THE MACROECONOMICS OF COMMODITY PRICE SHOCKS: 25 YEARS LATER

Michael Schmid

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Professor Michael Schmid
Department of Economics
University of Bamberg
Feldkirchenstraße 21
D-96045 Bamberg
Germany

Phone: ++49-951-863-2582
Fax: ++49-951-863-5582
e-mail: michael.schmid@sowi.uni-bamberg.de
http://www.uni-bamberg.de/sowi/economics

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Introduction

In their macrotext Auerbach-Kotlikoff (1998) present eight of the last US recessions saying they had been associated with temporary abrupt increases in the real oil price of ten per cent or more. Although no comparison of these US facts with EU data is known to me, today forecasters of the Eurozone or German economy appear to believe as Auerbach-Kotlikoff that this is more than just a coincidence. For in these days forecasters most of the time give their projections on the understanding of an oil price clause. This indicates that the oil-price shocks were not only an economic episode during the 1970s but are lingering on, especially for the Eurozone which must pay its oil bill sometimes at rising oil prices at the world market, sometimes using their depreciating Euro currency.

Apart from their devastating effects in the 1970s on most European oil-importing economies including Japan the oil crisis increased awareness that Keynesian economic theorizing which predominated during the 1970s and before had to be substantially amended by supply-side thinking along lines given later in Sargent’s (1979) macrotext. However, adding a supply side to an otherwise open economy could be done in a variety of ways even set aside whether one starts with a Keynesian or classical view of the world.

One of the more promising modelling strategies after the oil crisis has been among others Schmid (1976), (1980 a, b), (1981), (1985), Bruno-Sachs (1985) who acknowledged the value-added chain structure of an open economy. Exploiting this idea one has to replace or extend the horizontal final-goods trading pattern, i.e., the Mundell-Fleming structure by a vertical trading pattern. The vertical trade aspect just realizes that many categories of exports or imports are not final goods but raw materials (commodities) or intermediates. See Caves-Frankel-Jones (1990), chapt. 9 or Ethier (1988), chapt. 1.10 for evidence these authors have taken from newspapers or collected themselves due to apparent lack of official statistics.

This more structured approach to open-economy macroeconomics leads to three new insights. (1) There are two very different terms-of-trade shocks operating initially either at the demand side (final goods t-o-t) or at the supply-side (factoral t-o-t), respectively. (2) The Keynesian

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1 A very nice example of modern classical credit-oriented open economy modelling is Barro-Grilli (1994), chapt. 7. Without saying these authors demonstrate their accounting proficiency using first the orthodox Mundell-Fleming structure and then present two different intertemporal open economy models by adding two (very) different supply-side blocs: In the next section they throw away the Mundell-Fleming structure and model the first period of a well-known one-good two-country two-period world à la Fisher or Metzler. The third section models a t-o-t shock for a resource-exporting economy well-known to development or trade economists as the OPEC or sometimes the GUANO island economy. It seems not to bother them to deal with this type of open economy under the title “European Macroeconomics”.

2 The other structural macroeconomic model of the open economy is the well-known Scandinavian or Australian model where non-traded final goods are taken into account.
version of the model features a supply-side multiplier alongside of the traditional demand-side multiplier because there is a supply-side leakage besides the demand-side leakage. This makes the overall multiplier process of an open economy much smaller than usually claimed by the textbooks. (3) There exists sort of a super or twin Marshall-Lerner condition if one admits that openness in macroeconomics includes two different trading channels, one high up at the value-added chain and another one way down at the value-added chain. Applying our structural macro-model to the empirics of devaluation one should obtain better empirical results, the basic idea being: Much less stimulus perhaps even contraction (expansion) from a depreciating (appreciating) currency\(^1\). The purpose of this paper written 25 years after the oil crisis is very modest. How can I integrate t-o-t shocks from imported raw materials or equivalent imported intermediates due to outsourced or shared production schemes into the analysis of open economy macroeconomics? This should be done using just the right minimal structure to bring out the economic essence of a factorial t-o-t shock as a combined supply-cum-demand shock without going beyond a reasonable amount of algebraic difficulties. Surveying the top ten macrotexts in the world\(^2\) (see Fig. 11) it seems to me that twenty-five years after the event a balance should be attempted between misplaced oversimplification or more or less complete negligence on the one hand and a technical overkill on the other hand\(^3\).

Secondly, any reconstruction should take into account recent developments in international macroeconomics witnessed by modern intertemporal macroeconomics for instance Frenkel-Razin (1994), Turnovsky (1997) and Rogoff-Obstfeld (1996). This literature places heavy emphasis upon an intertemporal access to the credit approach pioneered by I. Fisher and L. Metzler among others employing the full-employment assumption most of the time\(^4\). To be as close as possible to this literature without going explicitly intertemporal\(^5\) it is preferable to give up the money and goods framework coming out of Chicago during the 1970s and early

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\(^1\) I am still puzzled why the work done in Gylfason-Schmid (1983) on the possibility of contractionary devaluation is being appreciated by development economists (see Agénor-Montiel (1996) chapt. 7) but mostly ignored by orthodox macroeconomists with the notable exception of Sachs-Larraine (1993).

\(^2\) Most of the time the literature takes the easy way out by lumping together a productivity shock with an oil-price shock. This is not correct. For instance following Dornbusch-Fischer (6th ed. 1995), chapt. 8, p. 277, in Blanchard (2nd ed. 2001), p. 140 an oil-price shock is modelled within a one final good closed-economy model just by changing the mark-up. Within the two-good M-F open economy, chapt. 19-21, oil shocks are not mentioned at all.

\(^3\) In Abel-Bernanke-McNabb (1998), p. 532 the complexities of an oil-price shock are acknowledged but beyond intuitive graphical illustrations no formal analysis is attempted. Although this book makes great progress in posing the Keynesian against the classical closure in macroeconomics along the lines of Sargent (1979) they, too, model oil shocks just as an adverse productivity shock, i.e., a drought.

\(^4\) It is still rather difficult to find intertemporal analysis of the Mundell-Fleming model, which is conducted within an unemployment framework, exceptions are Persson (1982) and Rankin (1988), (1989 a, b).

\(^5\) Bruno (1982) and Svensson (1981) are the first to use an intertemporal approach to the analysis of oil-price shocks within a classical set-up.
1980s, namely the monetary approach to the balance of payments\(^1\). Instead it is better to return here to an old fashioned IS-LM or AD-AS framework\(^2\).

The plan of the paper is as follows: First, I have a short look at basic accounting principles in an economy where the national value-added chain is broken because materials or intermediates exit or enter the productive system. Then I present a minimal non-Mundell-Fleming or anti-M-F model of a vertically trading economy. I derive the supply-side multiplier from a Keynesian version of this economy although it would be very easy indeed to extract a classical version from the basic structure along lines presented first in Schmid (1976) and Schmid (1982)\(^3\). Secondly, I then add the familiar Mundell-Fleming final-goods structure of a horizontally trading economy. This hybrid model obviously features two different trading channels which are useful to analyse both a factoral t-o-t shock and a final-goods t-o-t shock with respect to output and, more important, national income and the trade balance. The third section deals with an attempt to create a modern more realistic theory of devaluation using the structured approach along lines presented first in Gylfason-Schmid (1983). I derive a simple formula giving an anti-Marshall-Lerner condition which is seen to be completely isomorphic to the traditional M-L condition of a horizontally trading economy. The next sections in part 1 develop the anti-M-F model and analyses the differences between a commodity t-o-t shock and a currency devaluation with respect to the trade balance and the domestic labor market. Section 1.5 extends the simple anti-M-F model to a two-country world economy of interacting OECD and OPEC areas. It is shown that an oil crisis (or commodity-price shocks) can be best understood as a modern-day transfer problem. Part 2 investigates the hybride M-F model.

1. An Anti-Mundell-Fleming model of the open economy

Consider the following minimal structure of an open economy with vertical trade. The middle part of Fig. 1 (a) shows the physical circuit of the anti-M-F model in comparison to other possible structures.

\(^1\) The monetary approach was used in early oil-shock models in Schmid (1976), (1980 a, b), (1981) or Gylfason-Schmid (1983).
\(^2\) This route was taken in Bruno-Sachs (1985), chaps. 5 and 6. It is well-known since Foley-Sidrauski (1971), Brunner-Meltzer (1976), Henderson (1980) that a portfolio-balance model can be put behind the IS-LM system of the open economy. Thus the simplifications of IS-LM or AD-AS models are no way ad hoc or leading into the wrong direction.
\(^3\) This paper was presented at the Konstanz Seminar on Monetary Theory and Policy and at the Warwick Summer Workshop in International Trade in 1980.
Fig. 1.b portrays a version of the anti-M-F model, where a composite domestic factor H is assumed and a domestic endowment of material $\bar{N}$ can be enlarged by importing $N - \bar{N} > 0$.

In closed economies or in traditional M-F economies the value-added chain is usually not explicitly talked about. As a rule of national accounting the value of output, $PQ$, equals national income $PY$ where $P$ represents the final goods price and $Y$ represents real income in output units. National accounting must be refined as soon as factors are traded, i.e., in case of materials or intermediates the national value added chain is broken. Fig. 2 depicts national accounting with a broken value-added chain. Note that there are two variants: (i) domestic production of materials $Q_N$ is permitted and only the balance between domestic production and demand $N - Q_N > 0$ is imported; (ii) an endowment version assumes just an exogeneously given supply of materials $\bar{N}$ and again the difference $N - \bar{N} > 0$ is imported. Fig. 2 assumes (i). However, in what follows we model variant (ii) for reasons of simplification. We have the following equations describing the most important concepts without further discussion.

$\bar{N}$ domestic endowment of a traded raw material

$\bar{H}$ domestic endowment of a non-traded local factor of production.

