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Employment and Wage Effects of Social Security Financing –

An Empirical Analysis of the West German Experience and some Policy Simulations

Viktor Steiner

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Viktor Steiner

Zentrum für Europäische Wirtschaftsforschung (ZEW)
Centre for European Economic Research
Mannheim

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Correspondence to:

Dr. Viktor Steiner
ZEW
P.O. Box 10 34 43
D–68034 Mannheim
Germany

email: steiner@zew.de

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Abstract

This paper follows up recent work on the relationship between (un–)employment and wage effects of social security financing undertaken by the OECD Jobs Study. Based on a simple macroeconometric model of the labour market, I investigate whether the peculiar OECD results for Germany on the incidence of social security contributions and taxes also hold up within a somewhat different model. The study also provides some policy simulations to answer the topical question whether increasing indirect taxes to finance a reduction of the contribution rates to social security levied on employees and employers in Germany. The main result of the paper is that there is in fact a positive short–run employment effect of a revenue neutral switch of financing social security expenditures by increasing indirect taxes and reducing employers' contribution rates, but in the longer–term only modest effects remain due to higher wages.

JEL classification: E24, H55, J38

1 Introduction

The German social welfare state is under pressure from high taxes and social security contributions and, related to these, high unemployment. Recently, the united German unemployment rate has hit an all–time high, and there is little hope for a significant improvement in the near future. At the same time, the government aims to reduce the budget deficit, while the public faces ever increasing social security contribution rates which, due to demographic factors, are bound to increase even faster in the future. Reducing the already quite high contribution rates to social security financing is seen both as a short–term policy to reduce unemployment and a long–term strategy to secure the solvency of the social security system. Furthermore, on equity grounds, it is increasingly seen as necessary to reduce the share of general welfare transfers which are financed from social security contribution. It therefore comes as no surprise that a strategy to reduce the high contribution rates to social security meets with broad approval both in the policy arena and in the economics profession. As to the financing of these cuts, there is less agreement, although the idea to increase indirect taxes to compensate for reductions in social security contribution rates seems to have become more popular recently.

Germany, of course, is not the only country in Europe with both a dismal unemployment record and looming financing problems of the social security system. Both within the Commission of the European Union and the OECD the relationship between unemployment and taxes as well as social security financing has been on the agenda for some time. This topic has also featured prominently in the OECD Jobs Study, the White Book on Growth, Competition and Employment, and the 1995 Employment in Europe report by the Commission of the European Union. Although there seems to be widespread agreement on the potential to reduce labour costs and increase employment by shifting part of the financing of social security contributions to indirect taxes, the empirical support for such a policy is less than conclusive, to say the least. The most ambitious study on the relationship between employment and wage effects of social security financing has been undertaken as part of the OECD Jobs Study [OECD (1994)] for several member states. For Germany this study comes up with some surprising findings. In particular, it is estimated that increases in both employers' and employees' social security contributions, the income tax as well as indirect taxes lead to proportionate increases in real labour costs in the long–run, although there are some important differences in the short–run. As implied by the structure of the underlying model of the labour market, at least in the long–run the employment effects of shifting the burden of financing the social security system from contribution rates to direct or indirect taxation may be rather modest.

Following up the analysis on which the results in the OECD Jobs Study are based, this paper provides an empirical analysis of the West German development. In particular, I will investigate whether the peculiar OECD results for Germany on the incidence of social security contributions and taxes also hold up within a different econometric specification and for an extended observation period. Based on a simple macroeconometric model of the labour market the study also provides policy simulations to answer the topical question whether increasing indirect taxes to finance a reduction of the contribution rates to social security levied on employees and employers in Germany. The main result of the paper is that there is in fact a substantial positive short–run employment effect of a revenue neutral switch of financing social security expenditures by increasing indirect taxes and reducing employers' contribution rates, but in the longer–term only a modest effect remains as a result of subsequent price and wage increases.

The remainder of the paper proceeds as follows. In the next section, I will briefly summarize related existing research, in particular for Germany. The econometric model is described in section 3. Estimation results are presented and discussed in section 4. Section 5 contains some policy simulations with the model, and section 6 concludes.

2 Previous Related Studies

There are very few empirical studies which explicitely take into account the effects of social security contributions and taxes or try to separate these effects on aggregate employment and wages. Some descriptive evidence for the member states of the European Union has recently been compiled by the Commission (1994, Chapter 6; 1995, Part III, Section 1). The conclusion of these comparative analyses is that the relationship between the level of social security contributions and labour costs is rather weak, as is the relationship between the former and changes in employment or unemployment. The Commission also concludes from the presented descriptive evidence that employers' social security contributions are to a large extent shifted on to labour in the long–run, although some positive effects from reducing social security contributions are seen in the short–run.

