Will a productivity-oriented wage policy stabilize the labor share?

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Abstract

In the mid 1980s, the German Council of Economic Experts suggested a "productivity-oriented wage policy" rule. Some time series analytical considerations show that such a policy will fail to stabilize the labor share in the long run, except in the special case of a Cobb-Douglas production function. In general, the necessary cointegrating relationships cannot be established because the policy rule is formulated in terms of growth rates instead of levels. This finding holds for forward-looking rational as well as for backward-looking expectations. Some evidence is presented showing that the problem applies to the West German economy in the period 1980-1994.

Deutsche Zusammenfassung

Kann eine produktivitätsorientierte Lohnpolitik die Lohnquote stabilisieren?

Anhand einiger zeitreihentheoretischer Überlegungen wird gezeigt, dass eine produktivitätsorientierte Lohnpolitik im Sinne der Position des deutschen Sachverständigenrats zur Begutachtung der gesamtwirtschaftlichen Entwicklung (SVR) Mitte der 80er Jahre langfristig

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daran scheitern muss, die Lohnquote zu stabilisieren. Eine Ausnahme bildet nur der Fall einer Cobb-Douglas-Produktionsfunktion, im allgemeinen jedoch können die notwendigen Kointegrationsbeziehungen nicht etabliert werden, weil die damalige Politikregel des SVR sich auf die Wachstumsraten statt auf die Niveaus der Variablen bezieht. Dies gilt sowohl für vorwärtsgerichtete rationale wie für rückwärtsgerichtete Erwartungen. Die empirische Evidenz zeigt, dass das geschilderte Problem auf Westdeutschland im Zeitraum 1980-1994 zutrifft.

1 Introduction

The idea of a productivity-orientied wage policy plays a prominent role in German debates about labor compensation issues. This has been true at least since the Council of Economic Experts (*Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung, SVR*) officially started to promote the concept in the mid 1980s (SVR, 1985, text numbers 192-195). However, a guideline named cost level oriented wage policy existed even before. Although it shared many features of the productivity orientation, it was not formulated as explicitly (e.g. SVR, 1974, text number 141).

There was a double goal behind the plea for letting nominal wage setting being determined by productivity developments. On the one hand, the idea is to prevent economy-wide cost pressure that could lead to an inflationary episode which in turn could induce the central bank to bring about a stabilizing recession. In this sense the aim is to stabilize unit labor costs which are defined as the nominal wage bill (including social insurance contributions and other cost elements of labor inputs) divided by real output. This aspect of inflation control will not be analyzed any further in the present paper.

But on the other hand there is also a goal directly involving real variables. If excessive nominal wage growth cannot be completely rolled over into commodity prices the real wage will grow faster than productivity. This affects the distribution of revenues among the input factors, for instance capital and labor shares. (The latter is defined as the real wage bill divided by real output and thus results from deflating unit labor costs appropriately.) So one reason why a stabilization of the labor share might be desirable is that the status quo of the social conflict about income distribution is left untouched. This explains for example why unions in times of a falling labor share typically argue in favor of a productivity-oriented wage policy. But in addition to that, a change of relative prices of input factors will induce an adjustment of real input and output levels, such that a rising labor share could cause adverse employment developments. Therefore it would also be interesting from the perspective of allocative efficiency if the labor share could be stabilized, starting from an employment level commonly believed to be adequate.

Such arguments for a wage policy guided by productivity are usually derived, however, from a comparative-static analysis. In the past there have been considerable movements of the labor share in Germany as well as in other countries (see e.g. Bentolila and Saint-Paul, 1999), and thus there is a natural question to ask: Have these movements been due to a wage policy which was not productivity-oriented or did the stabilization fail despite wage setters adhering to the policy rule? In the latter case, is a failure of stabilization of the labor share merely coincidental or is it to be expected?

In order to clarify these issues in a dynamic context, the next section introduces some time series analytical definitions which will be needed for the rest of the investigation. After that, the third section contains a description of the assumptions of the model and a formalization of the policy rule of productivity orientation. The fourth section is split into two parts each of which contains the main analysis using a different assumption about the productivity expectations. First the implications are derived under rational expectations, and secondly backward-looking expectations are used. In both cases the result is that a stabilization of the labor share will not be achieved except in the special case of a Cobb-Douglas production function.

