A Note on Keynes' Integration of Monetary and Value Theory

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Abstract

A model of Keynes' integration of monetary and value theory that explicitly incorporates the supplies and demands in the markets for consumption and investment goods as well as for money, assets, and the government and foreign sectors is specified below. This model is used to demonstrate that when economic variables are assumed to be determined by the choices of those decision-making units that actually have the power to determine their values Keynes' general theory, based on Marshall's theory of supply and demand as presented in every economic principles textbook, provides an analytic framework within which a logically consistent, causal analysis of dynamic behavior is possible in economics—an analysis that does not depend on a mythical auctioneer bound by an arbitrary budget constraint.

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1. Intorduction

The behavioral and structural equations of Keynes' integration of monetary and value theory are specified in section 2 where the way in which Keynes' marginal efficiency of capital and consumption functions are derived from the supplies and demands for consumption and investment goods is explained. The adjustment functions that define the dynamic properties of the system are specified in section 3 based on Keynes' assumption that employment, output, and income (that is, the value of output produced) are determined at each point in time by the expectations of decision-making units as their expectations adjust to the realized results that are achieved within the system as the system evolves through time.

The structure of the model and the way in which each variable is determined by demanders and suppliers in the markets for consumption and investment goods and for money and assets is examined in section 4, and the nature of a system-wide equilibrium is examined in section 5 where the interrelationships between the various sectors of the system are outlined along with the interrelationships between the market functions and the aggregate functions of the model.

In section 6 the causal/dynamic nature of the analytical framework developed by Keynes throughout The General Theory is illustrated by examining how the effects of an increase in the foreign exchange rate work their way through the system over time within the context of this framework. Concluding observations are given in section 7 where the fundamental differences between Keynes' causal/dynamic methodology and the static/descriptive methodology of neoclassical economics are examined. The Appendix provides a list of the equations specified in the text.

2. Behavioral and Structural Equations

For the purpose of this paper it is assumed that the government sector's demand for goods and services ($\boldsymbol{G^d}$) is exogenously determined:

$$(\mathbf{1}) \quad \boldsymbol{G^d = G},$$

and that its demands for taxes net of transfers ($\boldsymbol{T^d}$) is a direct function of output/income

$(\boldsymbol{Y})$:[1]

$$(\mathbf{2}) \quad \boldsymbol{T^d = t(Y)}, \quad 0 < \boldsymbol{t'}.$$

It is also assumed that the foreign sector's demand for exports ($\boldsymbol{X^d}$) is inversely related to the prices of investment ($\boldsymbol{P^i}$) and consumption ($\boldsymbol{P^c}$) goods—that is, the complex of prices of investment $\boldsymbol{P^i}$ and consumption $\boldsymbol{P^c}$ goods—and the exogenously determined foreign exchange rate ($\boldsymbol{\mu}$):

$$(\mathbf{3}) \quad \boldsymbol{X^d = x(P^i, P^c, \mu)}, \qquad \boldsymbol{x_1, x_2, s_3} < 0,$$

and the demand for imports ($\boldsymbol{F^d}$) is assumed to be directly related to aggregate output/income ($\boldsymbol{Y}$), the prices of investment $\boldsymbol{P^i}$ and consumption $\boldsymbol{P^c}$ goods, and the foreign exchange rate $\boldsymbol{\mu}$:

$$(\mathbf{4}) \quad \boldsymbol{F^d = f(Y, P^i, P^c, \mu)}, \quad 0 < \boldsymbol{x_1, x_2, s_3, s_4}.$$

The supply price for consumption goods ($\boldsymbol{P^{sc}}$) is assumed to be a direct function of the real flow of consumption goods supplied ($\boldsymbol{C^s}$) and the foreign exchange rate $\boldsymbol{\mu}$ (to the extent imports are inputs to the productive process) and is given by:[2]

$$(\mathbf{5}) \quad \boldsymbol{P^{sc} = c^{sp}(C^s, \mu)}, \qquad 0 < \boldsymbol{c_1^{sp}, c_2^{sp}}.$$

It is also assumed that the demand price of consumption goods ($\boldsymbol{P^{dc}}$) is a direct function of output/income $\boldsymbol{Y}$ and of the government sector's demand for goods and services $\boldsymbol{G^d}$

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[1] Keynes defined income $\boldsymbol{Y}$ as the value of output produced, and income so defined is, by definition, equal to the value of output produced as *perceived in the minds of decision-making units*, and will be referred to as 'output/income' throughout this paper. See Keynes (1936, pp. 46-7) and Blackford (2024 pp. 86-7)

[2] See Keynes (1936, pp. 280-91). It should also be noted that for the purposes of this paper one can consider the variables as being measured in either wage-units or constant dollars as one wishes. See Blackford 2022b (p. 2,n1).

(**1**), and is an inverse function of the flow of consumption goods demanded ($\boldsymbol{C^d}$), of the international exchange rate $\boldsymbol{\mu}$ (to the extent the demands for imports $\boldsymbol{F^d}$ and exports $\boldsymbol{X^d}$ affect the demand for consumption ($\boldsymbol{C^d}$) goods), and the demand for taxes net of transfers $\boldsymbol{T^d}$ as given by:

(**6**) $\boldsymbol{P^{dc} = c^{dp}\left(C^d, Y, T^d, G^d, \mu\right)} \quad \boldsymbol{c_1^{dp}, c_3^{dp}, c_5^{dp} < 0 < c_2^{dp}, c_4^{dp}}$

$\boldsymbol{= c^{dp}\left(C^d, Y, t(Y), G, \mu\right)}$

$\boldsymbol{= c^{dp}\left(C^d, Y, G, \mu\right)}, \qquad \boldsymbol{c_1^{dp}, c_4^{dp} < 0 < c_2^{dp}, c_3^{dp}.}$

Keynes' consumption function is obtained by equating the supply price of consumption goods $\boldsymbol{P^{sc}}$ (**5**) and the demand price of consumption goods $\boldsymbol{P^{dc}}$ (**6**) to obtain:

(**7**) $\boldsymbol{c^{sp}(C^s, \mu) = c^{dp}\left(C^d, Y, G, \mu\right) = P^c,}$

and solving for the equilibrium rate of consumption goods demanded $\boldsymbol{C^d}$ (=$\boldsymbol{C^s}$) as a function of aggregate output/income $\boldsymbol{Y}$, government demand for goods and services $\boldsymbol{G}$, and the foreign exchange rate $\boldsymbol{\mu}$:

(**8**) $\boldsymbol{C^d = c(Y, G, \mu)}, \quad \boldsymbol{c_3 < 0 < c_1, c_2}$

where $\boldsymbol{C^d}$ (=$\boldsymbol{C^s}$) is the rate of consumption goods demanded (supplied) at each level of output/income $\boldsymbol{Y}$, government demand for goods and services $\boldsymbol{G}$, and the foreign exchange rate $\boldsymbol{\mu}$ given the assumption of equilibrium in the various markets for consumption goods.

Keynes' Marginal Efficiency of Capital (MEC) schedule can be obtained in a manner parallel to the derivation of Keynes' consumption function. If it is assumed that the supply price of investment goods ($\boldsymbol{P^{si}}$) is a direct function of the rate of investment goods supplied ($\boldsymbol{I^s}$) and the foreign exchange rate $\boldsymbol{\mu}$, the supply price of investment goods $\boldsymbol{P^{si}}$ can be written as:

(**9**) $\boldsymbol{P^{si} = i^{sp}(I^s, \mu)}, \quad \boldsymbol{0 < i_1^{sp}, i_2^{sp}.}$

If it is further assumed that the demand price of investment goods ($\boldsymbol{P^{di}}$) is an inverse function of the rate at which investment goods are demanded ($\boldsymbol{I^d}$), the rate of interest $\boldsymbol{R}$,

and the foreign exchange rate $\boldsymbol{\mu}$, and a direct function of the price of assets $\boldsymbol{P^a}$ (Keynes 1936, p. 151), the government sector's demand for goods and services $\boldsymbol{G^d}$ (**1**), and the demand for consumption goods $\boldsymbol{C^d}$ (**4**) (Keynes 1936, pp. 46, 210-12), the demand price of investment goods $\boldsymbol{P^{di}}$ can be written as:

$$(\mathbf{10}) \quad \begin{aligned} \boldsymbol{P^{di}} &= \boldsymbol{i^{dp}}\left(\boldsymbol{I^d}, \boldsymbol{R}, \boldsymbol{P^a}, \boldsymbol{C^d}, \boldsymbol{G^d}, \boldsymbol{\mu}\right), \quad \boldsymbol{i_1^{dp}}, \boldsymbol{i_2^{dp}}, \boldsymbol{i_6^{dp}} < 0 < \boldsymbol{i_3^{dp}}, \boldsymbol{i_4^{dp}}, \boldsymbol{i_5^{dp}} \\ &= \boldsymbol{i^{dp}}\left(\boldsymbol{I^d}, \boldsymbol{R}, \boldsymbol{P^a}, \boldsymbol{c}(\boldsymbol{Y}, \boldsymbol{G}, \boldsymbol{\mu}), \boldsymbol{G}, \boldsymbol{\mu}\right) \\ &= \boldsymbol{i^{dp}}\left(\boldsymbol{I^d}, \boldsymbol{R}, \boldsymbol{P^a}, \boldsymbol{Y}, \boldsymbol{G}, \boldsymbol{\mu}\right), \quad \boldsymbol{i_1^{dp}}, \boldsymbol{i_2^{dp}}, \boldsymbol{i_6^{dp}} < 0 < \boldsymbol{i_3^{dp}}, \boldsymbol{i_4^{dp}}, \boldsymbol{i_5^{dp}} \end{aligned}$$

