Effects of Exogenous Nominal Wage Increases: The Purchasing Power Argument vs. The Production Cost Argument*

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This paper is concerned with the well-known controversial issue whether an exogenous nominal wage increase will, due to its income redistribution effect and its production cost effect, on balance raise or lower production, employment and real NNP. We provide a theoretical analysis for a closed economy allowing for non-wage labour costs, income taxes, various price-setting rules and different concomitant monetary policies. The main conclusions are derived by simple verbal arguments and supported by a formal analysis.

1. Introduction

Especially in periods of economic slack wage negotiations in the Federal Republic of Germany have been, and presently are, heavily influenced by fierce disputes of whether or not an exogenous increase in nominal wages will raise or lower overall employment. Trade unions argue that higher wages would raise workers' purchasing power and demand for consumption goods thereby improving the employment situation. We shall call this the *Purchasing Power Argument* (PPA). Employers, however, argue that higher wages mean higher production costs and higher product prices. In addition, the resulting decrease in profits would reduce investment demand. So total production would decrease, especially if the monetary authorities would not accomodate the

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Jürgen Rohwedder died, much too early, on July 30, 1984 in the age of 46. He will be remembered by his friends and colleagues for his keen interest in economic problems, his amiability and his unusual sense of humor; *H. H.*

price increase by an expansionary monetary policy. In an open economy these deflationary tendencies would be aggravated by the deterioration of the country's international competitiveness. We shall call this the *Production Cost Argument* (PCA).

The discussion of these conflicting views among German academic economists has been intensified by the Council of Economic Experts who, in their 1977/78 report (see *Sachverständigenrat* (1977/78)), took a clear position against the PPA. But the ensuing debate has either been exclusively in verbal terms as in *Kalmbach* (1978), *Mertens* (1978), *Vaubel* (1980), *Welzmüller* (1980), or concentrated on an empirical investigation of the different positions as in *Lehment* (1982), *Roth* (1982). A rigorous formal analysis based on a suitable macroeconomic model is still largely lacking. There are, first, papers by *Spilker* (1955) and *Niehans* (1959), who, in the Keynesian tradition of those days, almost completely ignored the supply-side of the economy, and secondly the monograph by *Malinvaud* (1977) and papers like those by *Pethig* (1979) and *Schäfer* (1979), who, using rationing models, neglect price reactions.

Of course there is a lot of work on the effects of wage increases in the framework of Keynesian or neoclassical models (see for instance *Meade* (1982)), analyzing the inflationary effects, or *Schröder* (1980), looking at the macroeconomic effects of nonwage labor costs), but the specific problem of PPA vs. PCA is usually not mentioned. An exception are some short remarks on the PPA by Stobbe.[1]

In the present paper we try to shed some light on this problem from the vantage-point of macroeconomic theory. Whether the PPA or the PCA is valid, or to put it more cautiously, is supported by better reasons, is a highly controversial and economically eminently important issue. Therefore a careful analysis is required that, inter alia, takes into account different conceivable reaction patterns of workers, entrepreneurs and the government. We shall use a simple macroeconomic model for a closed economy producing a single commodity. Four types of pricing practices will be considered:

1. no price changes
2. marginal cost pricing
3. mark-up pricing based on variable (labor) costs
4. mark-up pricing based on variable and (some) fixed costs

Since the consequences of a nominal wage increase can be expected to depend on how monetary authorities react to it we deal with three alternatives:

[1] *Stobbe* (1962), 104 - 108.

1. non-accommodating or partly accommodating monetary policy
2. accommodating monetary policy
3. interest stabilizing policy

Moreover, since employers when confronted with higher wage claims always point to the gap between their total labor costs and workers' takehome pay we allow for income taxes and social security payments. However, higher tax revenues are not treated as a leakage from the circular flow as we assume the government's propensity to spend to be positive and possibly even unity. Social security revenues form part of the transfer income of the old-aged, sick and unemployed. The marginal propensity to consume of the different groups of income recipients may be different, especially it may be higher for workers than for capitalists. But changes in profits will not only effect consumption demand but probably also investment demand. We assume real after-tax profits to influence net investment: First, such profits are a source of finance for firms and, secondly, changes in their current level could well change investors' expectations as to their future level. On balance a redistribution of income from profits to wages need not, as trade unions usually argue, raise overall commodity demand but rather may lower it. Finally, as the PPA vs. PCA debate is related to a business cycle problem we perform a comparative-static analysis for the short run.

Not surprisingly, our main conclusion is that neither the PPA nor the PCA is generally valid. Instead the employment and production effects of an exogenous nominal wage rise depend crucially on

— the effect of an income redistribution on total commodity demand,
— the pricing practices of firms,
— the concomitant monetary policy.

