MACROECONOMICS WITH NON-PERFECT COMPETITION: TAX CUTS AND WAGE INCREASES*

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I. INTRODUCTION AND SUMMARY

In a recent paper, Ng [3] introduces non-perfect competition (imperfect competition and monopoly) into a simple macroeconomic model with no government, no time lags, no misinformation, etc. Under perfectly competitive assumptions that model gives the customary result that changes in (nominal) aggregate demand (introduced by changing the money supply) affect only nominal variables. Under conditions of non-perfect competition, such changes may affect real output and employment depending upon the elasticities of the marginal cost curve and of the (inverse) labour supply curve, and the expectations of firms. Under a specific set of conditions (involving labour supply and marginal cost curves that are horizontal, or whose elasticities are otherwise related in a particular way), if firms expect no price response then changes in aggregate demand affect only real variables, confirming expectations. However, since this set of conditions is stringent, Ng himself notes that it is unsafe to advocate expansionary policies on the basis of his anti-classical result, even in the presence of unemployment. Nevertheless contractionary counter-inflationary policies based purely on demand management are also unsafe as they may reduce real output without affecting the price level.

The purpose of the present paper is two-fold. First, we extend Ng’s analysis to include government expenditure and taxation with a view to investigating the effectiveness of fiscal policies in correcting unemployment and inflation. Given the possibility of varying tax rates, we show that the conditions for non-inflationary expansion become less stringent. Under reasonably favourable conditions (relatively flat marginal cost and labour supply curves), a reduction in tax rates with the money supply adjusted to hold the price level unchanged may increase output sufficiently to maintain (or even increase) government revenue. The price-constrained balanced-budget multiplier is negative and the unconstrained balanced-budget multiplier is also negative if the supply price of labour adjusts by the same proportion as the price level.

Secondly, we show that, even given the presumption that an increase in wage rates increases aggregate demand through a high marginal propensity to consume by wage-earners, an increase in wage rates is an inappropriate anti-stagflationary policy as it reduces real output and employment, and increases the price level.

Ng [3] uses a classical quantity theory demand for money function but notes that his results would hold even if a Keynesian specification were used. Partly to confirm this,

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and partly because the Keynesian expenditure function (Equation 2 or 32) below is more amenable to our second purpose, we adopt here a simple Keynesian model involving expenditure, production-employment and monetary sectors; the bond sector is suppressed, invoking Walras' Law. Apart from this, and the generalisation mentioned in the previous paragraph, we follow Ng's basic comparative static model in which commodities markets are not necessarily perfectly competitive, in which there is no entry and exit (to be considered elsewhere), and in which the realisation of expectations is taken into account. (Hence the analysis is consistent with rational expectations and with our comparative static framework.) The important extension to a dynamic analysis is not considered here.

The microeconomic analysis rests on the concept of a representative firm. Some care is needed in interpreting this construction. On the one hand, the fallacy of composition must be avoided. For example, while each single firm may be able (in some circumstances) to expand output without affecting its marginal cost, this does not imply that all of them can do so simultaneously. On the other hand, one must avoid also the reverse fallacy of attribution. If a representative firm (which may not actually exist) knows that it is representative, then it knows also that if it charges a price according to its own profit-maximising calculation, this will turn out to equal the average price. Nevertheless, it cannot then assume that, whatever price it charges, the average price will be equal to it. This would be the case only if there is complete (implicit or explicit) collusion. In the absence of collusion, each firm has to maximise with respect only to the variable under its control. It is a fallacy to attribute what all firms can do together to a single (even if representative) firm.¹

It may be noted also that the simple assumptions — which exclude misinformation, time lags, intertemporal substitution and the like — contribute to the strength of the model. Such complications will create problems in the real economy. But the point of our analysis is precisely that, quite apart from these issues, there could be problems of a different kind once non-perfect competition is recognised.

II. Specification of the Model

Let us consider a closed economy in which the authorities' fiscal instruments comprise the (exogenous) level of real government spending, \( G \), and the average rates of direct and indirect taxation, \( T \) and \( t (0 < T, t < 1) \).² Aggregate real private planned expenditure on current output, \( E \), is taken to be a function of real income \( Y \), the rate of interest \( r \), and the taxation rates \( T \) and \( t \). Thus the aggregate demand function may be written

\[
D = E(Y, r, T, t) + G; \tag{1}
\]

¹On some further methodological issues see Ng [4, 6], which develops the representative-firm analysis to incorporate elements of micro, macro, and general equilibrium. In particular equation 5 is discussed there.
²For simplicity, we do not include a government budget constraint at this stage, but the requirement to balance the budget will be discussed later. Basically, we are not concerned with cases where changes in tax rates will not lead to changes in revenue. In practice, due to time lags (positive or negative), deficits may initially appear. A full analysis of such transitory adjustments requires a dynamic model which is beyond the scope of the present paper.
$1 > E_Y > 0, E_r < 0, E_t \leq 0, E_e \leq 0$

where $E_Y$, $E_r$, etc. denote the respective partial derivatives. In equilibrium

$$Y = E(Y, r, T, t) + G.$$  

(2)

On the supply side of the goods market, ignoring external economies and intermediate production (or assuming a fixed capital stock) we have the production function

$$Y = F(N); F_N > 0$$

(3)

where $N$ is the level of employment. We suppose this to be aggregated from the individual production functions $Q_i = Q_i'(N_i)$ facing the several firms in the economy.

