19.2}$$

The incomes of entrepreneurs (excluding farmers) YP_t^{PR} represent special forms of participation in profits (dividends), which can be either direct or indirect. Hence, in the long-run we have:

$$YP_t^{PR^*} = \alpha_0 + \alpha_1 ZP_t^N + \varepsilon_t \tag{19.3}$$

and in the short-run:

$$\Delta YP_t^{PR} = \beta_0 + \beta_1 \left(YP_{t-1}^{PR} - YP_{t-1}^{PR^*}\right) + \beta_2 \Delta ZP_t^N + \varepsilon_t \tag{19.4}$$

where ZP_t^N is net profits (after tax).

If information on the level of profits is unavailable or unreliable, then symptomatic variables correlated with the level of profits are used, such as total receipts or value added.

Farmer incomes are estimated in a similar way. However, information on profits from agricultural activities is frequently not available. Then the most frequent symptomatic variable is value added generated by these activities, which is the source of consumer expenditures.

Transfers from mainly public financial institutions YP_t^S are an important component of personal incomes. The transfers primarily cover old-age and disability pensions YP_t^E, payments from social security funds, including payments to the unemployed, student scholarships and grants, payments from special funds and others YP_t^{SP}.

The level of old-age and disability pensions is regulated by law or agreements made with insurance companies. The implication of the applicable regulations having their main source in the concept of inter solidarity is that the insurance funds are to a large extent dependent on the subsidies from the government budget. In a few countries (for instance Chile and Poland) a different principle was implemented, which requires that obligatory direct payments be made from the wage bills to the funds and links the payments with employees' individual capital accounts. Regardless of which solution is used, the level of pensions depends on the level of wages

paid over a predetermined period and on the duration of employment. It is reviewed (indexed) annually to address a living cost increase and, to some extent, the growth rate of average wages (cf. Welfe and Welfe 2004).

Therefore, the average level of pensions in a given year can be determined from average wages paid in that and the preceding years, adjusted for changes in the level of living costs. An equation approximating this relationship may have the following form:

$$WP_t^E = \alpha_0 \left(\sum_{s=1}^{S} h_s WP_{t-s}^B \right)^{\alpha_1} e^{\alpha_2 (P_t^i / P_{t-1}^i) + \varepsilon_t} \tag{19.5}$$

Other transfers are related to average wages more or less directly. The relationships can be approximated using the following equation:

$$WP_t^{SP} = \alpha_0 \left(WP_t^B \right)^{\alpha_1} e^{\xi_t} \tag{19.6}$$

Total transfer incomes can be obtained by pre-multiplying the average transfer income by the number of recipients. While the number of pensioners (L_t) is generally known, the number of other recipients fluctuates, hence an approximation relating the total value of the transfers to the wage bill is used. We then have:

$$YP^S = YP_t^E + YP_t^{SP} = WP_t^E L_t + \beta_0 \left(YP^{WB} \right)^{\beta_1} \tag{19.7}$$

The property incomes of households depend on the interest rates on bank deposits and securities, dividends from equities, etc. Therefore, these incomes are determined by the nominal interest rates on deposits (R_t^D) and average earnings on bonds and stocks (R_t^A), as well as by the volume of deposits BP_t^{DE} and stocks (BP_t^{AO}).

It can be assumed that in the long-run the total property incomes YP_t^{DA} will be represented by the following equation:

$$\ln YP_t^{DA*} = \alpha_0 + \alpha_1 \ln \left(R_t^D BP_{t-1}^{DE} \right) + \alpha_2 \ln \left(R_t^A BP_{t-1}^{AQ} \right) + \varepsilon_t \tag{19.8}$$

In the short-run, unexpected shocks may occur, represented by variable U_t^{DA}:

$$\begin{aligned} \Delta \ln YP_t^{DA} = {} & \beta_0 + \beta_1 \left(\ln YP_{t-1}^{DA} - \ln YP_{t-1}^{DA*} \right) + \beta_2 \Delta \ln \left(R_t^D BP_{t-1}^{DE} \right) \\ & + \beta_3 \Delta \ln \left(R_t^A BP_{t-1}^{AO} \right) + \beta_4 U_t^{DA} + \varepsilon_t \end{aligned} \tag{19.9}$$

