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Dear Dr Narasimham,

I got your letter of August 6 as well as the one of May 21 and your article. I tried to ask the Faculty of the Rotterdam School of Economics about your eligibility but there was such a crowded program of discussions that I did not yet get the approval. I hope to be able to do so in September. You might meanwhile write a letter to the Netherlands Ministry of Education (Nieuwe Uitleg 1, the Hague) since they have to decide in this matter and will ask the School's advice. My stay in India has been postponed and we might therefore try to fix this matter by correspondence.

I want to thank you for your article and for the interest you took in my method. I am afraid there are some misunderstandings included, but it would certainly be interesting to discuss them with you in order to eliminate them. I may mention the most important ones briefly. At page 147 you assume the portion of national income going to workers to be 0.68 (indirect taxes expressed in total tax revenue). I am afraid I do not understand this at all and anyhow my guess would be that labour income in India might be lower because of the very large number of small independent employers.

On page 148 you mention figures for the marginal wage quota which I am afraid are very high indeed. I would assume them to be not more than $\frac{1}{2}$ and possibly quite a bit lower.

On page 149 your interpretation of the values found for government expenditure should be 0.4 % of national income which is rather much more than 0.4% of government expenditure.

On page 151 the last sentence of the first paragraph: "the former explanation holds in the case of positive solutions" is not correct.

These few points may illustrate that some important corrections would have to be made. Personally I am certainly willing to work with you; I shall let you know at my earliest possibility what the Faculty's opinion is.

Yours very sincerely,

Vragen Scheudnot agenda

PRICE-WAGE-TAX-SUBSIDY POLICIES

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With compliments
to
Professor Tinbergen

PRICE-WAGE-TAX-SUBSIDY POLICIES AS INSTRUMENTS IN
INCREASING OUTPUT*

BY

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SUMMARY

Following a method analogous to that adopted by J. Tinbergen for the Dutch economy, study has been made in the *first* part of this paper of likely structures of the Indian economy in respect of year-to-year changes in real national income within the last few years.¹ In the *second* part the bearing of these macro-dynamic economic structures on the role of price-wage-tax-tariff-subsidy policies in increasing immediately national output has been explained.

The main results of the present study are :

- (1) Inflationary forces are embedded in the very structure of Indian economy. Under present conditions, immediate expansion of output is possible mainly by employing increasing amounts of labour on the more or less fixed stock of capital, and this naturally causes productivity to fall, and costs and prices to rise. The great upward shift in post-war cost-price structure has to be attributed mostly to this structural deficiency.
- (2) An empirical examination of the view that foreign investment increases domestic output shows that it holds good for India, but the shift in domestic output brought about by such investment appears to be quite small.
- (3) Under the prevailing conditions in India, investment for immediate expansion of output necessitates a reduction in real expenditure of the community in the present. If voluntary abstinence from consumption through increased community savings is not possible, which is particularly true in a low-income country like India, then the main methods left for the choice of the government would be : increase in indirect taxes and reduction in subsidies to consumption. The last two methods would mean, in

* This paper was formerly submitted to the All India Economic Conference held at Patna in December, 1951.

1. The author is not aware of any other attempt at estimation of the economic structure of India. In considering the various inverted problems, *viz.* isolated investment policy, isolated price policy, etc., the objective is *mainly* to illustrate the practical utility of structural estimation in policy decisions.

fact, a reduction in community's consumption by means of raising prices to the required degree.

- (4) A comparison of the effectiveness of an isolated wage-policy with that of an isolated price-policy shows that the former is less efficient than the latter in increasing output. A control over wage-rate does not give control over labour-cost (per unit of output) which influences the size of output directly; because labour-cost is determined not only by wage-rate but also by productivity-of-labour which is likely to fall with an increase in employment in India.
- (5) Direct price-control by government, or a liberalisation of trade (*i. e.*, an increase in competition) by means of a reduction in the protective tariffs that are enjoyed so far by the high-cost producing industries is sure to bring about considerable expansion of output in the immediate future.

1. Introduction

The people who plan are generally faced with alternative policies leading to the same goal. There is not much point in trying to find out the effects of any policy after its implementation. The purpose of econometric research has been to find out in quantitative terms the possible effects of any policy before it is implemented.

'Decision models' have been considered by Harschak, Frisch, Tinbergen and others. Such constructions form a powerful tool of economic analysis as they combine economic theory and statistical inference, and assist the economist in comparing the effects of different kinds of policy and in deciding finally on the one which leads to the goal set before him.