The demand for labour is derived from the usual considerations of profit maximisation. In conventional competitive analysis, each firm is seen as a price taker in both product and factor markets, and for the viability of a competitive solution it is required that $F_{NN} < 0$. Under these circumstances, and if taxes are ignored, then the profit maximisation criterion reduces to the familiar equilibrium condition that $W = PF_N$, where $W$ and $P$ are the market-determined price and wage levels.

The present model, however, while accommodating perfect competition as a special case, allows for non-perfect competition (monopolistic competition or monopoly) in the product market. Thus the demand for the product of firm $i$, $Q_i$, is taken as a function of its own price, $P_i$, of an index $\bar{P}$ of the prices that it expects all other firms to set, and of real aggregate demand $D$:

$$Q_i = h(D, P_i/\bar{P}).$$

(4)

The economy is taken to comprise a given number of identical firms or alternatively firm $i$ is taken as a representative firm. Hence, following Ng [3] we take (4) to be homogeneous of degree one in its second argument, given its first. Thus,

$$Q_i = Dh(1, P_i/\bar{P}) \equiv D\bar{h}(P_i/\bar{P}).$$

(5)

Accordingly, in equilibrium where price expectations are realised so that $P_i = \bar{P} = P$ (and $Y = D$), the firm's (expected and realised) marginal revenue before accounting for taxes is

$$\mu = \partial P_i Q_i / \partial Q_i = P(1 + \bar{h}/\bar{h}')$$

(6)

where $\bar{h}'$ is the derivative of $\bar{h}$, and

$$d\mu = (\mu/P)dP$$

(7)

Assuming the absence of monopolistic power in the firm's employment of labour, the nominal demand price of labour $W^d$ equals the (net of indirect taxes) marginal revenue product,

$$W^d = (1-t)\mu Q_i^d = (1-t)PQ_i^d (1 + 1/\eta)$$

(8)

We could include the real-balance effects in our expenditure function $E$ and similarly complicate the demand for money function below, as was actually done in a preliminary analysis, without affecting the essence of our results.
where $\eta$ is the elasticity of demand for the firm's product.

The corresponding aggregative inverse labour demand function is

$$W_d = (1 - t)\mu F_N$$  \hspace{1cm} (9)

where $\mu$ is the marginal revenue of the representative firm. Since clearly (8) and (9) converge to the familiar competitive equilibrium condition as $\eta \to -\infty$, the labour demand curve of the standard competitive model is simply a special case of the present analysis.

The supply price of labour $W^s$ is taken as a function of the level of employment, the price level, the rate of income taxation, and government expenditure,

$$W^s = W^s(N, P, T, G);$$

$$W^s_N, W^s_T \geq 0, W^s_G \leq 0, W^s_T/(1 - t) Y \geq -W^s_G.$$  \hspace{1cm} (10)

Indirect taxes should affect labour supply only through their impact on the price level. The non-positive $W^s_G$ captures the possible effect on $W^s$ of such government expenditure as free school lunches ignored by most writers. Nevertheless, we assume that a dollar increase in income tax is no less effective in increasing $W^s$ than a dollar decrease in government expenditure. For this purpose we have to divide $W^s_T$ by $(1 - t) Y$ since a change in the income tax rate $T$ changes real government revenue at the rate of $(1 - t) Y$.

Equation (10) could readily be written in terms of the real, rather than nominal, supply price of labour. Under neoclassical assumptions, involving the absence of money illusion, the translation would of course be purely mechanical, resting on the requirement that $W^s_P = W^s/P$ (so that an increase in $P$, ceteris paribus, would lead to an equiproportional increase in $W$). However, as indicated by the sign attributed above to $W^s_P$, here we have favoured a more general labour supply function which embraces the possibility of some degree of money illusion, or of time lags in wage adjustments. However, our results below do not depend on the existence of such imperfections, since they hold even if $W^s_P = W^s/P$. The case of real post-tax wage rate rigidity discussed by Corden [1] corresponds to the case of $W^s_P = W^s/P, W^s_T = -W^s/(1 - T)$ and $W^s_G = 0$.

Since $W^s = W^d = W$ is required for labour market equilibrium, we have

$$(1 - t)\mu F_N = W^s(N, P, T, G).$$  \hspace{1cm} (11)

The monetary sector is simply specified, and entirely conventional. We take the real demand for money as a function of real income and the rate of interest:

$$L = L(Y, r); L_Y > 0, L_r < 0.$$  \hspace{1cm} (12)

The nominal supply of money, $M$, is assumed to be determined exogenously by the authorities.

