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AN APPROPRIATE SYSTEM FOR DEFLATION OF NATIONAL  
INCOME IN A DEVELOPING ECONOMY WITH  
ILLUSTRATION OF VALUATION OF THE PRODUCT  
OF THE INDUSTRIAL SECTOR OF INDIAN  
ECONOMY FROM 1950-51 to 1962-63.

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An Appropriate System for  
Deflation of National Income in a developing Economy with  
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By P. N. Mathur.

Introduction

The technique of national income accounting is primarily a part of what Hicks has termed as "The Fixprice Method".<sup>1</sup> "When prices are constant", writes Sir John, "quantities of goods and services can be added by adding their money values; money values becomes volume indexes. By its own inner logic, and without any deliberate decision having been taken to slew it in that direction, the model becomes a macro model. The fixprice method has an inherent tendency to go macro".<sup>2</sup>

Deflation is an attempt to approximate a real economy to a fixprice economy so that the techniques developed for analysing a fixprice system can be used. But, what price structure should be chosen to convert an economic series from actual changing prices to the one approximating a system having fixprices? The usual method is to deflate the whole series to a historically given price structure. The point to consider is whether that historically given price structure of the base period reflects the scarcity or constraints of a growing economy. For, then/<sup>and</sup>only then the fixprice system will prove to be analytically useful. (See appendix).

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1 J.R.Hicks, Capital and Growth, Oxford University Press, 1965

2 Hicks ibid p. 78.

## 2. Fixprice Structure with Stable Technology

If at the base period, the economy had been in a state of stationary equilibrium (or in a steady state of growth) the base period price structure would have reflected the technological complex corresponding to the then prevalent stationary state. It is ideal to deflate an economic series from the actual market prices of an economy to the price structure corresponding to the above base if the basic technological complex remain the same over the relevant period. This will iron out all the price variations due to transient market forces delineating the progress of an economy in the terms of its basic structure.

If there is no such historical period in which the economy has been in a stationary state, the corresponding price system will not be available as a historical datum. In that case, the best thing to do would be to construct one with the help of a given technological relations. To take any year as a base period and take the price relations prevailing in that year as the norm to deflate the national income would be arbitrary. For as pointed out above, the prevailing price system in any year, which is not in a stationary equilibrium, will be effected by transient market conditions, distortions due to monopoly practices etc., and will thus, not reflect the basic economic conditions.

But, as is well known, the technological relation by themselves are not able to determine the price-structure uniquely.<sup>3</sup>

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3 For fuller discussion see author's, "A Modified Leontief Dynamic Model and Related Price System" Econometric Annual of the Indian Economic Journal 1965.

There remains, what R. Frisch has aptly termed, one degree of freedom. That is to determine the price structure uniquely, it is necessary to fix either wage rate or profit rate for the economy. Emperically that may not pose an insuperable difficulty provided profit rate has been stable in the economy. If not, the analytical tools depending on fixprice methods are suspect.

### 3. Fixprice for a Developing Economy

In a developing economy the problem seem to be more intractable for not only the profit rate is likely to be much more instable in a developing economy, but the underlying technological base of the economy will also change significantly. In fact the development of an economy is primarily to change the economy from one technological complex to another, more efficient, one. The process of development consists mainly in accumulating the capital equipment necessary for the working of modern technological complex. In a developing economy two types of techniques of production - traditional and modern - exist side by side. In the process of development the modern technological complex increases in the economy.