The economist is often asked to advise on policies of a government or a firm. This requires him to estimate the effects of a given (intended or expected) change in the 'economic structure.' He cannot produce this change, as in a laboratory experiment, and study its effects beforehand. In other words, he has to estimate the effects of changes which he has not observed, or can never possibly hope to observe. This makes his method peculiar. He has to estimate, first of all, the past (or observational) structure, *i. e.*, the economic structure before the change. After estimation of the past structure, he has to estimate the effects of various types of variations in it producing different new structures (or future structures) by comparing which he can choose just those variations which would produce the most desirable economic structure. The operations of estimation of past structure, of estimation and comparison of effects of varying it characterise the decision models.

For estimating the past structure, a theoretical model has to be built at first. As the scope of this paper does not permit such an attempt, wide use is made of Tinbergen's decision model in this paper. This model is chosen not only for its simplicity and efficiency in explaining the changes of the most strategic economic variables, *viz.* level of national output, labour cost per unit of output, price-level, balance of payments, but also because it is well adapted to incorporation of the magnitudes of constants known through other sources of information than multiple-correlation studies which are difficult to be attempted for India in the absence of adequate data.

2. Tinbergen's Decision Model

Tinbergen's model is a system of linear simultaneous equations of a dynamic and stochastic character. As the definitional equations do not involve any structural constants, structural equations only are considered here. The latter are called

(1) The demand equation for National product by the home market :

$$\xi_1 y + D + \xi_2 p = \xi_3 l' + \xi_0$$

(2) The demand equation for that product by the world market :

$$-\mu y + D - \delta p = 0$$

(3) The supply, or price-fixation equation for that product :

$$-\pi_2 y + p = \pi_1 l' + \pi_0$$

where y , p , D are deviations of real national income, general price-level, and deficit in balance of payments; l' , labour cost per unit of output; ξ_0 an autonomous increase in national expenditure caused by many factors like taxation, subsidisation, or governmental investment; and π_0 similar autonomous changes in the margin of profits caused by factors like governmental price-policy, or liberalisation of trade. The last three variables are called the political parameters, as they are determined, individually or in combination, by the Trade Unions, Government, and private entrepreneurs.

3. Procedure of Estimation

The procedure in Tinbergen's estimation of the seven structural constants, ξ_1 , ξ_2 , ξ_3 , δ , π_1 , π_2 and μ is rather peculiar. It consists of two stages: In the first stage, the above constants are shown to depend on (or derived from) certain fundamental constants the knowledge of which he gets on the basis of his hypothesis about structural equations, namely economic theory. The theory that he employed is

a logical combination of the two lines of thought in the present-day economic literature, namely the income approach for which Keynes-Machlup-Meade models are typical, and the price-approach of Bickerdike, Joan Robinson, Polak, Metzler, etc. The equations are given as follows :

$$\xi_1 = \sigma (1 - \lambda)$$

$$\xi_2 = 1 - \bar{x} + \sigma (\mu + \lambda - \mu^{\varepsilon m})$$

$$\xi_3 = \sigma \lambda$$

$$\delta = \bar{m} \varepsilon^m + \bar{e} (\varepsilon^e - 1)$$

where

$\bar{x}$ = Total real expenditure,

$(1 - \sigma)$ = Marginal propensity to spend of non-workers.

μ = Marginal import quota.

$\bar{m}$ = Value of imports.

λ = The wage-quota in the national product.

ε^m = Elasticity of imports with respect to the domestic price level (foreign prices being taken constant)

$\bar{e}$ = Volume of exports.

ε^e = Absolute value of Elasticity of exports with respect to the home price-level.

π_1 = Marginal wage-quota (which may be interpreted not so much as a variation in the marginal wage-quota proper, but more as the tendency for certain trade margins to move in sympathy with labour costs).

π_2 = The flexibility of prices (or the inverted supply elasticity).²

Generally, the coefficients, $\mu, \varepsilon^m, \varepsilon^e, \pi_1, \pi_2, \sigma$ are taken from multiple-correlation studies for the inter-war period 1923 to 1938. But as a result of World War II, a number of changes have taken place in the structure of every economy necessitating alterations in these coefficients. So Tinbergen had to use a number of alternative trial values³ of the coefficients and construct alternative economic structures with a view to choose one with the least margin of uncertainty

2. $\bar{x}, \bar{m}, \bar{e}, \bar{D}$ indicate the initial values of x, m, e , and D .