In the OECD Jobs Study (OECD, 1994) potential unemployment effects of taxes and social security contributions are analysed in various ways. At its simplest, unemployment rates are correlated with the so–called *tax wedge* for a group of 12 countries. The tax wedge is the difference of labour costs (inclusive of employers' social security contributions) and the net wage after deduction of indirect taxes and employees' social security contributions. Holding taxes constant, the tax wedge is increasing in social security contributions. There seems to be no significant correlation between the tax wedge, labour costs and (un–)employment. The study also finds a negative correlation between employers' social security contributions and the employees' share in value added in the private sector of the sample of countries observed, which might be interpreted as backward shifting of employers' social security contributions on wages. However, the negative correlation does not hold up when changes rather than levels of these variables are analysed. Hence, at that level of analysis, no robust relationships can be observed.

Most of the econometric studies for various OECD countries are based on time series data either for the national economy or its private sector and relating wages and/or (un–)employment to the tax wedge and some other explanatory variables. Since these studies are summarized in OECD (1994) and Bean (1994), this will not be repeated here, except for Germany. Suffice it to note here that most studies do suggest that a higher tax wedge leads to higher labour costs and less employment. In particular, for Germany no statistically significant effects of the tax wedge on wages or unemployment were discernable (c.f. Bean, Layard and Nickell, 1986; Turner, Richardson and Rauffet, 1993). Missing from the summary in the OECD Jobs Study are at least the following recent German studies which include some measure of the tax wedge. Within a macroeconometric disequilibrium model of the Geman labour market, Entorf, König and Pohlmeier (1992) find a strong positive employment effect of a reduction of employers' social security contributions. Franz and Gordon (1993) include changes in the tax wedge as explanatory variable in their wage regressions and find a strong positive effect for the period 1973 to 1990, but no statistically significant effect when the observation period is extended back to 1960. In their analysis of the determination of contract wages in West Germany, Carruth and Schnabel (1993) find that the tax wedge only affects wages in the short–run, but has no effect on the long–run equilibrium relationship. Hence, in the long–run changes in the tax wedge seem to be entirely borne by labour, according to this study. By implication, there should also be no long–term wage effects on employment.

The most ambitious study on the employment and wage effects of social security financing and taxes in a comparative context is summarized in OECD (1994), which is based on econometric work by Tyrväinen (1995a, b) briefly discussed below. The study reports important differences in the adjustment of real labour costs to changes in both employers' and employees' social security contributions as well as direct and indirect taxes (see Table 1).

Table 1: Labour cost responses to changes in taxes and social security contributions

	Employers social security contributions	Value–added taxes and excises	Income taxes and employees' social security contributions
Germany	1.0	1.0	1.0
Canada	0.8	0.8	0.8
Japan	0.5	0.5	0.5
Finland	0.5	0.5	0.5
Australia	0.5	0.5	0.5
France	0.4	0.4	0.4
Italy	0.4	0.4	0.4
Sweden	0.0	1.0	0.0
United States	0.0	0.0	1.0
United Kingdom	0.25	0.25	0.25

Note: For the interpretation of the numbers see text below.

Source: OECD (1995, Table 9.5, p. 246).

The table shows that (West) Germany obtains a special position in the league of countries analysed. In Germany, an increase of, respectively, employers' as well as employees' social security contributions, the income tax or indirect taxes by 1 *percentage point* leads to an increase in real labour costs (real gross wages plus employers' social security contributions) by 1 *percent* in the long–run.[1] This implies that "wages do not fall in order to offset increases in employers' social security contributions and in the long run employees fully offset increases in indirect and direct taxes through wage demands" (OECD, 1994, p. 246).

This is not only an astonishing result in its own right, but gains even greater weight in light of the results for the other countries included in the study. In particular, it is to be expected that employees are the more likely to differentiate between taxes proper and social security contributions the stronger the social security system is related to previous (lifetime) earnings. In fact, the German social security system is built on this principle, at least with respect to its public pension and unemployment benefit parts. This insurance principle probably plays a greater role in Germany

[1] Note that the interpretations of the numbers in the table as "elasticities" given by OECD (1994, p. 246) and Tyrväinen (1995a, Table 2) differs from my interpretation given in the text. If the numbers were in fact elasticities in the usual sense, an increase of, say, the income tax rate, t, by one percentage point would increase real labour costs by 1/t percent. Given a mean value of t of about 0.15 in the observation period this would imply an incredibly large effect.

than in most other countries included in the OECD study. Nevertheless, the study's estimates for Germany imply that employers have to bear completely the social security contributions formally levied on them in the long run, while employees are able to shift increases in social security contributions and taxes on to higher real wages.

Since labour demand negatively depends on real labour costs, as was also confirmed for Germany by Tyrväinen (1995a), this would imply negative employment effects and, given the strong increases in social security contributions and taxes over the last decades, would account for a substantial share of the high level of (West) German unemployment. On the other hand, there would be little room for cutting unemployment by revenue neutral shifts from contribution rates to tax rates. It is therefore not only of academic interest but has also important policy implications whether these results are robust to different model specifications and the use of other data sets. The following analysis will provide some supporting, but also some contradictory evidence for the mentioned results for Germany.