Thus it is clear that the technological complex underlying the production in the developing economy will be constantly changing, until and unless, the whole of the labour force is employed with the capital of the modern vintage. The point to consider is whether in such circumstances any analytical tool based on fixprice method can be useful at all. And if the answer is in the affirmative, what then is the price structure which should be used in the evaluation the national product or the components

thereof? According to Hicks, "When the price ratios that are appropriate to the new equilibrium and the old are not the same, a corresponding 'fixprice' policy would presumably imply that prices are adopted at once (or sought to be adopted at once) to the new equilibrium".<sup>4</sup> He further says, "The stationary equilibrium could only be stationary because its continuance was expected; the change in technology was not expected. The new values that were set (or should have been set) were based on an expectation of permanence of the new technology".<sup>5</sup> Thus we see that Hick's answer to our question is that the fixprice methods may be useful in a developing economy, and the price structure adopted for that should be that corresponding to the new technology. We may consider Hicks to be over optimistic in so far as he thinks that the new price system will be 'adopted at once' or even 'will be sought to be adopted at once'. His important contention may be taken that prices 'should have been set' corresponding to the new technological complex.

The primary use of a price system is to give guidance for resource allocation. This is accomplished by putting a valuation on scarce resources and their products denoting the intensities of scarcity. When a new technological complex appears at the horizon, the problem of resource allocation throws itself up mainly in relation to it. After that there remains no question about the investment in the old technology. The new price system

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4 Hicks, ibid p. 196.

5 Hicks, ibid p. 305.

based on the new technological complex should be the guiding  
<sup>6,7</sup>  
 star.

Even after deciding that price system should be one relating to the new technological relations, to determine the price structure uniquely it is necessary to find out the relevant profit rate, or the wage rate. As the price system should reflect the implications of the "factor" scarcities, the problem boils down - to put it in known terminology - to find out the opportunity cost of different factors during the process of development. As we have already seen, the process of development consists mainly in accumulating the capital equipment of the modern vintage. For that labour is not the limiting factor, until the time the whole of labour force starts working on the new technology. The labour required on the new capital equipment can always be got transferred from that working with the capital of the older vintage and/or that which has been unemployed or underemployed previously. Thus, as far as, the growth of modern technological complex within the economy is concerned the opportunity cost of labour should be put as equivalent to zero. Thus it will be the prices derived from a capital theory of

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- 6 This should automatically lead to the revaluation of existing fixed capital goods also, as the relative unsuitability of the old equipment to the new technology should lead to a fall in its value.
- 7 This should be the guide line even for the working or closing the firms having capital of the older vintage. However, how long should an old firm should continue will depend not on relative price structure, but the rate of interest. For detailed discussion see author's "Interest Rates in a Developing Economy" (to be published).

value for the new technology that will be most appropriate. By the capital theory of value we may understand that the price system is such as would be prevalent if all the other factors except capital are available at zero price. Only shadow prices determined on this hypothesis are the ones that are relevant for taking decisions for the growth of the modern sector on the economy, which is in the process of transformation from the traditional economic system to the modern one.<sup>8</sup> This is the price system, which is the appropriate one if fixprice method of analysis is to be used. In other words, a constant price national income series in a developing economy should be expressed in the price system derived as above rather than in any historically given one. This is the price system in which components and aggregates of national income should be expressed.

#### 4. Calculation Procedure of the Appropriate Fixprice Structure

From the criteria discussed in the preceding section the fixprice structure for a developing economy A can be derived as follows. Let A be the Input-Output flow matrix corresponding

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8 It will be clear that such a price system will be purely of an accounting character. It can never be actually prevalent in the economy irrespective of the competitive character of the economy. It can only prevail if whole of the labour force is subsidised by the central planning authority and then free competition prevails in equalising the rate of return to all the entrepreneurs engaged in production with the technology of the modern vintage. This highlights vividly the different price systems that should govern the actions of individual entrepreneurs and the planning authority in a country experiencing technological transformation. In such circumstances a pure *laissez-faire* is not likely to deliver goods, nor a controlled economy unguided by the shadow price system described above.