This does not tell much about how the scales for the PPA and the PCA are loaded. For the benefit of the reader's own judgement we only report that a positive employment effect requires that firms keep their supply prices fixed or raise them only moderately in spite of the fact that they usually face a fall in their real after-tax profits.

This paper is organized as follows: In section 2 we describe the model and discuss its basic properties. Section 3 is devoted to a verbal analysis of the consequences of a wage increase under different pricing practices and monetary policies. In section 4 we summarize our conclusions and offer some arguments that they are not restricted to our special model but can be expected to be more generally valid. In two short appendices we deal with the stability problem and derive the formulae describing the precise comparative-static results.

2. The Model

2.1. Assumptions

(A 1) The economy produces a single (composite) commodity using capital as a fixed factor and labor as a variable factor of production. The marginal product of labor is positive and can decrease, increase or remain unchanged with increasing production:

$$y = f(n),\ f(0) = 0,\ f' > 0,\ f'' \gtreqless 0 \tag{1}$$

y = output, n = labor input

We need not concern ourselves with exogenous technical progress since if it should occur we only would have to re-interpret the exogenous rate of nominal wage increase, $\hat{W}$, net of the rate of increase in labor productivity.

(A 2) The price P of the (bundle of) goods depends on the output level, y, and the nominal wage rate, W:

$$P = P(y, W) \tag{2}$$

This function can be interpreted either as price-setting function of the representative firm or as a macroeconomic supply function. Its properties remain for the moment unspecified.

(A 3) There is unemployment in the labor market. The nominal wage rate can be changed exogenously by wage negotiations between employers and trade unions.

(A 4) Nominal NNP, Py, equals the sum of gross nominal wage income, Wn, non-wage labor costs, $\alpha\, Wn$, i.e. especially contributions by employers and employees to the social security system, and, as a residual, nominal profits, Pq:

$$Py = Wn + \alpha\, Wn + Pq,\ \alpha = \text{const} > 0 \tag{3}$$

It is assumed that the nonwage labor costs are distributed as transfer income among the old-aged, the sick and the unemployed.

Other incomes of these groups, for example from the general budget of the goverment are taken to remain constant and can therefore be omitted.

(A 5) Wages and profits are taxed, transfer income is not. For simplicity we assume a proportional tax rate that may be different for labor and profit income. So we get as the nominal amount of tax collected by the goverment

$$T = \tau\, Wn + \tau^*\, Pq,\ 0 < \tau \leq \tau^* < 1\ . \tag{4}$$

The last two assumptions show that W is the wage rate *before* taxes but *after* deductions of the employees' contribution to the social security system. The latter are part of nonwage labor cost αWn. Hence the net nominal wage rate is $(1 - \tau) W$ but total labor cost per hour equal $(1 + \alpha) W$. As we assume α to be constant we can omit it in the price equation (2).

(A 6) Real consumption expenditures, c, depend on the three types of real disposable income

$$c = c((1 - \tau) wn,\ \alpha wn,\ (1 - \tau^*) q) \tag{5}$$

where $w = W/p$ is the gross real wage rate. The marginal propensities to consume out of wage income, c_1, out of transfer income, c_2, and out of profit income, c_3, are positive but less than one and satisfy the following inequality:

$$0 \leq c_3 \leq c_1 \leq c_2 < 1 \tag{6}$$

(A 7) Real government expenditure for goods need not be wholly exogenous but may partly depend on real tax receipts $t = T/P$:

$$g = g(t) = g(\tau wn + \tau^* q), 0 \leq g' \leq 1 \tag{7}$$

(A 8) Real net investment, j, depends on real after-tax profits, $(1 - \tau^*) q$, and the interest rate, r:[2]

$$j = j((1 - \tau^*) q, r), j_q > 0, j_r < 0 \tag{8}$$

(A 9) Real money demand, l, is a function of real NNP and the interest rate:

$$l = l(y, r),\ l_y > 0,\ l_r < 0 \tag{9}$$

Nominal money supply, M, is exogenously determined by the central bank according to certain rules which are discussed later.

(A 10) All expectations are static.

This assumption is rather restrictive. We make it to simplify our formal analysis. But in the final section we shall discuss the robustness of our findings against changes in assumptions, including the last one.

(A 11) There always exists a unique, at least locally stable macroeconomic equilibrium.

This is a prerequisite for a meaningful comparative-static analysis. Stability conditions will be derived in the Appendix A.

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[2] We shall denote a partial derivative $\partial j/\partial q$ by j_q, a rate of change dW/W by $\hat{W}$ and a partial elasticity $(y/l)\ (\partial l/\partial y)$ by $E(l, y)$.