3 Econometric Model

To quantify the aggregate employment and wage effects of social security financing an econometric model is needed. In the basic specification of the econometric model, here I follow the approach in the OECD Jobs Study, which is based on the work by Tyrväinen (1995a, b). His model consists of a wage and a labour demand equation and an unemployment identity (the labour force is given). The main differences in specification between the equations Tyrväinen (1995a) estimates for (West) Germany and the present study lie in certain restrictions on the explanatory variables in the two equations, in particular the way the contribution rates to social security levied on employers and employees and taxes enter the model. As to data sources, I use yearly data from the national income accounts and information on social security contributions and taxes also supplied by the German Central Statistical Office (Statistisches Bundesamt) for the period 1960 to 1994. In contrast, the study by Tyrväinen (1995a) for Germany is based on semi–annual data covering the period 1972 to 1991 from the OECD macro data base and secondary data on social security contribution rates and income tax from OECD calculations on the "Tax/Benefit Position on an Average Production Worker". The two studies also differ in that I use contract wages instead of effective wages and salaries since this better corresponds to the idea of an underlying bargaining model.[2] A description of variables and references to data sources is contained in the appendix.

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[2] However, since the correlation between contract and effective wages is extremely high, there would be little difference in using the latter instead of the former.

3.1 Specification of Wage and Employment Equations

3.1.1 Wage Equation

The long–run wage equation estimated by Tyrväinen (1995a, b) and also in this study can be derived from a number of bargaining models, such as the monopoly union or the right–to–manage model (for summaries of these models see, e.g., Pencavel, 1985; Layard, Nickell and Jackman, 1991, Chapter 2). Within the system of German industrial relations the so–called *right–to–manage model* (Nickell and Andrews, 1983) perhaps provides the most plausible description of wage determination at the aggregate level. In this model, the union and the firm (or the employers' organization at the aggregate level) bargain over real wages where the union takes into account that there exists a well defined trade–off between wages and employment given by a negatively sloped labour demand schedule. The outcome of such bargains, i.e. the combinations of real wages and employment levels, will depend on the technology, union's (respectively its members') relative preferences for wages and employment, and the union's and employers' bargaining strength measured by the value of some fall–back option in case no bargain is struck. For these latter variables, which distinguish this model from other bargaining hypotheses, no adequate proxies which could be included in an aggregate wage equation seem available.[3] In contrast, the effect of technology, i.e. the labour demand constraint, on real wages can be proxied by labour productivity, whereas the effects of social security contributions and taxes enter the wage equation since they affect the union's (or its members') preferences. Since the focus of the analysis is on these latter variables, some comments on the way they are included in the wage equation seems appropriate here.

In principle, direct and indirect taxes as well as employees' and employers' contribution rates to social security could have different weights in the union's utility function, and all of them should therefore be included in the wage equation as separate explanatory variables. However, due to severe multicollinearity problems between these variables, this has turned out to be empirically infeasible. Figure 1 shows that employers' and employees' social security contribution rates have moved closely together within the observation period due to the principle that the overall rate is formally split equally between employers and employees. In contrast, the ratio of direct taxes to wages and salaries has increased much more than either contribution rate in the first half of the observation period, and has also

[3] In theoretical models, the value of the union's fall–back option is usually set equal to the level of unemployment benefits, whereas the employers' fall–back option is equated to the fixed costs of production. For practical applications to the German situation these values are obviously unrealistic. Since empirically credible proxies for these fall–back options are not available at the aggregate level no particular hypotheses about union behaviour will be tested here. In fact, for the purpose at hand, identification of structural parameters of the union's objective function is also not required.

shown more variability in the second half which experienced some noticeable tax reforms.

Figure 1: Income tax and social security contribution rates – West Germany 1960 – 1994

Note: The contribution rates to social security and the direct tax rate are calculated as ratios of total contributions to gross wages and salaries. Employers' contributions also include hypothetical contributions in the public sector.

Source: see data appendix

Given this strong multicollinearity between employers' and employees' contribution rates to social security, it seems infeasible to include both contribution rates as explanatory variables in the wage equation. Using data on contribution rates derived for a "representative" production worker, Tyrväinen (1995a) directly includes the employers' contribution rate and the sum of the direct tax rate and the employees' contribution rate to social security in his wage equation. Given the variability in the income tax rate, this could perhaps have mitigated the collinearity between the employers' and employees' contribution rates in my data, too. I have therefore tested this possibility using the estimated wage equation reported below. The result is that the effect of the employers contribution rate could not be determined with any precision (the estimated coefficient had a standard error three times the value of the estimate). Hence, it doesn't seem feasible to separately estimate the direct effects of the employers' and employees' contribution rates in the wage equation without imposing some identifying restriction.

There are two extreme cases to consider: First, the union doesn't put any positive value on the employers' contribution rate; second, it enters the union's utility function in opposite sign and the same absolute value as employees' contribution rates. The latter value could either be zero, in case the union considers the contribution rate as an actuarially fair insurance payment or perhaps as high as the negative value put on (direct) taxes. Of course, the (dis–)utility of contribution rates could also be some weighted average of these upper and lower bounds, but lacking additional information this cannot be inferred from the data. As to the evaluation of employers' social security contributions by the unions, their "official" position seems to be that employers have to bear their "adequate" share of financing social security, which traditionally has meant formally splitting contribution rates equally.