to the modern sector (new technological complex) of the economy. And let B be the corresponding capital coefficient matrix, of which the element  $b_{ij}$  will represent the amount of commodity i required for creating an unit capacity for the production of commodity j. Then if P is the price vector, then PB will give a vector of capital costs for the individual sectors of the economy. The value added in individual sectors is given by  $P(I-A)$ . From the viewpoint of the capital theory of value, this should be proportionate to PB. As pointed out earlier, it is only the capital theory of value that is relevant for deriving appropriate fixprice structure for a developing economy. Let r be this proportionality factor. Then we get

$$P(I-A) = rPB \quad \text{or} \quad P \left[ (I-A) - rB \right] = 0$$

$$\text{or, } P(I-A) \left[ I - (I-A)^{-1} rB \right] = 0 \quad \dots (1)$$

This shows that  $Z \equiv P(I-A)$  is an eigen row vector of the matrix  $(I-A)^{-1} B$ . As Z denotes the value added, it must be non-negative in all its elements. By Frobenius Theorem, it will be true for the eigen row vector corresponding to the greatest eigen value only. Thus the vector Z is uniquely determined determining P the price vector in its turn. The corresponding r will give the common Value <sup>Added</sup> / capital ratio.

##### 5. An Appropriate Fixprice Structure for Industrial Sector of Indian Economy

The above method enables us to calculate the appropriate fixprice structure for different commodity groups that are distinguished in an input-output table. For India an Input-Output table for the year 1959 has been prepared by the



Economics Division of the Planning Commission which distinguishes 21 different industrial commodity groups, including transport. The coefficients in it have been derived from the data thrown up by Annual Survey of Industries for the large scale sector. They can be taken as pertaining to the modern technological complex of the industrial sector. Corresponding to this, we at Gokhale Institute have prepared a capital coefficient matrix.<sup>9</sup> With the help of these two tables, we have calculated the appropriate fix-price structure for the Indian Economy. These are given in table No. 1. These give the percentage adjustment necessary to 1959 prices to arrive at the appropriate fixprice system. These have been normalised in such a way that the total output for the year 1959, when calculated by using these prices will be equal to the total output calculated by using the prevalent market prices in 1959. The proportion that different commodity groups form of the total output is also given in the same table. Table No. 2 gives the total output of various commodity groups in 1959 constant prices over the years 1951 to 1965. Corresponding figures in fixprices are given in Table No. 3. Output of each group for each year have been estimated by the help of the relevant index number of sectoral industrial production prepared by C.S.C. and the output for 1959 is taken from the Input-Output table.

Table No. 4 gives the yearly growth rate of industrial output calculated with these two price systems. It will be seen

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9 "An Inter-Industry Capital Table for India - First Approximation", by P. N. Mathur, presented at Input-Output Seminar, Poona 1965.

that the average growth rate during the last five years turn out to be more than that surmised on the basis of constant price series, though there is not much difference in pre 1958 growth rates. This signifies that it is mainly after 1958 that the structure of industrial production have become significantly growth oriented and now we are able to sustain a much higher rate of industrial growth than was possible before 1958.

#### 6. Deflation of Value Added

Once the fixprice-structure is given the proportion of the value added to the value of total output is fixed if underlying technological complex remains the same. But as pointed out above, in a developing economy, it is this technological complex that will be changing from year to year as the proportion of the capital of the modern vintage will go on increasing over years. This implies that the proportion of value added to the total output at the fixprice system described above is to be calculated every year for constructing a series of value added in each commodity group at fixprices. It will be seen that the total value added thus derived will be equal in each year to the total value of commodities available for use in the final demand at fixprices. This is a very important requirement that must be satisfied by all deflation schemes for their being analytically useful.

The construction of this requires the availability of average Input-Output tables of the economy for each year, so that differences in the proportion of value added due to technological change can be estimated. Unfortunately no average Input-Output

table is available for India. In the Input-Output table prepared by the Economic Division of the Planning Commission for the year 1959, the input coefficients for the manufacturing sector were derived from the data available for the large scale sector, from the census part of Annual Survey of Industries and the same coefficients were applied to the total output of the sectors to derive the total inputs. Therefore, this table cannot be taken as an average one for the purpose. Thus at present it is not possible to deflate the value added series in this manner due to the paucity of relevant information.