Keynes' MEC schedule can then be obtained by equating the supply price of investment goods $\boldsymbol{P^{si}}$ (**9**) and demand price of investment goods $\boldsymbol{P^{di}}$ (**10**) to obtain:

$$(\mathbf{11}) \quad \boldsymbol{i^{sp}}(\boldsymbol{I^s}, \boldsymbol{\mu}) = \boldsymbol{i^{dp}}\left(\boldsymbol{I^d}, \boldsymbol{R}, \boldsymbol{P^a}, \boldsymbol{Y}, \boldsymbol{G}, \boldsymbol{\mu}\right) = \boldsymbol{P^i},$$

and solving for the equilibrium rate of investment goods demanded $\boldsymbol{I^d}$ (=$\boldsymbol{I^s}$) as a function of the rate of interest $\boldsymbol{R}$, price of assets $\boldsymbol{P^a}$, aggregate output/income $\boldsymbol{Y}$, the governments' demand for goods and services $\boldsymbol{G^d}$, and the foreign exchange rate $\boldsymbol{\mu}$: [3]

$$(\mathbf{12}) \quad \begin{aligned} \boldsymbol{I^d} &= \boldsymbol{i}\left(\boldsymbol{R}, \boldsymbol{P^a}, \boldsymbol{Y}, \boldsymbol{G^d}, \boldsymbol{\mu}\right), \quad \boldsymbol{i_1}, \boldsymbol{i_5} < 0 < \boldsymbol{i_2}, \boldsymbol{i_3}, \boldsymbol{i_4} \\ &= \boldsymbol{i}(\boldsymbol{R}, \boldsymbol{P^a}, \boldsymbol{Y}, \boldsymbol{G}, \boldsymbol{\mu}), \quad \boldsymbol{i_1}, \boldsymbol{i_5} < 0 < \boldsymbol{i_2}, \boldsymbol{i_3}, \boldsymbol{i_4} \end{aligned}$$

where $\boldsymbol{I^d}$ (=$\boldsymbol{I^s}$) is the rate of investment goods demanded (supplied) at each rate of interest $\boldsymbol{R}$, output/income $\boldsymbol{Y}$, price of assets $\boldsymbol{P^a}$, the government sector's demand for

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[3] The assumption that $\boldsymbol{i_5} < 0$ presupposes that the positive effect of an increase in the foreign exchange rate $\boldsymbol{\mu}$ on the supply price of investment goods $\boldsymbol{i^{sp}}(\boldsymbol{I^s}, \boldsymbol{\mu})$ (**9**) due to the lower cost of imported inputs does not offset the negative effects of the increase in the foreign exchange rate $\boldsymbol{\mu}$ on the demand price of investment goods $\boldsymbol{i^{dp}}\left(\boldsymbol{I^d}, \boldsymbol{R}, \boldsymbol{P^a}, \boldsymbol{c}(\boldsymbol{Y}, \boldsymbol{G}, \boldsymbol{\mu}), \boldsymbol{G}, \boldsymbol{\mu}\right)$ (**10**) that results from the decrease in the demand for consumption goods $\boldsymbol{c}(\boldsymbol{Y}, \boldsymbol{G}, \boldsymbol{\mu})$ (**8**) and the resulting increase in imports and decrease in exports of investment goods. See Keynes (1936, pp. 105-06) and Blackford (2021; 2022a).

goods and services $\boldsymbol{G}$, and the foreign exchange rate $\boldsymbol{\mu}$ given the assumption of equilibrium in the various markets for investment goods.[4]

Keynes' liquidity-preference/money-demand function is assumed to be a direct function of output/income $\boldsymbol{Y}$ and inverse functions of the rate of interest $\boldsymbol{R}$ and price of assets ($\boldsymbol{P^a}$):

$$(\mathbf{13}) \quad \boldsymbol{M^d = m^d(Y, R, P^a)}, \quad \boldsymbol{m_2^d, m_3^d} < 0 < \boldsymbol{m_1^d}$$

where $\boldsymbol{M^d}$ is the stock of money demanded,[5] and we can think of 'the' rate of interest $\boldsymbol{R}$ in terms of "the complex of the various rates of interest current for different periods of time, i.e. for debts of different maturities" (Keynes, 1936, p 167n) "and risks"(p. 28) and the price of assets $\boldsymbol{P^a}$ as the complex of the various current prices of assets.[6]

Keynes assumed the stock of money to be exogenously "determined by the action of

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[4] Cf. Keynes:

> If Q_r is the prospective yield from an asset at time r, and d_r, is the present value of £1 deferred r years at the current rate of interest, $\sum Q_r d_r$ is the demand price of the investment; and investment will be carried to the point where $\sum Q_r d_r$ becomes equal to the supply price of the investment as defined above. (1936 p. 137)

[5] For a formal discussion as to how this function can be derived see Blackford (2019a).

[6] Keynes argued in *The General Theory* (p. 304) that the demand for money is a function of effective demand, and in his 1938 attempt to clarify the nature of this demand in its relationship to 'finance' Keynes also argued that the demand for money "is a function of income and of business habits" (1938, p. 321-2). I believe that for the purposes of this paper the best way to incorporate this aspect of Keynes' understanding of the demand for money is to assume that the demand for money is a direct function of realized output/income $\boldsymbol{Y}$ and that changes in effective demand $\boldsymbol{Y^e}$ as defined below (**27**) have the effect of shifting the demand for money function $\boldsymbol{m^d(Y, R)}$ (**13**) by way of changes in the 'finance' demand for money. See Bibow, Blackford (2019; 2020a), Davidson, and Keynes (1937b).

the central bank" in *The General Theory* (p. 247), but in 1937 he observed that "an illuminating way of expressing the liquidity-theory" is in terms of the willingness of the public "to become more or less liquid and ... the banking system ... to become more or less unliqulid." (1937b, p. 666) Hence, it is assumed that the real quantity of money supplied by the financial system ($\boldsymbol{M^s}$) is directly related to the rate of interest $\boldsymbol{R}$:

$$(\mathbf{14}) \quad \boldsymbol{M^s = m^s(R), \quad 0 < m^{s'}.}$$

It is also assumed that the existing stock of assets ($\boldsymbol{A}$) is exogenously determined; thus, the supply of assets ($\boldsymbol{A^s}$) is given by:

$$(\mathbf{15}) \quad \boldsymbol{A^s = A},$$

and that the demand for assets ($\boldsymbol{A^d}$) is inversely related to the price of assets $\boldsymbol{P^a}$ and the rate of interest $\boldsymbol{R}$, and is directly related to output/income $\boldsymbol{Y}$ and the foreign exchange rate $\boldsymbol{\mu}$: [7]

$$(\mathbf{16}) \quad \boldsymbol{A^d = a^d(P^a, R, Y, \mu)}, \qquad \boldsymbol{a_1^d, a_2^d < 0 < a_3^d, a_4^d.}$$

It is also instructive, for expository purposes, to specify the *asset equilibrium schedule* in this model even though Keynes did not utilize this relationship. This schedule can be obtained by setting the supply of assets (**15**) equal to the demand for assets (**16**),

$$(\mathbf{17}) \quad \boldsymbol{A = a^d(P^a, R, Y, \mu),}$$

and solving for the equilibrium price of assets $\boldsymbol{P^a}$ as a function of the rate of interest $\boldsymbol{R}$, output/income $\boldsymbol{Y}$, and stock of assets $\boldsymbol{A}$, given equilibrium in the markets for assets:

$$(\mathbf{18}) \quad \boldsymbol{P^a = a(A, R, Y, \mu)}, \qquad \boldsymbol{a_1, a_2 < 0 < a_3, a_4.}$$

The aggregate demand schedule implied by the demands for consumption (**8**) and investment (**12**) functions is given by:

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[7] In Blackford (2022b) only non-debt assets were referred to in the model. Here both debt and non-debt assets are combined in the assets variable $\boldsymbol{A}$.

$$(\mathbf{19}) \quad \begin{aligned} \boldsymbol{Y^d} &= \boldsymbol{c}(\boldsymbol{Y}, \boldsymbol{G}, \boldsymbol{\mu}) + \boldsymbol{i}(\boldsymbol{R}, \boldsymbol{P^a}, \boldsymbol{Y}, \boldsymbol{G}, \boldsymbol{\mu}) \\ &= \boldsymbol{d}(\boldsymbol{R}, \boldsymbol{P^a}, \boldsymbol{Y}, \boldsymbol{G}, \boldsymbol{\mu}), \qquad \boldsymbol{d_2}, \boldsymbol{d_5} < 0 < \boldsymbol{d_1}, \boldsymbol{d_3}, \boldsymbol{d_4}, \end{aligned}$$

and the implied aggregate savings function is given by:

$$(\mathbf{20}) \quad \begin{aligned} \boldsymbol{S^d} &= \boldsymbol{Y} - \boldsymbol{C^d} \\ &= \boldsymbol{Y} - \boldsymbol{c}(\boldsymbol{Y}, \boldsymbol{G}, \boldsymbol{\mu}) \\ &= \boldsymbol{s}(\boldsymbol{Y}, \boldsymbol{G}, \boldsymbol{\mu}), \qquad \boldsymbol{s_3} < 0 < \boldsymbol{s_1}, \boldsymbol{s_2} \end{aligned}$$

where $\boldsymbol{Y^d}$ is the real flow of aggregated demand, and $\boldsymbol{S^d}$ is the rate of desired saving.