Given that some restrictions on the way taxes and contribution rates enter the wage equation have to be imposed and taking into account the described instituional setting, I will assume that the employers' contribution rate do not *directly* affect unions' wage setting behaviour, but may affect wages *indirectly* through labour demand and, hence, employment as one component of labour productivity. As an alternative to this specification, I have restricted the long–run effect of the employers' contribution rate on wages to the same absolute value as that of the employees' contribution rate, but this restriction turned out not to be data admissible (see below). I tried to test for differences in wage effects between the income tax and the employees' contribution rate by including these variables separately in the wage equation, but the estimates turned out very imprecise due to strong collinearity between the two variables. I had therefore to impose equality of the wage elasticity with respect to the income tax and the employees' contribution rate to social security, respectively.

In addition to these restrictions, I will also impose a long–run elasticity of wages with respect to consumer prices of unity. Of course, this restriction need not hold in the short run, but it seems quite plausible in the long–run, and it is also supported by statistical tests (see below). Furthermore, these tests also show that price increases are passed on to higher wages irrespective whether they originate from higher producer costs or higher indirect taxes. Finally, I assume that the unemployment rate does not affect real wages in the long–run, but may have short–run effects on wage setting behaviour, which is compatible with the insider–outsider hypothesis (see, e.g., Layard, Nickell and Jackman, 1991).

Taking into account these restrictions the long–run wage equation which will be estimated takes the following form, where small letters denote (natural) logs of the corresponding variables and t is a time index:

(1) $$wr_t \equiv w_t - pc(1+tc)_t = \beta_{01} + \beta_{11} \cdot t + \beta_{21} \cdot (sw_t + ti_t) + \beta_{31} \cdot lpr_t + \varepsilon_{1t}$$

with *wr* real contract wage

w nominal contract wage

pc consumer price index exclusive indirect taxes

1+*tc* consumption tax rate

sw employees' social security contribution rate

ti income tax rate

lpr labour productivity

ε_{1t} error term

β_{j1} parameters to be estimated (j=0,1,2,3).

The linear trend in the wage equation should account for structural change, such as shifts between sectors, changes in union density and other factors not accounted for by labour productivity. Labour productivity is defined as the ratio of real net national income to the number of employees in the whole economy. In using net national income instead of gross national product it is assumed here that unions base their wage demands on what can actually be distributed in the economy.

Under certain conditions, which are discussed in section 3.2, a long–run relationship as the wage equation (1) also implies (and is implied by) a dynamic adjustment equation of the *error–correction form* (Engle and Granger, 1987) given by

$$(2) \quad \Delta wr_t = \alpha_{01} + \alpha_{11} \cdot \Delta wr_{t-1} + \alpha_{21} \cdot \Delta(ti_t + sw_t) + \alpha_{31} \cdot \Delta lpr_t + \alpha_{41} \cdot \Delta U_t + \gamma_1 \cdot ec_{1t-1} + \eta_{1t}$$

where Δ denotes the first–difference operator, η_1 is a serially uncorrelated error term, and the coefficients α_{j1} (j=0,1,2,3) are parameters to be estimated. Additional lags of the differenced variables may be included in the equation to purge remaining serial correlation from the error term, where the number of lags will be decided on by statistical criteria. The first difference of the unemployment rate is included in the short–run wage equation to account for disequilibria in the labour market. For statistical reasons discussed below, the change in the unemployment rate and not its level as in the traditional Phillips curve is included in the short–run wage equation. The lagged ec_1 term is defined by the error term from the long–run real wage, i.e.

$$(3) \quad ec_{1t-1} \equiv \hat{\varepsilon}_{1t} = r_{t-1} - \hat{\beta}_{01} - \hat{\beta}_{11} \cdot t(-1) - \hat{\beta}_{21} \cdot (sw_{t-1} + ti_{t-1}) - \hat{\beta}_{31} \cdot lpr_{t-1},$$

with the β_{ji} (j=0,1,2,3) corresponding to the parameters in equation (1) where a carat ("^") indicates an OLS estimate from this equation.

The economic rationale for the inclusion of the error–correction term is that temporary deviations of the real wage from its long–run equilibrium level will be adjusted by the factor γ_1 in each period until a new equilibrium is attained. Hence, this adjustment factor must be negative and significant. The short–run (within a year) impact of an explanatory variable on the real wage is given by the corresponding coefficient α_{j1}, whereas the long–run effect would be given by $\alpha_{j1}/(1-\alpha_{11})$, which should be similar to the corresponding coefficient estimate from the long–run wage equation.

3.1.2 Labour Demand Equation

The labour demand equation is derived under the assumption of imperfect competition in the labour and the goods markets. The implies that some demand shift variable instead of the output price is included as explanatory variable. Labour costs are given by the real contract wage, that is the nominal wage deflated by the GNP price deflator, plus employers' social security contributions. The effects of technological change and capital on labour demand are simply proxied by a time trend. In addition, I tried to include a measure of the aggregate capital stock, but this resulted in very imprecise estimates due to the extremely high collinearity between these two variables. I also included the ratio of export to import prices to account for terms of trade effects, but this variable always turned out as completely insignificant.