The nominal gross personal, disposable income of households (before tax) (YP_t^B) will be obtained by adding up its components:

$$YP_t^B = YP_t^{WB} + YP_t^{PR} + YP_t^S + YP_t^{DA} \tag{19.10}$$

The nominal net personal disposable income of households (after tax) YP_t will be derived by subtracting the personal income taxes and obligatory payments to the social security funds T_t^W:

$$YP_t = YP_t^B - T_t^W \tag{19.11}$$

Some macromodels use simplified relationships, mainly due to data scarcity. They relate personal disposable incomes to labour incomes and property incomes.

To determine the real disposable incomes (Y_t) the nominal incomes are divided by the appropriate deflator (PY_t):

$$Y_t = YP_t / PY_t \tag{19.12}$$

The nominal disposable incomes are the major source financing households' expenditures. An additional role as a source of households' ***receipts*** is played by consumer credits (KP_t^D). Both components constitute households' disposable funds. They are mainly used to purchase commodities and services (CP_t), then to repay credits (KP_t^{DS}) and to pay taxes (T_t^W). An increase in savings (ΔOP_t^G) is residual. This process is represented by the following balance equation:

$$YP_t^B + KP_t^D = CP_t + KP_t^{DS} + T_t^W + \Delta OP_t^G \tag{19.13}$$

Credit repayment is usually calculated by pre-multiplying the average rate of interest on consumer credits (R_t^G) by the lagged debt of households BKP_{t-1}^G.

Hence, we have:

$$KP_t^{DS} \cong R_t^G BKP_{t-1}^G \tag{19.14}$$

More detailed specifications of an increase in consumer credit and savings will be presented in the next chapter.

The saving increase is the basic component of the equation describing changes in the net wealth covering the financial assets owned by the households (WLP_t). In must be stressed that the notion of households' financial wealth can be understood differently (cf. also Chap. 16). The narrow definition contains, in addition to cash balances, also the value of possessed securities, including bonds and stocks. The broad definition which is sometimes used to specify the consumer demand functions takes account of the total debt of public institutions, the nominal value of domestic enterprises, and net foreign assets.

The net financial wealth of households is generated from the following equation:

$$WLP_t = WLP_{t-1} + \Delta OP_t^G \tag{19.15}$$

Their composition and changes will be shown in the next chapter.

19.3 The Modelling of Financial Flows of Enterprises

Financial flows in the enterprise sector are rather infrequently found in macroeconometric models. If they are present, then they are constrained to enterprises' receipts and the values of gross output and value added, on the one hand, and user costs and enterprises' profits, on the other, only exceptionally covering the capital flows of enterprises.

Enterprises' receipts are usually represented by the receipts from the sale of commodities and services, on which monthly information is available. As regards annual information, the data on gross output QP_t and value added XP_t are used. The gross

output value is obtained by pre-multiplying the volume of output (Q_t) by producer prices (PQ_t) generated in the appropriate blocks of macromodels' equations:

$$QP_t = Q_t \cdot PQ_t \tag{19.16}$$

Value added is calculated as a difference between the value of gross output and the costs of material inputs (KP_t^m):

$$XP_t = QP_t - KP_t^m \tag{19.17}$$

The costs of material inputs can be decomposed to distinguish raw materials and materials of domestic and foreign origin:

$$KP_t^m = a_t^K Q_t^{KS} P_t + a_t^M M_t^S P_t^{MS} \tag{19.18}$$

where

Q_t^{KS} is domestic output of raw materials, materials and energy,
M_t^S is imports of raw materials, materials and energy,
a_t^K is average unit use of domestic inputs,
a_t^M is average unit use of imported inputs.

The information on the unit use of domestic and imported materials and energy is often scarce. To cope with this, a reduced form of Eq. (19.18) is used, which contains on the right-hand side the output values of the domestic raw-materials industries and imports of intermediate inputs, *respectively*.