To complete the behavioral equations in Keynes' model it is necessary to specify the relationship between effective demand, employment, and output/income $\boldsymbol{Y}$ where Keynes defined *effective demand* as the point at which the "entrepreneurs' expectation of profits will be maximized" (1936, p. 25).[8] It is assumed that the rate at which labor is demanded in the investment ($\boldsymbol{N^{id}}$) and consumption ($\boldsymbol{N^{cd}}$) goods industries are direct functions of the effective demands for investment ($\boldsymbol{I^e}$) and consumption ($\boldsymbol{C^e}$) goods—that is, are direct functions of the level of output and employment at which producers

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[8] See Keynes:

> In Chapter 3 we have defined the aggregate supply function Z = φ(N), which relates the employment N with the aggregate supply price of the corresponding output. The employment function only differs from the aggregate supply function in that it is, in effect, its inverse function and is defined in terms of the wage-unit; the object of the employment function being to relate the amount of the effective demand, measured in terms of the wage-unit, directed to a given firm or industry or to industry as a whole with the amount of employment, the supply price of the output of which will compare to that amount of effective demand. Thus, if an amount of effective demand D_{wr}, measured in wage-units, directed to a firm or industry calls forth an amount of employment N_r in that firm or industry, the employment function is given by $N_r = F_r(D_{wr})$. Or, more generally, if we are entitled to assume that D_{wr} is a unique function of the total effective demand D_w, the employment function is given by $N_r = F_r(D_w)$. (1936, p. 280)

expect to maximize their profits. Accordingly, we can write the demand for labor in the investment-goods industries $\boldsymbol{N^{id}}$ as:

$$(\mathbf{21}) \quad \boldsymbol{N^{id}} = \boldsymbol{n^{id}}(\boldsymbol{I^e}), \qquad 0 < \boldsymbol{n^{id'}},$$

and the demand for labor in the consumption-goods industries $\boldsymbol{N^{cd}}$ as:

$$(\mathbf{22}) \quad \boldsymbol{N^{cd}} = \boldsymbol{n^{cd}}(\boldsymbol{C^e}), \qquad 0 < \boldsymbol{n^{cd'}}.$$

We can then write the output of goods produced in the investment goods industries ($\boldsymbol{I}$) as determined by the employment in the investment goods industries ($\boldsymbol{N^i}$):

$$(\mathbf{23}) \quad \boldsymbol{I} = \boldsymbol{i^n}(\boldsymbol{N^i}), \qquad 0 < \boldsymbol{i^{n'}},$$

and the output of goods produced in the consumption goods industries ($\boldsymbol{C}$) as determined by the employment in the consumption goods industries ($\boldsymbol{N^c}$):

$$(\mathbf{24}) \quad \boldsymbol{C} = \boldsymbol{c^n}(\boldsymbol{N^c}), \qquad 0 < \boldsymbol{c^{n'}}.$$

And "if we are entitled to assume that [employment in each firm or industry] is a unique function of the total effective demand" (Keynes 1936, p. 280), (**22**) and (**23**) imply that Keynes' aggregate employment function can be written as:

$$\begin{aligned}(\mathbf{25}) \ \boldsymbol{N^{wd}} &= \boldsymbol{N^{id}} + \boldsymbol{N^{cd}} \\ &= \boldsymbol{n^{id}}(\boldsymbol{I^e}) + \boldsymbol{n^{cd}}(\boldsymbol{C^e}) \\ &= \boldsymbol{n^{id}}(\boldsymbol{Y^e}) + \boldsymbol{n^{cd}}(\boldsymbol{Y^e}) \\ &= \boldsymbol{n^{w}}(\boldsymbol{Y^e}), \qquad \boldsymbol{n^{w'}} = 1\end{aligned}$$

where $\boldsymbol{Y^e}$ is the aggregate (i.e. total) effective demand: [9]

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[9] See footnote 8 above. Since the aggregate employment function is defined net of user cost, both ($\boldsymbol{N^{id}} + \boldsymbol{N^{cd}}$) and ($\boldsymbol{C} + \boldsymbol{I}$) define the number of hours-of-ordinary-labor/time-unit needed to satisfy $\boldsymbol{Y^e}$ when these aggregate variables are measured in 'wage-units'. Thus, $\boldsymbol{n^{wd}}(\boldsymbol{C^e} + \boldsymbol{I^e}) = \boldsymbol{n^{wd}}(\boldsymbol{Y^e}) = \boldsymbol{Y^e}$ and $\boldsymbol{dn^{wd}}(\boldsymbol{Y^e}) = \boldsymbol{dY^e}$ which implies that $\boldsymbol{n^{wd'}} = \mathbf{n^{wd-1'}} = 1$. See Blackford (2022, p. 2n) and Keynes (1936, p. 55n).

$$(\mathbf{26}) \quad \boldsymbol{Y^e = C^e + I^e},$$

and $\boldsymbol{N^{wd}}$ is the aggregate demand for labor if variables are measured in 'wage-units'; if variables are measured in constant dollars the aggregate demand for labor measured in constant dollars ($\boldsymbol{N^d}$) can be written as:

$$(\mathbf{27}) \quad \begin{aligned} \boldsymbol{N^d} &= \boldsymbol{n^{cd}(C^e) + n^{id}(I^e)} \\ &= \boldsymbol{n^{cd}(Y^e) + n^{id}(Y^e)} \\ &= \boldsymbol{n^d(Y^e)}, \qquad 0 < \boldsymbol{n^{d'}}. \end{aligned}$$

3. Dynamic Adjustment Functions

In specifying the dynamic adjustment functions that determine the dynamic behavior of the variables of the model it is assumed that demanders and suppliers behave in accordance with what Leijonhufvud referred to as Marshall's "laws of motion" (pp. 61-77) to equate supplies and demands. Thus it is assumed that demanders and suppliers of money adjust the rate of interest $\boldsymbol{R}$ to equate the demand for money $\boldsymbol{M^d}$ (**13**) to the supply of money $\boldsymbol{M^s}$ (**14**):

$$(\mathbf{28}) \quad \begin{aligned} \boldsymbol{dR} &= \boldsymbol{g^r\left(M^d - M^s\right)} \\ &= \boldsymbol{g^r\left(m^d(Y, R, P^a) - m^s(R)\right)}, \end{aligned}$$

as they adjust the stock of money $\boldsymbol{M}$ in existence to the short side of the market:

$$(\mathbf{29}) \quad \begin{aligned} \boldsymbol{dM} &= \boldsymbol{g^m\left(M^d - M\right)} \\ &= \boldsymbol{g^m\left(m^d(Y, R, P^a) - M\right)} \end{aligned}$$

where $\boldsymbol{dR}$ and $\boldsymbol{dM}$ are the time derivative operator $\boldsymbol{d}$ ($\boldsymbol{=d/dt}$) applied to $\boldsymbol{R}$ and $\boldsymbol{M}$, and the time derivative functions $\boldsymbol{g^r}$ and $\boldsymbol{g^m}$ (as well as the time derivative functions specified below) are assumed to increase monotonically through the origin.[10]

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[10] It should be noted that the time derivative functions in this model are not assumed to be continuous, well-behaved mathematical functions in the real world even though for

It is also assumed that demanders and suppliers of assets adjust the price of assets $\boldsymbol{P^a}$ to equate the existing supply of assets $\boldsymbol{A^s}$ (**15**) to the demand for assets $\boldsymbol{A^d}$ (**16**):

$$(\mathbf{30}) \quad \boldsymbol{dP^a} = \boldsymbol{g^{pa}}\left(\boldsymbol{A^d} - \boldsymbol{A^s}\right) = \boldsymbol{g^{pa}}\left(\boldsymbol{a^d}(\boldsymbol{P^a}, \boldsymbol{R}, \boldsymbol{Y}) - \boldsymbol{A}\right).$$

Next it is assumed that producers in the investment- and consumption-goods industries adjust their expectations to equate the effective demands for consumption $\boldsymbol{C^e}$ and investment $\boldsymbol{I^e}$ goods to the actual demands for these goods $\boldsymbol{C^d}$ $\boldsymbol{I^d}$ as defined by the inverses of (**6**) and (**10**): [11]

$$(\mathbf{31}) \quad \boldsymbol{dC^e} = \boldsymbol{g^{ce}}\left(\boldsymbol{C^d} - \boldsymbol{C^e}\right) = \boldsymbol{g^{ce}}\left(\boldsymbol{c^{dp-1}}(\boldsymbol{P^c}, \boldsymbol{Y}, \boldsymbol{G}, \boldsymbol{\mu}) - \boldsymbol{C^e}\right)$$

$$(\mathbf{32}) \quad \boldsymbol{dI^e} = \boldsymbol{g^{ie}}\left(\boldsymbol{I^d} - \boldsymbol{I^e}\right) = \boldsymbol{g^{ie}}\left(\boldsymbol{i^{dp-1}}(\boldsymbol{P^i}, \boldsymbol{R}, \boldsymbol{P^a}, \boldsymbol{Y}, \boldsymbol{G}, \boldsymbol{\mu}) - \boldsymbol{I^e}\right)$$

It is also assumed that as the effective demands for output in the investment $\boldsymbol{I^e}$ and consumption $\boldsymbol{C^e}$ goods industries adjust to the actual demands for the output of these industries in accordance with (**31**) and (**32**) and that employment in the investment $\boldsymbol{N^i}$ and consumption $\boldsymbol{N^c}$ goods industries adjust to the actual demand for employment $\boldsymbol{N^{id}}$ (**21**) $\boldsymbol{N^{cd}}$ (**22**) in these industries:

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ease of exposition they will be specified and discussed as such. They can be modified to fit the hypotheses of an endogenous money supply or markup pricing, oligopoly, monopoly, etc., as one wishes, but to do so here is beyond the scope of this paper. Cf., Brady, Hayes, Lavoie and Godley, and Keynes (1936; 1937a).