However, for the present paper, we have constructed a series of value added according to industrial origin in fix-<sup>10</sup> prices, on the assumption that the Input-Output table prepared by the Planning Commission is an average table and the average structure have remained the same. This is given in Table 5. As pointed out above, both these assumptions are very tenuous in our circumstances which leaves the series more as an illustrative exercise rather than a substantive piece. It can be considered only a counterpart in fixprice system of the usual constant price series, where the net value added is carried forward by an index of industrial production. Both involve the assumption of constant ratio of value added to total production during the relevant period, which is unlikely to be satisfied in the context of a developing economy.

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10 The fixprice system has been only derived for industrial sector. The shadow prices of other sectors have been taken as zero.

TABLE NO. 1 : Appropriate Fixprice Structure of Industrial Sector 1959.

Sr. No.	Commodity	Appropriate Fixprice Structure	1959 Production at Market Prices.	1959 Production at Appropriate Fixprices	Percentage of 1959 production at market price.	Percentage of 1959 production at Appropriate fix-prices.
I	II	III	IV	V	VI	VII
1	Coal	0.548434	94.9	52.046306	1.707879	0.9366
2	Iron ore and Iron & Steel	1.683783	243.3	409.664522	4.378577	7.3725
3	Other Minerals	0.678056	61.7	41.835980	1.110391	0.7529
4	Other Metals	1.109715	18.6	20.640769	0.334737	0.3715
5	Non-Electrical Equipments	1.049073	318.9	334.549609	5.739121	6.0207
6	Electrical Equipments	1.032469	101.8	105.105193	1.832056	1.8915
7	Transport Equipments	0.966744	237.9	229.988376	4.281395	4.1390
8	Chemicals	0.917944	212.0	194.604138	3.815283	3.5022
9	Petroleum & Crud Oil	1.283788	72.0	92.432745	1.295756	1.6635
10	Fertilizers	0.190709	25.6	81.682172	0.460713	1.4700
11	Cement	1.449592	44.4	64.361937	0.799050	1.1583
12	Glass, Wood, Non-metallic etc.	1.119183	180.9	202.460217	3.255588	3.6435
13	Food Industry	0.404913	1451.0	587.528197	26.113091	10.5734
14	Cotton & Other Textiles	0.760956	852.6	648.791246	15.343916	11.6760
15	Jute Textiles	0.541014	161.7	87.481861	2.910053	1.5744
16	Leather & Rubber Products	0.500473	153.6	76.872791	2.764280	1.3836
17	Paper & Products	1.468730	130.3	191.375537	2.344959	3.4441
18	Electricity generation	2.838343	124.6	353.657421	2.242378	6.3646
19	Other Industry	0.942413	100.7	94.900982	1.812259	1.7079
20	Railway Transport	2.256079	426.5	962.217488	7.675557	17.3166
21	Road Transport	1.332629	543.6	724.417144	9.782961	13.0372
			5556.6	5556.614631	100.000000	100.0000

TABLE NO. 2

## 1 Production at 1959 Constant Prices.

(in crore rupees)