Thus for monetary equilibrium

$$L(Y, r) = M/P.$$  \hspace{1cm} (13)
III. Comparative Statics Analysis

To explore the comparative statics of the model, we focus on the equilibrium conditions (2), (11) and (13). Differentiation of (2) gives

\[(1 - E_y) dY - E_r dr = E_r dT + E_r dt + dG. \tag{14}\]

Differentiation of (11), after substituting \(dY = F_N dN\) from the differentiation of (3), and (7) and (11) gives

\[-X dY + Z dP = W^*_T dT + \mu F_N dt + W^*_G dG, \tag{15}\]

where

\[X = [W^*_N - (1 - \mu) F_N] / F_N\]

and

\[Z = \left(\frac{W^*_T}{P}\right) - W^*_F.\]

Differentiation of (13) gives

\[P^2 L_y dY + P^2 L_r dr + MdP = PdM. \tag{16}\]

The three equations (14), (15) and (16) may now be used to solve for \(dY, dr\) and \(dP\). Rewriting them in matrix-vector form, we get

\[
\begin{pmatrix}
1 - E_y & -E_r & 0 \\
-X & 0 & Z \\
P^2 L_y & P^2 L_r & M
\end{pmatrix}
\begin{bmatrix}
dY \\
dr \\
dP
\end{bmatrix}
= \begin{bmatrix}
E_r dT + E_r dt + dG \\
W^*_T dT + \mu F_N dt + W^*_G dG \\
PdM
\end{bmatrix}. \tag{17}
\]

The determinant of this matrix is

\[H = AZ - ME, X, \tag{18}\]

where

\[A \equiv -P^2[(1 - E_y)L_r + L_y E_r] > 0.\]

Solving (17) by Cramer's Rule,

\[
HdY = (ME, W^*_T - P^2 L_r E_T Z) dT + (ME, \mu F_N - P^2 L_r E_r Z) dt + (ME, W^*_G - P^2 L_r Z) dG - PE_r Z dm \tag{19}
\]

\[
Hdr = -[BE_r + M(1 - E_y) W^*_T] - [BE_r + M(1 - E_y) \mu F_N] dt - [B + M(1 - E_y) W^*_G] dG - P(1 - E_y) Z dM \tag{20}
\]

\[
HdP = (A W^*_T - P^2 L_r E_T X) dT + (A \mu F_N - P^2 L_r E_r X) dt + (A W^*_G - P^2 L_r X) dG - PE_r X dm \tag{21}
\]

where

\[B \equiv MX + P^2 L_y Z \geq 0.\]
Clearly $H$ is non-negative if $X$ and $Z$ are non-negative. Given the signs already attributed to $W_{N}$, $t$, $F_{N}$, and given that feasible solutions will require $\mu > 0$, $X$ will be non-negative except when $F_{N}$ is markedly positive (so that marginal costs are sharply declining); but we return to the question again below.

$Z$ reflects the extent to which the supply of labour is governed by the real or the nominal wage rate (that is, the extent to which there is or is not a money illusion). Since $W_{p} = W/P$, we may rewrite $Z = W_{p} - W_{p}^*$ which can be seen as the difference in the adjustments of the demand price and supply price of labour with respect to a change in the price level. The profit maximisation assumption ensures that $W_{p} = W/P$. In the absence of money illusion in labour supply, $W_{p} = W/P$ and hence $Z = 0$. If, however, it is simply the nominal wage that is seen as the strategic variable (so that $W_{p} = 0$, or if employees exhibit a partial money illusion, adjusting wage bids with changes in prices but less than proportionally ($0 < W_{p} < W/P$), then $Z > 0$. $Z$ will be negative only if wage negotiators attempt to over-compensate for changes in prices.

The economic meaning of $X$ may be explained as follows. Since $X = [W_{N} - (1 - t)\mu F_{N}] / F_{N}$, and $W = (1 - t)\mu F_{N}$ in equilibrium, we have

$$\frac{NF_{N}X}{W} = \frac{\partial W/\partial N}{W} - \frac{\partial F_{N}/\partial N}{F_{N}}$$

Thus, the sign and value of $X$ depends on the sum of the elasticity of the labour supply curve (with respect to either the real or the nominal wage rate, since $P$ is unchanged in evaluating $\partial W/\partial N$) and the negative of the elasticity of the marginal product of labour (or of all variable inputs in a more general model), the latter elasticity being of opposite sign to that of the elasticity of the marginal cost curve of the representative firm. The higher the elasticity of labour supply, and the lower the elasticity of marginal cost (i.e., the less upward-sloping the marginal cost curve), the smaller is $X$. If both curves are horizontal, then $X = 0$. As indicated by eq. (18) and (21), the smaller is $X$ the greater may be the output effect, relative to the price effect, of a given demand increase. The intuitive explanation is as follows: the higher the elasticity of labour supply, the weaker is the upward wage pressure as employment expands; while the lower the elasticity of marginal cost, the weaker is the pressure on prices due to diminishing labour productivity. The combined effect is to increase the scope for firms to respond to higher demands by expanding output rather than increasing prices.4

It may be noted that the elasticity of the marginal revenue curve of the representative firm (which affects the elasticity of its marginal revenue product of labour and hence its demand for labour) does not affect the value of $X$ (and hence the output response to a demand increase). This is so because in an economy-wide