[11] Cf., Keynes: "the effects on employment of the realized sale-proceeds of recent output and those of the sale-proceeds expected from current input; and producers' forecasts are more often gradually modified in the light of results than in anticipation of prospective changes" (1936, p. 51).

$$(\mathbf{33}) \quad dN^i = g^{ni}\left(N^{id} - N^i\right)$$
$$= g^{ni}\left(n^{id}(I^e) - N^i\right)$$

$$(\mathbf{34}) \quad dN^c = g^{nc}\left(N^{cd} - N^c\right)$$
$$= g^{nc}\left(n^{cd}(C^e) - N^c\right)$$

as the rates of consumption C and investment I goods production adjust to the level of employment in those industries N^c N^i:

$$(\mathbf{35}) \quad dC = g^c(c^n(N^c) - C)$$
$$(\mathbf{36}) \quad dI = g^i(i^n(N^i) - I),$$

and that suppliers and demanders in the markets for investment I and consumption C goods adjust the prices of investment P^i and consumption P^c goods to equate the supplies I^s C^s and demands I^d C^d for these goods as given by the inverses of the supply prices P^{si} (**9**) P^{sc} (**5**) and demand prices P^{di} (**10**) P^{dc} (**6**) for these goods:

$$(\mathbf{37}) \quad dP^i = g^{pi}\left(I^d - I^s\right)$$
$$= g^{pi}\left(i^{dp-1}(P^i, R, P^a, Y, G, \mu) - i^{sp-1}(P^c, \mu)\right)$$
$$(\mathbf{38}) \quad dP^c = g^{pc}\left(C^d - C^s\right)$$
$$= g^{pc}\left(c^{dp-1}(P^c, Y, G, \mu) - c^{sp-1}(P^i, \mu)\right).$$

Thus, the aggregate effective demand Y^e (**26**) adjusts concomitantly to the actual demands for consumption C^d (**8**) and investment I^d(**12**) goods:

$$(\mathbf{39}) \quad dY^e = g^e\left(Y^d - Y^e\right)$$
$$= g^e(d(Y, R, P^a, G, \mu) - Y^e),$$

aggregate employment (N) adjusts concomitantly to the aggregate demand for employment N^d (**27**):[12]

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[12] This assumes, of course, that variables are measured in constant dollars. If

$$(\mathbf{40}) \quad \boldsymbol{dN} = \boldsymbol{g^n}\left(\boldsymbol{N^d} - \boldsymbol{N}\right)$$
$$= \boldsymbol{g^n}(\boldsymbol{n}(\boldsymbol{Y^e}) - \boldsymbol{N}),$$

and the aggregate output/income $\boldsymbol{Y}$ adjusts concomitantly to the aggregate demand for output/income $\boldsymbol{Y}^{\mathrm{d}}$ (**19**):

$$(\mathbf{41}) \quad \boldsymbol{dY} = \boldsymbol{g^e}(\boldsymbol{Y^d} - \boldsymbol{Y})$$
$$= \boldsymbol{g^e}(\boldsymbol{d}(\boldsymbol{Y}, \boldsymbol{R}, \boldsymbol{P^a}, \boldsymbol{G}, \boldsymbol{\mu}) - \boldsymbol{Y}).$$

Finally, it assumed that exports $\boldsymbol{X}$, imports $\boldsymbol{F}$, taxes net of transfers $\boldsymbol{T}$ and government expenditures $\boldsymbol{G}$, and saving $\boldsymbol{S}$ adjust according to the foreign sector's demand for exports $\boldsymbol{X^d}$ (**3**):

$$(\mathbf{42}) \quad \boldsymbol{dX} = \boldsymbol{g^x}(\boldsymbol{X^d} - \boldsymbol{X})$$
$$= \boldsymbol{g^x}(\boldsymbol{x}(\boldsymbol{P^i}, \boldsymbol{P^c}, \boldsymbol{\mu}) - \boldsymbol{X}),$$

the domestic sector's demand for imports $\boldsymbol{F^d}$ (**4**):

$$(\mathbf{43}) \quad \boldsymbol{dF} = \boldsymbol{g^f}(\boldsymbol{F^d} - \boldsymbol{F})$$
$$= \boldsymbol{g^f}(\boldsymbol{f}(\boldsymbol{Y}, \boldsymbol{P^i}, \boldsymbol{P^c}, \boldsymbol{\mu}) - \boldsymbol{F}),$$

the government sector's demands goods and services $\boldsymbol{G^d}$ (**1**) and taxes net of tr*ansfers* $\boldsymbol{T^d}$ (**2**):

$$(\mathbf{44}) \quad \boldsymbol{dG} = \boldsymbol{g^g}(\boldsymbol{G^d} - \boldsymbol{G})$$
$$(\mathbf{45}) \quad \boldsymbol{dT} = \boldsymbol{g^t}(\boldsymbol{T^d} - \boldsymbol{T})$$

and the various sectors' desire for saving $\boldsymbol{S^d}$ (**20**):

$$(\mathbf{46}) \quad \boldsymbol{dS} = \boldsymbol{g^s}(\boldsymbol{S^d} - \boldsymbol{S})$$
$$= \boldsymbol{g^s}(\boldsymbol{s}(\boldsymbol{Y}, \boldsymbol{G}, \boldsymbol{\mu}) - \boldsymbol{S}).$$

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employment is measured in wage-units $\boldsymbol{N^w}$ the employment adjustment function becomes: $\boldsymbol{dN^w} = \boldsymbol{g^{nd}}\left(\boldsymbol{N^{wd}} - \boldsymbol{N^w}\right) = \boldsymbol{g^{nd}}\left(\boldsymbol{n^{wd}}(\boldsymbol{Y^e}) - \boldsymbol{N^w}\right)$.

4. Structure of Keynes' *Aggregate* Model

The adjustment functions (**28**) - (**46**) define the way in which changes in nineteen endogenous variables are determined in the model: C^e, P^a, C, I^e, I, P^i, N^i, P^c, N^c, N, M, R, T, G, X, F, S, Y^e, and Y. Since these functions are assumed to pass through the origin the system is in equilibrium in the sense that there is no reason for any variable to change when all of the adjustment functions are equal to zero. This gives us nineteen equilibrium conditions which contain nineteen endogenous variables as summarized in **Table 1**.

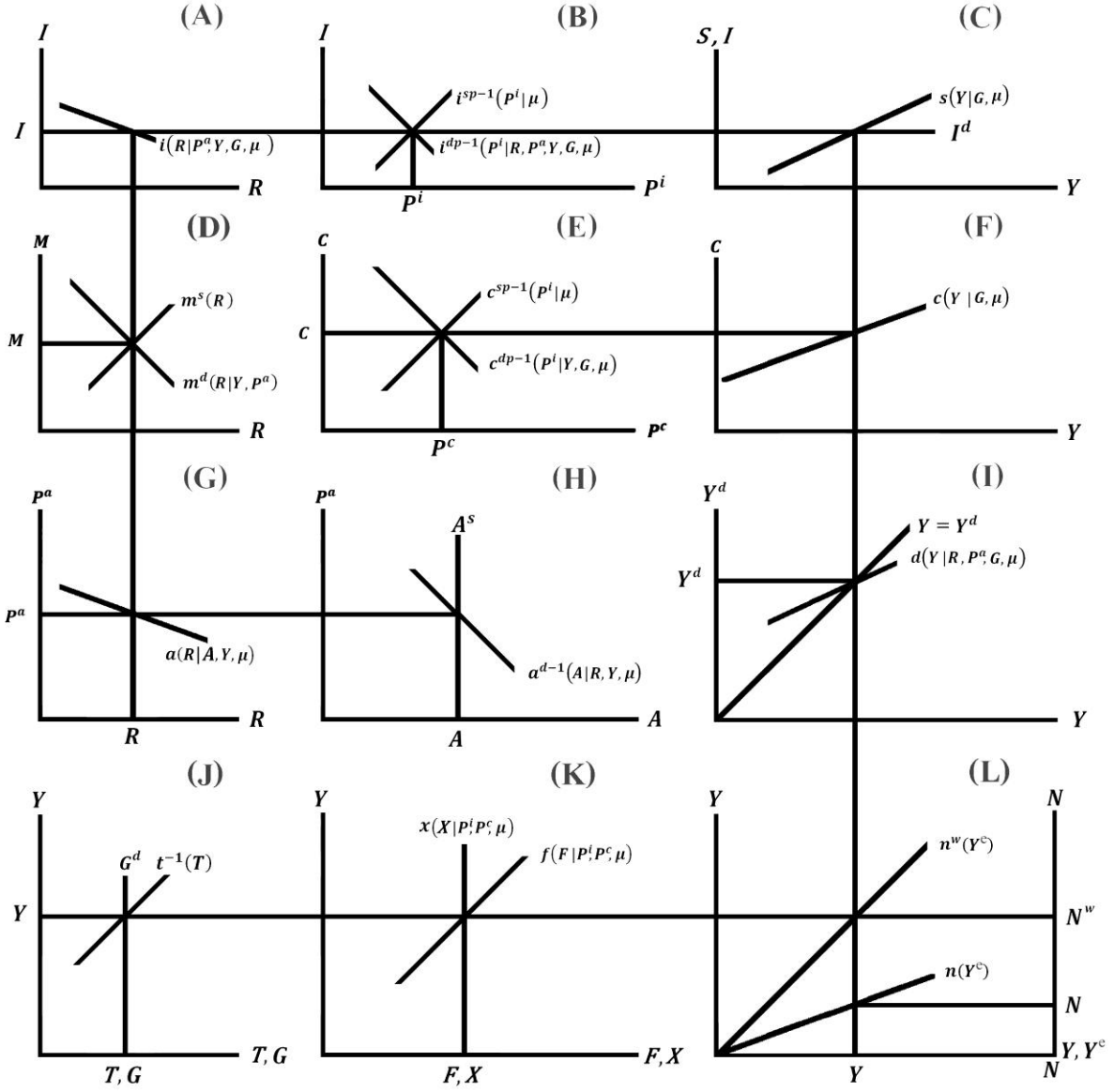
Table 1: Structure of Keynes' Aggregate Model			
Sectors	**Equilibrium Conditions**		**Endogenous Variables**
Consumption	$C^d = C^e$	$C^e = C$	C^e, C, P^c
	$C^d = C^s$		
Investment	$I^d = I^e$	$I^e = I$	I^e, I, P^i
	$I^d = I^s$		
Labor	$N^{id} = N^i$	$N_t^{cd} = N^c$	N^i, N^c, N
	$N^d = N$		
Money	$M^d = M^s$	$M^d = M$	M, R
Government	$T^d = T$	$G^d = G$	T, G
Foreign	$X^d = X$	$F^d = F$	X, F
Aggregate Income	$Y^d = Y^e$	$Y^d = Y$	Y^e, Y
Assets	$A^d = A^s$		P^a
Saving	$S^d = S$		S

This table outlines the mathematical structure of the short-run aggregate model specified above. The equilibrium values of the endogenous variables are assumed to be determined by the behavioral relationships defined by the behavioral equations (**1**) - (**27**) g*i*ven the assumption that employment is determined by the effective demands of producers as their expectations adjust to equate their effective demands to the actual demands that exist in markets by way of the adjustment functions (**28**) - (**44**).