Nb*	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965
1	69.2	72.4	72.1	74.1	77.1	79.5	87.7	91.5	94.9	104.4	111.4	122.2	132.8	127.0	137.1
2	146.4	151.9	143.3	165.7	167.1	173.7	171.6	182.0	243.3	333.6	326.5	411.1	468.0	470.4	487.6
3	43.7	46.2	45.5	46.9	48.8	50.3	55.1	58.3	61.7	69.0	74.1	81.1	88.5	85.0	91.9
4	11.3	11.0	10.5	13.2	13.9	14.1	14.5	16.2	18.6	20.5	21.8	28.3	30.4	30.7	30.6
5	77.6	61.3	64.7	98.7	142.9	171.6	222.3	254.5	318.9	406.3	461.2	503.2	625.6	704.7	843.6
6	33.3	37.7	39.8	44.6	54.9	76.3	90.5	95.1	101.8	134.2	139.8	161.3	181.4	215.3	240.2
7	111.6	96.1	100.7	119.8	176.9	242.0	255.1	231.1	237.9	289.0	316.6	366.4	365.2	466.1	502.7
8	117.9	126.8	135.4	136.6	155.7	161.7	162.5	188.2	212.0	238.8	253.5	311.5	383.6	366.3	386.2
9	3.5	3.3	3.4	9.0	42.3	54.4	62.2	66.7	72.0	80.3	85.1	92.0	106.9	118.1	123.9
10	4.4	11.4	15.9	18.8	20.1	20.4	22.0	23.2	25.6	28.2	36.2	40.0	46.4	51.2	53.1
11	20.8	23.0	24.6	28.6	29.2	32.1	36.4	39.5	44.4	50.2	52.8	55.0	59.9	62.0	66.9
12	79.8	85.6	87.0	99.1	108.4	123.9	142.0	159.5	180.9	208.3	224.0	272.8	253.5	267.3	286.2
13	1044.1	1097.8	1061.1	1063.7	1212.9	1308.4	1397.4	1414.4	1451.0	1564.8	1717.9	1702.2	1640.7	1823.9	1973.0
14	651.7	672.4	733.9	757.1	775.4	830.2	836.0	819.4	852.6	877.5	924.0	946.4	1008.7	1083.4	1427.9
15	129.6	139.5	131.1	139.5	153.8	164.5	155.8	160.0	161.7	163.3	147.4	181.6	192.8	199.0	207.1
16	101.3	90.7	94.6	110.4	120.7	131.1	135.6	140.8	153.6	187.0	203.3	218.9	242.3	255.2	280.6
17	59.6	62.0	64.6	72.9	85.9	89.6	98.1	114.1	130.3	155.4	163.0	170.8	203.2	213.1	221.5
18	50.1	52.4	56.8	63.7	72.5	82.2	92.8	104.8	124.6	140.7	163.6	183.9	212.2	243.5	264.4
19	63.5	65.5	67.2	71.8	79.4	86.4	90.0	92.7	100.7	112.5	120.3	130.8	141.6	151.0	159.7
20	294.7	273.5	273.3	289.7	319.7	350.3	387.1	392.3	426.5	462.0	505.4	574.6	632.8	640.8	705.8
21	301.5	309.4	336.7	364.2	384.4	438.6	454.3	490.2	543.6	576.9	617.3	684.6	784.8	N.A.	N.A.
	3415.6	3489.9	3562.2	3788.1	4242.0	4681.3	4669.0	5134.5	5556.6	6202.9	6695.2	7238.7	7801.3	7574.0*	8490.0*

N.A. = Not Available

\* = Sum of first twenty sectors.

\*\* = Serial Nos. of Commodities are same as Table No. 1.

TABLE NO. 3 : Industrial Production At Fixprice Structure.

(in crore rupees)