4It is tempting but wrong to think that the value of $X$ is determined by the sum of the slope of the labour supply curve and the negative of the slope of the labour demand curve. Since $W_{d} = (1 - t)\mu F_{N}$, the slope of the labour demand curve is $\partial W/\partial N = (1 - t)\mu F_{NN} + (1 - t)F_{N}\partial \mu /\partial N$. With non-perfect competition, marginal revenue $\mu$ may fall as output (and hence employment) increases. Hence, each individual firm's demand curve for labour may be downward sloping even if $F_{NN} = 0$. But if $F_{NN} = 0$ and the labour supply curve is also horizontal, $X = 0$ even if each firm's marginal-revenue-product-of-labour curve is downward sloping.
expansion the demand and hence marginal revenue curve of each firm moves rightward; but the effective net magnitude of this shift is determined (independently of demand elasticity) by the extent to which output can be expanded without accompanying price increases. This is in turn determined by the extent to which the expansion is inhibited by increasing marginal costs resulting either from an upward-sloping marginal cost curve (due to diminishing labour productivity) or to an upward shift in that curve (due to an upward sloping labour supply curve).5

In the traditional competitive model it is assumed that $F_{NN} < 0$ and $W_N^e > 0$, which implies that $X > 0$; and that $W_N^e = W/P$, so that $Z = 0$. It can be seen from (19) — (21) that these conditions entail neutrality of money: a change in the money supply has no effect on the equilibrium values of real variables, but changes the price level (and other nominal variables) by the same proportion $\partial P/\partial M = P/M$. The logic of this result is familiar. While an increased money supply creates excess demand and a higher price level in the goods market, profit maximising producers cannot respond to this stimulus without a reduction in real wages. But since rational wage-earners increase the supply price of labour equiproportionally with prices so as to keep the real wage constant ($Z = 0$), there can be no change in the equilibrium levels of employment and output.

In the present model, however, monetary disturbances may produce a variety of results. For example, under conditions of non-perfect competition it is possible that over some relevant range of output $F_{NN} = 0$, so that marginal cost curves are horizontal. If over this same range of output the supply of labour is infinitely elastic (i.e. $W_N^e = 0$), then $X = 0$. In this case, if also $Z = 0$, the outcome of a change in the money supply is indeterminate, depending entirely upon entrepreneurial expectations as shown in Ng [3]. On the other hand, if $X = 0$ and $Z > 0$ (unlikely except in the short run) then an increase in $M$ will increase output without affecting prices. Where $X < 0$, a cumulative expansion is likely.

But the conditions required for $X < 0$ are rather strong (for example constant or rising marginal product of labour, coupled with very high labour supply elasticity with respect to the nominal wage), and seem likely to prevail, if at all, only in deep depression. We therefore restrict ourselves, for the remainder of this paper, to cases where $X > 0$.

IV. THE EFFECTS OF TAX CUTS

Consider now the consequences of a reduction of the rate of indirect taxation. From (19) and (21) it can be seen that while real income is increased, the response of the price level is ambiguous, depending upon the relative strengths of what we may call the "price pressure effect", $-P^2 L, E, X$, and the "price relief effect", $A\mu F_N$. Let us now suppose that the former effect dominates, so that a reduction in $t$ is inflationary. The question then arises, is it possible, in this unfavourable case, to couple the tax reduction with a price-neutralising monetary programme such that the net result is still an increase in $Y$ but without an associated increase in $P$?

\footnote{For a more rigorous analysis of this point, see Ng [4, 6].}
In order to isolate the two policy variables $dt$ and $dM$, we set the other budgetary instruments $dT = dG = 0$. Setting $dP = 0$, we obtain from (21) as the required monetary adjustment

$$dM = \frac{A \mu F_N - P^2 L_r E_r X}{P E_r X} \, dt. \tag{22}$$

Substituting (22) into (19) we have as the net real income effect of the combined fiscal-monetary policy

$$\left. \frac{dY}{dt} \right|_{dT = dG = dP = 0} = -\frac{\mu F_N}{X} < 0. \tag{23}$$

Changes in the income tax rate, $T$, may be similarly analysed. Here the corresponding result is

$$\left. \frac{dY}{dT} \right|_{dT = dG = dP = 0} = -\frac{W^T}{X} \leq 0. \tag{24}$$

We conclude, then, that a reduction in tax rates can increase output even if accompanied by a monetary adjustment sufficiently restrictive to offset any upward pressure on prices.

But this result must be interpreted with care; for we have not so far considered the financial aspects of the budget. If a reduction in tax rates increases output only slightly, then the net effect on government revenue may be negative, and the deficit permanently increased. This may entail subsequent attempts to reduce the deficit, which in turn could negate the gains outlined above. Under what conditions, then, will the expansionary effect of the tax cut be sufficient to compensate for the reduced tax rate? To answer this question, let us examine the tax-reduction multiplier.