2.2. Equilibrium Conditions

A (short-run) macroeconomic equilibrium is described by eqs. (4) - (9) and the following relationships:

(10)	$y = c + j + g$	(commodity market equilibrium)
(11)	$l = M/P$	(money market equilibrium)
(12)	$P = P(y, W)$	(price equation)
(13)	$q = y - (1 + \alpha)\, wn$	(profit equation)
(14)	$y = f(n)$	(production function)

2.3. The Effect of an Income Redistribution on Commodity Demand

The impact effect of an income redistribution will be felt on the commodity market. Clearly, it is expansionary or contractionary depending on whether, at still unchanged levels of real NNP and employment, total commodity demand $c + j + g$ is raised or lowered. Let us take a closer look. First we substitute real profits as an argument of $c + j + g$ by the RHS of (13). The resulting commodity demand function depends on real NNP, y, and on real wage payments, wn. Its partial derivatives are:

$$\delta_1 := \partial (c + j + g)/\partial y = (1 - \tau^*)(c_3 + j_q) + \tau^* g' > 0 \tag{15}$$

$$\delta_2 := \partial (c + j + g)/\partial (wn) = \{(1 - \tau) c_1 + \alpha c_2 + \tau g'\} - \{(1 + \alpha)[(1 - \tau^*)(c_3 + j_q) + \tau^* g']\} \tag{16}$$

δ_1 measures the (positive) demand effect of a rise in real NNP at a given level of wage payments, i.e. the demand effect of an increase in real profits, other things remaining equal. (Clearly, $c_3 + j_q$ is the marginal absorption of capitalists.) δ_2 measures the demand effect of a redistribution of income from profits to wages at a given level of real NNP. More specifically, the first braces represent the increase in total spending due to the rise in wage and wage related income and the second braces represent the decrease in total spending due to the concomitant fall in profits. As δ_2 is subject to conflicting forces its sign is generally indeterminate.[3]

Some further insight can be gained by "reshuffling" the RHS of (16):

$$\delta_2 = \{(1 - \tau) c_1 + \alpha c_2 - (1 - \tau^*)(1 + \alpha)(c_3 + j_q)\} + \{[\tau - (1 + \alpha)\tau^*]\, g'\} \tag{17}$$

The effect of an income redistribution on private spending is shown by the first braces and on government spending by the last braces.

[3] *Niehans* (1959), 47 and *Stobbe* (1962), 105 point out that a nominal wage increase could, ceteris paribus, raise real investment as firms try to substitute capital for labour. Then a positive redistribution effect would be more likely but otherwise the findings reported below remain unscathed.

$\tau - (1 + \alpha)\,\tau^* < 0$ implies that such a redistribution reduces tax revenues. Hence whenever the spending propensity g' is positive there will be a decline in real government expenditures on commodities. Private spending, however, may either rise, fall or remain unchanged depending on whether the increase in non-capitalists' expenditures exceeds, falls short of, or equals the decrease in capitalists' expenditures, i.e. depending on whether $(1 - \tau)\,c_1 + \alpha\,c_2$ is larger, smaller, or equal to $(1 - \tau^*)\,(1 + \alpha)\,(c_3 + j_q)$. Again the overall effect is indeterminate.

It should be noted that a sufficient condition for $\delta_2 < 0$ is that real investment expenditures are reduced by more than real net profits, i.e. that $(1 - \tau^*)\,j_q > 1$, since

$$\delta_2 < (1 + \alpha)\,[c - (1 - \tau^*)\,j_q] \quad \text{with } c = \max(c_1, c_2, g') \leq 1\ . \tag{18}$$

Finally, as a special case $c_1 = c_2 = g'$. Then:

$$\operatorname{sign} \delta_2 = \operatorname{sign} [c_1 - (c_3 + j_q)] \tag{19}$$

Hence δ_2 is positive (negative) if workers, unemployed and retired people and the government happen to have the same marginal propensity to spend which is, moreover, larger (smaller) than the marginal propensity to spend of capitalists.

We shall speak of a positive redistribution effect if $\delta_2 > 0$ and of a negative redistribution effect if $\delta_2 < 0$. It should be kept in mind that the strength of this effect on total commodity demand depends not only on the absolute value of δ_2 but also on the change in real wage payments, $d\,(wn)$. As a given level of output in associated with some fixed level of employment it is the rise in the real wage rate, $w = W/P$, that matters. Therefore the redistribution effect is small or even nil if commodity prices rise by nearly or exactly the same percentage as the nominal wage rate.