The long–run labour demand equation to be estimated is therefore of the following simple form, where small letters again denote logs:

(4) $$l_t = \beta_{02} + \beta_{12} \cdot t + \beta_{22} \cdot wp_t(1+se)_t + \beta_{32} \cdot y_t + \varepsilon_{2t}$$

with l number of employees

wp real wage deflated by GNP price deflator ("product wage")

$1+se$ employers' social security contribution rate

y real GNP

ε_{2t} error term

β_{j2} parameters to be estimated (j=0,1,2,3).

The dynamic labour demand equation in error–correction form is given by

(5) $$\Delta l_t = \alpha_{02} + \alpha_{12} \cdot \Delta l_{t-1} + \alpha_{22} \cdot \Delta wp_t(1+se)_t + \alpha_{32} \cdot \Delta y_t + \gamma_2 \cdot ec_{2t} + \eta_{2t}$$

with $ec_{2t-1} \equiv \hat{\varepsilon}_{2t} = l_{t-1} - \hat{\beta}_{02} - \hat{\beta}_{12} \cdot t(-1) - \hat{\beta}_{22} \cdot wp_{t-1}(1+se)_{t-1} + \hat{\beta}_{32} \cdot y_{t-1}$

The interpretation of the error–correction term, the adjustment factor γ_2 and the coefficients α_{j2} (j=0,1,2,3) is completely analoguous to that given for the wage equation above.

3.2 Estimation

There are various ways to estimate the wage and employment equations derived in the previous section.[4] One particularly simply procedure is the two–step estimator suggested by Engle and Granger (1987) for cointegrated time series, which I will also apply here. However, since this estimator has some well–known potential drawbacks, I have also applied other procedures, such as direct estimation of the unrestricted error–correction equations of the dynamic wage and labour demand equations by OLS and NLSQ, as well as the Johansen (1991) ML method. Overall, estimated (long–run) coefficients in the static models differ little between the various estimation methods. In contrast, estimated short–run coefficients from the unrestricted error correction models are determined rather poorly due to the strong correlation with the levels of the corresponding variables. In the following section, only estimation results from the two–step estimator proposed by Engle and Granger (1987), which in my opinion yields the most reliable estimation results for the wage and labour demand models, will be reported. However, where it seems appropriate I will also refer to results from the other estimation procedures.[5]

The two–step estimation procedure starts with tests of the order of integration of the variables included in the static wage and labour demand equations. Following usual practice, I employ Augmented Dickey–Fuller (ADF) tests to determine the order of integration of these variables. Having established the order of integration of all variables, I estimate the static wage and labour demand equations by OLS and calculate the error correction terms required for the second step of estimation. I test for cointegration between the variables in the two equations and also determine the number of cointegrating vectors by the Maximum Likelihood method proposed by Johansen (1991). In a second step, I then estimate the dynamic wage and labour demand equations with the error correction terms calculated from the first step included.

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[4] For a detailed summary of estimation methods for non–stationary time series see, e.g., Banerjee et al. (1993).

[5] Detailed estimation results are available from the author on request.

4 Results

4.1 Integration Tests

Results from ADF tests summarized in Table 2 show that all variables included in the wage and labour demand equations are integrated at least of order one, I(1). Tests are performed both with and without a deterministic (linear) time trend, and the number of lags of the differenced variables is determined by standard statistical tests.

For the nominal wage and the consumer price index the ADF test indicates that these variables are I(2), implying that their first differences are still non–stationary. As the real wage is modelled here, this non–stationarity does not affect the cointegration relationship between the variables in the wage and employment equations. The only other variable for which there is some indication that it may be even I(2) is wp(1+se). Since it plays a role in the dynamic wage equation, it should be noted here that the unemployment rate, which is excluded from the static wage equation on a priori grounds, is also I(1).

Table 2: ADF tests of order of integration of variables in the wage equation (| t–value |)

	No deterministic time trend		Linear time trend	
Variable	Level	Difference	Level	Difference
w	1.78	2.45	.36	3.05
pc(1+tc)	.86	2.74	1.55	2.74
wr	2.12	2.82	0.70	3.55
ti	1.57	4.93	1.24	5.19
lpr	2.66	3.20	1.36	4.16
l	0.64	4.59	3.11	4.50
wp(1+se)	1.69	2.15	0.95	2.66
y	1.73	4.30	2.23	4.69
U	0.97	3.82	3.34	3.75

Note: Critical values for the model with no deterministic time trend are –2.95 at the 5 % and –3.65 at the 1 % significance level, respectively; for the model including a linear time trend these values are –3.56 and –4.27, respectively. The number of lags of the differenced variables to account for serial correlation in the residuals is one in most cases and two at most for some of the models in levels.