**	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965
1	37.9	39.7	39.5	40.6	42.2	43.6	48.1	50.1	52.0	57.2	61.0	66.9	72.8	69.6	75.1
2	246.5	255.9	241.3	279.0	281.3	292.4	288.9	306.5	409.7	561.8	549.8	692.2	788.1	792.2	821.2
3	29.6	31.3	30.8	31.7	33.1	34.1	37.3	39.5	41.8	46.7	50.2	54.9	59.9	57.6	62.2
4	12.5	12.2	11.6	14.6	15.4	15.6	16.0	17.9	20.6	22.7	24.2	31.3	33.6	34.0	33.9
5	81.4	64.3	67.9	103.5	150.0	180.0	233.1	267.0	334.5	426.1	483.7	527.9	656.2	739.2	884.9
6	34.4	38.9	41.1	46.0	56.6	78.8	93.4	98.2	105.1	138.6	144.3	166.5	187.3	222.3	248.0
7	107.9	92.9	97.3	115.8	171.0	234.0	246.6	223.4	230.0	279.4	306.0	354.2	353.1	450.6	486.0
8	108.2	116.4	124.2	125.4	142.9	148.4	149.2	172.8	194.6	219.2	262.2	285.9	352.1	336.2	354.5
9	4.5	4.2	4.4	11.5	54.2	69.8	79.8	85.6	92.4	103.1	109.2	118.1	137.2	151.6	159.0
10	14.1	36.4	50.7	59.8	64.0	65.0	70.3	74.0	81.7	90.0	115.4	127.6	148.0	163.4	169.4
11	30.1	33.4	35.7	41.5	42.3	46.5	52.8	57.2	64.4	72.9	76.6	79.7	86.9	90.0	97.1
12	89.3	95.8	97.4	111.0	121.4	138.7	158.9	178.5	202.5	233.2	250.8	305.4	283.8	299.2	320.4
13	422.7	444.5	429.6	430.7	491.1	529.8	565.8	572.7	587.5	633.6	695.6	689.2	664.3	738.5	798.9
14	495.9	511.7	558.5	576.1	590.0	631.7	636.2	623.5	648.8	667.8	703.1	720.2	767.6	824.4	1086.6
15	70.1	75.5	70.9	75.5	83.2	89.0	84.3	86.6	87.5	88.4	79.8	98.3	104.3	107.7	112.1
16	50.7	45.4	47.4	55.2	60.4	65.6	67.9	70.5	76.9	93.6	101.8	109.6	121.3	127.7	140.5
17	87.5	91.1	94.9	107.2	126.2	131.6	144.1	167.6	191.4	228.3	239.4	250.9	298.6	313.0	325.4
18	142.3	148.8	161.2	180.8	205.8	233.6	263.5	297.6	353.7	399.5	464.4	521.9	602.5	691.3	750.6
19	59.9	61.7	63.3	67.7	74.9	81.5	84.9	87.3	94.9	106.0	113.4	123.2	133.4	142.3	150.5
20	664.8	617.0	616.7	653.6	721.4	790.3	873.4	885.1	962.2	1042.3	1140.2	1296.2	1427.7	1445.8	1592.3
21	401.8	412.2	448.6	485.3	512.2	584.4	605.5	653.2	724.4	768.8	822.6	912.2	1045.8	N.A.	N.A.
	3192.1	3229.3	3333.0	3612.5	4039.6	4484.4	4800.0	5014.8	5556.6	6279.2	6793.7	7532.3	8324.5	7796.6	8668.6*

N.A. = Not available

\* = Sum of first twenty sectors.

Serial nos. of commodities are same as table No.1.

Table 4 : Yearly Industrial Growth Rate from 1951 to 1963

From	1951	1952	1953	1954	1955	1956	1957	Aver- age yearly growth rate	1958	1959	1960	1961	1962	Aver- age yearly growth rate
To	1952	1953	1954	1955	1956	1957	1958		1959	1960	1961	1962	1963	
At Appro- priate Fix- prices	3.54	3.20	8.25	11.41	10.84	6.80	4.69	6.96	11.32	15.44	9.09	10.27	9.82	11.19
At Constant 1959 prices	3.14	1.74	5.93	12.32	10.60	6.04	3.03	6.11	7.87	12.57	7.06	8.20	6.75	8.49

Table 5: Gross Value Added (At Fixprice)

(in Crore Rupees)