3. The simultaneous equation method of statistical estimation, as Leontief points out, is fortunately well adapted for incorporation of such magnitudes of structural constants known through other sources of information. It always can be used, according to him, as a last resort for estimating empirical coefficients which cannot be evaluated on the basis of some less indirect and more reliable inductive procedure.

(i.e., with the maximum probability) to represent the year-to-year changes in post-war economy.

At the next stage, a close scrutiny is made of the residuals computed for the different alternative empirical structures tried.

Generally, the observed values of economic variables include random disturbances, and the relations (equations) connecting them have therefore to include random or "error" elements. Economic theorists are already familiar with the necessity of introducing random or "error" elements into the description of economic relationships. The recent stochastic approaches require a specification, as an integral part of the scheme, of the probability distribution of such random "errors". The estimates of such "errors" computed from observations are called "residuals".

The residuals of the model under study are given by

$$U_1 = \xi_1 y + D + \xi_2 p - \xi_3 l'$$

$$U_2 = -\mu y + D - \delta p$$

$$U_3 = -\pi_2 y + p - \pi_1 l'$$

where U_1, U_2 and U_3 are assumed to be independent, and normally distributed with the same variance.⁴

4. Application to Indian Economy: Likely Structures

For the situation in 1948-49, $\bar{x}, \bar{m}, \bar{e}$, and $\bar{D}$ are fairly exactly known from the national income estimates; they are respectively equal to 1.02 (national expenditure expressed in national income), 0.08 (imports expressed in national income), 0.06 (exports expressed in national income), and 0.02 (deficit in balance of payments expressed in national income). As λ (portion of national income going to workers) is not directly known, it is assumed to be fairly related to 0.68 (indirect taxes expressed in total tax revenue). The inverted supply elasticity π_2 is taken as 0.615 (the ratio between percentage changes in general price-level and total production).

In view of the uncertainty of some coefficients, $\sigma, \mu, \varepsilon^m, \varepsilon^e, \pi_1$, a number of structures have been considered by giving different possible values to them within their limits of variation. These values are the general conjectures of economists. As regards the marginal propensity to save of workers, it is considered to be fairly exact to assume that

4. $3/2$ (Sample variance) is then an unbiased estimate of the variance of population of errors.

it is zero. But as regards the marginal propensity to save of non-workers, σ , we know it should be positive, but we are not certain about its exact value. So we have to give different conjectural values which are positive and less than unity. Similarly we do for μ , the marginal propensity to import. As regards the import and export elasticities, ε^m , ε^e , a greater range of (positive) values can be tried, because they are elasticities with respect to the domestic price-level. Some of the likely sets of values of these coefficients are given in Table I :

Table I

Structure No.	1	2	3	4	5	6	7
σ : Marginal prop. to save	0.2	0.1	0.1	0.2	0.2	0.2	0.2
ε^m Price elasticity of imports	0.3	0.3	0.3	0.3	1.0	0.8	0.3
ε^e Price elasticity of exports	1.5	1.2	1.5	2.0	2.0	2.0	0.5
μ Marginal prop. to import	0.2	0.1	0.3	0.2	0.2	0.2	0.1
π_1 Marginal wage quota	0.8	0.6	0.4	0.8	1.0	0.8	0.4

With the help of the values listed above, the dependent coefficients are found and tabulated below :

Table II

Structure No.	1	2	3	4	5	6	7
$\xi_1 = 0.32 \sigma$	0.064	0.032	0.032	0.064	0.064	0.064	0.064
$\xi_2 = -0.02 + \sigma \left(\frac{\mu + 0.68}{-\mu \varepsilon^m} \right)$	0.144	0.055	0.069	0.144	0.116	0.124	0.130
$\xi_3 = 0.68 \sigma$	0.136	0.068	0.068	0.136	0.136	0.136	0.136
$\delta = 0.08 \varepsilon^m - 0.06(\varepsilon^e - 1)$	0.054	0.036	-0.006	0.084	0.140	0.124	0.006

Structure No. 1 is considered to be a more likely representation of the Indian economy within the last few years.

II

5. Directives and Instruments of Policy

The practical utility of knowing the structure of a country's economy at any time is that we can know beforehand from the equations of the structure what would be the consequences of a given change in wage-rate l' , or in government price policy π_0 , or in governmental expenditure ξ_0 , on production y , prices p , deficit in balance of

payments D . Here the values of l' , ξ_0 , π_0 (policy parameters) are known while those of y , D , p are unknowns. But what more is expected from a decision model is this : It has to assist the policy-maker in knowing what amount of variation is to be made in a particular parameter ξ_0 (or l' or π_0) in order to bring about a given change, say in y , which is the directive (objective) of his policy. Here, the problem is inverted : y , now being given and ξ_0 unknown. The other parameters l' and π_0 are, however, given, and so, D and p are the other unknowns (same as before) in the equations. Such inversion is characteristic of a decision model. The following cases are examples of such (partially) inverted problems.