2.4. Pricing Rules

We shall consider four pricing rules of which the second and third have, however, the same consequences. The most unrealistic case seems to be that firms keep their supply prices fixed although their costs have increased:

$$E\,(P, W) = 0,\ E\,(w, W) = 1 \quad \text{(Keynesian case)} \tag{20}$$

Alternatively, firms could choose marginal cost pricing[4],

$$Pf' = (1 + \alpha)\,W, \quad \text{(neoclassical case)} \tag{21}$$

[4] For well-known reasons this requires non-decreasing labor productivity ($f'' \geq 0$).

or they could put a fixed proportional mark-up on average variable costs (mark-up pricing, Type A),

$$P = (1 + \varkappa)(1 + \alpha) Wn/y \ . \tag{22}$$

Under both circumstances,

$$E(P, W) = 1, \ E(w, W) = 0 \ . \tag{23}$$

Finally, a mark-up could be levied on average variable cost and average fixed costs like interest payments on loans (mark-up pricing, type B),

$$P = (1 + \varkappa)\,[(1 + \alpha) Wn + F]/y \ . \tag{24}$$

Obviously,

$$0 < E(P, W) = \lambda < 1, \ 0 < E(w, W) = 1 - \lambda < 1 \tag{25}$$
$$\text{with } \lambda := (1 + \alpha) Wn/[(1 + \alpha) Wn + F] \ .$$

Not surprisingly, only under the first and the last pricing rules a nominal wage increase will bring about higher real wages and hence an income redistribution.

2.5. Monetary Policies

In principle, the consequences of wage policies and monetary policies should be kept apart and studied separately. Nevertheless, as sometimes monetary authorities seem to be prepared, if only rather unwillingly, to "finance" wage increases it seems worthwhile to allow for a "policy mix" and deal with three alternatives:

(i) Non-accommodating or partly accommodating policy: $0 \leq \hat{M} < \hat{W}$

(ii) Accommodating policy: $\hat{M} = \hat{W}$

(iii) Interest stabilization policy: $dr = 0$

It should be kept in mind that we use the term "accommodating policy" in a slightly unusual sense as it normally refers to money supply changes in line with price changes: $\hat{M} = \hat{P}$. But as, except under special conditions, the overall price increases do not exceed the rise in the nominal wage rate ($\hat{P} \leq \hat{W}$) a $\hat{P} = \hat{M}$ policy will typically be a special case of policies (i) or (ii).

3. Verbal Analysis

We have now prepared the ground for a detailed discussion of the consequences of a nominal wage increase under various circumstances. Our arguments will be based on a 10 percent rise in W.

3.1. Fixed Commodity Prices

With commodity prices kept constant the real wage rate will also rise by 10 percent. Total commodity demand increases or decreases depending on whether the redistribution effect is positive or negative. Suppose the nominal money supply remains unchanged. Then, in the first case there will be an expansion of production and employment which is to some extent dampened by the increase in the interest rate and its effect on investment demand.[5] Similarly, in the second case there will be a contraction in production and employment which is to some extent reduced by the fall in the interest rate. Obviously, if the monetary authorities choose to fix the interest rate both these changes will be more pronounced. Finally, under a partly or fully accommodating policy the higher nominal money supply will put a downward pressure on the interest rate. Therefore, expansionary forces will be buttressed and contractionary forces weakened or even reversed. If, however, inspite of a negative redistribution effect real NNP increases this is entirely due to the monetary policy (which would be even more effective without the wage rise).

3.2. Marginal Cost Pricing or Mark-up Pricing, Type A

Under these pricing rules commodity prices are raised by 10 percent and the real wage rate remains unchanged. Consequently, there is no change in the distribution of real income between capitalists, non-capitalists and the government and hence no change in total commodity demand. With a non-accommodating or partly accommodating monetary policy the real money supply will fall and the interest rate rise. The resulting decline in investment demand causes a decrease in real NNP and employment. Only a fully accommodating policy or, what now amounts to the same, a fixed interest rate policy would prevent this slowdown in economic activities (and it would require an "over-accommodating" policy to overcome the contractionary forces indirectly associated with the nominal wage increase and to lead to an expansion).

3.3. Mark-up Pricing, Type B

This pricing rule implies an increase in commodity prices by, say, z percent ($0 < z < 10$) and a rise in the real wage rate by $10\text{-}z$ percent.

[5] This is in line with Malinvaud's conclusion, derived from a different model, that in Keynesian unemployment a money wage increase creates new jobs; cf. *Malinvaud* (1977), 60. Malinvaud assumes that only the marginal propensity to absorb from wages is positive, and he does not take taxes and nonwage costs into account; cf. op. cit., p. 40. Hence his redistribution effect is positive. Under our assumption this need not be the case as discussed in Section 2.3.