The user costs are composed of production costs and producer taxes (T_t^A). The production costs (KP_t^P) contain labour costs (KP_t^W), the costs of use of raw-materials, materials and energy (KP_t^M), fixed capital depreciation (KP_t^A) and other costs (KP_t^i):

$$KP_t^P = KP_t^W + KP_t^M + KP_t^A + KP_t^C \tag{19.19}$$

Each of these components can be explained separately. The equations explaining particular cost components share the assumption that they should account for the real volume of inputs expressed in current prices. The real inputs can be obtained from the inverted production function, as presented in Chap. 17 (cf. also Walters 1963).

Labour costs can be determined by pre-multiplying the gross average wages (WP_t^B) by the number of employees (N_t), i.e. as a wage bill augmented by obligatory social insurance payments and wage taxes:

$$KP_t^W = WP_t^B \cdot N_t(1 + \mu_{1t} + \mu_{2t}) \tag{19.20}$$

where:

μ_1 is the rate of social insurance payments,
μ_2 is the rate of wage taxes.

The equations explaining average wages and employment were presented in Chaps. 17 and 18.

The costs of material inputs can be generally obtained by pre-multiplying the value of global output by the global unit material input coefficient A_t:

$$KP_t^M = A_t \cdot QP_t \tag{19.21}$$

They can be decomposed by input source as in the formula (19.19) and also according to different sections or groups of materials.

The depreciation costs are most frequently calculated as prescribed by the law. The rates of depreciation are commonly assumed to be predetermined and are applied to the gross value of fixed capital (KP_t):

$$KP_t^A = \delta KP_t \tag{19.22}$$

where δ is an average depreciation rate.

Other user costs are composed of different payments, which are frequently related to the wage bill, the payments to the insurance funds and the debt service. The equation explaining other costs can be approximated with the following formula:

$$\ln KP_t^i = \alpha_0 + \alpha_1 \ln KP_t^W + \alpha_2 \ln\left(R_t^P \cdot BP_{t-1}^P\right) + \xi_t \tag{19.23}$$

where

R_t^P is the interest rate on short-term credits,
BP_t^P is enterprises' debt at period end.

Because the information on particular cost components is scarce, the analysis is frequently limited to the approximate, reduced form of the relationship between the total costs and major cost components on which information is readily available. The components are the labour costs and the costs of use of imported raw materials, materials and energy. Then we have:

$$\ln KP_t^P = \alpha_0 + \alpha_1 \ln KP_t^W + \alpha_2 \ln M_t^S P_t^{mS} + \varepsilon_t \tag{19.24}$$

The unit costs in the production sector are obtained from dividing the total costs by the volume of output. It is worth noting that the unit labour costs may take the following form:

$$KP_t^W / Q = WP_t^B / (X_t / N_t) \cdot (X_t / Q_t)(1 + \mu_{1t} + \mu_{2t}) \tag{19.25}$$

They depend on the ratio between average wages and labour productivity (X_t/N_t) adjusted for the share of value added in gross output (X_t/Q_t), allowing for social contributions and taxes.

New research projects that came into being recently used the neoclassical approach to minimize production costs under imperfect competition. The shares of particular cost components in the total costs have to be explained. The shares are assumed to be the functions of relative prices in the respective and other cost components. The costs of particular components are obtained by inverting the production function, which allows determining the volumes of use of respective production factors (Jorgenson 1993).

The early investigations into enterprises' production costs that distinguished between constant and variable costs are also worth mentioning. They were mainly based on the cross-section data (Barczak 1971; Pawłowski 1965).

The gross profits of enterprises ZYP_t^B are obtained as a difference between their receipts and user costs. Given that prices are predetermined, they are residual. In general, they are derived from the following identity:

$$ZYP_t^B = QP_t - KP_t^P \tag{19.26}$$

The net profits of enterprises ZYP_t^N are calculated by deducting taxes T_t^Z and extraordinary profits and losses from gross profits:

$$ZYP_t^N \approx ZYP_t^B - T_t^Z \tag{19.27}$$

Therefore, the net profits are residual. This does not guarantee that their predicted values will show satisfactory accuracy. For this reason, several researchers attempted to explain the fluctuations in the net profits, using equations which regressed the profits on the major components of receipts and user costs. This approach is of utmost importance because net profits are a significant source financing investments, household incomes through dividends, as well as social services (Brzeszczyński and Kelm 2000).