Equations (23) and (24) do not directly express the (price constrained) indirect and direct tax multipliers in the relevant sense, since $t$ and $T$ are rates, not amounts, of taxation. The (real) government revenue function may be written

$$R = t Y + (1 - t) T Y + R^0 \tag{25}$$

where $R^0$ is a fixed (possibly negative) component, and where for convenience progressivity in marginal rates is ignored. A reduction in $T$ reduces $R$ at the rate $(1 - t) Y$, and a reduction in $t$ reduces $R$ at the rate $(1 - T) Y$, before taking account of any consequent changes in $Y$. Hence we may define the direct and indirect tax multipliers, $k^T$ and $k^t$, as

$$k^T \equiv -\frac{\left. \frac{dY}{dT} \right|_{dT = dG = dP = 0}}{(1 - t) Y} = \frac{W^T}{(1 - t) Y X} \tag{26}$$

$$k^t \equiv -\frac{\left. \frac{dY}{dT} \right|_{dT = dG = dP = 0}}{(1 - T) Y} = \frac{\mu F_N}{(1 - T) Y X}. \tag{27}$$

It may be noted that if workers supply labour strictly according to the post-tax wage rate, then the direct and indirect tax multipliers are equal. Full adjustment of the

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6We assume that the money supply can be controlled within acceptable limits by means of a variable bank liquidity ratio.
supply price of labour to changes in the rate of income tax implies that 
\[ W^T = W/(1 - T) \]. Since also \( \mu F_N = W/(1 - t) \), we have 
\[ k^T = k^I = W/(1 - t)(1 - T)YX. \]

If \( X = 0 \), the tax multipliers are infinitely large. Though we have earlier dismissed such cases as unlikely, we cannot neglect the possibility of very small positive values of \( X \), and correspondingly very large multipliers \( k^T \) and \( k^I \), such that a tax reduction would generate a more than compensating increase in revenue. As \( X = [W^N - (1 - t)\mu F_N]/F_N \), we get such a result if the labour supply curve and the marginal cost curves are highly elastic. These conditions are presumably more likely to prevail in an economy with significant excess capacity and unemployment.

To identify the ultimate revenue effect of a tax rate change, totally differentiate (25) and substitute in 
\[ dY = -(pF_NdT + \mu F_N dT)/X \] (derived similarly to Eq. 23, but without holding \( dT = 0 \)). This yields 
\[ dR = \left[ (1 - t)Y - (t + T - tT)W^T/X \right] dT \]
\[ + \left[ (1 - T)Y - (t + T - tT)\mu F_N/X \right] dt \]
(28)

Thus, if \( [(t + T - tT)W^T/X] > (1 - t)Y \) and/or \( [(t + T - tT)\mu F_N/X] > (1 - T)Y \), a reduction in tax rates may actually increase government revenue at the new equilibrium level of activity, even though monetary policy restrains \( P \) from increasing.\(^7\)

Under reasonably favourable assumptions it would not be impossible in a depressed economy for the multipliers to exceed five, so that a reduction in the tax rates worth \$1 million at existing GNP would increase the equilibrium real output by \$5 million or more, even when the money supply is restricted to keep the price level unchanged. Given an average tax rate, direct and indirect combined, of about 30 per cent (typical for many countries), such an increase in real output would yield more than enough additional revenue to balance the revenue lost due to reduced tax rates, quite apart from any saving in unemployment benefits.\(^8\)

The microeconomics of the foregoing analysis may be illustrated in Figure 1. \( D_0 \) and \( D_0' \) are the initial pre-indirect tax and post-indirect tax demand curves of the representative firm, and \( MR_0 \) and \( MC_0 \) the (post-tax) marginal revenue and cost curves. The initial equilibrium is accordingly at \( P_0, Q_0 \) (point \( a \)). Suppose that aggregate demand is now increased (by 50 per cent, for the sake of exaggerated geometrical illustration), but that the firm expects this to bring no increase in \( P \). The demand curves move horizontally to \( D_1 \) and \( D_1' \), and the marginal revenue curve to \( MR_1 \).

If the \( MC \) curve is horizontal (as shown in \( MC_0 \)) and does not shift as output adjusts, then the new equilibrium point \( b \) involves an increase in output to \( Q_1 \) with no

\(^1\)If increased government revenue is not desired, then obviously under these favourable conditions a balanced budget can be achieved by adopting a larger reduction in tax rates.

\(^8\)See Ng [2] on some empirical evidence relevant to this conjecture.
change in $P$, thus confirming the firm's expectations. The result will be the same if the $MC$ curve has a non-zero slope whose effect is balanced by a compensating shift of the curve as output changes. In both cases, $X=0$. The prevailing conditions in the labour and goods markets facilitate a response to the demand shift which validates entrepreneurial expectations.

But for our present purpose, let us assume that $MC$ either is positively sloped, with no compensating downward shift, or alternatively is horizontal but (as illustrated) shifts upwards to $MC_1$ due to an increase in the wage rate as employment increases. The apparent new equilibrium at $c$ then implies a higher price. Because this outcome invalidates the original expectation of a zero price change, it cannot be sustained. The demand curve will shift to a steeper locus, leading to a further price increase. The process will continue until finally an expectation-consistent equilibrium is achieved; this can occur only where $P$ is 50 per cent above its initial level, with no change in output.