Composite factor: labor cum capital

\[
\begin{align*}
\text{Production (Output)} & \quad \text{Income} \\
Q &= F (N, \bar{H}) & Y &= Q (\cdot) - p_N [N - \bar{N}]
\end{align*}
\]

goods market (output version) shows the use of output

\[
Q = C + I + X
\]
goods market (income version) shows the trade balance

\[ Q - p_N [N - \bar{N}] = C + I + X - p_N [N - \bar{N}] \quad \text{or} \]
\[ Y = C + I + X - p_N [N - \bar{N}] \]

where

\[ Y = w\bar{H} + p_N \bar{N} \]

represents national income from the view of factor incomes.

The production function \( Q(\cdot) \) is a linear-homogeneous neoclassical production function with standard properties. It shows output \( Q \) produced with a composite local (home) primary factor of production \( H \) representing labor cum physical capital to save on variables\(^1\). We use real wage \( w \) as real factor price for \( H \) though it represents the renumeration of labor and capital. \( p_N = P_N/P \) represents the real oil (material) price which is the inverse of the t-o-t of this economy. Real national income of an economy with a fragmented value-added chain\(^2\) is only that income which accrues to the local factors of production. Under a shared production regime some income for the use of foreign-owned factors must be deducted first before the rest can be considered national income.

The microfoundation of a regime of shared production with vertical trading can be explained best by an ingenious diagram which we adopt from H.G. Johnson. The factor-trade diagram in Fig. 3 portrays the endowment point \( E \) which represents output of \( Q \) in autarchy via the isoquant \( Q^a \). Note that in autarchy there is a factor-price relation \( p_g \beta^a = W/P_N \). Thus in autarky the \( Q^a \) isoquant represents \( Y^a \) simultaneously. If we assume \( P_N^f < P_N^a \) a lower material price \( p_N^f \) in free trade, this economy exhibits a trade gain from vertical trading.

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\(^1\) In Schmid (1982) und Bruno-Sachs (1985) a three-factor production function is used. However this would complicate the analysis. We intend here for the sake of simplicity to use just neoclassical production theory with two factors.

\(^2\) Obviously with \( \bar{N} \) given as an endowment this is not a complete value-added chain, where otherwise \( \bar{N} \) would have to be produced by some input of the local factor, i.e., \( \bar{N} = Q_N = F_N \left( H_N \right) \) which would have to be allocated between the two stages of production, i.e., \( Q = F(H_Q, N) \) and \( H_N + H_Q = H \).
Namely at a lower world-market price for material it pays to import an amount of \( N - \bar{N} > 0 \) and to produce \( Q^f \) at point B where the local factor of production is still fully employed. To represent the domestic factor of production we switch from here on from symbol H to symbol L and we use \( w \) “real wage” for the factor price. This is not precisely correct because L is still considered a composite factor of production. Note that the economy reaches \( Y^f > Y^n \) at an output isoquant \( Y^f \) where the iso-cost line through point E becomes a tangent at point A. Obviously national income grows further if we increase the amount of vertical trading at even lower world-market prices for material. Note, that we conduct this experiment under the assumption of balanced vertical trade and it is obvious that with balanced trade a rising income allows for an increase in absorption. Thus, if imported material is paid in accordance with marginal productivity the home economy can enjoy trade gains which show up either as an increase in absorption or are equivalent to an increase of the real factor price \( w \) at lower \( p_N \). Using this basic idea from the theory of factor trade it would be easy to present a fully-fledged (neo) classical macro model of vertical trade. We would just introduce a consumption function \( C = C(Y, i) \) and an investment function \( I = I(i) \) to close the model. Since this model is well documented in the literature (see Bruno (1982)) we rather turn now to a Keynesian closure of the vertically trading open economy.

Keynesian models typically put emphasis on demand and quantities while prices are fixed. Since we have a structured supply-side, one non-traded primary factor of production and the other partially imported, we obtain a Keynesian adjustment at the supply side, if we move the economy in Fig. 3 outward along the two rays OP and OR. The position of these rays is given from fixed relative price \( W/P_N = w/p_N = \text{const.} \). In doing this we assume that the endowment point E is not binding because we assume that domestic resources are unemployed. Note further that the economy can obtain imported material at any amount from

\[ \text{Figure 4 about here} \]

\[ 1 \text{ The important part of this basic theorem on vertical trade gains is the fact that } Y = wL + p_N \bar{N} \text{ must be rising unambiguously although } w \text{ and } p_N \text{ move in opposite directions.} \]

\[ 2 \text{ X can be treated as an exogenous variable or as a function } X = X(P/E). \text{ Note that this neoclassical model would be just equivalent to the first period in an intertemporal approach as in Bruno-Sachs (1985), chapt. 4.} \]
the world market equivalent to the vertical distance between the two rays at a given real commodity price \( p_N \).

This basic idea of Keynesian quantity adjustment with fixed prices can be put more forcefully within a diagram we adopt from C. Föhl\(^1\). The Föhl diagram in Fig.4 is a modified 45°-Keynesian cross which stresses income distribution between foreign and domestic-owned factors of production in a shared production process\(^2\). The Föhl diagram can be best explained with a fixed coefficient technology\(^3\). With fixed coefficients we have a linear factor-price frontier for the processing stage of production

\[
1 = \alpha w + a_N p_N
\]

and the cost shares of the factors of production are

\[
\theta_N = a_N p_N \quad \text{material ("oil") share}
\]

\[
1 - \theta_N = \alpha w \quad \text{value-added share}
\]

In order to obtain very clear-cut results, we further simplify without loss of generality by ignoring the local supply of material, i.e., \( \bar{N} = 0 \). This yields the following behavioural equations of the supply side:

real import value of material

\[
NIM = p_N N = \theta_N Q
\]

real national income in output units

\[
Y = Q - p_N N = (1 - \theta_N) Q
\]

From this supply side we obtain two important relations

---

\(^1\) Carl Föhl (1966) was an engineer, entrepreneur and economic scientist who used his knowledge in fluid mechanics to write a book on Keynesian economics before Keynes. During his years at Free University of Berlin he studied income and wealth distribution and the macroeconomics of imperfect competition.

\(^2\) Note that Föhl used the diagram for explaining the \textit{internal} distribution of income between two heterogeneous household agents, while I make use of in the diagram for describing \textit{external} income distribution.

\(^3\) I deliberately switch here from a flexible to a fixed-coefficient technology, because we shall assume later a linear-homogeneous CES technology. Thus the microfoundation of our supply side must be independent of substitution possibilities.
output-income relation \[ Q = \frac{1}{1-\theta_N} Y \]

import-income relation \[ \text{NIM} = \frac{\theta_N}{1-\theta_N} Y \]

or \[ \text{NIM} = m_N Y \quad \text{with } m_N \equiv \frac{\theta_N}{1-\theta_N} \]

Fig. 4 portrays the distribution of income between foreigners and domestic residents by showing the real value of imported material as the vertical distance between the Q (output) line and the 45° line. Given relative price \( W/P_N = w/p_N \) either by fixing \( p_N \) or \( w \) there is a gap between the real value of total final goods, i.e., output and domestic real income. If I assume the elasticity of substitution \( 0 \leq \sigma < 1 \) the size of the gap depends upon \( W/P_N \).

Using the Föhl diagram the scale of economic activity can be determined now from the demand side in the familiar manner shown in Fig. 5 where exports and interest rate are given exogenously. Fig. 5 demonstrates a balanced trade position from which we observe the standard result applied to a vertically trading economy: In an open economy with a shared production process and balanced trade absorption must equal national income which must be less than output because foreigners have to be paid first.

It is easy to write down the model for of this “Veredelungswirtschaft” if we assume a linear consumption function and make I and X exogenous variables ignoring the interest rate. As any student of income distribution knows, there are always two different ways of analysis: (i) output analysis or (ii) income analysis. Output analysis solves for the output variable, by realising that income and output are different with a broken value-added chain. Income analysis mimics the traditional analysis which solves for the income variable.

\[ ^1 \text{The two real factor prices are related via the factor-price-frontier.} \]
Output analysis:  

\[ Q = C(Y) + I + X \]
\[ Y = (1 - \theta_N)Q \]
\[ C = \alpha Y + \bar{C} \]
\[ I = \bar{I}; X = \bar{X}; \bar{A} = \bar{C} + \bar{I} \]
\[ Q = \frac{1}{1 - c(1 - \theta_N)}[\bar{A} + \bar{X}] \]

Income analysis:  

\[ Y = C(Y) + I + X - NIM(Y) \]
\[ C = cY + \bar{C} \]
\[ I = \bar{I}; X = \bar{X}; \bar{A} = \bar{C} + \bar{I} \]
\[ NIM = \theta_N Q = \frac{\theta_N}{1 - \theta_N}Y = m_N Y \]
\[ Y = \frac{1 - \theta_N}{1 - c(1 - \theta_N)}[\bar{A} + \bar{X}] \]
\[ Q = \frac{1}{1 - \theta} \frac{1}{s + m_N}[\bar{A} + \bar{X}] \]

because \[ \frac{1}{s + m_N} = \frac{1 - \theta_N}{\theta_N + s (1 - \theta_N)} > 0 \]
\[ Q = \frac{1}{\theta_N + s (1 - \theta_N)}[\bar{A} + \bar{X}] \]

As usual we assume for stability \[ \frac{1}{s + m_N} \geq 1 \] and this implies \[ c \geq \frac{\theta_N}{1 - \theta_N} = m_N \]. We can also express the trade balance (current account) which appears quite familiar if we make use of the \( m_N \) parameter.

\[ B = X - NIM \]
\[ = \frac{s}{s + m_N} \bar{X} - \frac{m_N}{s + m_N} \bar{A} \]

If we introduce the parameter \( m_N \) the Keynesian equilibrium of this vertically trading economy appears algebraically isomorph to a Mundell-Fleming economy. However notice the economic meaning is totally different. The multiplier \( 1/(s + m_N) \) is a supply-side multiplier because the leakage \( m_N \) is a supply-side leakage which operates independently from the traditional demand-side leakage.
1.1 Effects of a t-o-t shock

Consider an open economy which is trading vertically but does suffer from a rising real commodity (material) price, \( p_N = N/P \). Note that the t-o-t of this economy must worsen if the real material price goes up. In what follows we could stick to the linear (fixed coefficient) supply side introduced above. But for the sake of more generality we would like to assume a more general linear-homogeneous CES technology where \( \sigma \geq 0 \), the elasticity of factor substitution is bound to play a major role. In addition we assume: (1) Rigid domestic factor price, in particular nominal wage rigidity, \( W = \text{const.} \), while the material (commodity) price is fixed in foreign currency. Thus \( P_N = E P^*_N \), may change exogenously via the exchange rate \( E \) or \( P^*_N \). (2) There exists no domestic supply (endowment) of material, i.e., \( N = 0 \). (3) Export demand may change exogenously but it also depends negatively on the foreign currency price of domestic output, \( P^* = P/E \). The exchange rate, \( E \), is fixed for the time being. Finally, we are going to use hat calculus, a method of analysis pioneered by R. Jones (see Caves-Frankel-Jones (1990)).

