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ABSTRACT

Disentangling Pay and Productivity in a Corporatist Economy: The Case of Germany*

Conventional theory predicts that productivity gains lead to pay hikes. Pay increases, however, can influence labor productivity. But what about in a corporatist economy? Focusing on Germany, we use an innovative technique developed by Geweke to disentangle the relationship between pay and productivity.

JEL Classification: J41, C22, J50, J30

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* All econometric results (including those of diagnostic tests) are available from the authors. Likewise, technical details on the bias adjustment procedure and the construction of the confidence intervals are available on request.

1. Introduction

Conventional theory predicts that productivity gains stimulate labor demand and drive up pay. On the other hand, following a wage hike firms may rely more on capital, which could boost output per worker. According to efficiency wage models, pay hikes can have a wide-spread impact on labor productivity by reducing turnover, boosting morale, or encouraging long-term employment (see the collection edited by Akerlof and Yellen, 1986). Productivity should drive pay; likewise pay can influence productivity. But what about in a corporatist economy?

Corporatism is usually characterized as labor-management coordination in wage setting, with industry- or economy-wide bargaining between union and employer federations. According to critics, labor pacts are driven not so much by market forces, but institutional considerations (see Olson, 1996). But it also has been argued that in a corporatist setting unions must account for the external effects of their demands, making wages flexible (Calmfors and Driffil, 1988).

As European markets become more integrated, some observers have questioned whether corporatism can survive there. To consider such a question, it is crucial to understand how pay and productivity are related. Are industry-wide pay pacts responsive to changes in productivity? Does corporatist consensus to boost pay help or hinder productivity? Such questions reflect an identification problem, whether productivity gains are the *result* or the *source* of higher pay. To overcome this problem we use a statistical method developed by Geweke (1982, 1984) to assess bi-directional causality between time series. For the case of Germany, a prominent corporatist country, we use the Geweke method to disentangle pay-productivity relationships.

2. Collective Bargaining Structure in Germany

In the words of Paqué (1993, p. 209), Germany's industrial relations are based on "tight corporatism." In an industry, collective agreements on wages and salaries are concluded between a labor union and an employer federation. Typically, a labor pact is for twelve months, with the annual bargaining round occurring in the first quarter of the year. Contract terms extend to nonunion workers, so nearly 90 percent of all employees work under the terms of union contracts. The metal industry is especially critical. It encompasses motor vehicles, engineering, and electronics, more than half of Germany's industrial employment. In this key sector, the *IG Metall* union negotiates with the *Gesamtmetall* employers' association. Their contract settlements often set a standard for others to follow.[1]

Given the industry-wide consensus necessary to reach labor settlements, it is not obvious how responsive pay is to productivity gains. Cozy labor relations may make efforts to improve productivity seem less crucial. Or perhaps an accord to raise pay is a signal, stimulating labor's efforts or encouraging accumulation of more capital.

3. Geweke Linear Feedback Method: Overview

Geweke (1982, 1984) has developed measures of statistical feedback which also account for any interdependence between time series, thereby extending Granger's (1969) definition of causality. This method can be used to disentangle the direction and magnitude of the linear relationships between two time series, while controlling for any contemporaneous association.[2]

For the case of Germany, we apply Geweke's feedback technique to measure the extent to which adjustments in contractual pay have followed or led changes in productivity. The data distinguish between wages of blue-collar workers and salaries of white-collar employees. Therefore, we can assess how wage or salary settlements are related, if at all, to productivity.

Suppose there are two time-series vectors *prd* (productivity) and *pay* (pay specified in a labor contract). Geweke (1982) decomposes linear dependence between the series into three components: (1) feedback from *prd* to *pay*, (2) feedback from *pay* to *prd*, and (3) contemporaneous association between the series.

[1] For a particular geographic area of Germany (usually a federal state), a labor pact applies to all firms in an industry. There is some firm-level bargaining, but most pacts are industry-wide. See Berghahn and Karsten (1987) and Paqué (1993) for historical details.

[2] Focusing on Japan, which has its own unique brand of coordinated labor relations, Fuess and Millea (2002) used the Geweke method to evaluate wage setting in manufacturing.

The interrelationship between pay and productivity is likely to differ according to labor market conditions. The basic feedback method described below can be extended to include what Geweke (1984) called *conditioning information*, that is, a control variable. Including such a variable allows us to decompose *pay* and *prd*, conditional on different states of the labor market.