However, if we introduce a reduction in direct taxes to shift the $MC$ curve back to $MC_0$ (by reducing the pre-tax wage rate) or in indirect taxes to shift the demand curve from $D_1$ to $D_1'$, the new equilibrium point ($b$ or $d$) will entail an increase in output from $Q_0$ to $Q_1$ with no change in $P$. If that increase in output is sufficiently large to offset the effect of the reduced tax rate, then tax revenue need not fall. In the case of indirect taxation, this will be so if the dotted area is no smaller than the shaded area.
Some of the foregoing results may be illustrated in terms of the text-book IS-LM and labour market analysis. Let us start from an initial equilibrium in which the real income $Y_0$ required to clear the commodities and money markets (determined by Eqs. 2 and 13 above, and indicated by the intersection of $IS_0$ and $LM_0$ in the first quadrant of Fig. 2) equals the real output produced (Quadrant III) by the equilibrium level of employment $N_0$ in Quadrant II (Eqs. 3 and 11). Consider first a pure monetary expansion. Given the initial price level, the $LM$ curve shifts to $LM_1$, the $IS$ curve remains at $IS_0$ and the output required to satisfy the new level of aggregate demand increases to $Y_1$ in Quadrant I. An increase in aggregate real demand induces a shift (upwards) in the demand curve for labour at the given price level (Eqs. 8, 9), increasing employment and output. But will this higher level of output, associated with the change in labour market equilibrium, precisely correspond with the output that is now needed for equilibrium in the commodities and money markets, so that at the initial

\*Except for the special case in which (in Quadrant IV) the labour supply function is vertical ($W^*_N = 0$).
price level $P_0$ equilibrium may prevail over the whole system? It can be shown that, given $t$, $P$ and $W$, the demand for labour changes with aggregate demand by $dN^d = dY/F_N$ (where $dY$ is the change in output required to satisfy the change in aggregate demand). In Figure 2, $dY$ (or rather $\Delta Y$) = $Y_0 - Y_1$, so the demand for labour curve shifts leftward by $\Delta N^d = N_0N_1 = AB$ (Quadrant II). If the labour supply curve is horizontal over the relevant range ($N^s_0$), the point $B$ will be the new equilibrium in the labour market (given $P_0$). If the marginal cost curve is horizontal ($F_{NN} = 0$, $Y = F_1(N)$ in Quadrant III), then the increase in employment $N_0N_1$ will raise output by $Y_0 - Y_1$, just matching the increase in aggregate demand indicated by $IS_0$ and $LM_1$ at $P_0$ (Quadrant I). Then the whole system can come to equilibrium with higher output and employment, and no change in the price level.

But if the labour supply curve ($N^s_1$) is upward sloping and/or the marginal cost curve is upward sloping ($F_{NN} > 0$; $Y = F_1(N)$ in Quadrant III), the increased employment $N_0N_2$ will raise output by only $Y_0 - Y_2$, which is insufficient to achieve an overall equilibrium of the system. The assumption that prices remain at $P_0$ cannot then be sustained. Excess demand raises the price level, which shifts the $LM$ curve leftwards, the $N^d$ curve downwards and possibly (depending on $W^d_P$) the $N^s$ curve upwards until equilibrium is restored at $N_0$ and $Y_0$.

By contrast, consider the effect of a cut in taxes (say by a reduction of the indirect tax rate $t$) in the presence of slightly upward sloping labour supply and/or marginal cost curves. The $IS$ curve moves to $IS_1$, and, with $LM_0$, determines a new equilibrium in Quadrant I at $Y_1$, given $P_0$, as before. Again this increase $Y_0 - Y_1$, justifies an increase in labour demand. But since the demand price for labour is determined by $(1-t)\mu F_N$, as $t$ is reduced the demand for labour curve moves out further than before, to $N^d_2$. If the labour supply curve and marginal cost curve are not too upward sloping, the new equilibrium point $C$ may involve an increase in employment ($N_0N_3$) sufficient to produce the required increase in output $Y_0 - Y_1$. Accordingly a new equilibrium with higher output and employment and the same price level may be possible.

If the price pressure effect is greater than the price relief effect, we have shown above that a tightening of the money supply can then serve to hold prices at $P_0$, while leaving a positive effect on $Y$. But if the positive effect on $Y$ is small, the government budget may go into deficit. We have specified above the conditions under which the tax cut will be self-financing. In contrast, if the price pressure effect is smaller than the price relief effect, an expansion of the money supply is possible without increasing the price level, thereby increasing output even further.

The determinants of the relative strengths of the price pressure and price relief effects are shown in (22). Geometrically, a given reduction in the indirect tax rate, for example, shifts the labour demand curve upward, leading to an increase in employment and output (from $Y_0$ to $Y_1$ in Figure 3). The more elastic the labour supply curve and the less the marginal product of labour falls, the larger is the increase

$$10\frac{dN^d}{dt} = \frac{dW^d}{dN} \frac{dW^d}{dN} \mid du = \frac{dP}{dP} = 0; \mid dt = 0 = \frac{dY}{F_N}.$$  

See Ng [5] on more details about the lifting of the demand curve for labour.
in output. Because of its effects on aggregate demand, the tax cut also shifts the IS curve out. There is no reason to suppose that in general these demand side and supply side effects will be equal.