6. Isolated Investment Policy

The problem here is to find out the actual increase in governmental expenditure ξ_0 if it alone were to be used as an instrument for raising the level of production by (say) one per cent. That is, for what value of ξ_0 this condition $y = 0.01$ is fulfilled considering $l' = \pi_0 = 0$. This may be solved by rewriting the equations (1), (2) and (3) putting $y = 0.01$ and $l' = \pi_0 = 0$

$$-\xi_0 + D + \xi_2 p = \xi_1 (y = 0.01)$$

$$D - \delta p = \mu y$$

$$p = \pi_0 y$$

and solving for ξ_0 leading to

$$\xi_0 = \{ \mu + \xi_1 + \pi_2 (\delta + \xi_2) \} (y = 0.01)$$

the numerical values of which are :

Structure No.	1	2	3	4	5	6	7
$\xi_0 =$	0.004	0.002	0.005	0.004	0.004	0.004	0.002

(necessary for $y = 0.01$)

It is interesting to note that the necessary increase in governmental expenditure by way of direct investment or its subsidies to production, lies within the range of real possibilities ; only 0.4 per cent rise in governmental expenditure being required for raising national output by 1 per cent.

7. Isolated Price Policy

As against isolated investment policy, we may consider an isolated price policy, i. e., a policy of deliberate lowering of price margins, say by price control or by a liberalisation of international trade or by breaking up monopolies tending to increase competition. The problem is similar to the above one : to find out the actual change in π_0 in order

depression
policy, i.e.
by increasing
demand

0.4 %
of nat.
income!

that it alone can raise the level of production by 1 per cent. The method of answering is similar to the one used in the previous case. We, therefore, give only the analytical expression for π_0 and the numerical results :

$$\pi_0 = \frac{-0.01 \{ \xi_1 + \mu + \pi_2 (\delta + \xi_2) \}}{(\delta + \xi_2)}$$

Structure No.	1	2	3	4	5	6	7
π_0	-0.02	-0.02	-0.07	-0.02	-0.02	-0.02	-0.02

(necessary for $y=0.01$)

The meaning of these apparently small negative figures is very significant. They show that an increase in competition among the producers alone is able to increase output, by 1 per cent. This means that the high profit margins enjoyed by domestic producers must be reduced either by direct government control over profit-margins, or by allowing the inefficient entrepreneurs, in industries like sugar, to face foreign competition. A thorough revision of existing protective duties seems to have a greater power of expanding national output. This is obvious from the two sets of numerical results above. The numerator of the analytical expression for π_0 is, in fact, the same as that of ξ_0 in absolute value. π_0 is greater than ξ_0 by $(\delta \pm \xi_2)$ times. The reduction in profits-margin required for expansion of output in this manner will be the smaller, the greater the value of δ . The solutions for π_0 require 2 per cent reduction in profit-margin, which is certainly within the range of real possibilities.

8. Isolated Wage-Policy

It is proposed in certain quarters that a fixation of wage-level, or a reduction in the existing wage-rate, if possible, would expand output. So let us know from our equations what should be the wage-rate if production is to rise by 0.01. As the method of answering is similar to those above, it is enough if the analytical expression for l' and the numerical results are given. (In order to be more precise and scientific, we consider index of labour cost per unit of output, l' , rather than wage-rate per labourer, l .) =

$$l' = \frac{0.01 \{ \mu + \xi_1 + \pi_2 (\delta + \xi_2) \}}{\xi_3 - \pi_1 (\delta + \xi_2)}$$

Structure No.	1	2	3	4	5	6	7
l'	-0.17	0.14	0.11	-0.09	-0.04	-0.07	0.03

(necessary for $y=0.01$)

These results are outside the range of what could be considered as small changes, and therefore outside the range of real possibility. But they do not surpass anyhow the possible boundary condition that l' shall not be less than -1. They are certainly meaningful. The high positive and negative values of l' can be better explained if l' is split up into its components, the wage-rate l and the index of productivity h in the following way :

$$l' = (l - h)$$

An increase in labour cost per unit may therefore be due to either an increase in wage-rate l , or a decrease in productivity h , or both ; and similarly a decrease in l' may be due to a fall in wage rate or a rise in productivity, or both. The former explanation holds in the case of positive solutions for l' ; and the latter for the negative solutions.