From the linear-homogeneous production function it is well known that output can be expressed as follows

1. \[ \hat{Q} = \hat{N} - \left(1 - \theta_N \right) \left[ \hat{N} - \hat{L} \right] \]

2. \[ \hat{Q} = \hat{L} + \theta_N \left[ \hat{N} - \hat{L} \right] \]

From the definition of the elasticity of substitution \( \sigma \geq 0 \) we obtain the change in factor intensity as a function of the change in relative factor price.

3. \[ \hat{N} - \hat{L} = \sigma \left[ \hat{P}_N - \hat{W} \right] \]

---

1 In what follows a certain familiarity with factor demand functions and their properties is useful (see Silberberg (1978) or the appendices in Caves-Frankel-Jones (1990)). I continue to assume only two factors of production.
Note, that \( W \) is exogenous but \( P_N = E P_N^* \) if we assume a world market price of materials given in foreign currency units, i.e., \( \hat{P}_N = \hat{E} + \hat{P}_N^* \). Using (3) in (1) and (2) we obtain the usual output-constrained factor demand\(^1\) for material and the composite domestic factors of production.

\[
4 \quad \hat{N} = -\sigma (1 - \theta_N) \left[ \hat{P}_N - \hat{W} \right] + \hat{Q}
\]

\[
5 \quad \hat{L} = \sigma \theta_N \left[ \hat{P}_N - \hat{W} \right] + \hat{Q}
\]

From (4) we obtain the real value of imported materials (commodities).

\[
6 \quad \hat{N} M = \hat{P}_N - \hat{P} + \hat{N} = (1 - \sigma) (1 - \theta_N) \left[ \hat{P}_N - \hat{W} \right] + \hat{Q}
\]

It is now possible to derive a fundamental relation between \( Y \) and \( Q \) if there is a change in relative factor price \( P_N / W \).

From the production function given the relative factor price it is obvious that the following relation must hold.

\[
7 \quad \hat{Y} = \frac{1}{1 - \theta_N} \hat{Q} - \frac{\theta_N}{1 - \theta_N} \hat{N} M
\]

Using (6) in (7) yields

\[
8 \quad \hat{Y} = - (1 - \sigma) \theta_N \left[ \hat{P}_N - \hat{W} \right] + \hat{Q}
\]

Given output a rise in \( P_N \) reduces domestic income the more the smaller \( 0 \leq \sigma < 1 \). Obviously, given the relative factor price income and output must rise proportionally as a result of linear homogeneity. Moreover real imports can be expressed as well as a function of the relative

\(^1\) Note, that there exist also factor-constrained factor demand functions and output-supply functions which we do not employ.
factor price and of real income instead of output (see Gylfason-Schmid (1983)) if we replace \( \dot{Q} \) in (6) using (7).

\[
\dot{Q} = \left(1 - \sigma\right)\left[\dot{P}_N - \dot{W}\right] + \dot{Y} 
\]

Finally we would like to introduce two behavioral functions at the demand side. Without loss of generality we neglect investment as part of national absorption and thus drop the interest elasticity of absorption. However, we would like to model a domestic demand shock \( \xi_c \). Thus domestic consumption

\( \equiv \) absorption is given by the following consumption function, where \( 0 < \alpha < 1 \) is the income elasticity to consume.

\[
\dot{C} = \alpha \dot{Y} + \xi_c \quad 0 < \alpha < 1 
\]

Foreign demand for domestic output is captured by the export function

\[
\dot{X} = -\eta^*\left[\dot{P} - \dot{E}\right] + \xi_x \quad \eta^* > 0
\]

which shows a foreign demand shock \( \xi_x \) and a negative price elasticity with respect to the price of domestic output in foreign currency units.

In this simple framework the use of output is only for domestic consumption and export. Thus goods market equilibrium is represented by

\[
Q = C + X \quad \text{or}
\]

\[
\dot{Q} = \left(1 - \theta_N\right)\dot{C} + \theta_N \dot{X} 
\]

Equation (13) assumes balanced trade \( X = \text{NIM} \) which implies consumption = absorption = income.
We can solve (13) with (10), (11) and (8) for $\hat{Q}$.

$$
\hat{Q} = -\frac{\theta_N}{\Delta} \left[ \alpha \left( 1 - \sigma \right) \left( 1 - \theta_N \right) \left[ \hat{E} + \hat{P}_N^* - \hat{W} \right] \right] - \frac{\theta_N}{\Delta} \eta^* \left[ \hat{P} - \hat{E} \right] + \frac{1 - \theta_N}{\Delta} \xi_c + \frac{\theta_N}{\Delta} \xi_x
$$

with $\Delta = 1 - \alpha \left( 1 - \theta_N \right) > 0$

It is important to see that using the supply-side multiplier\(^1\) of a vertically trading economy $\Delta^{-1} = 1/ \left( 1 - \alpha \left( 1 - \theta_N \right) \right)$ we can rewrite the following expressions

$$
\frac{\theta_N}{\Delta} = \frac{\theta_N}{1 - \alpha \left( 1 - \theta_N \right)} = \frac{m_N}{s + m_N}
$$

$$
\frac{1 - \theta_N}{\Delta} = \frac{1 - \theta_N}{1 - \alpha \left( 1 - \theta_N \right)} = \frac{1}{s + m_N}
$$

From (14) and (15) we get a concise result for an isolated increase in the world market price of commodities.

$$
\hat{Q} = -\frac{m_N \alpha \left( 1 - \sigma \right) \left( 1 - \theta_N \right)}{s + m_N} \hat{P}_N^* = -\frac{\theta_N \alpha \left( 1 - \sigma \right)}{s + m_N} \hat{P}_N^*
$$

Output response is a mixture between a domestic income loss initially imposed by a rising commodity price and a multiplier effect. The income loss acts like a tax effect and starts the contractive multiplier process. It depends upon the economic capability to substitute in the short run. With no substitution the income loss is strongest and it completely disappears if price and quantity effects in factor substitution just compensate. Note further that the commodity-price shock hurts output the more the larger, i.e., the dependency of imported foreign materials.

Equation (16) expresses clearly the short-run effect at the demand side if we assume substitution is a longer-run phenomenon. It should be noticed, however, that in the medium run the economy must in addition face a negative price effect if we assume profit

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\(^1\) The reader should realize that we indeed observe a supply-side multiplier because the demand-side leakage has been deliberately assumed away. The leakage is spending by firms for imported foreign-owned factors of production.
maximization. In deriving (3) – (5) we only used cost minimization. By adding a marginal-cost-price rule, i.e., profit maximization producers push up the price of final goods if factor prices are rising.

\[
\hat{p} = \theta_N \left[ \hat{E} + \hat{P}_N^* \right] + \left( 1 - \theta_N \right) \hat{W} 
\]

Taking (17) into account in (14) the combined output effect is becoming worse and we obtain the clear stagflationary pattern of a structural slump.

\[
\hat{Q} = -\frac{\theta_N}{\Delta} \left[ (1 - \theta_N) \alpha (1 - \sigma) + \theta_N \eta^* \right] \hat{P}_N^*
\]

\[
\hat{P} = \theta_N \hat{P}_N^*
\]

Obviously a commodity-price shock yields an unambiguously contractionary output effect via the cost-push channel even if the income-distribution effect is missing, i.e., \( \sigma = 1 \).\(^1\)

As we have mentioned increasing commodity prices normally, i.e. \( 0 \leq \sigma < 1 \), drive a wedge between national income and output. Therefore, with respect to welfare (or absorption) it is much more relevant to look at national income instead of output which is just an indicator of economic activity here.\(^2\)

Repeating our expression (8) for national income

\[
\hat{Y} = \hat{Q} - \theta_N (1 - \sigma) \left[ \hat{E} + \hat{P}_N^* - \hat{W} \right]
\]

we make use of (14) to obtain the following expression

\[
\hat{Y} = -\frac{\theta_N}{\Delta} (1 - \sigma) \left[ \hat{E} + \hat{P}_N^* - \hat{W} \right] - \frac{\theta_N}{\Delta} \eta^* \left[ \hat{P} - \hat{E} \right] + \xi_c + \xi_x
\]

\(^1\) Here it is very clear that a commodity-price shock is a combined demand and supply shock. As was said by commentators of the oil crises: Increasing oil prices are very detrimental, they must be evaluated like a tax combined with an adverse productivity shock.

\(^2\) Note, that in traditional Mundell-Fleming models output and income always are equivalent concepts because there exists no broken value-added chain.
Holding the exchange rate $E$ and $W$ constant we can isolate the possible effects from a commodity-price shock with respect to real national income.

\begin{align}
\dot{Y} &= -\frac{\theta_N}{\Delta} (1 - \sigma) \dot{P}_N^* - \frac{\theta_N}{\Delta} \eta^* \dot{P} \\
\text{(21)}
\text{ } \\
&= - \frac{m_N (1 - \sigma)}{s + m_N} \dot{P}_N^* - \frac{m_N \eta^*}{s + m_N} \dot{P}
\end{align}

The first term of the expression in (21) should be compared to equation (16) as it demonstrates that income shrinks always more than output after a commodity-price shock.

