#### CHAPTER II

# DEFINITIONAL, INSTITUTIONAL AND TECHNICAL RELATIONS

#### A. THE BALANCE OF PAYMENTS

As long as the gold standard with a fixed proportion of sterling to gold prevails, exchange rates may be considered as given constants and the balance of payments equation may be considered as an equation determining the inflow  $A\dot{u} + \Delta M^c$  (or outflow) of gold 1). The equation will be given a simplified form, where shipping earnings, commissions and all dividends and interest have been combined in one term: income from abroad,  $I^A$ . Exports are, in our notation,  $U^e + V^e$ , and imports  $U^i + X^i + Y^i$ ; capital exports are indicated by  $K^e$ . The equation therefore runs:

$$U^e + V^e + I^A = U^i + X^i + Y^i + K^e + A\dot{u} + \Delta M^c$$

which will be given the form:

(II 1) 
$$Aii = U^e + V^e + I^A - (U^i + X^i + Y^i + K^e) - \Delta M^c$$

A statistical test is superfluous since the figures for  $K^e$  have been determined by Hobson<sup>2</sup>) from this equation and since no unknown coefficients appear in it.

# B. BALANCE AND TECHNICAL EQUATIONS FOR LABOUR

### II 2. BALANCE EQUATION FOR LABOUR

This equation simply expresses that

$$(II 2) \qquad a = b + c$$

or: total employment equals employment in investment goods industries plus employment in consumers' goods industries.

# II 3/4. TECHNICAL EQUATIONS FOR LABOUR

(i) Theoretical. The amount of labour applied in each year depends on the production plans of employers and is therefore intimately connected with the volume of production. The pure theory of this connection is very complicated. For our purposes the following treatment seems to be sufficiently accurate. By definition we have:

$$b=g'v$$
 and  $c=gu$ ,

The symbol  $A\dot{u}$  is used to indicate the rate of increase during any year, of Au; hence  $A\dot{u}=(dAu/dt)$ .

<sup>2)</sup> The Export of Capital, London 1914.

where  $\overline{g}$  and  $\overline{g'}$  are the inverted labour productivity in the consumers' goods industries and the investment goods industries respectively. Any discussion on the technical relations now considered may therefore be given the form of a discussion on labour productivity. We may even go one step further and take from observation that there is, for the short fluctuations, a very high correlation between  $\overline{b}$  and  $\overline{v}$ , and between  $\overline{c}$  and  $\overline{u}$ . In formulae this means:

$$b=\beta v,$$
  $c=\gamma u.$ 

Such a relation does not exclude trend movements or cyclical fluctuations in labour productivity. Trend movements, however, do not interest us in this study. And if  $\beta$  differs from  $(\bar{b}/\bar{v})$  even the short-run changes in  $\bar{b}$  are non-proportional to  $\bar{v}$ , and labour productivity may be higher or lower than normal in depression periods. The expression  $(\beta/\bar{v})\bar{b}$  may, in analogy to similar concepts, be called the elasticity of employment with respect to output. For a number of separate industries in various countries in pre-1914 periods, the correlation just mentioned holds good and nearly always yields elasticities below one, as is shown by table II 3:

TABLE II 3

Elasticities of employment with respect to output

Country and period	Investment goods industries	Elast. 1)	Consumers' goods indust.	Elast. 1)
		The state of the s		NAME OF THE PARTY
U.S.A. post-war	investm. goods ind.	0.70	cons. goods ind.	0.87
Holland post-war	investm. goods ind.	0.70	cosn. goods ind.	0.84
Germany pre-war	iron ore (1882-1912)	0.68	lignite (1881—1912)	0.64
Germany pre-war			coal (1885-1908)	1.03
France pre-war	blast furnaces (1874—1911)	0.70	coal (1854—1878)	0.75
France pre-war			coal (1879—1913)	0.66
Belgium pre-war	blast furnaces (1845—1913)	0.86	railways (1862 — 1903)	0.66

The correlations found are so high, especially in post-war times—which may be the consequence of better statistics, but also of a sharper reaction of entrepreneurs—that all further influences acting on labour productivity may be considered as corrections to this primary relation, and in most cases even as small corrections.

The primary relation may be called, from a theoretical point of view, the automatic adaptation of labour to output. Apart from that there may be "spontaneous" changes in labour productivity, brought about by the introduction of new methods of production. This introduction will be largely influenced by

These elasticities have been determined on the basis of diagonal regression equations between the variables b and v or c and u.