The analysis is complemented by an example in the fifth section, where empirical evidence is presented for West Germany in the period 1980-1994. It will be shown that wage setting indeed followed the policy rule discussed above, whereas the labor share displays a clearly unstable behavior. It thus appears that the argument put forward in this paper is empirically relevant.

2 Time series analytical definitions

The focus of the present work is not necessarily empirical, but for an adequate treatment of dynamic economic processes we resort to the toolbox of time series analysis in order to account for the fundamental properties of the data. We will use the time series methodological terminology as follows, see e.g. Hamilton (1994). By L we denote the lag operator which is defined as $L^i x_t = x_{t-1}$ for integer i. Accordingly, the difference operator Δ is given as $\Delta = 1 - L$. Then a polynomial in the lag operator $A(L)$ has the following form, where in general the series may be infinite:

$$A(L) = a_0 + a_1 L + a_2 L^2 + \ldots \tag{1}$$

This polynomial is stable and invertible if and only if its characteristic roots lie outside the complex unit circle. Given some stable polynomials $A(L)$ and $B(L)$, the equation

$$A(L) x_t = m + B(L) u_t \tag{2}$$

describes a weakly stationary process x_t of the ARMA class, where u_t is a *white noise* process. The constant m generates a non-zero expectation of the process x_t. We call such a process integrated of order zero, or shortly $I(0)$. The notation $I(d)$ for integer d means that the process has to be differenced at least d times to become stationary. Loosely speaking, a stationary process has a constant expectation and a constant variance.

The first difference of such a process (Δx_t) is an $I(-1)$ process which –although it is also stationary– contains a non-invertible moving average component $(1 - L)B(L)u_t$. It is also called overdifferenced.

On the opposite side, the cumulation of an $I(0)$ process ($\sum_{i=0}^{t} x_i$) is an integrated process, or more precisely $I(1)$. If we wanted to represent this non-stationary process in the form of (2), namely as $A'(L) \sum x_t = B(L) u_t$, then the according polynomial $A'(L) = A(L)(1 - L)$ would not be invertible anymore, but would contain a so-called unit root. An $I(1)$ process has a diverging variance wherefore over time it can deviate from its expected value by an infinitely large amount.

The prototypical example is a *random walk*, $rw_t = \sum_{i=0}^{t} u_i \Leftrightarrow \Delta rw_t = u_t$. We also call it a stochastic trend, of which kind there is at least one in every $I(1)$ time series. Two (or more) of such integrated processes are called *cointegrated* if there exists a linear combination of them which is stationary. In such a cointegrating relationship the stochastic trend responsible for the non-stationarity exactly cancels.

3 The modeling setup

3.1 The assumptions

With respect to the institutional background of wage policy we make the plausible assumption that the wage setting parties do not at the same time bargain over employment levels, i.e. firms determine labor inputs unilaterally. Therefore we are not dealing with a model of efficient contracts (which would not be time consistent), but we use the so-called right-to-manage assumption. Because of this the labor demand function is the central component of the model. As shown in the appendix, when it is derived from a constant elasticity of substitution (CES) production function it takes the following logarithmic form:[1]

$$l_t = c - \frac{\rho}{1+\rho} a_t - \frac{1}{1+\rho} w_t + \frac{1+\frac{\rho}{\mu}}{1+\rho} y_t + \epsilon_{1,t} \tag{3}$$

The equilibrium level of labor inputs l_t (in logarithms) depends on a constant c, on the influence of (log) technical development levels a_t, on (log) real wage levels w_t, as well as on (log) output y_t. Let the technical development term be exogenous; for the derivation we used the common assumption that it is Harrod neutral (and thus labor saving). The parameter $\rho > -1$ is the substitution parameter of the CES production function. Note that the coefficient of the real wage is therefore the elasticity of substitution. For the

[1]More general specifications for the production function, e.g. the translog function, typically lead to non-linear relationships which cannot be analyzed with the time series theoretical tools used in this paper.

special case of a Cobb-Douglas production function it holds that $\rho = 0$ and thus the mentioned elasticity is equal to -1. The demand for goods is not explicitly modeled in our mini model and will depend at least partially on exogenous developments. The influence of y_t on l_t changes as the result of different combinations of ρ and of the homogeneity parameter $\mu > 0$.