Furthermore, if foreign owners of commodities ask a higher price for their factors and $\sigma < 1$ these expressions for income again separate the initial income loss from the medium-term loss of income due to the cost-push effect from higher commodity prices which reduces chances to export. We can incorporate the cost-push effect using profit maximization (17).

\begin{align}
\dot{Y} &= -\frac{\theta_N}{\Delta} \left[ (1 - \sigma) + \eta^* \theta_N \right] \dot{P}_N^* \quad 0 \leq \sigma \leq 1 \\
\text{(22)}
\end{align}

Compare (22) and (18) to realize, if the international income-distribution effect is assumed away (i.e. $\sigma = 1$) then output and income are reduced at the same rate. Put differently, if we neglect the international-income distribution effect we are left with the cost-push effect only. Only in this completely unrealistic special case a commodity-price shock would become equivalent to a drought\(^1\).

If we neglect the price effect, i.e., $\dot{P} = 0$ the results (20) or (21) can be portrayed in Fig 6. The ray OR is twisted anticlockwise to OR’ if a commodity-price hike leads to an income loss in case of weak substitution, $0 \leq \sigma < 1$. The initial income loss depends on the degree of substitution and is represented by $Y_s = (\sigma - 1) \theta_N$. The income loss leading to a shortfall in

\(^1\) Equations (18) and (22) emphasize the criticism against many macroeconomic textbooks, which fail to make a distinction between an oil price shock and a drought.
demand starts a contractionary multiplier process. At the new equilibrium $E'$ income has fallen by $\Delta Y = (\theta_N / \Delta) (\sigma - 1)$ and a trade deficit $BA'$ has developed.

### 1.2 Devaluation in the Anti-Mundell-Fleming model

Traditional open economy macroeconomics\(^1\) demonstrates the influence of a varying exchange rate on income by a simple formula where the Marshall-Lerner condition and the multiplier are mixed together\(^2\). I would like to demonstrate that income and elasticity approach can be married as well in the anti-Mundell-Fleming model where the economy trades vertically. I am going to derive an isomorphic formula with the elasticity of imported final goods demand replaced by $\sigma$, the elasticity of factor demand. The usual demand-side multiplier is replaced by the supply-side multiplier $\Delta^{-1}$, we derived above.

We obtain this result from (19) collecting terms related to the exchange rate.

\[
\hat{Y} = \frac{\theta_N}{\Delta} (\eta^* + \sigma - 1) \hat{E} - \frac{\theta_N \eta^*}{\Delta} \hat{p}
\]

We rewrite (23) using the propensity to import $m_N$.

\[
\hat{Y} = \frac{m_N (\eta^* + \sigma - 1)}{s + m_N} \hat{E} - \frac{m_N \eta^*}{s + m_N} \hat{p}
\]

The first term in (24) is an expression showing the effect of a devaluation on income in a vertically trading economy which is completely isomorphic to the formula by which we normally capture the devaluation effect on income within a Mundell-Fleming model\(^3\). A devaluation has a positive income effect if the anti-Marshall-Lerner condition $(\eta^* + \sigma - 1) > 0$ is satisfied. This condition balances the stimulating export effect from a devaluation against the income loss from low substitution. It is important to understand that in a vertically trading economy a devaluation exerts additional pressure upon the final goods price under profit

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\(^1\) A survey of traditional Mundell-Fleming open economy macroeconomics is given in Frankel-Razin (1994).

\(^2\) The well-known marriage of the income and the elasticity approaches.

\(^3\) Note, that the isomorphism appears only with the chosen definition of the new parameter $m_N = \theta_N / (1 - \theta_N)$ the propensity to import foreign-owned factors of production with respect to $Y$. However, this definition is very useful because $m_N$ also plays a role in the multiplier process. A larger dependency on imported resources increases $m_N$ thereby a devaluation becomes more powerful if the anti-M-L condition holds.
maximization. Thus the full impact of a devaluation including the cost-push effect is given from (24).

\[ \dot{Y} = \frac{m_N}{s + m_N} \left[ \sigma - 1 + \eta^* (1 - \theta_N) \right] \dot{E} \]  

It is also important to note that (25) allows the possibility of a contractionary devaluation because the net effect on export demand is positive or zero while the income effect is negative if \( \sigma < 1 \).

These conflicting forces from a devaluation in an open economy with a broken value-added chain are fundamentally important. The total effect from a devaluation (23) or (25) can be broken down\(^1\)

\[ \dot{Y} = \dot{Y} / \dot{E} \bigg|_{\text{P = const}} + \left( \dot{Y} / \dot{P} \right) \left( \dot{P} / \dot{E} \right) \]  

where

\[ \dot{Y} / \dot{E} \bigg|_{\text{P = const}} = \frac{m_N (\eta^* + \sigma - 1)}{s + m_N} > 0 \quad \text{if} \quad (\eta^* + \sigma - 1) > 0 \]  

"anti-M-L condition"

\[ \dot{Y} / \dot{E} \bigg|_{\text{cp}} = -\frac{m_N \eta^* \theta_N}{s + m_N} < 0 \]

Fig. (7) illustrates the point in a \( P, Y \) diagram\(^2\) where the cost-push effect is captured in an upward shifting AS curve to \( AS' \) while the two demand effects (i) the negative effect due to a redistribution of income towards foreigners and (ii) the positive demand effect from stronger exports induced by a devaluing currency are on balance expansionary if the anti-M-L condition is satisfied. The diagram shows clearly that a priori the

\[ Figure \ 7 \ about \ here \]

\(^1\) This method of breaking down the total effect is due to Gylfason-Schmid (1983), p. 645. Note, that any labor (factor) market pressures resulting from unemployed domestic resources are still disregarded here.

\(^2\) The AD-AS diagram was used in Schmid (1982) to demonstrate ambiguous income effects from a devaluation in a monetary-approach framework.
direction of the total effect must be ambiguous because the relative magnitudes of these opposing shifts depend on the structural parameters. From (25) the condition which rules about the relation between national income and the exchange rate\(^1\) is

\[
(29) \quad (\sigma - 1) + \eta^* (1 - \theta_N) \geq 0 \quad \eta^* > 0
\]

The reader should note that with realistic parameter values \(0 \leq \sigma \leq 1\) and \(0 \leq \eta^* < \infty\) contractionary devaluation becomes more likely the lower the values for \(\sigma\) and \(\eta^*\). A very simple example for contractionary devaluation would be \(\sigma = \eta^* = 0\). This shuts off all reactions from exports while it maximizes the collapse of the demand side via the external (international) income-distribution effect\(^2\).

Although the present model has no particular structure which would represent the peculiar features of a development economy, the internal income-distribution problem figures prominently for LDCs but for DCs as well. We have dismissed internal income-distribution because of two implicit assumptions.

(1) We employ a representative household agent. (2) Even if we wouldn’t, with the assumed composite domestic factor of production domestic income distribution cannot be modelled. If instead we followed Bruno-Sachs (1985) who model three factors of production, we could assume heterogeneous household agents (what B-S don’t do) and would obtain a further demand-reducing channel. This would assume that workers have higher propensities to consume and with nominal wages kept constant while entrepreneurs pass along the devaluation-related higher production cost in the final goods price this would add to contraction. This sort of event has been discussed after the oil crisis between German labor unions and employers because under this regime labor income would be heavily squeezed because the burden of the income lost to foreigners would then be carried mostly by workers.

Within the present set-up of the model an appropriate retaliatory response to higher commodity prices (not so much devaluation) would be an equal increase in the price of the composite factor of production\(^3\), i.e., \(\hat{W} = \hat{P}_N^*\). This would reverse the income loss to

\(^1\) This condition was obtained in Schmid (1982) if the real-balance effect is suppressed from his formula (49).

\(^2\) Within the development literature internal income distribution as opposed to external income distribution is seen as an additional possible effect for contractionary devaluation (Diaz-Alejandro (1963)).

\(^3\) This would amount to rising wage and rental rates simultaneously within a heterogeneous household model.
foreigners but the world would end up in a perfect world-wide spiral of a cost-push-induced price-level increase. I don’t want to follow this avenue here because the argument was presented in Schmid (1980 b) within the two-country OPEC vs. OECD world economy which is presented later in section 1.5. Moreover, to get the full flavor of a commodity price based world inflation it would be useful to incorporate explicitly the monetary side of the world economy.

Within the present anti-M-F model we turn now to an analysis of the vertical trade balance and the “labor” market.

1.3 Trade account of the Anti-Mundell-Fleming model

From the definition of the balance of trade follows

\[(30) \quad B = X - NIM = Y - [C + I]\]

We continue to assume \(I = 0\) but it is obvious from (30) that a positive (negative) trade account must be equivalent to a credit (debt) given (taken) to (from) the rest of the world, because the economy would just sell (receive) goods in exchange for credit.

Using the behavioral functions (6), (11) we have

\[(31) \quad B = X \left( \frac{P}{E} \right) - NIM \left( \frac{(EP_{N}^*)}{P, Y} \right)\]

In rate-of-change form we have the following if we assume balanced trade initially

\[(32) \quad dB = X \left[ E - NIM \right] = X \left[ \eta^* \left[ \hat{E} - \hat{P} \right] - \left(1 - \sigma \right) \left[ \hat{E} + \hat{p}_{N}^* - \hat{\pi} \right] - \hat{Y} \right] \]

---

1 The reader again is reminded that “labor” market is shorthand here for the market of the composite domestic factor of production.