5. Achieving Equilibrium

The way in which the short-run equilibrium values of the variables in the model are determined by suppliers and demanders in individual markets is illustrated in **Figure 1** where:

Figure 1: Short-Run Equilibrium.



1. Given the rate of interest R, the price of assets P^a, output/income Y, government demand for goods and services G, and the foreign exchange rate μ, the equilibrium price of investment goods P^i and rate of investment goods production I are determined in panel (**B**) by demanders and suppliers of investment goods as dictated by the demand for $i^{dp-1}(P^i|R,P^a,Y,G,\mu)$ (**10**) and supply of $i^{sp-1}(P^i|\mu)$ (**9**) investment goods from which Keynes' MEC schedule $i(R|P^a,Y,G^d,\mu)$ (**12**) in panel (**A**) is derived.

2. Given output/income Y, government demand for goods and services G, and the

foreign exchange rate $\boldsymbol{\mu}$, the equilibrium price $\boldsymbol{P^c}$ and rate of consumer goods production $\boldsymbol{C}$ are determined in panel (**E**) by demanders and suppliers of consumer goods as dictated by the demand for $\boldsymbol{c^{dp-1}(P^c|Y,G,\mu)}$ (**6**) and supply of $\boldsymbol{c^{sp-1}(P^c|\mu)}$ (**5**) consumer goods from which Keynes consumption function $\boldsymbol{c(Y|G,\mu)}$ (**8**) in panel (**F**) is derived.

3. Given output/income $\boldsymbol{Y}$ and price of assets $\boldsymbol{P^a}$, the equilibrium rate of interest $\boldsymbol{R}$ and stock of money $\boldsymbol{M}$ are determine in panel (**D**) by the demanders and suppliers of money as dictated by the demand for $\boldsymbol{m^d(R|Y,P^a)}$ (**13**) and supply of $\boldsymbol{m^s(R)}$ (**14**) money functions.

4. Given the rate of interest $\boldsymbol{R}$, output/income $\boldsymbol{Y}$, and the foreign exchange rate $\boldsymbol{\mu}$, the equilibrium price of assets $\boldsymbol{P^a}$ is determine in panel (**H**) by the demanders and suppliers of assets as dictated by the supply of $\boldsymbol{A^s}$ (**15**) and demand for $\boldsymbol{a^{d-1}(A|R,Y,\mu)}$ (**16**) assets from which the asset equilibrium function $\boldsymbol{a(R|A,Y,\mu)}$ (**18**) in panel (**G**) is derived.

5. Given the level of aggregate effective demand $\boldsymbol{Y^e}$ the equilibrium level of employment $\boldsymbol{N}$ is determined in panel (**L**) in accordance with the labor demand schedule $\boldsymbol{n^w(Y^e)}$ (**25**) if variables are measured in wage-units and by $\boldsymbol{n^d(Y^e)}$ (**27**) if variables are measured in constant dollars where it is assumed that $\boldsymbol{Y^e}$ is equal to $\boldsymbol{Y}$ in this panel.

6. Given the rate of interest $\boldsymbol{R}$, price of assets $\boldsymbol{P^a}$, government demand for goods and services $\boldsymbol{G}$, and the foreign exchange rate $\boldsymbol{\mu}$, the equilibrium aggregate output/income $\boldsymbol{Y}$ is determined in accordance with the aggregate demand schedule $\boldsymbol{d(Y|R,P^a,G,\mu)}$ (**19**) such that aggregate output/income $\boldsymbol{Y}$ is equal to the aggregate demand for output $\boldsymbol{Y^d}$ in panel (**I**) .

7. Given the government's demand for goods and services $\boldsymbol{G}$, the foreign exchange rate $\boldsymbol{\mu}$, and the value of output/income $\boldsymbol{Y}$, the equilibrium rate of saving $\boldsymbol{S}$ is determined in panel (**C**) by savers in accordance with Keynes' savings function $\boldsymbol{s(Y|G,\mu)}$ (**20**).

8. Given output/income $\boldsymbol{Y}$, the prices of investment $\boldsymbol{P_t^i}$ and consumption $\boldsymbol{P_t^c}$ goods, and the exchange rate $\boldsymbol{\mu}$, the equilibrium value of exports $\boldsymbol{X}$ is determined by the demands of foreigners as dictated by the export demand function $\boldsymbol{x(X|P^i,P^c,\mu)}$ (**3**)

in panel (**K**), and the equilibrium value of imports $\boldsymbol{F}$ is determined in this panel by the demands of consumers, investors, and governments given the import demand function $\boldsymbol{f(F|P^i, P^c, \mu)}$ (**4**) where it is simply assumed that exports $\boldsymbol{X}$ are equal to imports $\boldsymbol{F}$ in this panel.

9. Finally, given output/income $\boldsymbol{Y}$, the equilibrium values of taxes net of transfers $\boldsymbol{T}$ and of government goods and services $\boldsymbol{G}$ are assumed to be determined by governments as dictated by the government demand for taxes net of transfers function $\boldsymbol{t^{-1}(T)}$ (**2**) in panel (**J**) and government demand for goods and services $\boldsymbol{G}$ in this panel where it is simply assumed that government goods and services $\boldsymbol{G}$ is equal to taxes net of transfers $\boldsymbol{T}$ in this panel. [13]

But what is most significant about the model embodied in equations (**1**) through (**46**) and summarized in **Figure 1** above is that it formalizes the analytical framework developed by Keynes throughout *The General Theory*—a framework within which a *logically consistent, causal analysis of* the *dynamic behavior of the economic system is possible*. (Blackford 2024) Rather than view the economic system from the perspective of a set of Walrasian equations Keynes viewed the system from the perspective of a set of Marshallian partial equilibrium models in which the values of individual variables are determined by the choices of those decision-making units that actually have the power to determine the value of each variable *at each point in time* as the system evolves *through time*. (Blackford 2022; 2024) Accordingly, it is assumed that:

1. The complex of prices and rates of production and sale of goods and resources along with the complex of prices of assets are determined through the interactions of suppliers and demanders in the markets for goods, resources, and assets.
2. The rate of interest (i.e., the complex of rates of interest on new loans and debt

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[13] For a detailed discussion of the way in which equilibrium is defined and achieved in the works of Marshall, Keynes, and neoclassical economists see Hayes (2006), and Lavoie and Godley.

assets) is (are) determined by the suppliers and demanders for money (i.e., liquidity) in "the money market" (Fisher 1930, p. 12).

3. Employment and output/income are determined by producers in accordance with their *effective demands*—that is, the levels of employment and output/income at which producers *expect* to maximize their profits.
4. And the entire process by which these variables are determined *at each point in time* is governed by the *expectations* of decision-making units as their expectations adjust to the realized results that are achieved within the system as the system evolves *through time*.

These assumptions make it possible to isolate those factors that *directly* and *in themselves* determine each variable at *each point in time* whether the *system* is in equilibrium or not. This, in turn, makes it possible to establish *the temporal order in which events must occur* (Blackford 2024) as decision-making units respond to changes in the exogenous determinants of the variables *in each sector* of the economy at each point in time. It is the ability to establish the temporal order in which events must occur within the analytical framework developed by Keynes throughout *The General Theory* that makes it possible to separate cause and effect within this context and within economics in general. [14]

6. Increasing the Foreign Exchange Rate

To illustrate the causal/dynamic nature of the analytical framework developed by Keynes' throughout *The General Theory* as embodied in the model specified above, consider a situation in which the domestic sector allows the foreign sector to bid up the foreign exchange rate $\boldsymbol{\mu}$ by purchasing the domestic sector's assets $\boldsymbol{A}$ as the United States has been allowing the foreign sector to do for the past thirty odd years. [15] How

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[14] See Blackford (2020; 2021; 2022; 2024) and Hume, and cf., Brady, Hayes, and Lavoie and Godley.

[15] See Blackford (2018, ch. 2) for a discussion of the effects of capital flows (i.e., foreign

will this affect the equilibrium position of the system in **Figure 1**, and, other things being equal, how will a new equilibrium come about? We can begin to answer this question by examining the *direct* effects of this policy on the behavioral equations in **Figure 1**.

The increase in the foreign exchange rate $\boldsymbol{\mu}$ will cause the demand for imports $\boldsymbol{f(F|P^i, P^c, \mu)}$ (**4**) to increase and the demand for exports $\boldsymbol{x(P^i, P^c, \mu)}$ (**3**) to decrease in panel (**K**). It will also cause the supplies of investment $\boldsymbol{i^{sp-1}(P^i|\mu)}$ (**9**) and consumption $\boldsymbol{c^{sp-1}(P^c|\mu)}$ (**5**) goods to increase and the demands for these goods $\boldsymbol{i^{dp-1}(P^i|R, P^a, Y, G, \mu)}$ (**10**) $\boldsymbol{c^{dp-1}(P^c|Y, G, \mu)}$ (**6**) to decrease in panels (**B**) and (**E**). At the same time, the increase in the demand for assets $\boldsymbol{a^{d-1}(A|R, Y, \mu)}$ (**16**) in panel (**H**) will lead to an excess demand for assets which will cause an increase in the price of assets $\boldsymbol{P^a}$ in accordance with (**30**). The increase in the price of assets $\boldsymbol{P^a}$ will inhibit the fall in the demand for investment goods $\boldsymbol{i^{dp-1}(P^i|R, P^a, Y, G, \mu)}$ (**10**) in panel (**B**) as it decreases the demand for money $\boldsymbol{M^d = m^d(Y, R, P^a)}$ (**13**) in panel (**D**). To the extent that the positive effects of the increase in the price of assets $\boldsymbol{P^a}$ and foreign exchange rate $\boldsymbol{\mu}$ on the supplies of investment $\boldsymbol{i^{sp-1}(P^i|\mu)}$ (**9**) and consumption $\boldsymbol{c^{sp-1}(P^c|\mu)}$ (**5**) goods are more than offset by their negative effects on the demands for investment $\boldsymbol{i^{dp-1}(P^i|R, P^a, Y, G, \mu)}$ (**10**) and consumption $\boldsymbol{c^{dp-1}(P^c|Y, G, \mu)}$ (**6**) goods the result will be to create excess supplies in the markets for consumption goods $\boldsymbol{C}$ in panel (**E**), investment goods $\boldsymbol{I}$ in panel (**B**), and money $\boldsymbol{M}$ in panel (**D**) as the demand for exports $\boldsymbol{x(P^i, P^c, \mu)}$ (**3**) decreases and the demand for imports $\boldsymbol{f(F|P^i, P^c, \mu)}$ (**4**) increases in panel (**K**) as illustrated in **Figure 2** where the price of assets has increased from $\boldsymbol{P^a}$ to $\boldsymbol{P^{a*}}$ and the foreign exchange rate from $\boldsymbol{\mu}$ to $\boldsymbol{\mu^*}$.