As (3) should be a well-defined equilibrium relationship the equilibrium deviation $\epsilon_{1,t}$ must be $I(0)$ with expectation zero. With respect to the time series properties of the other variables we make the plausible assumption that we are dealing with $I(1)$ processes. This is a potentially binding restriction only in the case of the technical level a_t which is not directly observable. In contrast, for real output and real wages this assumption reflects common empirical usage. (The linear time trend usually used as a proxy for the technical level only helps to explain the mean growth of technological progress and does not imply any assumption about the order of integration of the stochastic deviations from this trend.)

Using the definition of (log) labor productivity $q_t = y_t - l_t$, if we rewrite (3) in such a way that we have the (log) labor share on the left hand side, we obtain:

$$w_t - q_t = c + \frac{\rho}{1+\rho}\left(w_t - a_t + \frac{1-\mu}{\mu} y_t\right) + \epsilon_{1,t} \tag{4}$$

First of all let us clarify that we will refer to a stabilization of the labor share as a situation when the left hand side of (4) follows a (weakly) stationary process. This means that real wages and productivity would have to be cointegrated on a 1:1 basis if they are indeed integrated processes.

It is trivial that the labor share is stabilized if wage policy directly acts in a way such that the desired value of the labor share will be attained on average. But this is not referred to as productivity oriented wage policy, cf. the next subsection.

Apart from that, because of the right hand side of (4) it is the term in parentheses which is crucial for the stability or stationarity of the labor share. It vanishes only in the Cobb-Douglas case with $\rho = 0$ where the labor share will be stationary without further conditions. For this reason in the following calculations it will not be specially mentioned if this case has to be excluded for mathematical reasons.

In general, however, the term in parentheses must be stationary and hence has to represent a cointegrating relationship. It is necessary that the real wage follows the long-run development of the technological level, corrected for the component $\frac{1-\mu}{\mu} y_t$. (Note that in the case of constant returns to scale, $\mu = 1$, this final component drops out.) Therefore we will analyze whether the following condition holds:

$$w_t - a_t + \frac{1-\mu}{\mu} y_t \sim I(0) \tag{5}$$

Note that while a stationary labor share is compatible with a general CES function under the condition (5), the empirical identification of the parameters in equation (3) would become problematic. The reason is that there would be a superposition of two cointegrating relationships in the equation. In that case it would be advisable to use equation (4) for estimation purposes, where only a single potential cointegrating relationship would be present.

3.2 The policy rule

Now we wish to analyze whether the popular rule of a productivity-oriented wage policy will lead to the cointegration properties described above. Such a wage setting policy calls for nominal wage growth to equal the (expected) productivity growth, see SVR (1985, text numbers 192-195). In a normal economic environment without strict price level stability a factor may be added that reflects the inflation rate which even the central bank believes to be unavoidable. With p_t denoting the (log) price level and $(\Delta p_t)^u = p_t^u - p_{t-1}$ for the unavoidable or target inflation rate of the central bank this yields the following prescription:

$$\Delta(w_t + p_t) = (\Delta q_t)^e + (\Delta p_t)^u + v_t \tag{6}$$

This specification encompasses a possible interpretation of the wage policy rule as not including any adjustment for likely future inflation; it would suffice to simply set $(\Delta p_t)^u$ to zero. The "implementation error" v_t captures random and idiosyncratic influences on the wage setting process that lead to transitory deviations of nominal wage growth from the policy rule. But the rule can only be sensibly regarded as fulfilled if v_t does not contain any permanent component. This implies that the implementation error should be stationary (at most $I(0)$) with an expectation of zero.

The deviation of the inflation rate from its target and the implementation error of the productivity rule can be combined in a total error term $\epsilon_{2,t}$, where the past price level cancels and the deviation of the price level from its current target remains:

$$\epsilon_{2,t} = (p_t^u - p_t) + v_t \tag{7}$$

This error term is $I(0)$ as long as the relevant institutions succeed in keeping inflation around its target path. Here it remains an open question, however, whether this is achieved by a stabilization of the actual inflation rate or by a continuous adjustment of the value regarded as unavoidable.