2 It is possible and to the point to interpret our model just as a representation of a first-period episode within a two-period framework. See Bruno-Sachs (1985), chapt. 4 for an intertemporal full-employment model. However, notice that intertemporal modelling of Mundell-Fleming structures with unemployment is still hard to find in the literature with the exception of Rankin (1989 a, b). Intertemporal modelling of a classical systems is quite common today.
Substituting for $\hat{Y}$ from (19) yields after some calculations

$$
\text{dB} = X \left( \frac{1 - \theta_N}{\Delta} \right) s \left[ (\sigma - 1) \hat{P}_N^* + (\eta^* + \sigma - 1) \hat{E} - \eta^* \hat{p} \right]
$$

(33)

$$
= X \frac{s}{s + m_N} \left[ (\sigma - 1) \hat{P}_N^* + (\eta^* + \sigma - 1) \hat{E} - \eta^* \hat{p} \right]
$$

Three observations follow immediately from (33):

1. If $\sigma < 1$ a commodity-price shock unambiguously deteriorates the trade balance the more the less substitution the economy musters.

2. A devaluation unambiguously improves the trade balance if the anti-Marshall-Lerner condition holds.

3. The formula describing a devaluation is completely isomorphic to the standard formula of the Mundell-Fleming economy where usually the marriage of elasticity and income approach is stressed. It is important to realize, however, that in the anti-M-F model $m_N = \theta_N / (1 - \theta_N)$ and $\sigma$

are pure supply-side parameters instead of the conventional demand-side parameters $\eta^*$ and $\eta$ (elasticities of export and import demand) and $m$ (marginal propensities to spend on imported (final) goods).

Finally, we have to take into account the cost-push effect from both a commodity-price increase and a devaluation if we assume realistically that profit maximization rules at the supply side. Under this assumption our results deteriorate a bit because the cost-push effect lowers export possibilities by a factor $\eta^* \theta_N$. This yields

$$
\text{dB} = X \frac{s}{s + m_N} \left[ (\sigma - (1 - \theta_N)) - \theta_N (1 - \eta^*) \right] \hat{P}_N^* + \left[ \eta^* (1 - \theta_N) + \sigma - 1 \right] \hat{E}
$$

(34)

Note, again, that we continue to assume that the domestic factor of production does not react with its own factor price $W$. To judge if this is a realistic assumption we turn next to the market for the domestic factor of production. With respect to devaluation we compare (34) and (25) to say the following: If a devaluation improves domestic income it improves the balance of trade. This is also obvious from (30).
1.4 The market for the domestic factor of production ("labor" market)

The major drawback of our simplified production function with one imported material and a lumpy domestic factor of production is our description on the "labor" market\(^1\). Nevertheless it is worthwhile to analyse the fate of the non-traded domestic factor. In particular we want to know within a Keynesian closure of the model, what happens to employment of the domestic factor after the economy is hit by a commodity-price shock or by a currency devaluation given the nominal wage. A priori the employment effect is not trivial because in contrary to traditional unstructured macroeconomics we observe the conflicting forces of a positive substitution effect and a negative output effect after a commodity shock. In the beginning assuming full employment of the domestic factor and exogenously given \(P_N^*, E\) and \(W\) we can determine the real wage \(w = W/P\) via profit maximization. The situation is illustrated in Fig. 8 by point \(E^2\). The basic ambiguity of employment of the domestic factor of production is visualized by a lower real wage \(w'\) and a leftward shift of the labor-demand schedule due to the drop in \(Q\). We portray in B the borderline case where after an increase in \(P_N = E\) the real wage falls due to a rigid nominal wage and a rising product price \(P^3\) and employment shrinks due to falling \(Q\).

We start with the output-constrained employment function represented in Fig. 8 by the falling curve \(F_L (L; Q)\). The hat form of this relation is

\[
\hat{L} = -\sigma (\hat{W} - \hat{P}) + \hat{Q}
\]

Using the factor-price frontier as a result of profit maximization we rewrite (35) to obtain

\[
\hat{L} = \theta_N \sigma (\hat{P}_N - \hat{W}) + \hat{Q}
\]

\(^1\) In this respect we pay a price for our simplistic production function. It would be preferable here to follow Bruno-Sachs (1985) who use a three-factor nested CES production function, and explicitly formulate labor demand as a function of real wage and real material price holding capital \(K\) constant.

\(^2\) Note that we show an output-constrained labor demand function.

\(^3\) This result just follows from the factor-price frontier: \(0 = \theta_N \hat{P}_N + (1 - \theta_N) \hat{w}\)
Equation (36) distinctly separates the substitution and scale effects and is well-known from the neoclassical theory of production. Substitution for $\dot{Q}$ from (14) yields

$$
\dot{L} = \frac{\theta_N}{\Delta} \left[ \sigma - \alpha \left( 1 - \theta_N \right) \right] \left[ \hat{P}_N - \hat{W} \right] - \frac{\theta_N}{\Delta} \eta^* \left[ \hat{P} - \hat{E} \right] + \frac{\theta_N}{\Delta} \xi_c + \frac{1}{\Delta} \theta_N \xi_x
$$

We can evaluate (37) for both a commodity-price shock and a devaluation.

**Commodity-price shock:**

$$
\dot{L} = \frac{\theta_N}{\Delta} \left[ \sigma - \alpha \left( 1 - \theta_N \right) \right] \hat{P}_N^* - \frac{\theta_N}{\Delta} \eta^* \hat{P}
$$

or evaluating the cost-push effect via the final-goods price

$$
\dot{L} = \frac{\theta_N}{\Delta} \left[ \sigma - \alpha \left( 1 - \theta_N \right) - \eta^* \theta_N \right] \hat{P}_N^*
$$

**Devaluation:**

$$
\dot{L} = \frac{\theta_N}{\Delta} \left[ \sigma - \alpha \left( 1 - \theta_N \right) + \eta^* \right] \hat{E} - \frac{\theta_N}{\Delta} \eta^* \hat{P}
$$

$$
\dot{L} = \frac{\theta_N}{\Delta} \left[ \left( \sigma + \eta^* - 1 \right) + \Delta \right] \hat{E} - \frac{\theta_N}{\Delta} \eta^* \hat{P}
$$

or including the cost-push effect

$$
\dot{L} = \frac{\theta_N}{\Delta} \left[ \sigma - \left( \alpha - \eta^* \right) \left( 1 - \theta_N \right) \right] \hat{E}
$$

(39) and (41) are very interesting results showing that in a Keynesian version of the anti-Mundell-Fleming structure there are no direct links between domestic employment and output or income. If in (39) the substitution effect is absent, i.e., $\sigma = 0$ employment must fall after a
commodity-price increase together with a falling output from (18). On the other hand it is highly interesting to observe that in the case of a devaluation the suppression of the substitution effect in (41) is not sufficient to decide upon the sign of the employment effect. Here it is the conflict of a stimulation of exports against the tax-like income loss from a devaluation which determines the sign of the employment effect of a devaluation.

Closing this section we like to emphasize the loose ends of our labor market specification. We assumed nominal wage rigidity. Alternatively we could have assumed a flexible wage rate as in Schmid (1980 b) or wage regimes with even more stickiness (Frisch-Hof (1987)). Some conservative analysts even recommended a falling wage rate to preserve price stability.

1.5 OPEC vs. OECD in a two-country world

Until now the model was a small-country version of a (raw) material-importing macroeconomy, which faced exogenous $P_N^*$ and a given export function $X = X(p/e)$ where exports reacted negatively to $P^*$, the foreign currency price of the domestic final good. After the oil shocks had happened expectations built up, that events would turn out much better for OECD, if the group of oil-exporting countries (OPEC for simplicity) started to recycle some of the new revenues buying final goods in the OECD area. We now construct a simple two-country model$^1$ along these lines. Apart from the theorist’s feeling that it is always nice to model a closed world economy, the two-country model formalizes a basic idea which was ventured by some analysts during the oilprice crisis of the 1970s: According to this view a sudden oilprice increase should be explained just as a modern-time transfer problem$^2$. In what follows we develop the argument using Y-analysis instead of Q-analysis.

We do the following two variations in assumptions to obtain the two-country model:

real income of OPEC $Y^* = \frac{P_N}{P} \left[ N - \bar{N} \right] = NIM \text{ with } \bar{N} \geq 0$

export function of OECD $X = X \left( Y^* \right)$

---

$^1$ The present framework is a bit harassing to the oil exporting economies since it denies any economic activity beyond resource extraction. Therefore, all final goods must be imported, while after having set the price of raw materials OPEC produces materials in any extent OECD demands at this price. Apart from the fact, that there are barren economies which do just that, it is because of simplification that I have chosen this setup.

$^2$ The OPEC-OECD framework was developed in Schmid (1976) and Schmid (1980 a, b), (1981) within a monetary approach. The reader should note that in 2000 the real side of the model could capture some of the economic relations between the EU and Russia and/or GUS.
If we continue to assume that investment is absent, OPEC consumption of final goods must be totally imported from OECD, thus

\[ \dot{X} = \alpha \cdot \dot{Y} * = \alpha \cdot N \dot{M} = \alpha \cdot [\hat{P}_N - \hat{P} + \hat{N}] \quad \text{if} \quad \hat{N} = 0 \]

We know from (6) and (9) that the OECD import function can be expressed as a function of the real material price \( P_N = P_N / P \) or more useful as a function of the relative factor price \( P_N / W \) and OECD income \( Y \).

\[ N \dot{M} = (1 - \sigma) [\hat{P}_N - \hat{W}] + \dot{Y} \]

Plotting (42), (43) and (10) into the \( Y \) version of the goods-market equilibrium equation yields

\[ \dot{Y} = \frac{C}{Y} \hat{C} + \frac{N \dot{M}}{Y} [\dot{X} - N \dot{M}] \]

\[ = \hat{C} + \frac{\theta_N}{1 - \theta_N} [\dot{X} - N \dot{M}] \]

\[ \dot{Y} = \frac{\theta_N}{(1 - \theta_N) s + \theta_N s^*} [s^* (\sigma - 1)] [\hat{P}_N - \hat{W}] \]

A few more calculations yield the corresponding expression for OPEC’s income\(^1\)

\[ \dot{Y} * = -\frac{1 - \theta_N}{(1 - \theta_N) s + \theta_N s^*} [s (\sigma - 1)] [\hat{P}_N - \hat{W}] \]

From (44) and (45) we ascertain that in the empirically relevant case \( 0 \leq \sigma < 1 \) OECD will unambiguously lose income and OPEC must gain\(^2\). Only in the borderline case \( s^* = 0 \) where OPEC spends all income gains for OECD goods, OECD income would survive undamaged.