If the demand shift is to IS\(_1\), then the increase in output \((Y_0 Y_2)\) exceeds that which is required to clear the commodities and money markets \((Y_0 Y_1)\). There is accordingly scope then for stimulating aggregate demand further, without any upward pressure on prices, by increasing the money supply (shifting the LM curve rightwards). On the other hand, if the tax cut shifts the IS curve to IS\(_2\), the resulting excess demand will cause prices to increase unless LM is shifted leftward by a monetary contraction.

It may be thought that since \(W^d = (1 - t)\mu F_N\), and since, accordingly, a reduction in \(t\) shifts the demand curve for labour upward, the elasticity of this demand curve must also affect the size of the employment effect. Clearly this elasticity influences the impact effect upon the labour market of an indirect tax cut. But further analysis shows that as the economy responds to this change the labour demand curve may shift further upward or downward (through changes in demand curves faced by firms and hence in \(\mu\)) according to the degree to which that response is in real terms. The ultimate (equilibrium) employment effect is therefore independent of the elasticity of labour demand, depending rather on the elasticities of the labour supply and marginal cost curves (which determine the responsiveness of aggregate output).

V. THE NEGATIVE BALANCED BUDGET MULTIPLIER

Before we turn to analyse the effects of changes in the wage rate, let us consider the implications of a balanced budgetary expansion in this system. In particular it is of interest to establish whether we have the familiar unitary (or at least positive) balanced budget multiplier of the text books.
At any level of real income a balanced change in the budget requires that
\[ dG = (1 - t) YdT + (1 - T) Ydt. \tag{29} \]

Substituting (29) and \( dM = 0 \) into (19), we have as the real output effect of a balanced budgetary expansion
\[
HdY \Big|_{(29), dM = 0} = \left[ ME, \left\{ W_T^* + (1 - t) Y W_G^* \right\} - P^2 L_r Z \right\{ (1 - t) Y + E_T \} \right] dT
+ \left[ ME, \{ \mu F_N + (1 - T) Y W_G^* \} - P^2 L_r Z \right\{ (1 - T) Y + E_T \} \right] dt. \tag{30}
\]

This will be negative, whether the increase in \( G \) is financed by increasing \( T \) and/or \( t \), if (but not only if) all the following reasonable conditions hold:

1. A dollar increase in income tax is more effective in raising the supply price of labour than is a dollar increase in government expenditure in reducing it; that is, \( W_T^* > -(1 - t) Y W_G^* \).

2. A dollar increase in government expenditure reduces the supply price of labour but not by so much as to reduce post-tax labour income by a dollar (before adjustment in \( Y \) and hence \( N \) is considered); i.e. \( W/(1 - t)(1 - T) Y > W_G^* \), noting that \( \mu F_N = W/(1 - t) \).

3. The supply price of labour adjusts in the same proportion as any change in the price level; i.e. \( W_P^* = W/P \) or \( Z = 0 \).

If only (3) and (1)/(2) hold, the negativity applies to income/indirect tax financing of increases in \( G \).

In the short run, as we have noted earlier, there may be an element of inertia, or money illusion in the labour market so that \( Z > 0 \). But in this case, the balanced-budget expansion will also cause the price level to increase. Suppose then that we repeat our earlier experiment and constrain \( P \) by a simultaneous adjustment of \( M \). Setting \( dP = 0 \) in (21), and substituting the resulting expression for \( dM \), together with (29), into (19), we obtain
\[
dY \Big|_{(29), dP = 0} = - \left\{ W_T^* + (1 - t) Y W_G^* \right\} dT + \left\{ \mu F_N + (1 - T) Y W_G^* \right\} dt \big/ X < 0. \tag{31}
\]

Thus the balanced-budget multiplier is negative if \( Z = 0 \), and the price-constrained balanced-budget multiplier is negative irrespective of the value of \( Z \). By failing to account for the effect of indirect taxes on marginal costs, and the effects of direct taxes and prices on wage rates, the conventional naive balanced-budget multiplier theory is simply irrelevant and therefore misleading.

VI. THE EFFECTS OF WAGE INCREASES

An important controversy concerning the macroeconomic implications of wage policy has centred upon the interaction between wage rates, aggregate demand and the demand for labour. Advocates of increased wages to alleviate unemployment have
invoked the alleged positive effects — seldom elucidated by formal analysis — of higher wage income, through the higher marginal propensity to consume of wage-earners, on the demand for goods and hence on the “derived demand” for labour. Critics, influenced by the standard competitive analysis, have questioned this argument principally on the ground that since the production function imposes a unique relation between the demand for labour and the real wage rate, no increase in aggregate demand (whether due to wage increases or not) can lead to higher output and employment unless the price level increases at a greater rate than nominal wages. Not only is the effect on total real wage income then problematical; but an increase in prices has its own adverse effects on aggregate real demand. Thus the assertion that an economic recovery can be promoted by the demand effects of a wage increase has not received wide scholarly acceptance.

However we have shown that in the present model an increase in aggregate demand may directly increase the demand for labour (Eqs. 8, 9) and therefore real output without raising the price level. Since this seems to lend support to a policy of increasing wages to stimulate employment, a re-examination of the argument is warranted.