Thus there will be some income redistribution, and total demand will increase or decrease whenever the redistribution effect is positive or negative, respectively. Under a fixed interest rate policy these initial demand effects alone are of crucial importance: real NNP and employment expand in the first case and contract in the second case. Otherwise there will be an additional interest effect: If the nominal money supply is kept unchanged or raised by less than z percent real money supply will fall and the interest rate will go up. This strengthens contractionary forces and weakens or even reverses expansionary forces. Clearly, the opposite consequences would result from an increase in nominal money supply by more than z percent. Obviously, ceteris paribus, the primary redistribution effect is the smaller and the secondary interest rate effect is the larger the more firms raise their supply prices. If both effects combined tend to depress economic activities a sufficiently expansionary monetary policy is again required to raise, nevertheless, the level of production and employment.

It should be noted that capitalists face a decline in their income share whenever a nominal wage increases raises real wages as well. The absolute amount of gross and net real profits will only rise if the wage policy and the concomitant monetary policy combined cause a sufficiently strong expansion in real NNP. However, this seems unlikely and it will be shown in the appendix that such an outcome can hardly be expected; cf. the comment on eq. (24′).[6]

4. General Conclusions and Some Further Extensions

Our last arguments and also the formal analysis that is to follow lead, in the framework of our model, to the following general conclusions:

1. The PPA is erroneous if firms raise, at any level of output, their commodity prices rise by the same percentage as the nominal wage rate (or even by more).
2. Generally, a nominal wage increase is the more likely to reduce (to reinforce) recessionary forces by improving (worsening) the country's overall production and employment situation, as predicted by the PPA (the PCA),
   - — the weaker (stronger) the wage-price link,
   - — the more positive (negative) the redistribution effect, or/and
   - — the larger (smaller) the concomitant money supply increase.

[6] Not surprisingly, an increase in real profits is rendered more likely in case of decreasing labor productivity ($f'' < 0$). In eq. (24′) $E(P, n)$ is then negative since the supply price falls with increasing output and employment.

3. Trade unions relying on the PPA to justify their demand for higher nominal wages in recessionary periods explicitly or implicitly maintain that a redistribution of income towards labor will raise overall commodity demand. Hence they take the redistribution effect to be positive. But even then the PPA need not be valid unless,
   - — firms are willing and capable to keep their supply prices fixed or raise them by a smaller percentage than their labor costs have risen although they face, except under rather special circumstances, a decline in total real profits, and,
   - — in case of nevertheless substantial price increases, the monetary authorities follow a sufficiently expansionary policy.

Since our analysis was based on some rather restrictive assumptions the relevance of its results might be questioned. Therefore, we like to offer some reasons why we think our conclusions are more generally valid. We take up several points in turn:

1. Increases in labor productivity: If labor productivity improves we only have to redefine $\hat{W}$ as the rate of nominal wage increase net of labor productivity increases. Whenever $\hat{W}$ is positive there will be a rise in labor costs per unit of output and our findings remain unscathed. Should the productivity changes result from capital deepening there also would be a tendency for fixed costs to increase and under mark-up pricing, type B, for commodity prices to be raised more than otherwise. This would weaken the PPA.

2. Non-static income expectations of workers: If workers believe in the PPA they will expect that the nominal wage increase leads to a permanent increase in real labor income. The same is true for those who receive transfer income. According to the permanent income hypothesis this would lead to relatively high marginal propensities to consume c_1 and c_2. This clearly makes a positive redistribution effect more likely. However, the opposite would be true if workers do not believe in the PPA, fear that higher nominal wages make their jobs less secure and therefore, for precautionary reasons, save more.[7] It is an empirical question which kind of income expectations is prevalent and, thus, whether the case for the PPA is strengthened or weakened.

3. Non-static price expectations: If in general economic agents expect prices to rise following a nominal wage increase and if they react accordingly, especially by basing their investment and money demand on the expected real rate of interest, our arguments in principle still apply. We observe, however, that a policy of stabilizing the nominal

[7] A similar argument has been proposed by *Stobbe* (1962), 105 - 6.

interest rate would have additional expansionary effects as the real interest rate declines. It is difficult to judge to what extent expected higher future prices directly effect present commodity demand although a (slight) rise appears more likely. Our conjecture is that on balance the weights between the PPA and the PCA do not change much.

4. Progressive income tax: The decline in real tax revenues caused by a nominal wage increase is aggrevated by a progressive income tax since, with the marginal tax rate on profits not smaller than that on wages, it means a more pronounced fall in nominal tax revenues. The redistribution effect will be weakened if the governments's marginal propensity to spend is positive.