More generally low \( s^* \) and high \( s \) would help to mitigate the OECD income loss. Where is the

---

1 The reader should notice, that we use \( s \) and \( s^* \) although here they represent elasticities instead of marginal propensities.

2 These results were obtained in Schmid (1980), (1986 b) if I assume away the real balance effects. The present model could be enlarged by money market equations.
transfer condition? Once again the reader is reminded to distinguish between income and output if an economy operates with a sliced value-added chain. It is easy to obtain an expression for output Q if we recall from (8)

\[ \dot{Q} = \dot{Y} + (1 - \sigma) \theta_N \left[ \hat{P}_N - \hat{W} \right] \]

Substitution for \( \dot{Y} \) from (44) yields

\[ \dot{Q} = \frac{\theta_N}{\Delta'} \left[ (\sigma - 1) (1 - \theta_N) (s^* - s) \right] \left[ \hat{P}_N - \hat{W} \right] \]

and \( \Delta' = \left( 1 - \theta_N \right) s + \theta_N s^* > 0 \)

Obviously the world-output reaction now depends upon the relative propensities to spend. Assuming \( s^* \geq s \) and \( \sigma < 1 \) world output of final goods must improve (deteriorate) as a consequence of the relative size of the spending parameters. Here is where the conflict of international income- distribution is modelled in analogy to the transfer problem. Notice, however, the conflict is about the division of world output Q into \( Y \) and \( Y^* \) which indicate national welfare. But even at this level of abstraction some commentators of the two oil crises of the 1970s argued that the OPEC-price hike was not a first strike but a retaliatory action after the devaluation of the dollar in a collapsing Bretton-Woods system, where oil resources had been traded against dollars for the most part.

2. The hybrid Mundell-Fleming structure

2.1 Equilibrium of the model

So far we assumed a refining economy (Veredelungswirtschaft) which applied domestic factors of production to process basic material into final goods usable for consumption and investment purposes.\(^1\) Although this is the fundamental paradigm of manufacturing, the macroeconomics of the open economy has developed along a very different pattern namely exchanging final goods. That structure (see Fig. 1.a upper part) has been used in the famous

\(^1\)This way of thinking we have baptized the anti-Mundell-Fleming structure, which is remarkably absent in the macroeconomics of the open economy. However, this author found the idea in programmes and speeches of German political parties and the German council of economic advisors.
Mundell-Fleming model, which became the workhorse of macroeconomic thinking. Obviously it tacitly assumes that the value-added chain behind the production process of the single output good is totally nationalized, i.e., the national economy is characterized by a very deep closed value-added chain. Though in economic history some agricultural economies may almost fit this description, major industrial economies of the past probably do not. And major economies of the present certainly do not fit the Mundell-Fleming structure because they do also import raw material, commodities and intermediates in an increasing amount. Since the Mundell-Fleming structure is well-known, we do not present the Keynesian version of this model. In Fig. 9 rather we present the geometry of the Mundell-Fleming structure using the well-known 45°-line apparatus. The careful reader should observe the sequence of subtracting first the final goods imports from the absorption line and then adding exports to obtain the total expenditures for domestically produced goods. Only if we apply this routine, we are able to show directly the import or export shares and the trade share. Moreover, in the lower part of Fig. 9 we portray the credit market of the open economy operating in a Keynesian mode. We observe an upward sloping credit-supply function, which is confronted with the downward sloping credit-demand curve of the rest of the world. The coordinates of the credit-market equilibrium at point E show a trade surplus and the equilibrium output.

The hybrid Mundell-Fleming structure in the lower part of Fig. 1a acknowledges the traditional horizontal final-goods trade but adds the anti-Mundell-Fleming structure. This blend of two basic structures of the open economy may then serve as a sufficient realistic description of the economies of the modern industrial countries. The hybrid M-F model has been used in Gylfason-Schmid (1983) to demonstrate a realistic modern theory of devaluation where the exchange rate works not only on the demand side of the economy but at the supply side as well. This fundamental revision of the theory of devaluation can be used to substantially improve the empirical work on the effects of exchange rate changes.

1 Some economists tend to think this slicing of value-added chains is behind the current round of globalisation (see Jones (2000)).

2 Note, that here we do not capture the full Mundell-Fleming model, which is best known for its ingenious way to cope with capital mobility and alternative exchange-rate systems. See Frenkel-Razin (1994) for a thorough description of the complete model.

3 Note, the credit-market curves can be derived completely from the corresponding curves in the upper panel.

4 It seems strange that the Gylfason-Schmid criterion for a successful devaluation so far has only caught the interest of development economists at the IMF, although the structure of the model has no specific properties which are typical for a
Furthermore the hybrid M-F model was used in Bruno-Sachs (1985, chapt. 5) to analyse an oil-price shock. This section of the paper reconstructs both the oil-shock analysis in Bruno-Sachs (1985) and the devaluation analysis in Gylfason-Schmid (1983). The former will be modelled in a way more usual in open economy macroeconomics as Bruno-Sachs themselves present their analytics. The latter will be summarized by presenting a twin Marshall-Lerner condition and showing that it is completely equivalent to the super-Marshall-Lerner condition given in Gylfason-Schmid (1983).

Discussing the hybrid Mundell-Fleming structure it is easiest to consider Fig. 10 which builds upon Fig. 9. The diagram in the upper part is organized around the Keynesian cross. However, it is a mixture of Fig. 4 and Fig. 9. Since we extend the standard M-F structure aggregate demand corresponds to output at the equilibrium point E. The supply (output) line must be a ray from the origin with a slope $1/(1-\theta_N)$ larger than one, if the economy imports material. Fig. 10 assumes just a balanced overall trade account, where income equals absorption or equivalently final-goods exports pays for both imports of final-goods and imports of imported raw material. There exist a number of very useful shares which can be read off the diagram in Fig. 10 and are listed without further comment.\(^1\)

\(^1\) Note, that we assume no autonomous imports of neither final-goods nor imported material.
Shares in the hybrid M-F-Model
assumptions:  
- no domestic production of materials $\bar{N} = 0$
- balanced overall trade account

Output related shares

\[ \frac{NIM}{Q} = \frac{p_N N}{Q} = \theta_N \]  
material (commodity) share

\[ \frac{Y}{Q} = \frac{wL}{Q} = 1 - \theta_N \]  
value-added share

\[ \frac{X}{Q} \]  
export share

Income related shares

\[ \frac{NIM}{Y} = \frac{p_N N}{Y} = \frac{\theta_N}{1 - \theta_N} \equiv m_N \]  
propensity to procure globally sourced material  
(with $\bar{N}IM = 0$)

\[ \frac{FIM}{Y} = \frac{pC_f}{Y} = \delta c \equiv m \]  
propensity to consume imported final goods  
(with $\bar{FIM} = 0$; $\delta, 1 - \delta$ marginal propensities to spend)

\[ \frac{FIM}{Q} = m(1 - \theta) \]  
propensity to import final goods with respect to output

The assumption of a balanced overall trade account yields:

\[ \frac{X}{Q} = \frac{NIM}{Q} + \frac{FIM}{Q} = \theta_N + m(1 - \theta_N) \]  
\[ \frac{X}{Y} = \frac{NIM}{Y} + \frac{FIM}{Y} = m_N + m = \frac{\theta_N}{1 - \theta_N} + m \]
share of material imports in total import (Gylfason-Schmid 1983)

\[
\frac{\text{NIM}}{\text{NIM} + \text{FIM}} \equiv \beta = \frac{m_N}{m_N + m} = \frac{\theta_N}{\theta_N + m(1 - \theta_N)}
\]

share of final goods imports in total import

\[
\frac{\text{FIM}}{\text{NIM} + \text{FIM}} \equiv 1 - \beta = \frac{m}{m_N + m} = \frac{(1 - \theta_N)m}{\theta_N + m(1 - \theta_N)}
\]

More revealing than the upper panel of Fig.10 is the representation of the credit market in the lower panel. We can use this diagram to compare the influence of different structures upon the equilibrium, because \(E_s\) represents the standard M-F equilibrium and \(E\) shows the effects of adding the supply side of the anti-M-F structure. Obviously, national income \(Y\) declines and the trade account deteriorates, turning a surplus into a balanced overall trade account.\(^1\) This reflects the twin leakages which are the main characteristics of the hybrid M-F model.\(^2\)

It is easy to calculate \(Y\) and \(Q\) for the hybrid M-F model and we do so without further comment.

\(^1\) The reader should note, that we are extending the standard model with four demand side parameters by two more parameters \(\theta_n\) and \(\sigma\) which cover the supply side.