In general, of course, the components on the right hand side will be correlated, such that for instance low nominal wage growth ($v_t < 0$) may coincide with the inflation rate falling short of its target ($p_t^u - p_t > 0$). Here it is monetary policy which plays a central role. The question is how strictly the central bank reacts to cost push signals or how far it loosens liquidity constraints when facing deflationary tendencies. As a consequence of this we would also expect correlations between $\epsilon_{2,t}$ and the developments of output and labor inputs and thus also with the equilibrium deviation $\epsilon_{1,t}$. However, in this paper we will not formulate a complete model providing parameterizations of these correlations. Therefore for our purposes the following wage policy rule in quasi-real terms is obtained:

$$\Delta w_t = (\Delta q_t)^e + \epsilon_{2,t} \tag{8}$$

4 Implications

In order to be able to solve the model and derive meaningful results an assumption concerning the formation of expectations about productivity growth is still needed. Here we will differentiate between two cases, namely "rational" model consistent expectations on the one hand, and backward-looking expectations with a fairly general lag structure on the other hand. The analysis therefore covers the most important possibilities of expectation formation.

4.1 The result assuming rational expectations

In this subsection we posit that expectations are formed as the mathematical conditional expectation using the information set of the previous period, written as $x_t^e = E_{t-1}x_t$. Furthermore it should be noted that for expected growth it holds that $(\Delta x_t)^e = E_{t-1}\Delta x_t = E_{t-1}x_t - x_{t-1}$, and in particular we do not obtain the difference of expectations $E_{t-1}x_t - E_{t-2}x_{t-1}$. In this sense we acknowledge that $E_{t-1}\Delta x_t \neq \Delta E_{t-1}x_t$.

A combination of (4) and (8) leads to the following relationship:

$$\frac{1}{1+\rho}(\Delta q_t)^e - \Delta q_t = \frac{\rho}{1+\rho}\left(-\Delta a_t + \frac{1-\mu}{\mu}\Delta y_t\right) + \Delta\epsilon_{1,t} - \frac{1}{1+\rho}\epsilon_{2,t} \quad (9)$$

Applying the conditional expectation to (9) and solving for $E_{t-1}\Delta q_t$ yields:

$$E_{t-1}\Delta q_t = E_{t-1}\Delta a_t - \frac{1-\mu}{\mu}E_{t-1}\Delta y_t - \frac{1+\rho}{\rho}E_{t-1}\Delta\epsilon_{1,t} + \frac{1}{\rho}E_{t-1}\epsilon_{2,t} \quad (10)$$

According to (8) and (10) we obtain the following statement:

$$\Delta w_t = E_{t-1}\Delta a_t - \frac{1-\mu}{\mu}E_{t-1}\Delta y_t - \frac{1+\rho}{\rho}E_{t-1}\Delta\epsilon_{1,t} + \frac{1}{\rho}E_{t-1}\epsilon_{2,t} + \epsilon_{2,t} \quad (11)$$

When we explicitly switch from differences to levels and rearrange the terms according to our intention, equation (11) translates into the following two equations. These are related by the definition that (12)−(13) equals (11), where ik is an arbitrary integration constant.

$$w_t - E_{t-1}a_t + \frac{1-\mu}{\mu}E_{t-1}y_t = ik + \sum_{i=0}^{t}\epsilon_{2,i} + \frac{1}{\rho}E_{t-1}\sum_{i=0}^{t}\epsilon_{2,i} - \frac{1+\rho}{\rho}E_{t-1}\epsilon_{1,t} \quad (12)$$

$$w_{t-1} - a_{t-1} + \frac{1-\mu}{\mu}y_{t-1} = ik + \sum_{i=0}^{t-1}\epsilon_{2,i} + \frac{1}{\rho}\sum_{i=0}^{t-1}\epsilon_{2,i} - \frac{1+\rho}{\rho}\epsilon_{1,t-1} \quad (13)$$

The left hand side of (12) is practically identical to the term in condition (5) whose stationarity we wish to assess. As the rational expectations of the non-modeled variables technical development a_t and output y_t will differ from their actual path only by white noise processes, the order of integration of the left hand side of (12) will not be affected. On the right hand side, however, all terms would be stationary only if the cumulated error term $\sum \epsilon_{2,i}$ (and therefore also its rational expectation) were stationary.[2]