19.4 The Modelling of Public Finances

Public finances involve the collection and distribution of monetary resources for the national government, local governments, social insurance systems, and other public institutions. In market economies public finances developed gradually, together with the widening scope of public tasks. This scope was country specific: moderate where the liberal state model prevailed, and extended in countries emphasising Keynesian concepts or in welfare states that paid much attention to government interference as an important instrument for reducing market inefficiencies (Brainard and Tobin 1968).

The alternative concepts concerning the role of the state and public finances gave rise to differences in fiscal policy. Briefly speaking, the neoclassical concepts required that the policy be neutral, accompanied by efforts to keep the government budget balanced and by measures preventing public debt from growing larger. The Keynesian views justified expansionary fiscal policy (i.e. one allowing the use of credit to finance public investments, etc.) and thus larger public debt.

Macroeconometric analysis is mainly interested in the government budget revenues and expenditures. Local government finances and special public funds are left aside, as the primary source of their revenues is the national budget.

The government budget revenues have domestic and foreign sources. Domestic revenues containing incomes from taxes and other incomes are the most important. Because the tax incomes play a key role, they are a common subject of macroeconometric analysis. The other revenues are either exogenous (e.g. central bank payments) or endogenous (for instance the dividends and profits of the state-owned firms), but these revenues are not easy to model.

The following taxes are commonly distinguished: direct taxes including the personal income tax (PIT) and the corporate income tax (CIT) and indirect taxes represented by the tax on the sale of commodities and services or the value added tax (VAT), the excise tax and custom duties.

For tax revenues to be estimated, their base, the tax scheme and the scope and amounts of tax exemptions must be determined. It is also necessary to allow for transfers made to local government budgets and special funds.

How much a person will pay in taxes is regulated by the law. This information can be obtained from the tax administration, but the actual amounts paid by particular individuals are usually not reported to the statistical offices. Consequently, the total flows of tax revenues must be approximated.

The personal income tax (PIT) is a progressive tax in most cases, although sometimes linear taxes involving a flat tax rate are used. The tax rates in the progressive systems are incremental, which means that a larger tax base (personal incomes) entails higher tax payments (Welfe and Welfe 2004).

The PIT revenues BYP_t^G can be estimated from the following approximate equation:

$$BYP_t^G = \alpha_0 + \alpha_1 YP_t^B + \varepsilon_t \tag{19.28}$$

where YP_t^B is the gross disposable personal income (the tax base).

The marginal effective tax rate α_1 can be substituted by its estimate t_t^G, calculated as a difference between the average tax rate and the fraction of tax exemptions:

$$BYP_t^G = \beta_0 + \beta_1 \ln\left(t_t^G YP_t^B\right) + \xi_t \tag{19.29}$$

The CIT revenues (BYP_t^P) are estimated in a similar way. These taxes are frequently linear, so they are easy to compute. We have then:

$$BYP_t^P = \alpha_0 + \alpha_1 ZYP_t^B + \varepsilon_t \tag{19.30}$$

where ZYB_t^B is the gross surplus (the tax base); if exemptions are not granted, then $\alpha_0 = 0$.

Today the paramount source of government revenues is VAT (BYP_t^V). Its main rate is accompanied by a range of reduced rates applied to particular foodstuffs, books and other cultural goods. Because detailed information on the sale of particular products is typically not available, the tax base is constrained to totals. This tax is most frequently levied on domestic and foreign consumer goods purchased by households and public institutions. The equation approximating these relationships treats all goods alike, assuming that the share of goods covered by preferential VAT rates is more or less constant. Hence, VAT revenues can be determined from the following equation:

$$\ln BYP_t^V = \alpha_0 + \alpha_1 \ln(CP_t + GP_t) + \alpha_2 \ln BYP_t^C + \xi_t \tag{19.31}$$

The revenues from custom duties (BYP_t^C) are generally determined as the functions of imports. The duty rates commonly differ depending on commodity and import sources. The detailed information is rather scarce. Hence, an approximation assuming that the average rates do not change significantly is used. The equation reads as follows:

$$\ln BYP_t^C = \alpha_0 + \alpha_1 \ln MP_t^C + \varepsilon_t \tag{19.32}$$

where MP_t^C is the value of imports from countries covered by import duties.