\(^2\) Note, in the lower panel we determine \(Y\), although in the upper panel we determine \(Q\) first but \(Y\), too.
**Q analysis**

\[ Q = C(Y) + 1 + X - \text{FIM}(Y) \]

\[ Y = (1 - \theta_N)Q \]

\[ \text{FIM} = \frac{1}{\theta_N} \frac{\text{FIM}}{m_N} + mY \]

\[ C = \bar{C} + cY \]

\[ I = I; \; X = \bar{X}; \; \bar{A} = \bar{C} + I \]

\[ Q = \frac{1}{1 - (c - m)(1 - \theta_N)} [\bar{A} + \bar{X} - \text{FIM}] \]

\[ Y = \frac{(1 - \theta_N)}{1 - (c - m)(1 - \theta_N)} [\bar{A} + \bar{X} - \text{FIM}] \]

\[ = \frac{1}{s + m + m_N} [\bar{A} + \bar{X} - \text{FIM}] \]

\[ Y = \frac{1}{s + m + m_N} [\bar{A} + \bar{X} - \text{FIM}] \]

**Y analysis**

\[ Y = C(Y) + 1 + X - \text{FIM}(Y) - NIM(Y) \]

\[ \text{FIM} = \frac{1}{\theta_N} \frac{\text{FIM}}{m_N} + mY \]

\[ NIM = \frac{1}{1 - \theta_N} Y = m_N Y \]

\[ C = \bar{C} + cY \]

\[ I = I; \; X = \bar{X}; \; \bar{A} = \bar{C} + I \]

\[ Y = \frac{1}{s + m + m_N} [\bar{A} + \bar{X} - \text{FIM}] \]

\[ Q = \frac{1}{1 - \theta_N} \frac{1}{s + m + m_N} [\bar{A} + \bar{X} - \text{FIM}] \]

\[ Q = \frac{1}{\theta_N + (s + m)(1 - \theta_N)} [\bar{A} + \bar{X} - \text{FIM}] \]

with

\[ \frac{1}{s + m + m_N} = \frac{(1 - \theta_N)}{\theta_N + (s + m)(1 - \theta_N)} \]

and

\[ m_N = \frac{\theta_N}{1 - \theta_N} \]

**trade account**

\[ B = -\frac{m + m_N}{s + m + m_N} \bar{A} + \frac{s}{s + m + m_N} [\bar{X} - \text{FIM}] \]
The message of Fig. 10 appears very clear in these formulas:

(1) The double leakage is represented by \( m \) and 
\[
m_N = 1/(1-\theta_N),
\]
the propensity to import final goods and the propensity (with respect to income) to procure globally sourced raw materials or intermediates.

(2) The additional parameter \( m_N \) reduces the size of \( Q \) and \( Y \) and it also reduces the trade account \( B \).

(3) Therefore the multiplier of the hybrid M-F model is much smaller than the traditional multiplier depending on the size of the supply-side leakage \( m_N \).

(4) The demand-side leakage is captured by \( m \) or correspondingly by 
\[
c - m = (1 - \delta) c, \text{ the propensity to consume domestic goods.}
\]

2.2 Effects of different t-o-t shocks

We could do the following analysis using the output measure \( Q \) or national income \( Y \) in output units, i.e., a value-added measure. For ease of exposition we use the latter. Thus we need the \( Y \) version of the goods-market equilibrium and all the behavioral equations must be given with respect to \( Y \).

Goods-market equilibrium ( \( Y \) version)

\[
Y = C(Y) + I + X(p) - pC_f(p,Y) - p_NN(p_N,Y)
\]

with

\[
p = \frac{EP_p^*}{P} = \frac{1}{t-o-t_{\text{goods}}} \quad \text{real exchange rate}
\]

\[
p_N = \frac{EP_N^*}{P} = \frac{1}{t-o-t_{\text{factoral}}} \quad \text{real commodity price}
\]
If we assume balanced overall trade we can easily transform the goods-market equilibrium in hat form.

\[ \hat{Y} = \hat{A} + \frac{X}{Y} \hat{X} - \frac{FIM}{Y} FIM - \frac{NIM}{Y} NIM \]

\[ = \hat{A} + \frac{X}{Y} [\hat{X} - (1 - \beta) FIM - \beta NIM] \]

with

\[ \frac{X}{Y} = \frac{FIM + NIM}{Y} = m + \frac{\theta_n}{1 - \theta_n} = m + m_N \]

or

\[ \frac{X}{Y} = \frac{1}{1 - \theta_n} \frac{X}{Q} = \frac{1}{1 - \theta_n} [m (1 - \theta N) + \theta N] \]

We also use the following behavioral functions in hat form.

Consumption (expenditure function)

\[ \hat{C} = \alpha \hat{Y} + \xi_C \]

imported material (material procurement function) see (9)

\[ NIM = (1 - \sigma) [\hat{P}_N - \hat{W}] + \hat{Y} \]

imported final goods (traditional import function)

\[ FIM = (1 - \eta) \hat{P} + \hat{Y} \quad \text{and} \quad \eta = \frac{dC_f}{dp} \frac{P}{C_f} > 0 \]

export function

\[ \hat{X} = \eta^* \hat{P} + \xi_X \quad \text{and} \quad \eta^* = \frac{dX}{dp} \frac{P}{X} > 0 \]
Obviously, we neglect investment as part of absorption and the interest rate, and we treat the exchange rate as fixed but adjustable.\(^1\)

Substitution of the behavioral equations into the goods-market equation and collecting terms yields

\[
\Delta^H \dot{Y} = m \left[ \eta^* + \eta - 1 \right] \dot{p} + m_N \left[ \eta^* \dot{P} + (\sigma - 1) \right] \left[ \dot{P}_N - \dot{W} \right]
\]

\[
\Delta^H = 1 - \alpha + m + m_N < 1
\]

Note, that the multiplier \(1/\Delta^H\) of the hybrid M-F model depends on \(m_N = \theta_N/(1 - \theta_N)\). It is smaller than the standard multiplier if \(\theta_N > 0\), and if \(\theta_N = 0\) we observe the standard open-economy multiplier.\(^2\)

It is useful now to exhibit the foreign currency price of material and final goods respectively, because these are representing the exogenously given world market conditions:

\[
\Delta^H Y = m \left[ \eta^* + \eta - 1 \right] \left[ \hat{E} + \dot{P}_t^* - \dot{P} \right]
\]

\[
+ m_N \left\{ \eta^* \left[ \hat{E} + \dot{P}_t^* - \dot{P} \right] + (\sigma - 1) \left[ \hat{E} + \dot{P}_N^* - \dot{W} \right] \right\}
\]

\[
+ \xi_C + \left( m + m_N \right) \xi_X
\]

It is very clear from (47) that there are three different price shocks which can influence the goods market: (i) a change in the final-goods t-o-t via \(\dot{P}_t^*\), (ii) a change in the factorial t-o-t via \(\dot{P}_N^*\), and (iii) a change in \(\dot{P}\), the final-goods price. The first two prices are definitely exogenous variables. The price of final goods is treated as semi-endogenous. We do not intend here to treat \(P\) as a completely endogenous variable as in Schmid (1980a) (1981) or Bruno-Sachs (1985, chapt. 5).\(^3\) However, we will demonstrate the direct cost-push effect on

---

\(^1\) It would be possible to introduce the interest rate and to switch to a flexible exchange-rate regime where the exchange rate is determined by asset markets.

\(^2\) If \(m = 0\) we obtain the multiplier of the anti-M-F model discussed above. We use the superscript \(H\) to distinguish both multipliers.

\(^3\) This could be done by introduction of an output-supply function which would correspond to the factor constrained factor-demand functions for \(N\) and \(L\).
the final-goods price which always emerges in an economy with imported materials. This cost-push effect is unique to any economy with a broken value-added chain. It appears in connection with both shocks the commodity price shock $\hat{P}_N^*$ and the changing exchange rate $\hat{E}$. The last shock in (47) is the exchange-rate shock, which we will discuss in a moment. Next, we evaluate (47) separately for $\hat{P}_f^*$, $\hat{P}_N^*$ and we single out the cost-push effect for both of these disturbances.

**Final-goods t-o-t shock**

\[
\frac{\hat{Y}}{\hat{P}_f^*} = \frac{1}{\Delta^H} \left[ m (\eta^* + \eta - 1) + m_N \eta^* \right]
\]

**Commodity t-o-t shock**

\[
\frac{\hat{Y}}{\hat{P}_N^*} = \frac{1}{\Delta^H} \left\{ m_N (\sigma - 1) - [m_N \eta^* + m (\eta^* + \eta - 1)] \hat{P}/\hat{P}_N^* \right\}
\]

\[
= \frac{\hat{Y}}{\hat{P}_N^*} \bigg|_P + (\hat{Y}/\hat{P}) \left(\hat{P}/\hat{P}_N^* \right)
\]

The demand-side effect is contractionary if $\sigma < 1$ and the cost-push effect is also contractionary if $(\eta^* + \eta - 1) > 0$. Thus a commodity-price shock most likely is to reduce income. Equation (49) should be compared to equation (21) to see that with $m = 0$ they become equal. If we put $m_N = 0$ we obtain no influence of commodity prices, because we are back into the traditional Mundell-Fleming structure.

---

1 The cost-push effect of exchange rate changes works in both directions. This is one of the disadvantages the Eurozone must cope with as long as Europeans pay their oil bill in $ and not in €.
2.3 Devaluation: The Super-Marshall-Lerner condition

The discussion of a devaluation is most interesting within the hybrid Mundell-Fleming structure. Since a devaluation works here as a simultaneous demand and supply shock, where the latter exerts both a negative demand-side effect and a direct cost-push effect, we obtain the following dissection of separate effects

\[
\frac{\dot{Y}}{\dot{E}} = \left[ \frac{\dot{Y}}{\dot{E}} \right]_p + \left( \frac{\dot{Y}}{\dot{P}} \right) \left( \frac{\dot{P}}{\dot{E}} \right)
\]

where

\[
\left[ \frac{\dot{Y}}{\dot{E}} \right]_p = \frac{1}{\Delta^H} \left\{ m \left( \eta^* + \eta - 1 \right) + m_N \left( \eta^* + \sigma - 1 \right) \right\}
\]

\[
\left[ \frac{\dot{Y}}{\dot{E}} \right]_{cp} = -\frac{\theta_N}{\Delta^H} \left\{ m \left( \eta^* + \eta - 1 \right) + m_N \eta^* \right\}
\]

with \( \Delta^H = 1 - \alpha + m + m_N < 1 \)

The demand-side effect is now governed by the twin Marshall-Lerner condition (50.1) which represents the two parts of the hybrid Mundell-Fleming structure in a symmetric way. The first part is well-known from the traditional theory of devaluation and represents the genuine M-L term. The second part picks up the condition (24) from our anti-Mundell-Fleming structure. If both parts are positive the demand curve in Fig. 7 shifts to the right. Obviously this is not enough to warrant an expansionary devaluation, since we observe a conflicting cost-push effect from (50.2). To summarize: A devaluation can theoretically become contractionary if we realistically allow for imported material which is used within a relatively inflexible production technology. The total effect from a devaluation has become a matter of empirical estimation of the six parameters in the hybrid M-F structure especially the supply-side parameters \( \sigma \) and \( \theta_N \). Even if we rule out contractionary devaluation – a problem known in development economies for a long time – we have to recognize a much less
expansionary (contractionary) effect from a devaluation (appreciation) in industrial economies.\(^1\)

While the twin M-L condition highlights the importance of structure an alternative version has been given in Gyfason-Schmid (1983) which puts emphasis on the traditional format, but allows for the necessary extensions. We could call this version of our devaluation result the super-Marshall-Lerner condition, which we are going to derive next.