Germany has experienced different labor market trends over the years. Between 1960 and 1972 its unemployment tended to hover around 1 percent, falling as low as 0.7 percent. Since 1972 it has been trending steadily upward, from 1.1 percent (1972) to 10.5 percent (1998). Presumably, the responsiveness of pay to productivity improvements may vary as unemployment varies. Any efficiency consequences of pay changes are also likely to be different when unemployment is rising.

A conditional forecast of productivity at time t (prd_t) can be made using past values of productivity (prd_{t-s}), pay (pay_{t-s}), and unemployment (ur_{t-s}):

$$prd_t = \sum_{s=1} a_1(s)prd_{t-s} + \sum_{s=1} a_2(s)pay_{t-s} + \sum_{s=1} a_3(s)ur_{t-s} + \varepsilon_{1t}, \tag{1}$$

where the a's are coefficient vectors and ε_{1t} is the random prediction error with variance σ^2_1.

To account for the marginal contribution of pay_{t-s} in the productivity forecast, we compare the prd_t forecast generated *with* the earnings series to a prediction created *without* the series. Thus, we modify equation (1) and estimate prd_t again:

$$prd_t = \sum_{s=1} b_1(s)prd_{t-s} + \sum_{s=1} b_2(s)ur_{t-s} + \varepsilon_{2t}, \tag{2}$$

where var (ε_{2t}) = σ^2_2. Conditional feedback from pay to productivity is defined as

$$F_{pay \rightarrow prd|ur} \equiv \log(\sigma^2_2 / \sigma^2_1). \tag{3}$$

If the two variances are the same, then pay_{t-s} values do not improve the precision of the productivity forecast, so $F_{pay \rightarrow prd|ur} = 0$.

For conditional feedback from productivity to pay, we estimate the following equations:

$$pay_t = \sum_{s=1} a_4(s)pay_{t-s} + \sum_{s=1} a_5(s)prd_{t-s} + \sum_{s=1} a_6(s)ur_{t-s} + \varepsilon_{3t}, \tag{4}$$

$$pay_t = \sum_{s=1} b_3(s)pay_{t-s} + \sum_{s=1} b_4(s)ur_{t-s} + \varepsilon_{4t}, \tag{5}$$

where the prediction error variances are, respectively, σ^2_3 and σ^2_4. Conditional feedback from productivity to pay is simply

$$F_{prd \rightarrow pay|ur} \equiv \log(\sigma^2_4 / \sigma^2_3). \qquad (6)$$

A distinguishing feature of the Geweke method is that it also accounts for any simultaneous association that cannot be disentangled. To identify this contemporaneous component, we modify the prd_t forecast by also including *current* pay:

$$prd_t = \sum_{s=1} c_1(s)prd_{t\text{-}s} + \sum_{s=0} c_2(s)pay_{t\text{-}s} + \sum_{s=1} c_3(s)ur_{t\text{-}s} + \varepsilon_{5t}, \qquad (7)$$

where $\mathrm{var}(\varepsilon_{5t}) = \sigma^2_5$. Including current earnings may improve the forecast's precision. Thus, the measure of contemporaneous association is

$$F_{pay \bullet prd|ur} \equiv \log(\sigma^2_1 / \sigma^2_5). \qquad (8)$$

If including current pay does not reduce the prediction error, then $\sigma^2_5 = \sigma^2_1$ and $F_{pay \bullet prd|ur} = 0$, meaning there is no contemporaneous association between the series.

Given the different types of feedback, we can disentangle pay and productivity. The feedback measure $F_{prd \rightarrow pay|ur}$ indicates whether productivity leads employee earnings, which would be consistent with conventional labor demand. The measure $F_{pay \rightarrow prd|ur}$ shows whether pay leads productivity, that is, whether there are efficiency consequences from pay adjustments. Finally, $F_{pay \bullet prd|ur}$ shows the extent of simultaneity between *pay* and *prd*.

The feedback measures defined above can be transformed into growth rates using the formula [1 - exp(-*F*)]. For example, transforming $F_{pay \rightarrow prd|ur}$ shows the proportional reduction in the prediction error variance of prd_t that can be attributed to past values of $pay_{t\text{-}s}$, conditional on unemployment. In other words, the transformation illustrates the capacity of past earnings to reduce the variance of prediction error in the productivity forecast.