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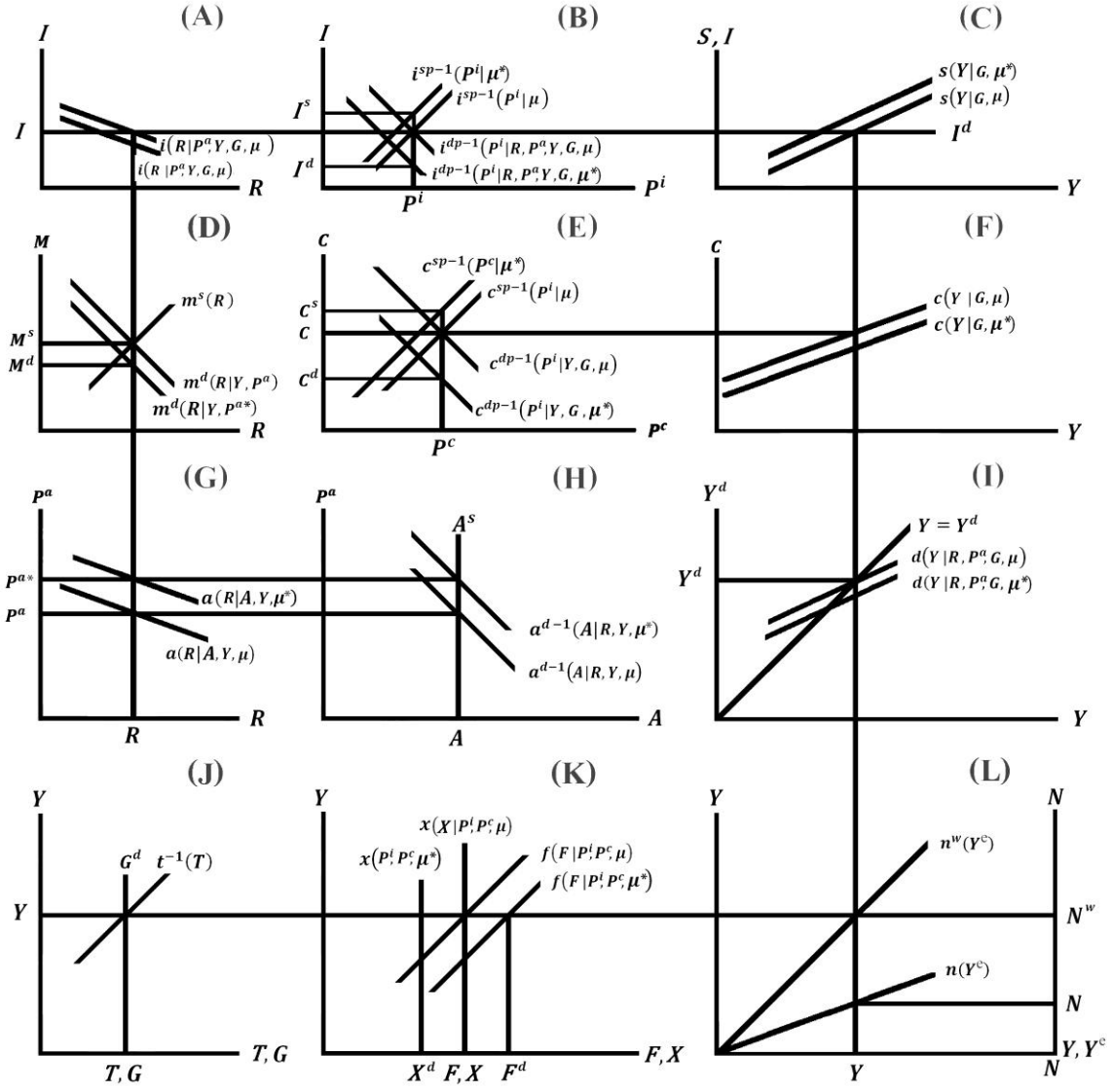
purchases of domestic assets) on exchange rates in international financial markets.

Figure 2: Direct Effects of an Increase in International Exchange Rate.



As the excess supplies of consumption C and investment I goods are created, the effective demands for these goods C^e I^e must adjust to the actual demands for these goods C^d I^d in accordance with (**31**) and (**32**), and as these effective demands adjust to their actual demands it will, in turn, cause employment in the consumption N^c *and* *i*nvestment N^i goods industries to fall along with aggregate employment N in accordance with (**33**), (**34**) and (**40**). This will lead to a fall in the production of consumption C and investment I goods in accordance with (**35**) and (**36**) as the prices of consumption P^c and investment P^i goods begin to fall in panels (**E**) and (**B**) in accordance with (**38**) and (**37**). The fall in the production of consumption C and

investment $\boldsymbol{I}$ goods means that the value of output produced—that is, output/income $\boldsymbol{Y}$—will fall as well. In addition, as the effective demands for consumption $\boldsymbol{C^e}$ and investment $\boldsymbol{I^e}$ goods adjust to the actual demands for these goods in accordance with (**31**) and (**32**) the resulting decrease in the demand for 'finance' (Bibow) will cause the demand for money $\boldsymbol{m^d(Y|R)}$ (**13**) to fall in panel (**D**) which will enhance the fall in the demand for money in this panel caused by the increase in the price of assets $\boldsymbol{P^a}$ in panel (**K**). The result will be an enhanced excess supply of money in panel (**D**) that will be further enhanced as output/income $\boldsymbol{Y}$ falls. This, in turn, will cause the rate of interest $\boldsymbol{R}$ and stock of money $\boldsymbol{M}$ to fall in panel (**D**) accordance with (**28**) and (**29**).

The fall in output/income $\boldsymbol{Y}$ will further increase the fall in the demands for investment $\boldsymbol{i^{dp-1}(P^i\,|R,P^a,Y,G,\mu)}$ (**10**) and consumption $\boldsymbol{c^{dp-1}(P^c|Y,G,\mu)}$ (**6**) goods in panels (**B**) and (**E**) as it and inhibits the increase in imports $\boldsymbol{f(F|P^i,P^c,\mu)}$ (**4**) in panel (**K**) and in the demand for assets $\boldsymbol{a^{d-1}(A|R,Y,\mu)}$ (**16**) in panel (**H**). The fall in the prices of consumption $\boldsymbol{P^c}$ and investment $\boldsymbol{P^i}$ goods will, in turn, also inhibit the increase in the demand for imports $\boldsymbol{f(F|P^i,P^c,\mu)}$ (**4**) in panel (**K**) as it inhibits the decrease in the demand for exports $\boldsymbol{x(P^i,P^c,\mu)}$ (**3**) as well. The fall in the production of consumption $\boldsymbol{C}$ and investment $\boldsymbol{I}$ goods (and, therefore, in employment $\boldsymbol{N}$ and output/income $\boldsymbol{Y}$) will, in turn, cause an additional decrease in the demands for consumption $\boldsymbol{c^{dp-1}(P^c|Y,G,\mu)}$ (**6**) and investment $\boldsymbol{i^{dp-1}(P^i\,|R,P^a,Y,G,\mu)}$ (**10**) goods in panels (**E**) and (**B**) where the decrease in the demand for investment goods $\boldsymbol{i^{dp-1}(P^i\,|R,P^a,Y,G,\mu)}$ (**10**) will be partially offset by the fall in the rate of interest $\boldsymbol{R}$ and increase in the price of assets $\boldsymbol{P^a}$ in panels (**D**) and (**H**).

The result will be a continuation of the excess supplies of consumption $\boldsymbol{C}$ and investment $\boldsymbol{I}$ goods that will lead to a continuation of the fall in employment $\boldsymbol{N^c}$ $\boldsymbol{N^i}$ $\boldsymbol{N}$ and the prices of consumption $\boldsymbol{P^c}$ and investment $\boldsymbol{P^i}$ goods as the production of consumption $\boldsymbol{C}$ and investment $\boldsymbol{I}$ goods continue to fall along with output/income $\boldsymbol{Y}$. At the same time, the excess demand for money $\boldsymbol{M}$ in panel (**D**) will cause both the rate of interest $\boldsymbol{R}$ and the stock of money $\boldsymbol{M}$ to fall in accordance with (**28**) and (**29**) which will, in turn, further inhibit the fall in the demand for investment goods $\boldsymbol{i^{dp-1}(P^i\,|R,P^a,Y,G,\mu)}$ (**10**) in panel (**B**) along with the effects of the fall in income $\boldsymbol{Y}$ on

the demand for assets $\boldsymbol{a^{d-1}(A|R,Y,\mu)}$ (**16**) in panel (**H**).