4.2 Wage Equations

Estimation of equation (1) by OLS yielded the following static wage equation:

(6) $$wr_t = 2.571 - 0.002 \cdot t + 0.314 \cdot (sw_t + ti_t) + 0.536 \cdot lpr_t + \hat{\varepsilon}_{1t},$$

adj. $R^2 = 0.98$, DW = 0.95, estimation period: 1960 – 1990 (n = 35),

where the coefficients on sw_t and ti_t were restricted to be equal in the estimation. Due to the strong autocorrelation in the residuals from this first–stage regression, estimated standard errors of coefficients are biased and not normally distributed. Hence, they are not reported here. However, estimated coefficients would be consistent even though potential dynamic misspecification and simultaneity between variables in the model are ignored if they were in fact cointegrated.[6] A standard ADF test on the residuals of the estimated static wage equation yielded a value of –3.17 which is below (in absolute value) the tabulated critical 5 % value of –3.82 (for n=50, constant, no trend, one lag) – see Banerjee et al. (1993, Table 7.1). On the other hand, the likelihood–ratio test suggested by Johansen (1991) does reject the hypothesis of no cointegration at the 5 % significance level. Furthermore, this test indicates that there is just one cointegrating vector in the system.[7] Hence, taken together, it may be concluded that the variables in the wage model are in fact cointegrated.

The point estimate of the coefficient on the income tax and employees' contribution rate to social security seems much too high on a priori grounds, as it would imply that real wages increase by more than one percent for each *percentage* increase in either the income tax rate or the contribution rate. On the other hand, the point estimate for the elasticity of wages with respect to labour productivity of about .5 seems a bit low at first sight. It also conflicts with the estimate by Carruth and Schnabel (1993) and Tyrväinen (1995a) who have estimated an elasticity of one. Some experimentation has shown that the estimated coefficient on the productivity term is sensitive to the way the income tax and contribution rates enter the static wage equation. It should be noted that the cointegrating vector (normalized on the real wage rate) estimated by the Johansen (1991) ML method in fact yielded a somewhat higher coefficient on the productivity term and a lower coefficient on the income tax contribution rate variables than the ones reported in equation 3 above. However, given the relatively large and most likely downward–biased standard errors in these static models, both estimates are probably not statistically different from each other.

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6 In fact, estimated long–run parameters would converge to their "true" values even at a faster rate as OLS estimates under standard conditions.

7 These tests and all other estimation in this paper were performed using EVIEWS 2.0.

More efficient parameter estimates may be expected from the second–step estimation of the dynamic wage equation reported in Table 3, where the one–period lagged residual from the first–step static wage equation is included as error–correction term. As it turned out, the inclusion of the lagged value of the dependent variable and the differenced explanatory variables was sufficient to purge the autocorrelation from the residuals in the dynamic wage equation. With the exception of the unemployment rate, for which the first difference turned out insignificant whether or not its lagged value was included, estimated coefficients of lagged differences of explanatory variables were also always insignificant.

Table 3: Dynamic real wage equation – OLS regression

Variable	Coefficient	|t–value|
constant	0.004	1.23
Δw(t–1)	0.492	5.32
Δsw	0.079	2.65
Δti	0.079	2.65
Δlpr	0.205	1.90
ΔU	–0.555	2.07
ec_1(t–1)	–0.358	4.78
adj. R^2	0.77	
DW	1.97	
LM–statistic: $\chi^2(1)$	2.49	
n	33	

Notes: The coefficients of Δsw and Δti were restricted to be equal in the estimation. The Lagrange–Multiplier (LM) statistic tests for an AR(1) process in the residuals and has a χ^2 distribution with one degree of freedom; the crititical value at the 5% level is 3.84.

To start with the error–correction term, its coefficient is correctly signed and highly significant. This is to be expected if the variables in the long–run wage equation are in fact cointegrated (Engle and Granger, 1987). The value of the estimated coefficient implies that about a third of the deviation from the long–run equilibrium defined by the static wage equation is corrected within a year. This value is almost the same as the one estimated for Germany by Tyrväinen (1995a, p. 79) who, using semi–annual data, reports a value of 0.15.

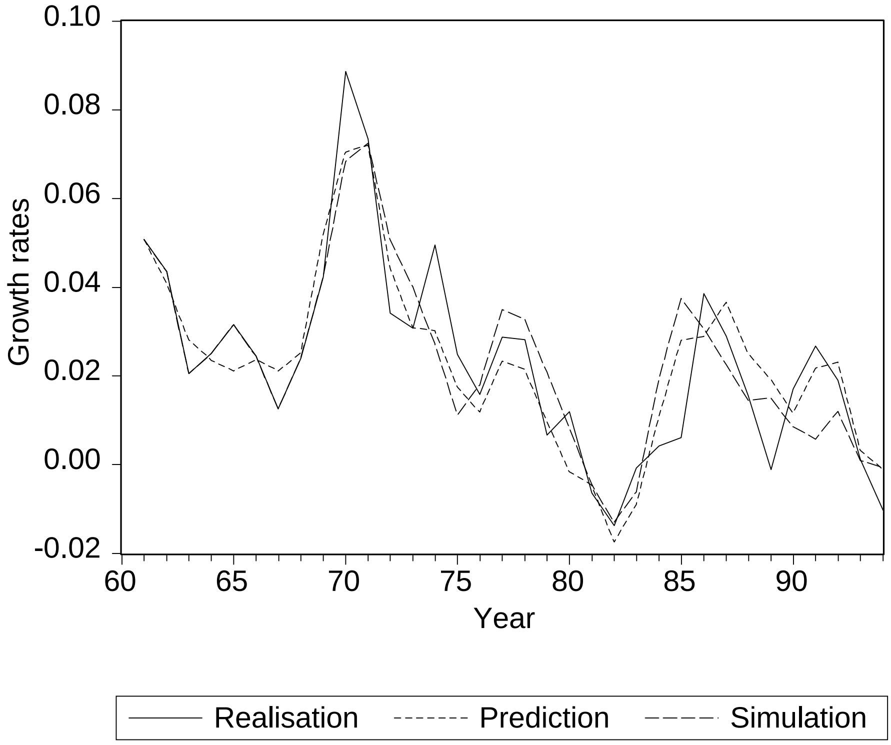
The other estimated coefficients of the explanatory variables in the dynamic wage equation are also all correctly signed and highly significant. Of primary interest here is the coefficient on the change in the income tax and employees' contribution rate, which implies a long–run elasiticity of real wages with respect to these variables of about .16 (=.079/(1–.491)). This would mean that real wages in the long–run increase by 1 percent when the income tax rate or the employees' contribution rate is increased by one percentage point and would thus correspond to the estimates by Tyrväinen (1995a) discussed in section 2. Unfortunately, this does not correspond to the point estimate in the static labour demand model. Hence, some doubts remain.