Even in the absence of a price increase, the effect of an increase in the wage rate on aggregate demand is of dubious sign. Total wage income may or may not increase; but if it does there may be an offsetting reduction in non-wage income. While consumption may be stimulated investment demand may be adversely affected. Nevertheless, for the purpose of the argument let us accept that the net direct effect is positive. If we can still show in this case that increasing the wage rate fails to combat stagflation, then for the alternative case the conclusion is established a fortiori. Furthermore by assuming for this purpose that the government has as its only other policy instrument the quantity of money, we present the analysis within a framework that is relatively favourable to wage policy. Where government revenue and expenditure are included in the analysis, these additional instruments (especially a change in tax rates) obviously increase the range of alternative strategies, and do not affect our conclusions below against increases in wages.

Instead of (2), then, we have

\[ Y = E(Y, r, W/P); 1 > E_y > 0, E_r < 0, \xi = E_{W/P} > 0. \]  

To analyse the effects of changes in wage rates we treat \( W \) as an exogenous, policy-determined variable, and assume that for all relevant settings of that instrument there is no excess demand for labour. (This is a reasonable assumption in an analysis of policies to cure unemployment.) Hence, instead of (11) we have

\[ \mu F_N = W. \]  

Equations (3) and (13) remain unchanged.

Following the procedure used in the derivation of (19) and (21), we may now derive

\[ H'dY = E_r(MdW - WdM) \]  

\[ H'dP = \left\{ (P\xi L_r \mu F_{NN}/F_N) - P^2(1 - E_y)L_r - P^2 L_y E_r \right\} dW + \]  

\[ (PE_r \mu F_{NN}/F_N) dM \]
where

$$H' = \left\{ ME_r + W_r L_r \right\} \mu F_{NN}/F_N \left\{ -PW \right\} (1 - E_r) L_r + L_Y E_r.$$

$H'$ is positive unless $F_{NN}$ is positive and very large (implying a sharply declining marginal cost curve); but since the system would be unstable in this event, we assume that it does not arise.

Since $E_r < 0$, we can see from (34) that an increase in $W$ with $M$ held constant necessarily reduces $Y$, while conversely an increase in $M$ with $W$ held constant necessarily increases $Y$. If $W$ and $M$ increase by the same proportion, i.e. if $dW/W = dM/M$, then $dY = 0$.

Since $F_{NN}$ is assumed to be not large enough to make $H'$ negative, the big bracketed term associated with $dW$ in (35) is a fortiori positive. Hence an increase in $W$ with $M$ held constant necessarily increases $P$. An increase in $M$ with $W$ held constant increases, does not affect, or decreases $P$ according to whether $F_{NN}$ is negative, zero or positive. An equi-proportional increase in $M$ and $W$ increases $P$ by the same proportion, since by substituting $dM/M = dW/W$ into (35) we obtain $dP/P = dM/M = dW/W$.

From these results it may be concluded that in terms of its effects on both output (and employment) and the price level, an increase in wage rates is counter-productive as an anti-stagflation measure even given the (questionable) presumption that the "first-round" effect on aggregate demand is positive.

The macroeconomics of wage rate changes may be illustrated in terms of our earlier IS-LM analysis (Figure 2). Let the initial situation be described by $IS_0$, $LM_0$, $N_0^d$ and (say) $F_2(N)$, and by the equilibrium values $Y_0$, $N_0$, $W_0$ and $P_0$. Suppose now that the wage rate is increased exogenously to $W'$, and that the (assumed) positive effect of this on aggregate demand shifts the IS curve from $IS_0$ to $IS_1$ (Figure 2). In the labour market (Quadrant III) the higher wage rate in itself tends to reduce employment; but the increase in aggregate demand shifts the demand for labour curve leftwards (by $AB = Y_0 Y_1$) at the initial price level $P_0$ to $N_1^d$. Even if the net effect is to increase employment (as shown in Figure 2), unless $F_{NN}$ is positive and very large (which we have ruled out above on grounds of instability), the associated increase in output ($Y_0 Y_1$) is insufficient to meet the higher level required to satisfy aggregate demand. The resulting excess demand drives up the price level, which (given $M$) shifts the LM curve leftwards (not shown), thereby reducing equilibrium below $Y_1$. The reduction of real aggregate demand shifts the demand curve for labour downwards, contracting employment and output. The result of this process will be a new equilibrium (not shown in Figure 2) in which, as demonstrated earlier, employment and output lie below, and prices above, their initial levels.

VII. CONCLUDING REMARKS

We have shown that the conditions for the success of a non-inflationary expansionary policy are much less stringent than in the case analysed by Ng[3] where government expenditure and taxes are absent. Nevertheless, we must still warn against undue optimism, since the economy in a particular situation may not satisfy the
conditions required. Moreover, since our analysis is in comparative statics terms, further consideration would need to be given to such real world questions as adjustment lags before one can be reasonably confident about the success of an expansionary policy even in the presence of unemployment. Our analysis also strengthens Ng's caution against a contractionary policy based purely on demand management. An increase in tax rates may reduce output and employment without reducing the price level or increasing government revenue.

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