- (i) new inventions, occurring independently of the economic situation;
- (ii) the pressure of "the economic situation". This may be the relation between wage rate and machine cost—as is supposed in most theoretical considerations about the subject—or simply the profit situation. It would seem that the ratio of wage rates to machine cost—leading, when high, to replacement of workers by machines—would work out only very gradually since machines are durable goods and cannot all be replaced at one moment. Simple increases in labour intensity may, on the other hand, be more obtained quickly and especially in bad times. This is what was in fact found to be the case in a number of branches, especially mining, but also in industry as a whole <sup>1</sup>).
- (ii) Statistical. It is, however, doubtful whether our rather rough figures admit of the detection of these more subtle peculiarities of the relation considered. Therefore only the primary relation was assumed to exist. For investment goods it proved to exist even fairly exactly. The coefficient found was, however, only 0.20, corresponding to an elasticity of about 0.5. This low figure may point either to a higher rate of "overhead labour" or to a more social attitude of employers in a depression or finally to a compensation by shorter hours in a depression and over-time in booms. Thus, equation II 3 runs:

(II 3) 
$$b = 0.20 v$$

For consumers' goods direct employment figures are so scanty that it has been thought better to construct them on the basis of the above type of relation found for investment goods, but choosing the coefficient so as to be in rough agreement with the only series of unemployment figures available, viz. those for "all other trades". A priori, one would expect the elasticity to be lower than in investment goods industries, since retail trade and other services probably show a considerable proportion of "overhead labour". The coefficient chosen corresponds to an elasticity of 0.40, which is in fact somewhat lower than that found for investment goods. Nevertheless it is very uncertain as long as no better statistics are available. The relation between c and u would therefore be

$$c/\bar{c}=0.4 u/\bar{u}$$

which, for the average values of the nine-year averages for 1883 and 1904:  $\bar{c} = 506$  and  $\bar{u} = 1439$ , yields:

$$(11 4) c = 0.14 u$$

The low figures found for the elasticities remain rather remarkable; and it will be worth while carefully to investigate their influence on our model. This influence turns out to be very slight, however. A doubling

<sup>1)</sup> Cf. De invloed van de arbeidsproductiviteit op de conjunctuur, De Ned. Conjunctuur, March 1934, p. 13.

of the elasticity does not even change the course of cycles at an appreciable rate 1).

# C. BALANCE EQUATIONS FOR COMMODITIES

#### II 5. CONSUMERS' GOODS

For finished consumers' goods stocks were not considered separately, i.e. consumption includes increase in stocks of those goods. Although this was simply a statistical necessity it may be defended by pointing to the rather quiet developments in most of the corresponding branches. Moreover it may be mentioned that in the "explanation" of this "apparent consumption" such factors are included as might especially be held responsible for the formation of stocks <sup>2</sup>).

Under these circumstances the balance equation for consumers' goods takes the simple form of

$$(II 5) \qquad u = u' + u^e - u^i$$

#### II 6. INVESTMENT GOODS

Investment goods mainly belong to one of two classes: iron and steel manufactures and buildings. Smaller items are disregarded. As a measure of consumption of investment goods (v') we take Mr Cairneross' estimate of the consumption of pig iron (which includes an estimate of scrap consumption, and excludes iron in exports) plus the imports of sawn and hewn timber (average of year under consideration and preceding year). This average was taken in order to account for changes in stocks. In a number of cases where stock figures exist, this was found to be fairly exact (cf. the fuller treatment of this question in section III 1). For timber there was an indication in this direction in so far that this two-year moving average showed a far better inverted correlation with unemployment in the building trades than do the rough import figures. As a measure of production we take the same quantities except that consumption of pig iron from stocks is excluded and that the exports of investment goods are added. Indicating by  $\dot{w}^I$  the rate of increase in stocks of pig iron during the year (December 31 minus previous December 31), we therefore get:

$$(II 6) v = v' + v^e + \dot{w}^I.$$

Since this is an identity, there is, as in the previous case, no need for statistical testing or graphical representation.

# D. VALUE EQUATIONS

There is a simple relation, for each commodity, between quantity, price and aggregate value, which is here given a linear form. For small

<sup>1)</sup> This may be calculated with the help of the methods developed in chapter VIII.

<sup>&</sup>lt;sup>2</sup>) Cf. section III 1.

deviations this form is sufficiently accurate. The exact form for the value (U') of consumption of consumers' goods is:  $\overline{\bar{U'}} = 0.01$   $\overline{\bar{u}}$   $\overline{\bar{p}}$  or  $100 \ (\bar{U'} + U') = (\bar{u'} + u') \ (\bar{p} + p) = \bar{u'} \ \bar{p} + \bar{p} \ u' + \bar{u'} \ p + p \ u'.$ 

Since

$$100 \ \bar{U}' = \bar{u}' \, \bar{p}$$

and since we neglect products of deviations (p u'), we get:

$$100 U' = \bar{u}' p + \bar{p} u'.$$

Since the average values  $\bar{p}$  and  $\bar{u}'$  are 199 and 1528 respectively, we have:

(II 7) 
$$U' = 0.99 u' + 15.3 p$$

In complete analogy we have:

(II 8) 
$$U^e = 0.90 u^e + 1.80 p^e$$

(II 9) 
$$U^i = 1.10 u^i + 1.65 p^i$$

(II 10) 
$$V' = 0.87 v' + 1.49 q$$

(II 11) 
$$V^e = 0.86 v^e + 1.41 q$$

(II 12) 
$$X^i = 0.95 x^i + 2.01 r^i$$

(II 13) 
$$Y^i = 0.77 y^i + 0.59 s$$

Equation (II 10) has, however, been obtained by correlation analysis, since V' (and v') are composed of two parts (metal products and buildings) and the "price of buildings"—which, for the sake of simplicity has not been introduced as a separate variable—shows a considerably more stable course than that of metal products. Since, nevertheless, the price of metal products q has been taken to represent investment goods as a whole, the coefficient before q has to be taken smaller.