The stationarity of $\sum \epsilon_{2,i}$, however, would simply mean that $\epsilon_{2,t}$ is an overdifferenced $I(-1)$ time series. Then the policy rule (8) would represent the differenced form of a directly postulated 1:1 cointegrating relationship between real wages and productivity. In this case the labor share would be trivially stationary, as could already be seen in (4). So one would implicitly argue that a productivity-oriented wage policy does not refer to the growth rates but to the levels of the variables. In order to tackle existing disequilibria, the parties involved in the bargaining process would thus have to take into account not only the currently expected productivity development but also the past. This would seem to be an unusual interpretation to say the least,

[2]Note that the case $\rho = -1$ has been excluded from the analysis, which would represent a von Neumann technology with linear isoquants and an infinite elasticity of substitution. Otherwise the cumulated error term would vanish from equations (12) and (13) because $-E_{t-1}\sum_{i=0}^{t}\epsilon_{2,i}$ can be decomposed into $-\sum_{i=0}^{t}\epsilon_{2,i}$ and a white noise process.

e.g. because $\epsilon_{2,t}$ also contains the deviations from the inflation target.

Therefore under rational expectations a productivity-oriented wage policy will fail to stabilize the labor share in general.

4.2 The result assuming backward-looking expectations

Modeling expectations as backward-looking is especially important in applied empirical research. A simple special case is given by static expectations, i.e. $x_t^e = x_{t-1}$ and $(\Delta x_t)^e = x_{t-1} - x_{t-2}$. Here the expectation and difference operators are commutative, in contrast to the discussion in the subsection with rational expectations: $(\Delta x_t)^e = \Delta(x_t^e)$. However, the price to pay is a slight inconsistency of expectation formation: If the realization x_{t-1} is known and the expectation is formed as $x_t^e = x_{t-1}$ the expected growth should logically be zero. But even after acknowledging this problem we still adopt the above definition for expectations of differences which clearly appears to be more adequate for the analysis.

It is possible to choose a more general perspective for backward-looking expectations by using a richer lag structure such that $(\Delta x_t)^e = A(L)\Delta x_{t-1}$. Here $A(L)$ is a potentially infinite lag polynomial with the restriction that in the steady state it replicates the actual value of a variable, and therefore we impose $A(1) = 1$ for long-run consistency. Furthermore we require $A(L)$ to be invertible. Obviously the special case $A(L) = 1$ represents static expectations as described above.

Applying these definitions to our problem we get $(\Delta q_t)^e = A(L)\Delta q_{t-1}$ so that we can write:

$$\Delta q_t = \frac{\Delta w_{t+1} - \epsilon_{2,t+1}}{A(L)} \tag{14}$$

After some calculations and returning from differences to levels by integration, this equation together with equations (4) and (8) yields

$$A(L)\left(w_t - a_t + \frac{1-\mu}{\mu}y_t\right) = ik+$$
$$\frac{1+\rho}{\rho}\left(\sum_{i=0}^{t+1}\epsilon_{2,i} - A(L)\epsilon_{1,t} - \Delta w_{t+1} - (1-A(L))w_t\right). \tag{15}$$

Here ik again is an arbitrary integration constant.

Again, on the left hand side we obtain the term relevant for fulfilling condition (5). As $A(L)$ is a stable polynomial it does not alter the order of integration of the left hand side. An analogous argument holds for $A(L)\epsilon_{1,t}$ on the right hand side. As w_{t+1} was assumed to be $I(1)$ the difference Δw_{t+1} is stationary, and given that $A(1) = 1$ the factor $1-A(L)$ has a unit root such that $(1-A(L))w_t$ is stationary, too. The crucial term again is the cumulated error process $\sum \epsilon_{2,i}$ which appears on the right hand side. The remarks in the previous subsection with rational expectations apply here by analogy.

Thus a stabilization of the labor share is hardly possible with backward-looking expectations for productivity growth, either.