From the definition of the import shares \(\beta, 1 - \beta\) which represent specific imports of material and final-goods, respectively, we have from (50.1)

\[
\left. \frac{\dot{Y}}{\dot{E}} \right|_P = \frac{m + m_N}{\Delta^H} \left[ \eta^* + (1 - \beta) \eta + \beta \sigma - 1 \right]
\]

\[
\Delta^H = 1 - \alpha + \tilde{m} \quad \tilde{m} \equiv m + m_N
\]

If we define the overall propensity to import \(\tilde{m} \equiv m + m_N\) we observe in (51) an isomorphism because the super-M-L condition becomes isomorph to the traditional M-L condition. Note, however, that in the super-M-L condition we can switch between the genuine M-L condition and the condition (24) obtained in Schmid (1982) for the anti-M-F structure by putting \(\beta = 0\) or \(\beta = 1\) respectively.

**Conclusions**

The main thrust of this paper is an argument for a more structural approach in open economy macroeconomics, where the Mundell-Fleming model is to be seen as just the beginning. Structuralism in the context of this macroeconomic paper is to be understood as modelling more of the value-added chain, i.e., as being more explicit about the vertical structure of an economy. Note that in following this strategy we dismiss what other authors perhaps would consider more structure, namely two final goods sectors or heterogeneous household agents in each economy\(^2\). However, our minimal two-country version of the world economy emphasizes the economic interplay between so to say a high tech final-goods producer and a

---

\(^1\) Note, that we do not take into account here the longer run effects from a devaluation, via wage demands resulting from a higher P or CPI. These effects, too, are clearly accentuated because of the cost-push effect on P.

\(^2\) In section 1.5 we had different household agents in the world economy, which appears to be a minimum requirement if two open economies share a production process.
raw material producing (extracting) economy, which very often is associated with the macroeconomy of a developing country\(^1\).

The results we obtain within a material-importing anti-M-F structure turn out to be isomorphic both to the standard M-F model (effects of devaluation on income and the trade account) and diverse (effects of a devaluation on output and employment of the domestic factor of production). It is obvious that a commodity-price shock can be properly dealt with only within the anti-M-F structure\(^2\). Secondly, a special feature of the anti-M-F structure is a very intimate interplay between parameters of the demand and the supply side. This marriage between micro- and macroeconomics is a hallmark of the anti-M-F structure and indeed, enlightened analysts of the oil crisis had perceived it as a combined supply and demand-shock right from the beginning. The slump in income, therefore, deserves the special name structural slump to distinguish it from simpler adversities as a drought or a demand-side insufficiency. It is highly important, however, that here we emphasize the structural properties and not the modus operandi of the economy. Within the present paper we have chosen a Keynesian closure of the anti-M-F structure. Space does not allow here to spell out and analyse a classical closure of the anti-M-F structure, where by assumption the domestic factor of production would be always fully employed because the “labor” market would work with a perfect flexible wage rate. Thirdly, employment, income and output are decoupled macroeconomic quantities at least in a Keynesian closure of the present model. With respect to employment substitution and scale effects have to be carefully separated. Finally, the anti-M-F structure is useful in general as a building block or modul where the basic economic idea of refining or processing is precisely modelled. It is to be considered a prototype model of manufacturing and distribution\(^3\) because it describes the economics of just one link within any economic value-added chain, be it at the managerial or macroeconomic level. And we all know that inside the black box of macroeconomics it must be the creation of value-added which constitutes income as the welfare of nations.

The richer vertical structure of the hybrid M-L model allows the formulation of a more realistic theory of devaluation, where not only the traditional demand side effects are present, but exchange rate changes afflict the economy from the supply side too. These supply side

---

\(^1\) Barro-Grilli (1994) on p. 124 follow this idea looking at a resource-based economy within an intertemporal two-period framework, namely at the effects of changing real commodity t-o-t.

\(^2\) Sometimes it appears very farfetched if textbooks in international macro lacking the present structure squeeze an orthodox M-F structure to cope with oil-price shocks just by making wild assumptions about demand elasticities.

\(^3\) The reader should notice that we used a full-information neoclassical marginal-productivity approach to formulate the income-distribution problem inherent to any shared production process. Instead, we could have used other assumptions like a markup approach to final-goods pricing or outright cheating (pilfering and shirking) schemes undertaken by both producers and consumers under imperfect information and imperfect competition. This would require more structure at the household side, namely a principal agent model. In the present context the income-distribution problem appears at the international level but has been assumed away at the national level.
effects are only a consequence of a broken value-added chain. Moreover a devaluation exerts a direct cost-push effect for locally produced output, besides a presumable small demand side effect if $0 < \sigma < 1$. Thus, compared to the traditional analysis a devaluation affects the CPI directly, i.e. in addition to the share of imported consumption goods which helps explain the J-curve effect. While empirical estimates do not suggest a reversal of the traditional result for industrial countries, i.e. expansionary income after a devaluation, the empirics of devaluation should be improved a lot if estimations would be organized along the Gylfason-Schmid criterion.
References


Three flow charts
alternative structures in open economy macroeconomics

Assumptions:

- all circuits are strictly physical
- representative production / household agents
- one/two final goods, two factors of production

**Mundell-Fleming**

\[ Q = Y \]

\[ PU \] \[ L \] \[ HH \]

normal production

\[ Q = Y \]

**Anti-Mundell-Fleming**


\[ Q \neq Y \]

\[ PU \] \[ L \] \[ HH \]

shared production

**Hybrid Mundell-Fleming**


\[ Q \neq Y \]
Figure 1.b

Anti-M-F structure with domestic production of materials

\[ Q \neq Y \]

\[ N - \overline{N} > 0 \]
Figure 2

The broken value-added chain:

Y (national income) ≠ Q (output)

\[ Y = Q - \frac{P_N}{P} [N - Q_N] \]

or: output value equals income paid to domestic and (imported) foreign factors of production

\[ Q \]

with \( NIM = \frac{P_N}{P} [N - Q_N] \) real import of material

Endowment model

\[ Y = Q - \frac{P_N}{P} [N - \bar{N}] \]

\( \bar{N} \geq 0 \) domestic endowment of material (natural resources)
Figure 3

Microfoundation of shared production
H. G. Johnson diagram (endowment model)

\[ N = \beta L \]

\[ f = \text{const} \]

\[ R = \text{const.} \]

\[ Y^a = Q^a \]

\[ Y^a = \text{const.} \]

\[ \frac{N}{L} \]

\[ \frac{W}{P_N} = \frac{w}{p^a_N} \]

\[ \alpha \]

\[ \beta^r \]

\[ \beta^a \]

Factor intensity

\[ \tan \alpha = \frac{N}{L} \]

Factor price relation at free trade

\[ \tan \beta^f = \frac{W}{P_N} = \frac{w}{p^a_N} \]

Factor price relation in autarky
The Föhl diagram is valid for both a linear homogeneous processing function $Q = F(N, L)$ and a fixed coefficient production function.

Note: The Föhl diagram assumes fixed factor prices $p_N$ and $w$ but unlimited supply of factors of production.

Note: The dashed line which splits national income $Y = wL + p_N \bar{N}$ between labor income and natural resource income must coincide with the 45° line if $\bar{N} = 0$. 

Figure 4

International income distribution with shared production

C. Föhl diagram
The Anti-M-F Model: Keynesian closure assumption: balanced vertical trade

\[ Q = \frac{1}{1 - \theta_N} Y \]

credit market (Keynesian mode)
Commodity (oil) price shock in the Anti-Mundell-Fleming model

initial equilibrium at E implies balanced trade

new equilibrium at E' implies trade deficit BA'
Devaluation in the Anti-M-F Model

The case of contractionary devaluation

Figure 7

Devaluation in the Anti-M-F Model

The case of contractionary devaluation

\[
\frac{m_N}{s + m_N} \left( \eta^* + \sigma - 1 \right) > 0 \quad \text{if} \quad (\eta^* + \sigma - 1) > 0
\]

\[
\frac{m_N}{s + m_N} \left( \sigma - 1 + \eta^* (1 - \theta_N) \right) < 0 \quad \text{if} \quad \sigma - 1 + \eta^* (1 - \theta_N) < 0
\]
The domestic factor ("labor") market

Employment and commodity price increase

\[ w = \frac{W}{P} \]

real wage

The diagram portrays the special case from (39):

\[ \hat{L}/\hat{P}_N = 0 \quad \text{if} \quad \sigma - \alpha = (\eta^* - \alpha)\theta_N \]
Open economy: Mundell-Fleming structure

based on Blanchard (2000)

\[
\begin{align*}
\frac{EA}{EO} &= \text{export share} \\
\frac{BA}{EO} &= \text{import share} \\
\frac{EB}{EO} &= \text{trade balance} \\
\end{align*}
\]

\[
Y = [\bar{C} + \bar{I}] + (c - m)Y + [\bar{X} - \bar{M}]
\]

\[
sY - [\bar{C} + \bar{I}] = [\bar{X} - \bar{M}] - mY
\]

Credit market of a Keynesian open economy
Equilibrium of the Hybrid-Mundell-Fleming Model

assumptions:
- balanced overall trade account $X-[FIM+NIM]=0$
- $FIM = NIM = 0$

Figure 10

The credit market in a Keynesian open economy
List of Textbooks, which cover the oil crisis of the 1970s (or not!!)

Top Ten Macro Texts


Top Five Texts in International Economics


Advanced Textbooks in International Macroeconomics