I have therefore also estimated the unrestricted form of the dynamic wage equation using other standard estimation methods. Instead of the residual from the first–stage estimation the error–correction term enters the dynamic wage equation unrestricted, i.e. in terms of the levels of the variables as in equation (4) above, and the β_{j1} coefficients are estimated along with the α_{j1} coefficients in one of two alternative ways. The most simple estimation method is by OLS with the β_{j1} coefficients recovered from the estimated ones which are compounded with the adjustment coefficients, say $\beta_{j1}* = \gamma \cdot \beta_{j1}$. An alternative method is to estimate this equation, which is non–linear in the β_{j1} parameters, by NLSQ. The result of this exercise is that, irrespective of the method used, both the short–run and the long–run coefficients on the income tax and employees' contribution rate are almost identical to the one estimated by the two–step method. This shows that estimation results are rather robust to the estimation method, but leaves the reason for the divergence between the long–run wage elasiticity of the income tax and contribution rate derived from, respectively, the static and dynamic wage equations unexplained.

Another potential problem with the estimated coefficients in the dynamic wage equation is simultaneity bias, especially with respect to the change in the income tax and the contribution rate as well as labour productivity. I have therefore instrumented these variables by their lagged values, contemporaneous and lagged values of the other exogeneous variables in the model as well as the growth rates in money supply and the government budget deficit. However, estimation results hardly differed between these IV estimates and those in Table 3 and are therefore not reported here.

Judged by standard summary statistics the fit of the dynamic wage equation seems reasonable, and there is no indication of dynamic misspecification. Stability tests (Cusum, Cusum squared, sequential Chow tests) also show that, with the possible exception of one or two years, the estimated equation is stable over the whole observation period. The performance of the model can also be gleaned from Figure 2 which plots the realisation, the estimate (ex post forcast) and the dynamic simulation of the growth rate of wages. The latter is started in 1970 and runs through 1994. Compared to an ex post forcast, the dynamic simulation is a harder test of the estimated model, and it performs quite well. Below, the dynamic simulation will be used to perform some policy simulations.

Figure 2: Realised, predicted and simulated growth rates of employment



Note: Predicted and simulated growth rates are derived from the dynamic real wage equation in Table 3; the dynamic simulation starts in 1970.

4.3 Labour Demand Equations

Estimation of equation (4) by OLS yielded the following static labour demand equation:

(7) $l_t = 8.937 + 0.001 \cdot t - 0.230 \cdot wp_t (1 + se)_t + 0.368 \cdot y_t + \hat{\varepsilon}_{2t}$

adj. R^2 = 0.95, DW = 0.54, estimation period: 1960 – 1990 (n = 35),

where the coefficients on wp_t and ($1+se_t$) were restricted to be equal in the estimation. For the reason given above, estimated standard errors of coefficients are not reported here. The ADF cointegration test on the residuals of the estimated static labour demand equation yielded a value of –5.03 which by far exceeds (in absolute value) the tabulated critical 5 % value already referred to above. Hence, from this test it may concluded that variables in the wage model are in fact cointegrated. This conjecture is also supported by the Johansen test which rejects the hypothesis of no cointegration at the 5 % significance level. Furthermore, this test indicates there is just one cointegrating vector in the system.

The point estimate of the coefficient on the real wage and employers' contribution rate to social security is –.23. As to the real wage elasticity, this estimate is somewhat higher than the one obtained by Flaig and Steiner (1989) using a similar methodology, but quarterly data for West German manufacturing. In contrast, it is much lower than the value of –1 Tyrväinen (1995a) reports for Germany. To me, this latter estimate seems excessively large. The estimated coefficient also implies that labour demand decreases by .23 percent for each *percentage* increase in the employers' contribution rate to social security, which seems reasonable. On the other hand, the point estimate for the elasticity of labour demand with respect to real GNP seems quite low, both on a priori grounds and in comparison to other estimates, e.g. those by Flaig and Steiner (1989) who report an elasticity of about 0.6. A possible reason for this rather low elasiticity is that it refers to the whole economy, whereas the Flaig and Steiner (1989) estimate refers to the manufacturing sector only, where the wage responsiveness of labour is certainly higher.