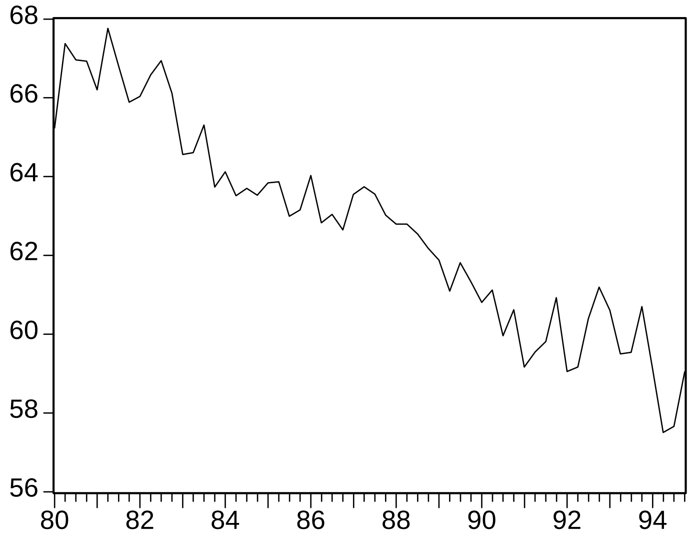
5 An example: The West German labor share

Let us finally take a brief look at some data.[3] Figure 1 shows the development of the level of the labor share in Germany, where for simplicity we have used West German data to avoid the structural break due to unification. These data are generally available until 1994. This is not problematic as the analysis here serves illustrative purposes and is not meant to focus on the most recent developments.

In order to eliminate the strong deterministic seasonal components the time series was regressed on centered seasonal dummies. Such a dummy for quarter i takes the value 0.75 in quarter i, else -0.25, such that over the span of a full year its mean is zero. Hence a seasonal adjustment of this type leaves the mean of a time series unaltered.

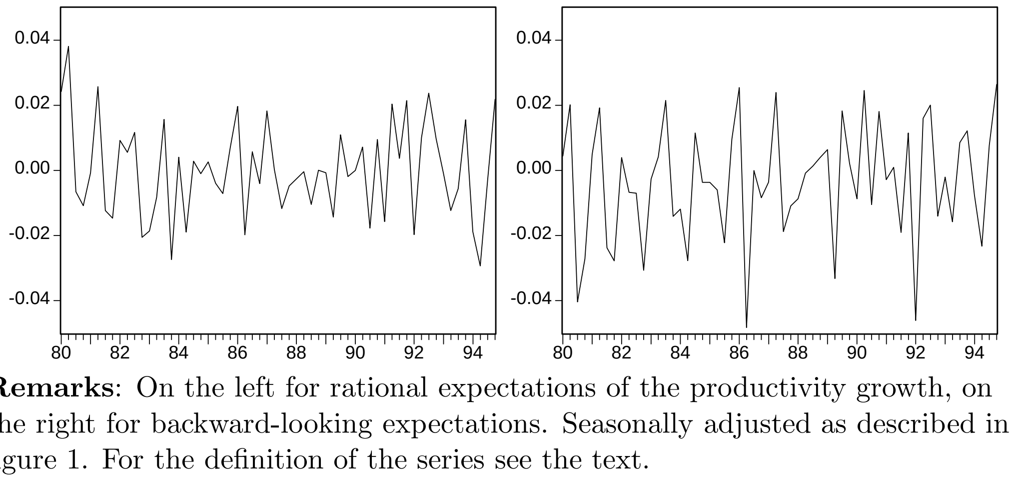
[3] All statistical calculations were performed with Eviews 3.1.

Figure 1: The labor share in West Germany 1980-1994



Remarks: Levels in per cent. Gross compensation of dependent workers (GCD) divided by gross domestic product (GDP), both adjusted with the GDP deflator, i.e. $exp(l_t)exp(w_t)/exp(y_t)$. Quarterly series from national accounts data from the German Institute for Economic Research (DIW). Seasonal adjustment carried out as the last step by regressing on three centered seasonal dummies which do not affect the mean.

Figure 2: Deviations from the productivity-oriented wage policy, 1980-1994



Remarks: On the left for rational expectations of the productivity growth, on the right for backward-looking expectations. Seasonally adjusted as described in figure 1. For the definition of the series see the text.