4. Disentangling Contractual Pay and Productivity in Germany

4.1. Implementing the Geweke Method

The German Ministry of Labor publishes an index of the collectively bargained pay of wage earners in trade and industry (*gewerbliche Wirtschaft*). Likewise, there is an index for the collectively bargained pay of salary earners. The respective indices, available back to 1960, reflect the level of contractual pay for blue-collar and white-collar employees in German industry (see appendix for data sources).

The German government also reports an index of labor productivity (real output per gainfully employed person), which is available through 1998 (see appendix).[3] Using the unemployment rate for western Germany as the labor market conditioning variable, for 1960-1998 we can analyze the interrelationship between productivity and contractual wages (salaries). We determine if productivity changes in Germany have affected contractual wages or salaries. Perhaps contractual pay hikes are a signal, leading to more effective labor efforts. So we determine if pay changes have affected productivity.

In implementing the Geweke method, the forecast equations must be estimated with stationary time series, otherwise the forecasts may be subject to spurious correlation. One may wish to use productivity and pay levels to estimate the forecast equations. But using the Phillips-Perron (1988) unit root test, we cannot reject the null hypothesis of nonstationarity for the *prd* and *pay* series in levels. Their first-differences, however, are stationary. Thus, we used $prd^*_t \equiv (prd_t - prd_{t\text{-}1})$, $pay^*_t \equiv (pay_t - pay_{t\text{-}1})$, which reflect changes in productivity and pay, respectively. Unemployment is not stationary in levels-form either, but $ur^*_t \equiv (ur_t - ur_{t\text{-}1})$ is stationary.

To obtain the prd^*_t and pay^*_t forecasts we used OLS regression.[4] Then we computed the feedback measures $F_{prd^* \rightarrow pay^* | ur^*}$, $F_{pay^* \rightarrow prd^* | ur^*}$, and $F_{pay^* \cdot prd^* | ur^*}$. These feedback estimators are consistent, but because they are based on variances they are nonnegative by construction and potentially biased upward in small samples. Following the procedure developed by Cushing and McGarvey (1990), we adjusted the point estimates for small sample bias and then created 90-

[3]Our 1960-1998 sample period includes German reunification. To insure consistent series over time, all data used in this study are only for western Germany (*Früheres Bundesgebiet*).

[4]According to Akaike's information criterion, for the forecast equations the optimal lag length was one.

percent confidence bands for each estimator.[5] Using [1 - exp(-F)], we transformed the adjusted feedback measures and associated confidence bands, which allows us to gauge the rate of change in the prediction error variance of a forecast.

4.2. Conditional Feedback Results

Table 1 presents conditional feedback measures, with results for wage earners in Panel A and those for salaried employees in Panel B. In one respect the findings are similar: there is little simultaneity between pay changes and productivity gains. The point estimates indicate virtually no contemporaneous association between wg^* (sl^*) and prd^*. There is, however, meaningful directional feedback between the series.

Consider the impact of productivity on pay. The conditional feedback measures indicate that changes in productivity lead changes in both contractual wages and salaries.

For wage earners (Panel A), the feedback point estimate shows that prd^*_{t-s} improves the wg^*_t forecast by 7.3 percent. According to the confidence interval, the improvement could be as great as 91.5 percent. The results are similar for salaried employees (Panel B). Looking at the point estimate, prd^*_{t-s} reduces the prediction error variance of the sl^*_t forecast by 8.3 percent. The confidence interval shows that the reduction may be as much as 72.9 percent.

Clearly, productivity changes lead to labor contracts that adjust both wages and salaries, confirming conventional labor demand behavior.[6] Industry-wide collective bargaining notwithstanding, both contractual wage and salary setting in Germany are consistent with classical labor demand theory.

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[5]The adjusted feedback point estimates do not have associated test statistics. Following the simulation process of Cushing and McGarvey (1990), we constructed bands to indicate the potential magnitude of the feedback measures.

[6]The conditional feedback measures show that prd^*_{t-s} leads wg^*_t and sl^*_t. Strictly speaking, they do not verify that the impacts are *positive*. Using the impulse response method developed by Sims (1980) – which is often used to trace out the reaction of one time series to an impulse in another series – we confirmed that an innovation in prd^* leads to wage and salary increases.

Turning to the impact of pay on productivity, there is a difference between types of employees. For blue-collar workers, changes in contractual wages have *no effect whatsoever* on productivity growth. The conditional feedback point estimate is 0 percent, with the high value of the confidence interval reaching a mere 0.8 percent.