Now, suppose the wage-rate is stabilised by the government with the cooperation, of course, of labour unions. Then, the negative solutions of l' require a rise in productivity in order that the level of production might rise by 1 per cent. This is evidently impossible in a period so short as one year. Let us then try the positive solutions for l' : The meaning of these solutions is that, wage-rate being stabilised, productivity would fall and labour cost per unit would rise with every increase in employment and output. The significance of this result is that, under existing conditions, expansion of current output is possible mainly by employing increasing amounts of labour on the more or less fixed capital equipment, and this naturally causes productivity of labour to fall and costs and prices to rise. The great upward shift in post-war cost-price structure might probably have to be attributed to this structural deficiency of Indian economy. In the presence of such a fundamental drawback, the wage-rate becomes an "inefficient regulator" in economic policy.

9. Combined Foreign Investment, Price and Tax Policy

So far, the role of D in expanding national production has not been considered. A surplus $(-D)$ in the balance of payments on current account is generally considered by economic theorists as investment abroad, which tends to increase employment and output at home. If foreign investment $(-D)$ and our third parameter, ξ_0 , are to be used for expansion of current output at home, then, the latter ξ_0 has to be understood as a decrease in public expenditure, which may be in the shape of a reduction in government subsidies to public consumption.

This should be presented differently

Here all the three political parameters ξ_0 , l' , and π_0 are the unknowns, but we have only two equations (1) and (3) involving them. If we know that l' is known once p is given (i. e., if price is assumed to be 1.5 times labour cost) then there will be two unknowns and two equations involving them. If l' , ξ_0 , and π_0 are now expressed in terms of D which now acts as a mathematical parameter, we get from equations (1), (2) and (3), putting $y=0.01$ and $p=1.5 l'$:

$$l' = \frac{-(0.01\mu - D)}{1.5\delta}$$

$$\pi_0 = -0.01 \pi_2 + (\pi_1 - 1.5) l'$$

$$\pi_0 = 0.01 \xi_1 - (1.5 \xi_2 - \xi_3) l' + D$$

By expressing l' and $p=1.5$ in D (with the aid of the above equations) in the equation for deviation in real expenditure (Ref. Tinbergen) we get:

$$x = 0.01 + (0.02 - \mu + \mu^m) \frac{(0.01\mu - D)}{\delta} + D$$

If due to an increase, 0.01, in real income, y , it is assumed that expenditure is assumed to be more or less constant, then x (deviation in expenditure) may be equated to 0, and the value of D and hence of the political parameters may be found. The results are:

Structure No.	1	2	3	4	5	6	7
(-D) foreign investment.	-0.002	-0.009	+0.003	-0.003	-0.012	-0.008	-0.003
l' , increase in employment.	0.05	0.19	0.04	-0.01	0.07	-0.03	0.17
π_0 , increase in competition (or reduction in Tariff)	-0.04	-0.18	-0.05	-0.001	-0.04	-0.02	-0.19
ξ_0 , reduction in Public expenditure.	-0.005	-0.011	-0.002	-0.002	-0.014	-0.006	-0.007

The meaning of these results is that

1. the necessary surplus for investment, abroad is within the range of real possibilities except in the case (5) where it surpasses the boundary value 0.01 (the desired increase in output); but the shift in domestic employment due to such investment *appears to be* quite small particularly in cases (4) and (6);

2. the resulting increase in labour-cost per unit seems to take place simultaneously with investment;
3. the reduction in profit-margin necessary for increasing competition is within possibility; as the maximum reduction is of the order of 20 per cent;
4. the necessary reduction in national consumption is also within the range of what may be considered as small changes; the maximum for such reduction being 1.4 per cent.

As regards (2) and (3), explanations are already given in section 9 and 8 respectively. The significant point of this section is that, under present conditions in India, any investment for immediate expansion of output necessitates a reduction in real expenditure of the community in the present. This may probably have to be attributed to the relative constancy of the national output (or national cake) per head. If voluntary abstinence from consumption through increased community savings is not possible, which is particularly true in a low-income country like India, then the main methods left for the choice of the government would be: increase in indirect taxes and reduction in subsidies to consumption. The last two methods would mean, in fact, a reduction in community's real consumption by means of raising prices to the required degree.

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