5. Indirect taxes: As long as there is only a proportional indirect tax with a given tax rate, introduction of such a tax would not change our results. When we are using the mark-up pricing hypothesis, indirect taxes are just part of the mark-up factor.

6. International trade: Domestic price increases would impair the country's international competitiveness and thus reduce overall demand for its products.[8] A devaluation of the home currency would reduce the change in the terms of trade but add to the cost increases via higher prices of imported intermediate goods.

Looking back at the various possible consequences of a nominal wage increase and judging their likelihood we think that the PCA carries the greater weight. Only under rather special circumstances the PPA will be stronger. But even then the rise in production and employment is more due to an accompaning expansionary monetary policy than to the wage increase itself. What also in required is that commodity prices remain fixed or that firms apply a mark-up rule of type B that is not profit maximizing. More important, one should not neglect that real profits are usually reduced so that the rate of real investment may well decline and the country's future economic situation be harmed.

On balance, our conclusions, based on a theoretical study of a rather broad variety of possible circumstances, supports the critical appraisal of the PPA by the German Sachverständigenrat[9] and they cast coubt on the validity of the opposing stance taken by *Kalmbach* (1978) and *Welzmüller* (1980).

[8] Under fixed exchange rates and with a high degree of international capital mobility a country would face, ceteris paribus, a (nearly) fixed interest rate. Hence one should expect that a nominal wage increase has similar consequences for an open economy as described above under an interest stabilization policy.

[9] See especially *Sachverständigenrat* (1977/78). *Lehment* (1982) and *Roth* (1982) provide empirical findings supporting this appraisal and *Vaubel* (1978) arguments in its favor.

To put it differently: Anyone using the Purchasing Power Argument to propose a nominal wage increase during a recession ought to examine carefully the country's economic situation and to take into account the current attitude of the monetary authorities.

Appendix A: Stability Analysis

We make the following assumption about the adjustment process during disequilibrium:

$$\dot{n} = \lambda_1 (c + j + g - y) \tag{1'a}$$

$$\dot{r} = \lambda_2 (Pl - M) \tag{1'b}$$

$$\dot{P} = \lambda_3 [P(y, W) - P] \tag{1'c}$$

where $\dot{n}$ is the time derivative of n and λ_i are positive constants. In addition we have to take into account eqs. (4) - (9), (13) and (14). Thus we assume that employment adjusts to the excess demand in the commodity market, the interest rate to the excess demand in the money market and prices to the differences between the desired and actual prices.

Linearizing the system (1') to taking total differentials of the RHS with respect to the three endogenous variables yields the following matrix of coefficients:

$$\begin{bmatrix} -\lambda_1 \delta_3 & \lambda_1 j_r & -\lambda_1 \delta_2 wn/P \\ \lambda_2 P l_y f' & \lambda_2 P l_r & \lambda_2 l \\ \lambda_3 P_y f' & 0 & -\lambda_3 \end{bmatrix} \tag{2'}$$

with

$$\delta_3 := (1 - \delta_1) f' - \delta_2 w = \text{change in excess commodity supply following an increase in labor input, other things remaining equal.}^{10} \tag{3'}$$

We denote by A_1 the trace of this matrix, by A_2 the sum of its second order principal minors and by A_3 its determinant. According to the Routh-Theorem the equilibrium is locally stable, if the following conditions hold:

$$A_1 < 0, A_2 > 0, A_3 < 0 \text{ and } A_1 A_2 - A_3 < 0 \tag{4'}$$

To simplify the notation we introduce the following abbreviations:

$$\begin{aligned} \delta_4 &:= \delta_3 + \delta_2 wnP_y f'/P \\ \delta_5 &:= -P(\delta_4 l_r + j_r l_y f') \end{aligned} \tag{5'}$$

[10] Therefore, $\delta_3 > 0$ amounts to a negative and $\delta_3 < 0$ to positive slope of the IS curve in a (n, r) or a (y, r) diagram.

Both expressions are second order minors of the matrix (2'). We can interpret δ_4 as the influence of an increase in employment on the excess supply of commodities taking into account the price reaction but assuming a given interest rate. δ_5 has the same sign as the difference between the slope of the LM-curve $[-(l_y f'/l_r) > 0)]$ and the IS-curve (δ_3/j_r) in an (n, r)-diagram. For $\delta_3 < 0$ the IS-curve has a positive slope but for $\delta_5 > 0$ it is, at their point of intersection, steeper than the LM-curve. In addition, we note that $\delta_2 \geq 0$ and $\delta_3 \geq 0$ implies $\delta_4 \geq 0$ and $\delta_5 > 0$.