Focusing on white-collar workers, the results are less clear cut. According to the point estimate, sl^*_{t-s} has only a slight influence on the prd^*_t forecast. But the 90-percent confidence interval shows that sl^*_{t-s} improves the prd^*_t forecast by as much as 48.9 percent. Including sl^*_{t-s} can reduce considerably the prediction error variance of the prd^*_t forecast. Thus, there are efficiency consequences following salary growth: bigger salary hikes for white-collar workers can yield widespread improvements in productivity.[7]

Predictions of the demise of corporatism may be premature. Germany's corporatist pay setting has been responsive to market signals, with productivity gains stimulating wage and salary increases. Moreover, salary increases for managers and executives can lead to efficiency gains.

In an exhaustive study, Teulings and Hartog (1998) hypothesized that corporatism enhances the efficiency of nominal contracts, because it is easier to adjust pay to aggregate shocks. We find another possible efficiency benefit. Evidently pay can affect managerial performance, and thus, labor productivity. It remains to identify more precisely how the productivity improvements are achieved. Perhaps there is efficiency pay setting, with salary increases motivating managers and executives to work harder or monitor workers more closely. Or perhaps pay hikes lead managers to deploy factors of production more effectively. We would expect future research to examine in detail the particular incentive effects of white-collar pay, to identify the means by which salary adjustments stimulate productivity gains.

[7] With impulse response analysis (see Sims, 1980), we confirmed that an innovation in sl^* leads immediately to bigger productivity gains.

Appendix

Productivity. The index of real labor productivity is real output per gainfully employed person. Figures for productivity growth are reported in [2], 1998 edition, Table 36; 1992 edition, Table 40; see "Data References" below. Setting 1985 = 100, we constructed the index for 1960-1998.

Contractual Wages and Salaries. The index of collectively bargained (nominal) contract wages for wage earners (*Index der Tariflöhne*) employed in trade and industry or regional authorities is reported in [1], Table 5.1. Likewise, the index of collectively bargained salaries for salary earners (*Index der Tarifgehälter*) is reported in [1], Table 5.1.

To generate real values, we deflated each index using the GDP deflator for western Germany. Growth rates for the western German GDP deflator (base year, 1991) are reported in [2], 1998 edition, Table 36; 1992 edition, Table 40. With these growth rates, we constructed an index for the GDP deflator.

Unemployment. Unemployment rates for western Germany for 1960-1991 are reported in [1], Table 2.10; for 1991-1998 the rates are reported in [2], 1999 edition, Table 23. In Germany, the unemployment rate is defined as the number of unemployed persons as a percentage of gainfully employed persons.

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Table 1

Disentangling Contractual Wages/Salaries and Productivity in

Western Germany, 1960-1998: Geweke Conditional Linear Feedback Measures[a]

Percent Reduction in the Prediction Error Variance of
Salary /Wage and Productivity Forecasts:
Adjusted Point Estimates (90-Percent Confidence Bands)

	Panel A: Wage earners		
Feedback Measures[b]	$F_{prd^* \rightarrow wg^* \mid ur^*}$	$F_{wg^* \rightarrow prd^* \mid ur^*}$	$F_{wg^* \cdot prd^* \mid ur^*}$
	7.34 (2.66, 91.49)	0.00 (0.00, 0.76)	0.00 (0.00, 0.03)
	Panel B: Salary earners		
Feedback Measures[b]	$F_{prd^* \rightarrow sl^* \mid ur^*}$	$F_{sl^* \rightarrow prd^* \mid ur^*}$	$F_{sl^* \cdot prd^* \mid ur^*}$
	8.30 (3.16, 72.93)	0.68 (0.19, 48.85)	0.02 (0.01, 3.45)

[a]For sources of the salary, wage, productivity, and unemployment data, see the appendix.

[b]On conditional feedback from productivity to earnings, see equations (4-6). For conditional feedback from earnings to productivity, see equations (1-3). On contemporaneous association between earnings and productivity, see equations (1, 7-8). In all cases, $wg^*_t \equiv (wg_t - wg_{t-1})$; $sl^*_t \equiv (sl_t - sl_{t-1})$; $prd^*_t \equiv (prd_t - prd_{t-1})$; $ur^*_t \equiv (ur_t - ur_{t-1})$.

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