**	11951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965
1	21.7	22.7	22.6	23.3	24.2	25.0	27.6	28.7	29.8	32.8	35.0	38.4	41.7	39.9	43.1
2	145.9	151.5	142.8	165.1	166.5	173.1	171.0	181.4	242.5	332.5	325.4	409.7	466.5	468.9	486.0
3	22.3	23.6	23.2	23.9	24.9	25.7	28.1	29.8	31.5	35.2	37.8	41.4	45.2	43.4	46.9
4	5.3	5.2	4.9	6.2	6.5	6.6	6.8	7.6	8.7	9.6	10.2	13.2	14.2	14.4	14.3
5	46.9	37.0	39.1	59.6	86.4	103.7	134.2	153.7	192.6	245.4	278.5	303.9	377.8	405.6	509.5
6	17.4	19.7	20.8	23.2	28.6	39.8	47.2	49.6	53.1	70.0	72.9	84.1	94.6	112.3	125.3
7	57.8	49.8	52.1	62.0	91.6	125.3	132.1	119.7	123.2	149.6	163.9	189.7	189.1	241.4	260.3
8	54.0	58.1	62.0	62.6	71.3	74.1	74.1	86.2	97.4	109.4	129.8	142.6	175.8	167.8	176.9
9	3.1	2.9	3.1	8.0	37.7	48.5	55.4	59.5	64.2	71.6	75.9	82.0	95.3	105.3	110.5
10	8.4	21.8	30.4	35.8	38.3	38.9	42.1	44.3	48.9	53.9	69.1	76.4	88.6	97.8	101.4
11	19.6	21.7	23.1	26.9	27.5	30.2	34.3	37.2	41.8	47.3	49.7	51.8	56.4	58.4	63.0
12	58.0	62.3	63.3	72.1	78.9	90.1	103.3	116.0	131.6	151.5	163.0	198.5	184.4	194.4	208.2
13	296.5	311.8	301.4	302.1	344.5	371.6	396.9	401.7	412.1	444.4	487.9	483.4	466.0	518.0	560.4
14	284.8	293.9	320.7	330.9	338.9	362.8	365.3	358.1	372.6	383.5	403.8	413.6	440.8	473.5	624.0
15	43.3	46.6	43.8	46.6	51.4	54.9	52.0	53.5	54.0	54.5	49.2	60.6	64.4	66.5	69.2
16	24.7	22.1	23.1	26.9	29.5	32.0	33.1	34.4	37.5	45.7	49.6	53.4	59.2	62.3	68.5
17	60.6	63.0	65.7	74.1	87.3	91.1	99.7	115.9	132.4	157.9	165.6	173.6	206.5	216.5	225.1
18	109.5	114.5	124.0	139.1	158.3	179.7	202.7	229.0	272.1	307.3	357.3	401.5	463.5	531.6	577.4
19	31.8	32.8	33.6	36.0	39.8	43.3	45.1	46.4	50.4	56.3	60.2	65.4	70.9	75.6	79.9
20	616.8	572.4	572.1	606.4	669.3	733.2	810.3	821.2	892.7	967.0	1057.8	1202.6	1324.6	1341.3	1477.3
21	317.7	326.0	354.7	383.7	405.0	462.1	478.7	516.5	572.8	607.9	650.5	721.3	827.0	N. A.	N. A.
	2246.1	2259.4	2326.5	2514.5	2806.4	3111.7	3340.3	3490.4	3861.6	4333.3	4693.1	5207.1	5752.5	5255.1*	5827.2*

Rates  
of  
Growth %

0.59 2.97 8.10 11.61 10.88 7.35 4.49 10.63 12.22 8.30 10.95 10.47

N.A. = Not Available.

\* = Sum of first twenty sectors.

\*\* = Serial Nos. of commodities are same as Table No. 1.



MATHEMATICAL APPENDIX

The suitability of the Appropriate Fixprice System for Macro-  
Analysis of a Developing Economy

Let A and B denote Input and Capital Coefficient matrices respectively. And let  $\bar{P}$  denote the Fixprice system appropriate for developing economies developed in the text. Then irrespective of the composition of the output vector X,

$$\bar{P} (I - a - \rho B) X = 0 \quad \dots\dots (1)$$

where  $\rho$  is the value-added-capital ratio which is same in each activity (industry) with  $\bar{P}$  price-structure. Let  $\pi_j$  be the rate of profit in j-th industry and  $\pi$  be the diagonal matrix having  $\pi_j$  as an element in its j-th row and j-th column. Further, let  $r_j$  be the rate of growth of the output of j-th industry and R be the diagonal matrix having  $r_j$  as an element in its j-th row and j-th column. Further, let  $S_c$  be the rate of savings of the profit earners and  $S_w$  that of wage earners.