The total government revenues BYP_t are usually obtained from a bridge equation, assuming that the dynamics of other incomes and of tax revenues is similar. We have:

$$BYP_t = \alpha_0 + \alpha_1\left(BYP_t^G + BYP_t^P + BYP_t^V + BYP_t^C\right) + \xi_t \tag{19.33}$$

Macromodels initially treated government budget expenditures (BCP_t) as exogenous or as instruments of economic policy. Today only a few expenditure items are regarded as quasi-exogenous, i.e. the defence expenditures and the investment expenditures. Other expenditures are usually endogenized.

The budget expenditures can be generally decomposed into rigid expenditures, quasi-rigid expenditures and flexible expenditures that, being the instruments of economic policy, may show strong variations. Of practical importance is their decomposition into the current expenditures ($BCCP_t$) and the investment expenditures ($BCJP_t$), basically treated as an economic policy variable.

The current expenditures are further decomposed into expenditures on wage bills, pension funds, subsidies for local governments and state-owned firms, and on the service of domestic and foreign debt.

The wage-bill related expenditures depend on average wages and the number of employees in the public sector (cf. Chap. 18). How the allocations to pension funds are calculated has been explained earlier in this chapter. The expenditures on subsidies are regulated by law. Their amounts depend on the established unit norms and the respective base (Welfe and Welfe 2004).

The expenditures on debt service (BCP^I) are approximated using the average interest rates on credits (R_t) pre-multiplied by the lagged value of debt (BKP_t^I) as the explanatory variables:

$$\ln BCP_t^I = \alpha_0 + \alpha_1 \ln\left(R_t BKP_{t-1}^I\right) + \xi_t \tag{19.34}$$

The current budget expenditures can also be decomposed according to the sections and industries. The budget expenditures are allocated among institutions (ministries) representing particular sections following negotiations, where arguments accentuating the necessity to preserve infrastructure and employment play an important role. The outcomes of the negotiations can be represented by means of equations explaining the absolute values of the expenditures on an i-th section or the expenditures' shares in the total level of current expenditures.

In the first case we have:

$$BCCP_{it} = \alpha_0 + \alpha_1 BCCP_t + \varepsilon_t \tag{19.35}$$

In the second case:

$$BCCP_{it}/BCCP_t = \beta_0 + \beta_1(1/BCCP_t) + \varepsilon_t \tag{19.35'}$$

The results of the estimates for Poland are presented in Welfe and Welfe (2004).

19.5 Financial Flows—The Interim and Outside Links

In the demand-determined market economies financial flows between particular institutional sectors are interlinked. Financial flows taking place between households,

enterprises and financial institutions are characterised by the following relationships that lead to important feedbacks.

The government budget expenditures on the public sector wages, old-age and disability pensions, and social benefits (some made through dedicated funds) increase the personal, disposable incomes of households. As a result, additional personal income tax amounts flow to the budget, thus increasing its revenues. With a budget deficit remaining constant even larger transfers can be made to households.

Owing to subsidies or tax exemptions enterprises increase their profits. Higher corporate taxes they pay then enlarge budget revenues. As before, if the budget deficit does not change, more subsidies can be paid to firms. These feedbacks are called fiscal multipliers.

The transmission to the real sector induces increases in budget expenditures, among which the increase in public investment expenditures plays a central role. This increase starts the accelerator mechanism. Growing expenditures on wages, pensions and social benefits that enlarge personal disposable incomes activate the consumer multiplier. These effects may be constrained, if larger expenditures are financed with credits (Welfe et al. 2002).

In the supply-determined economies, such as the former centrally-planned economies, the above transmission relationships are blocked. An increase in disposable incomes and consumer demand would result in an increase of excess demand, because of the prevalent scarcity of output and production factors. A comprehensive analysis of these relationships was provided in a study by Welfe (1990).

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