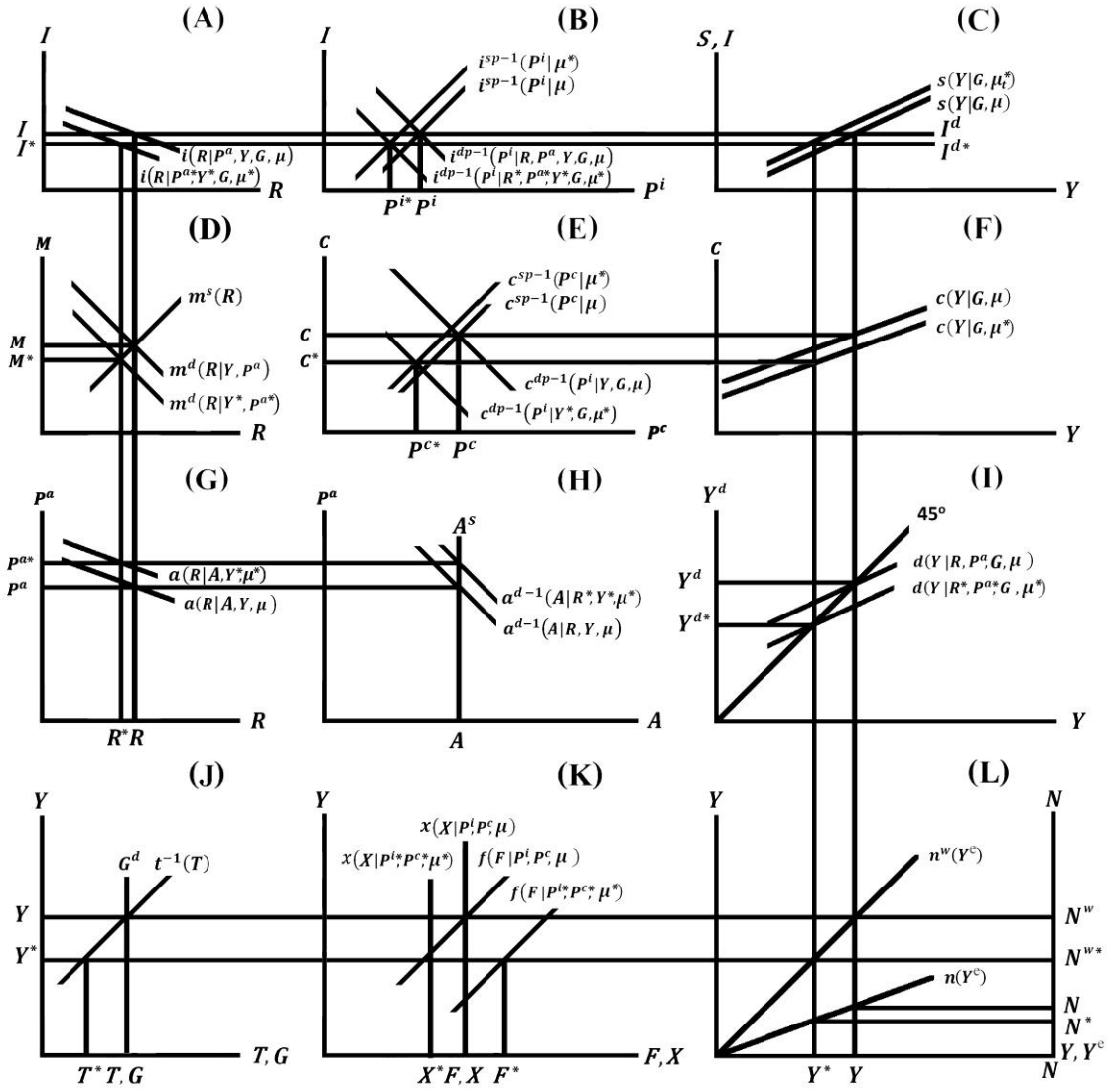
In the absence of a change in the exogenous variables or parameters in the system the interactions of suppliers and demanders in the markets for investment and consumption goods, money, exports and imports, and assets in panels (**B**), (**E**), (**D**), (**K**) and (**H**) must cause the prices $\boldsymbol{P^cP^i}$ and production of consumption $\boldsymbol{C}$ and investment $\boldsymbol{I}$ goods, income $\boldsymbol{Y}$, and exports $\boldsymbol{X}$ to fall. At the same time, the fall in the rate of interest $\boldsymbol{R}$ and increase in the price of assets $\boldsymbol{P^a}$ in panels (**D**) and (**H**) will continue to inhibit the fall in the demand for investment $\boldsymbol{i^{dp-1}(P^i|R,P^a,Y,G,\mu)}$ (**10**) in panel (**B**) as the multiplier and accelerator processes eventually diminishes the rate of fall in income to the point at which an equilibrium is obtained where the demands for consumption $\boldsymbol{C^d}$, investment $\boldsymbol{I^d}$, money $\boldsymbol{M^d}$, exports $\boldsymbol{X^d}$, assets $\boldsymbol{A^d}$, and imports $\boldsymbol{F^d}$ are equal to their respective supplies $\boldsymbol{C^s}$, $\boldsymbol{I^s}$, $\boldsymbol{M^s}$, $\boldsymbol{X^s}$, $\boldsymbol{A^s}$, $\boldsymbol{F^s}$. At this point the increasing aggregate saving $\boldsymbol{s(Y|G,\mu)}$ (**20**) schedule and the falling demand for investment $\boldsymbol{I^d}$ in panel (**C**) and falling aggregate demand schedule $\boldsymbol{d(Y|R,P^a,Y,G,\mu)}$ (**19**) in panel (**I**) will have reached a point of equilibrium at which the fall in aggregate output/income $\boldsymbol{Y}$ equates aggregate demand $\boldsymbol{Y^d}$ in panel (**I**) and aggregates saving $\boldsymbol{S}$ and investment $\boldsymbol{I}$ in panel ($\boldsymbol{C}$).

Figure 3 shows the resulting decreases in the prices $\boldsymbol{P^i}$ $\boldsymbol{P^c}$ and rates of investment $\boldsymbol{I}$ and consumer $\boldsymbol{C}$ goods production in panels (**B**) and (**E**), in the stock of money $\boldsymbol{M}$ and rate of interest $\boldsymbol{R}$ in panel (**D**), in output/income $\boldsymbol{Y}$ in panel (**I**), in employment $\boldsymbol{N}$ ($\boldsymbol{N^w}$) in panel (**L**), in exports $\boldsymbol{X}$ in panel (**K**), and in taxes $\boldsymbol{T}$ in panel (**J**), and the increase in the price of assets $\boldsymbol{P^a}$ in panel (**H**) and in imports $\boldsymbol{F}$ in panel (**K**) from ($\boldsymbol{P^i}$, $\boldsymbol{P^c}$, $\boldsymbol{C}$, $\boldsymbol{I}$, $\boldsymbol{M}$, $\boldsymbol{R}$, $\boldsymbol{Y}$, $\boldsymbol{N}$, $\boldsymbol{X}$, $\boldsymbol{T}$, $\boldsymbol{P^a}$, $\boldsymbol{F}$) to ($\boldsymbol{P^{i*}}$, $\boldsymbol{P^{c*}}$, $\boldsymbol{C^*}$, $\boldsymbol{I^*}$, $\boldsymbol{M^*}$, $\boldsymbol{R^*}$, $\boldsymbol{Y^*}$, $\boldsymbol{N^*}$, $\boldsymbol{X^*}$, $\boldsymbol{T^*}$, $\boldsymbol{P^{a*}}$, $\boldsymbol{F^*}$).

It should be noted that the implication that the rates of consumption $\boldsymbol{C}$ and investment $\boldsymbol{I}$ goods production fall in this situation presupposes that the positive effects of the increase in the exchange rate $\boldsymbol{\mu}$ on the supplies of investment $\boldsymbol{i^{sp-1}(P^i|\mu)}$ (**9**) and consumption $\boldsymbol{c^{sp-1}(P^i|\mu)}$ (**5**) goods along with the positive effects of the increase in the price of assets $\boldsymbol{P^a}$ on the demand for investment goods $\boldsymbol{i^{dp-1}(P^i|R,P^a,Y,G,\mu)}$ (**10**) in **Figure 3** are more than offset by the negative effects of the increase in the exchange rate $\boldsymbol{\mu}$ on the demands for investment $\boldsymbol{i^{dp-1}(P^i|R,P^a,Y,G,\mu)}$ (**10**) and consumption

$c^{dp-1}(P^c|Y,G,\mu)$ (**6**) goods in panels (**B**) and (**E**).

Figure 3: Short-Run Effects of an Increasing the Foreign Exchange Rate.



It should also be noted that the negative effects of the fall in income $\boldsymbol{Y}$ and prices of consumption $\boldsymbol{P^c}$ and investment $\boldsymbol{P^i}$goods on the demand for imports $\boldsymbol{f(F|P^i,P^c,\mu)}$ (**4**) in panel (**K**) are assumed to more than offset by the positive effect of the increase in the foreign exchange rate $\boldsymbol{\mu}$, and the negative effects of the fall in income $\boldsymbol{Y}$ on the demand for assets $\boldsymbol{a^{d-1}(A|R,Y,\mu)}$ (**16**) in panel (**H**) are more than offset by the positive effects of the fall in the rate of interest $\boldsymbol{R}$ and increase in the foreign sector's demand for assets in this panel.

7. Concluding Observation

It is worth emphasizing that it is the decision-making units that exist in the real-world markets for investment and consumption goods, assets, and money along with those that determine the demands of governments, imports, and exports that are assumed to determine the behaviour of the variables in the system at any point in time, not a mythical auctioneer constrained by an arbitrary Walrasian budget constraint. The result is an analytic framework in which the determination of each variable can be examined, analyzed, explained, and predicted in terms of the behaviour of decision-making units that actually exist in the real world. This means that while it is assumed in the example above that there are no changes in the exogenous variables and parameters in the system—money wages, stock of assets $\boldsymbol{A}$, foreign exchange rate $\boldsymbol{\mu}$, expectations, and the other exogenous variables and parameters in the system—the analytical framework outlined above provides a logically consistent context within which it is possible to examine the way in which changes in these variables and parameters affect the system through time in terms of their effects on the behavior of those decision-making units that actually have the power to determine the behavior of the endogenous variables in the system. [16]

The fundamental difference between the structure of the analytic framework embodied in Keynes general theory as exemplified in the model specified above and that of the Walrasian paradigm of neoclassical economics is that Keynes' behavioral equations are assumed to be consistent with Marshallian supply and demand functions rather than the Walrasian supply and demand functions assumed by neoclassical economists.[17] They are presumed to be determined by the optimizing behavior of decision-making units as they interact in markets, just as Walrasian supply and demand

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[16] For a detailed examination of the way in which changes in money wages and expectations affect the economic system within this analytical framework see Keynes (1936, Chs. 19 and 22).