The following results are easy to derive:

(6') $$A_1 = -\lambda_1 \delta_3 + \lambda_2 Pl_r - \lambda_3$$

Each of the following conditions is sufficient for $A_1 < 0$:

(7') $$\delta_3 \geq 0$$

(7'b) λ_2 and/or λ_3 are sufficiently large

(8') $$A_2 = \lambda_1 \lambda_2 \delta_5 - \lambda_2 \lambda_3 Pl_r + \lambda_1 \lambda_3 \delta_4 \qquad \square$$

Each of the following conditions is sufficient for $A_2 > 0$:

(9'a) $\delta_4 \geq 0$ and $\delta_5 \geq 0$

(9'b) $\delta_4 \geq 0$ and λ_3 sufficiently large

(9'c) $\delta_5 \geq 0$ and λ_2 sufficiently large $\qquad \square$

(10') $$\begin{aligned} A_3 &= -\lambda_1 \lambda_2 \lambda_3 (\delta_5 - P_y j_r lf' - \delta_2 P_y l_r wnf') \\ &= \lambda_1 \lambda_2 \lambda_3 [Pl_r \delta_4 + (Pl_y + lP_y) j_r f'] \end{aligned}$$

Each of the following conditions is sufficient for $A_3 > 0$ with at least one of the inequalities holding strictly:

(11'a) $\delta_4 \geq 0$ and $Pl_y + lP_y = \partial (Pl)/\partial y \geq 0$

(11'b) $\delta_2 \geq 0, \delta_5 \geq 0$ and $P_y \geq 0 \qquad \square$

(12') $$\begin{aligned} A_1 A_2 - A_3 = \lambda_1 \lambda_2 \lambda_3 (2 Pl_r \delta_3 - P_y j_r lf') - \lambda_1^2 \delta_3 (\lambda_2 \delta_5 + \lambda_3 \delta_4) \\ + \lambda_2^2 Pl_r (\lambda_1 \delta_5 - \lambda_3 Pl_r) + \lambda_3^2 (\lambda_2 Pl_r - \lambda_1 \delta_4) \end{aligned}$$

Each of the following conditions is sufficient for $A_1 A_2 - A_3 \leq 0$:

(13'a) $\delta_2 \geq 0$, $\delta_3 \geq 0$ and $2 Pl_r \delta_3 - P_y j_r lf' \leq 0$

(13'b) $\delta_4 \geq 0$ and λ_3 sufficiently large

(13'c) $\delta_5 \geq 0$ and λ_2 sufficiently large $\qquad \square$

Hence for local stability of a macroeconomic equilibrium each of the following conditions is sufficient if always at least one of the inequalities is strictly fulfilled:

(14'a) $\delta_2 \geq 0,\ \delta_3 \geq 0,\ P_y \geq 0$ and $2\,Pl_r\,\delta_3 - P_y\,j_r\,lf' \leq 0$

(14'b) $\delta_2 \geq 0,\ \delta_5 \geq 0,\ P_y \geq 0$ and λ_2 sufficiently large

(14'c) $\delta_4 \geq 0,\ Pl_y + lP_y \geq 0$ and λ_3 sufficiently large □

None of these conditions is self-contradictory. We observe that local stability is compatible with both a positive and a negative redistribution effect.

Appendix B: Comparative-Static Analysis

Since real NNP and employment are closely related we need to study only one of these variables. Obviously, using (14),

(15') $$P_n = f'\,P_y = (P/n)\,E\,(P, y)\,E\,(y, n) = (P/n)\,E\,(P, n)\ ,$$

(16') $$l_n = (l/n)\,E\,(l, y)\,E\,(y, n) = (l/n)\,E\,(l, n)\ .$$

Hence, taking also eqs. (4) - (9) into account, total differentiation of (10) - (13) yields:

(17')
$$\begin{bmatrix} n\,\delta_3 & -jE\,(j, r) & \delta_2\,wn & 0 \\ -E\,(l, n) & -E\,(l, r) & -1 & 0 \\ -E\,(P, n) & 0 & 1 & 0 \\ -n\,[f' - (1+\alpha)\,w] & 0 & -(1+\alpha)\,wn & 1 \end{bmatrix} \begin{bmatrix} \hat{n} \\ \hat{r} \\ \hat{P} \\ dq \end{bmatrix} = \begin{bmatrix} \delta_3\,wn \\ -\beta \\ E\,(P, W) \\ -(1+\alpha)\,wn \end{bmatrix} \hat{W}$$

Here β describes the relationship between the nominal increases in the money supply and the wage rate: $\hat{M} = \beta\,\hat{W}$. Thus $\beta = 0$ represents a non-accommodating, $0 < \beta < 1$ a partly accommodating and $\beta = 1$ a fully accommodating monetary policy. For an interest stabilization policy the second row and the second column in (17') have to be deleted. Formally, this is equivalent to $E\,(l, r) = -1, E\,(j, r) = \beta = 0$. Hence, with these specifications the following equations apply to the third policy alternative as well.