Obviously the labor share is grossly non-stationary, and by visual inspection there does not seem to be a change of the development after the beginning of the campaign for the productivity-oriented wage policy in the mid 1980s. The same finding holds for the logarithm of the labor share which is not shown. Already at this stage it should be acknowledged that these data properties cannot be modeled with a Cobb-Douglas production function. Now there are two possible explanations: Either wage setting was not guided by productivity growth, or the stabilization of the labor share failed for different reasons, for instance because of the effects outlined in the present paper.

Checking the first possibility, namely that wage policy did not really act in a productivity-oriented fashion, we will examine the implementation error known from equation (6):

$$v_t = \Delta(w_t + p_t) - (\Delta q_t)^e - (\Delta p_t)^u \tag{16}$$

The relevant question here is whether v_t is really stationary with expectation zero, because then there would not have been any systematic departures from the policy rule.

The unavoidable inflation variable $(\Delta p_t)^u$ will be operationalized with a series describing the implicit inflation target of the Bundesbank, taken from Bofinger et al. (1996, p. 259, table V.2). These figures at annual rates are constant for each calendar year. The conversion into quarterly rates was approximated by dividing the numbers by four. If a range was given the upper bound was chosen.

In analogy to section 4 we will analyze two variants, namely with rational expectations for productivity developments on the one hand and with backward-looking expectations on the other hand. For the assumption of rational expectations we simply substituted the actual values because they will only differ by a white noise term. For the case of backward-looking expectations we calculated a forecast of the productivity growth in each period using a recursive estimate of a univariate fifth-order autoregressive model with a constant and seasonal dummies. The sample period begins in 1960, wherefore this method represents a simple but genuine forecast that does not take into account information unavailable at the respective date. The specification was chosen according to common model selection procedures which above all demand uncorrelated residuals and furthermore prefer a parsimonious parameterization.

The resulting two variants of v_t are displayed in figure 2 after having been regressed on centered seasonal dummies. It is obvious that the time series are stationary, such that we refrained from carrying out formal unit root tests. We also observe informally that the deviations from the productivity rule appear to be centered around zero. Therefore it seems that for the period of illustration on average the nominal wage growth was indeed equal to expected productivity growth including the unavoidable inflation term.

Formal tests do at least not provide any evidence in favor of the alternative hypothesis. The significance of the mean in both variants of v_t was assessed by fitting an autoregressive model with the following structure:

$$v_t = \beta_0 + \sum_{i=1}^{3} \beta_i zd_{i,t} + \sum_{j=1}^{k} \beta_{3+j} v_{t-j} + \varepsilon_t \tag{17}$$

Here the $zd_{i,t}$ are centered seasonal dummies for the i-th quarter as described above. The hypothesis of interest is $\beta_0 = 0$.

Let us start with the variant with rational expectations for productivity growth. Here the resulting specification includes only the fourth lag, i.e. all β_{3+j} with $j \neq 4$ are restricted to zero. The diagnostic tests are satisfactory: the null hypothesis that the residuals are normally distributed is tested with a Jarque-Bera test and is accepted at the marginal significance level (p-value) of 0.51. The Breusch-Godfrey test for the null hypothesis of absence of autocorrelation in the residuals yielded a p-value of 0.64 (fourth order) and 0.57 (eighth order), respectively. The genuinely interesting estimate for the constant term produces $\hat{\beta}_0 = -0.0003$ with a t-statistic of -0.14 (p-value 0.89), such that the unambiguous conclusion here is that the series should be modeled as having a zero mean.

When we turn to the alternative with backward-looking expectations we are obliged to include a richer model structure than before. First the lags $j =$

$\{1, 2, 4, 5\}$ are needed, and second it also turned out necessary to include an impulse dummy for the first quarter of 1992 to eliminate an outlier. Then the Jarque-Bera normality test accepts with a p-value of 0.87, and the Breusch-Godfrey serial correlation tests accept with p-values of 0.66 (fourth order) and 0.35 (eighth order). For the estimate $\hat{\beta}_0$ we obtain -0.0033 with a t-statistic of -1.43 (p-value 0.16), and thus here the null hypothesis of a zero mean cannot be rejected, either.

This means that in the period 1980-1994 West German nominal wage growth was indeed guided by productivity developments and official target inflation rates. That the labor share still became non-stationary is of course not surprising considering the theoretical results of this paper.