[17] See Brady, Clower, Hayes, Leijonhufvud, and Blackford (2022b).

functions are presumed to be determined by optimizing behavior. The difference is that in Keynes' understanding of these functions they are specified by isolating those factors that are perceived to have a *direct* effect on the *willingness* of buyers and sellers to buy and sell in individual markets whether the system as a whole is in equilibrium or not without assuming that these choices are constrained by an arbitrary Walrasian budget constraint that is nothing more than an ex-post, accounting identity—an identity that may be true after the fact but does not actually constrain one's choices at any point in time. (Blackford 2019a; 2020a, pp. 20-77; 2024)

Instead, they are derived by observing the actual behavior of decision-making units in markets, hypothesizing with regard to the motivations of these units given their *expectations* with regard to those magnitudes that affect their choices *directly* in each individual market, and then reasoning through the logical implications of what the actual choices available to decision-making units and their motivations and expectations imply with regard to their willingness to buy and sell in individual markets. As a result, even though the set of equilibrium conditions specified above define a general equilibrium of the system as a whole they are the product of a *partial* equilibrium analysis of individual markets in which *the values of individual variables are assumed to be determined by the choices of those decision-making units that actually have the power to determine the value of each variable at each point in time as the system evolves through time*, and there is no reason to assume that the system is in equilibrium at any point in time. [18] This way of looking at the economy made it possible for Keynes to establish *the temporal order in which events must occur* and, thereby, to undertake a *logically consistent, causal* analysis of the *dynamic* behavior of the system (Blackford 2024) by way of "an organized and orderly method of thinking out particular problems, … isolating the complicating factors one by one" and after reaching provisional conclusions going back, as well as he could, to account "for the probable interactions of

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[18] See Marshall (1920; 1961, Books III-IV) and Blackford (2019; 2020a pp. 18-73), and cf., Keynes (1936, Books III-IV), Hayes, Brady, and Lavoie and Godley.

the factors amongst themselves" in an attempt to understand "the complexities and interdependencies of the real world." (Keynes 1936, pp. 297-8)

This was Keynes' method of analysis throughout *The General Theory of Employment, Interest, and Money* as he followed the example set by Marshall. It is the inability or unwillingness of neoclassical economists to examine economic problems in this way that led to their downfall as they advocated the policies that led to the economic, political, and social problems we face today—problems that were the inevitable result of economic policies that ignored Keynes' analysis in *The General Theory* and led directly to the Crash of 2008, the economic stagnation that followed, and the economic, social, and political chaos we see throughout the world today. (See Keynes 1936; Blackford 2016; 2021; 2022; 2024.)

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Appendix: List of Equations

2. Behavioral and Structural Equations

(1) $G^d = G,$

(2) $T^d = t(Y), \quad 0 < t^{'}.$

(3) $X^d = x(P^i, P^c, \mu), \qquad x_1, x_2, s_3 < 0,$

(4) $F^d = f(Y, P^i, P^c, \mu), \qquad 0 < x_1, x_2, s_3, s_4.$

(5) $P^{sc} = c^{sp}(C^s, \mu), \qquad 0 < c_1^{sp}, c_2^{sp}.$

(6) $P^{dc} = c^{dp}\left(C^d, Y, T^d, G^d, \mu\right) \quad c_1^{dp}, c_3^{dp}, c_5^{dp} < 0 < c_2^{dp}, c_4^{dp}$

$= c^{dp}\left(C^d, Y, t(Y), G, \mu\right)$

$= c^{dp}\left(C^d, Y, G, \mu\right), \qquad c_1^{dp}, c_4^{dp} < 0 < c_2^{dp}, c_3^{dp}.$

(7) $c^{sp}(C^s, \mu) = c^{dp}\left(C^d, Y, G, \mu\right) = P^i,$

(8) $C^d = c(Y, G, \mu), \quad c_3 < 0 < c_1, c_2$

(9) $P^{si} = i^{sp}(I^s, \mu), \quad 0 < i_1^{sp}, i_2^{sp}.$

(10) $P^{di} = i^{dp}\left(I^d, R, P^a, C^d, G^d, \mu\right), \quad i_1^{dp}, i_2^{dp}, i_6^{dp} < 0 < i_3^{dp}, i_4^{dp}, i_5^{dp}$

$= i^{dp}\left(I^d, R, P^a, c(Y, G, \mu), G, \mu\right)$

$= i^{dp}\left(I^d, R, P^a, Y, G, \mu\right), \qquad i_1^{dp}, i_2^{dp}, i_6^{dp} < 0 < i_3^{dp}, i_4^{dp}, i_5^{dp}$

(11) $i^{sp}(I^s, \mu) = i^{dp}\left(I^d, R, P^a, Y, G, \mu\right) = P^i,$

(12) $I^d = i\left(R, P^a, Y, G^d, \mu\right), \qquad i_1, i_5 < 0 < i_2, i_3, i_4$

$= i(R, P^a, Y, G, \mu), \qquad i_1, i_5 < 0 < i_2, i_3, i_4$

(13) $M^d = m^d(Y, R, P^a), \qquad m_2^d, m_3^d < 0 < m_1^d$

(14) $M^s = m^s(R), \qquad 0 < m^{s^{'}}.$

(15) $A^s = A.$

(16) $A^d = a^d(P^a, R, Y, \mu), \qquad a_1^d, a_2^d < 0 < a_3^d, a_4^d.$

(17) $A = a^d(P^a, R, Y, \mu),$

(18) $P^a = a(A, R, Y, \mu), \qquad a_1, a_2 < 0 < a_3, a_4.$

(19) $Y^d = c(Y, G, \mu) + i(R, P^a, Y, G, \mu)$

$= d(R, P^a, Y, G, \mu), \qquad d_2, d_5 < 0 < d_1, d_3, d_4,$

(20) $S^d = Y^d - C^d$

$= d(R, P^a, Y, G, \mu) - c(Y, G, \mu)$

$= s(R, P^a, Y, G, \mu), \qquad s_1, s_2, s_3 < 0 < s_3, s_5$

$= s(Y, G, \mu), \qquad s_3 < 0 < s_1, s_2$

(21) $N^{id} = n^{id}(I^e), \qquad 0 < n^{id^{'}},$

$$(22)\ N^{cd} = n^{cd}(C^e), \qquad 0 < n^{cd'}.$$

$$(23)\ I = i^n(N^i), \qquad 0 < i^{n'},$$

$$(24)\ C = c^n(N^c), \qquad 0 < c^{n'}.$$

$$(25)\ N^{wd} = N^{id} + N^{cd}$$
$$= n^{id}(I^e) + n^{cd}(C^e)$$
$$= n^{id}(Y^e) + n^{cd}(Y^e)$$
$$= n^w(Y^e), \qquad n^{w'} = 1$$

$$(26)\ Y^e = C^e + I^e,$$

$$(27)\ N^d = n^{cd}(C^e) + n^{id}(I^e)$$
$$= n^{cd}(Y^e) + n^{id}(Y^e)$$
$$= n^d(Y^e), \qquad 0 < n^{d'}.$$

3. Dynamic Adjustment Functions

$$(28)\ dR = g^r\left(M^d - M^s\right)$$
$$= g^r\left(m^d(Y, R, P^a) - m^s(R)\right),$$

$$(29)\ dM = g^m\left(M^d - M\right)$$
$$= g^m\left(m^d(Y, R, P^a) - M\right)$$

$$(30)\ dP^a = g^{pa}\left(A^d - A^s\right)$$
$$= g^{pa}\left(a^d(P^a, R, Y) - A\right).$$

$$(31)\ dC^e = g^{ce}\left(C^d - C^e\right)$$
$$= g^{ce}\left(c^{dp-1}(P^c, Y, G, \mu) - C^e\right)$$

$$(32)\ dI^e = g^{ie}\left(I^d - I^e\right)$$
$$= g^{ie}\left(i^{dp-1}(P^i, R, P^a, Y, G, \mu) - I^e\right)$$

$$(33)\ dN^i = g^{ni}\left(N^{id} - N^i\right)$$
$$= g^{ni}\left(n^{id}(I^e) - N^i\right)$$

$$(34)\ dN^c = g^{nc}\left(N^{cd} - N^c\right)$$
$$= g^{nc}\left(n^{cd}(C^e) - N^c\right)$$

$$(35)\ dC = g^c(c^n(N^c) - C)$$

$$(36)\ dI = g^i(i^n(N^i) - I),$$

$$(37)\ dP^i = g^{pi}\left(I^d - I^s\right)$$
$$= g^{pi}\left(i^{dp-1}(P^i, R, P^a, Y, G, \mu) - i^{sp-1}(P^c, \mu)\right)$$

$$(38)\ dP^c = g^{pc}\left(C^d - C^s\right)$$

$$= g^{pc}\left(c^{dp-1}(P^c, Y, G, \mu) - c^{sp-1}(P^i, \mu)\right).$$

$$(39)\quad dY^e = g^e\left(Y^d - Y^e\right)$$
$$= g^e(d(Y, R, P^a, G, \mu) - Y^e),$$

$$(40)\quad dN = g^n\left(N^d - N\right)$$
$$= g^n(n(Y^e) - N),$$

$$(41)\quad dY = g^e(Y^d - Y)$$
$$= g^e(d(Y, R, P^a, G, \mu) - Y).$$

$$(42)\quad dX = g^x(X^d - X)$$
$$= g^x(x(P^i, P^c, \mu) - X),$$

$$(43)\quad dF = g^f(F^d - F)$$
$$= g^f(f(Y, P^i, P^c, \mu) - F),$$

$$(44)\quad dG = g^g(G^d - G)$$

$$(45)\quad dT = g^t(T^d - T)$$

$$(46)\quad dS = g^s(S^d - S)$$
$$= g^s(s(Y, G, \mu) - S).$$