The determinant of the coefficient matrix is

(18') $$\Delta = -nE\,(l, r)\,[\delta_3 + \delta_2\,wE\,(P, n)] - jE\,(j, r)\,[E\,(P, n) + E\,(l, n)]$$

It is easy to confirm that Δ and the determinant A_3 of (2') are of opposite sign. Hence, local stability requires $\Delta > 0$.

Let us further simplify the notation by setting

(19') $$\Theta := wn/y = \text{share of gross wage income in NNP}$$

(20') $$\delta_6 = 1 + \alpha - (1-\tau)\,c_1 - \alpha\,c_2 - \tau\,g' > (1-\tau)\,(1-c_1) + \alpha\,(1-c_2) \geq 0\ .$$

Taking $E(v, n) = E(v, y)\, E(y, n)$ for $v = P, l$ into account and using Cramèr's rule we find after some tedious rearranging of terms:

$$(21') \qquad \hat{n}/\hat{W} = -(1/\Delta)\,[1 - E(P, W)]\,[\delta_2\, wnE(l, r) + jE(j, r)] + (1/\Delta)\,(1 - \beta)\, jE(j, r)$$

$$(22') \qquad \hat{w}/\hat{W} = 1 - (\hat{P}/\hat{W}) = -(1/\Delta)\,[1 - E(P, W)]\,[\delta_3\, nE(l, r) + jE(j, r)\, E(l, n)] - (1/\Delta)\,(1 - \beta)\, jE(j, r)\, E(P, n)$$

$$(23') \qquad (\hat{w} + \hat{n})/\hat{W} = -(1/\Delta)\,[1 - E(P, W)]\,\{(1 - \delta_1)\, yE(y, n)\, E(l, r) + jE(j, r)\,[1 + E(l, n)]\} + (1/\Delta)\,(1 - \beta)\, jE(j, r)\,[1 - E(P, n)]$$

$$(24') \qquad \hat{q}/\hat{W} = (y/q\,\Delta)\,[1 - E(P, W)]\,\{\delta_6\, E(l, r)\, E(y, n) + (1 + \alpha)\,\Theta\, jE(j, r)\, E(l, n)\} + (y/q\,\Delta)\, jE(j, r)\,\{[\beta - E(P, W)]\,(n/y)\,[(1 + \alpha)\, w - f'] + (1 - \beta)\,(1 + \alpha)\,\Theta\, E(P, n)\}$$

Eqs. (23′) and (24′) are of interest as they describe the changes in real (gross and net) income of workers and capitalists. While total real wage payments may well increase there is a strong presumption that, as mentioned earlier, total real profits decline since δ_6 is positive and $(1 + \alpha)\, w - f'$ is negative unless labor costs exceed labor productivity.

The last four formulae clearly indicate that indeed the price/wage elasticity $E(P, W)$ and also the money supply parameter β are of crucial importance for the consequences of a nominal wage increase. We leave it to the interested reader to specify eqs. (21′) - (24′) for the various price setting rules, taking (20), (23) and (25) into account, and for the various monetary policies. The results will confirm our verbal conclusions and, in case they were ambiguous, allow to derive precise conditions for the different possible outcomes.

Summary

This paper is concerned with the well-known controversial issue whether an exogenous nominal wage increase will, due to its income redistribution effect and its production cost effect, on balance raise or lower overall economic activities. A theoretical analysis for a closed economy is provided allowing for non-wage labor costs, income taxes, various price-setting rules and different concomitant monetary policies. The general conclusion is that such a wage increase will normally reduce production and employment except if firms keep their supply prices more or less fixed and if the monetary authorities follow a sufficiently expansionary policy.

Zusammenfassung

Diese Arbeit behandelt die bekannte kontroverse Frage, ob eine exogene Nominallohnerhöhung aufgrund der damit verbundenen Einkommensumverteilung und Kostensteigerung insgesamt expansiv oder kontraktiv wirkt. Dieses Problem wird für eine geschlossene Volkswirtschaft theoretisch untersucht, und zwar unter Berücksichtigung von Lohnnebenkosten, Einkommensteuern, verschiedenen Preissetzungsverfahren und unterschiedlichen Zentralbankreaktionen. Die allgemeine Schlußfolgerung ist, daß eine derartige Lohnerhöhung normalerweise die Produktion und die Beschäftigung verringert, falls nicht die Unternehmen ihre Güterpreise mehr oder weniger konstant halten und die Zentralbank eine hinreichend expansive Geldpolitik betreibt.

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