6 Concluding comments

In conclusion we can say that it is the formulation of the wage policy rule in terms of growth rates instead of levels which is responsible for the failure to achieve a stable labor share. Even starting from a desired value there will be an unforeseeable cumulation of implementation errors and inflation target deviations producing a stochastic trend in the labor share. The theoretically important exception is the special case of a Cobb-Douglas production function, where the labor share is always stationary because of the factor substitution elasticity of -1. As this case is omnipresent in economic policy debate, it is important to stress the fact that this assumption was not adequate at least for the given West German data set, which displayed a clearly non-stationary labor share. Another finding was that wage setting in West Germany in the period 1980-1994 is well described as productivity-oriented.

In recent times the German Council of Economic Experts promotes a modified rule which takes into account the level of unemployment (see e.g. SVR, 1994, text numbers 444-446, or SVR, 1998, text number 317). But this does not mean being guided by the (log) levels of the variables analyzed in the present paper, where neither the labor force nor working time do appear. A stabilization of the labor share will thus not be achieved by the new rule, either, but of course that is also not the objective (anymore).

Appendix

Derivation of the labor demand function from a CES production function

Let e^l be physical labor inputs, e^k capital inputs, e^w the real wage, e^y real output according to the production function F, and e^a the level of Harrod neutral technical development.

The following calculations are adapted from Franz (1996, subsection 4.2.1), where we substituted labor inputs by efficiency units ($e^a e^l$) in the spirit of Harrod neutral progress.

First of all it holds that the marginal productivity of labor and the real wage must be tightly related:

$$\frac{\partial F}{\partial e^l} = e^w \eta \tag{18}$$

Here η is an elasticity factor reflecting the potential price setting power on input and output markets. It is assumed to be constant, such that in this sense no structural breaks are allowed for.

If one chooses a constant elasticity of substitution (CES) form for the production function F, it will be composed as follows:

$$Y = F\left(e^l, e^k\right) = \gamma \left[\delta \left(e^a e^l\right)^{-\rho} + (1-\delta)\left(e^k\right)^{-\rho}\right]^{-\frac{\mu}{\rho}} \tag{19}$$

Here γ is the scale parameter ($\gamma > 0$), δ is the distribution parameter ($0 < \delta < 1$), ρ is the substitution parameter ($\rho > -1$), and μ is the homogeneity parameter ($\mu > 0$). For the case of constant returns to scale we would have $\mu = 1$ as F will then exactly be linearly homogeneous. The substitution elasticity between input factors is given by $-\frac{1}{1+\rho}$.

Now it is possible to determine the marginal productivity of labor and set it equal to the real wage (adjusted for the elasticity factor). Following Franz (1996) we apply some algebraic manipulations where the output level is re-substituted into the equation in order to eliminate the capital stock. Then after taking logarithms we obtain the following labor demand function:

$$l = c - \frac{\rho}{1+\rho}a - \frac{1}{1+\rho}w + \frac{1+\frac{\rho}{\mu}}{1+\rho}y \tag{20}$$

The parameters γ, δ, and η are incorporated in the constant c along with some other components. This static equilibrium relationship is translated into a dynamic context by adding time indices along with the stochastic equilibrium deviation process $\epsilon_{1,t}$, which leads to (3).

References

[1] Bentolila, S., and G. Saint-Paul (1999): Explaining Movements in the Labor Share. CEMFI working paper no. 9905, Madrid.

[2] Bofinger, P., J. Reischle, and A. Schächter (1996): Geldpolitik. München: Franz Vahlen.

[3] Franz, W. (1996): Arbeitsmarktökonomik. 3rd edition, Berlin: Springer.

[4] Hamilton, J. (1994): Time Series Analysis. Princeton: Princeton University Press.

[5] Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung (Council of Economic Experts, SVR) (1974): Annual report 1974/75. Stuttgart/Mainz: W. Kohlhammer.

[6] SVR (1985): Annual report 1985/86. Stuttgart/Mainz: W. Kohlhammer.

[7] SVR (1994): Annual report 1994/95. Stuttgart: Metzler-Poeschel.

[8] SVR (1998): Annual report 1998/99. Stuttgart: Metzler-Poeschel.