The total profits earned will be  $\bar{P} B \pi X$  while the wages will be equal to the remaining output viz.  $\bar{P} (I - A - B \pi) X$ .

Therefore, the total savings of the economy will be  $\bar{P} (B \pi S_c X + (I - A - B \pi) S_w X)$ .

Further, the investment requirements for the output of j-th good to grow at the rate  $r_j$  ( $j=1, 2 \dots n$ ) is  $\bar{P} B R X$ .

For this to be equal to the savings of the economy

$$\bar{P} [BR - B \pi (S_c - S_w) - (I - A) S_w] X = 0 \dots (2)$$

$$\text{or, } \bar{P} [(BR - B \pi (S_c - S_w) - \rho B S_w - (I - A - \rho B) S_w] X = 0 \dots (3)$$

$$\text{But by (1) } \bar{P} (I - A - \rho B) X = 0.$$

Therefore (3) gives

$$\bar{P} B R X = \rho \bar{P} B S_w X + \bar{P} B \pi (S_c - S_w) X \quad \dots\dots (4)$$

Dividing both sides by  $\bar{P} B X$  the value of the total capital - in the economy, we get

$$\bar{r} = \rho S_w + \bar{\pi} (S_c - S_w) \quad \dots\dots (5)$$

where  $\bar{r}$  is the rate of growth of capital and  $\bar{\pi}$  is the rate of profit in the economy.

We know from (1), that

$$\bar{P}B = 1/\rho (\bar{P} (I-A) \dots \dots \dots (6)$$

Substituting this in (4), we get,

$$\bar{P}(I-A)RX = \rho \bar{P} (1-A) S_W X + \bar{P} (I-A) \pi (S_C - S_W)X \dots (7)$$

Dividing both side  $\bar{P} (1-A)X$ , the amount of value added in the economy, we again get eq. (5)

$$\bar{r} = \rho S_W + \bar{\pi} (S_C - S_W) \dots \dots \dots (5)$$

This means that  $\bar{r}$  and  $\bar{\pi}$  may as well be considered as average rate of growth of value added and average profit rate.

Equation (5) is the classical macro-economic equation of growth theory. If there is a common rate of savings in the economy, viz.  $S_C - S_W = S$ . This becomes  $\bar{r} = \rho S \dots (6)$  - the Harrod-Domar equation for growth rate.

Further, if the rates of growth and rates of profits are same in all the sectors of the economy, the equation (4) becomes

$$r\bar{P}BX = \rho \bar{P}BS_WX + \pi \bar{P}B(S_C - S_W)X \dots \dots \dots (8)$$

Dividing both side by  $\bar{P}BX$ , we get

$$r = \rho B_W + (S_C - S_W) \pi \dots \dots \dots (9)$$

While equation (5) refers to the rate of growth of capital or of value added, equation (8) gives the same relationships for the rate of growth of output.

The point to note is that the above simple relationships are based on the equation (1) above, which is true if and only if the price structure used for valuation is that derived from capital theory of value.<sup>1</sup>

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<sup>1</sup>This equation also holds if output structure is proportional to the Eigen column vector. But that condition will be rarely satisfied in practice. See author's op.cit., p. 334.

Further, it may be noted that if rates of growth and/or rates of profit are different for different industries the macro growth relation will hold good for capital goods or for value added but not for total output.<sup>2</sup>

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2

It may be noted that in the above demonstration not only rate of growth and profit rate can be taken different for different industries, but even rates of savings - both from profits and wages - can be taken as differing from industry to industry. In that case,  $S_c$  and  $S_w$  will have to be conceived as corresponding diagonal matrices. Further, matrices  $R$ ,  $\pi$ ,  $S_c$ , and  $S_w$  may be taken as full rather than only diagonal introducing interrelatedness between growth rates, profit rates and saving rates in different industries. None of these complications will distract from the main result.