Results from the second–step estimation of the dynamic labour demand equation are reported in Table 4. As in the wage equation, the inclusion of the lagged value of the dependent variable and the differenced explanatory variables was sufficient to purge the autocorrelation from the residuals in the dynamic wage equation.

Table 4: Dynamic labour demand equation – OLS regression

Variable	Coefficient	|t–value|
constant	–0.006	2.53
Δl(t–1)	0.565	7.01
Δwp(1+se)	–0.189	2.28
Δy	0.423	7.43
ec_2(t–1)	–0.299	3.75
adj. R^2	0.83	
DW	2.01	
LM–statistic: $\chi^2(1)$	0.03	
# Observations	33	

Notes: The coefficients of Δwp and $\Delta(1+se)$ were restricted to be equal in the estimation. The Lagrange–Multiplier (LM) statistic tests for an AR(1) process in the residuals and has a χ^2 distribution with one degree of freedom; the crititical value at the 5% level is 3.84.

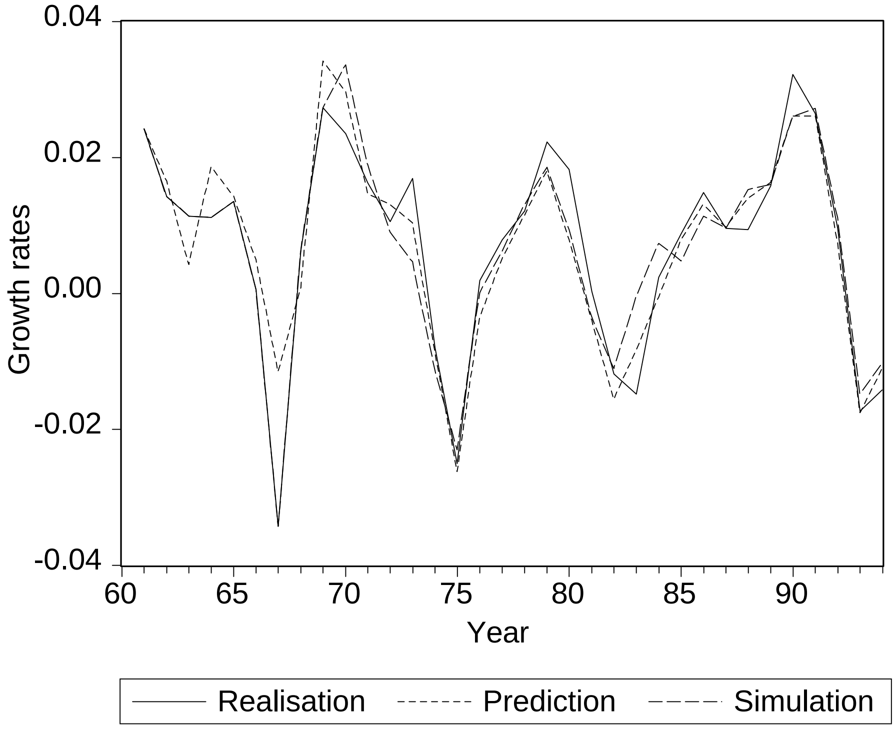
As expected given the results from the first–stage estimation, the coefficient of the error–correction term is correctly signed and highly significant. The value of the estimated coefficient implies that about a third of the deviation from the long–run equilibrium defined by the labour demand equation is corrected within a year. This corresponds to the estimate in the dynamic wage equation above.

The other estimated coefficients of the explanatory variables in the dynamic labour demand equation are also all correctly signed and highly signficant. Of primary interest here is the coefficient on the change in the real wage and the employers' contribution rate, which implies a somewhat higher long–run elasiticity of real wages with respect to these variables than obtained from the static labour demand equation. The same also holds for the long–run elasticity of labour demand with respect to output.

To probe the sensitivity of results to the estimation method used, I have also estimated the unrestricted form of the dynamic labour demand equation by OLS and NLSQ as above. However, these methods yielded insignificant short–run and long–run coefficient estimates for most variables, in particular the real wage and the employers' contribution rate. The obvious reason for this result is the high correlation between the first differences and the levels of these variables. It should be noted that the Johansen ML method also yielded very imprecise estimates of the parameter in the static labour demand equation. Hence, I will rely on the results from the two–step estimation method and, since IV estimation produced quite similar results, use the OLS estimates reported in Table 6 for the simulations below.

The fit of the dynamic labour demand equation seems reasonable, and there is no indication of dynamic misspecification. Stability tests (Cusum, Cusum squared, sequential Chow tests) also show that, with the possible exception of one or two years, the estimated equation is stable over the whole observation period. The performance of the model can also be gleaned from Figure 3 which plots the realisation, the estimate (ex post forcast) and the dynamic simulation of the growth rate of labour demand. Again, the dynamic simulation of the labour demand model seems to perform reasonably well.

Figure 3: Realised, predicted and simulated growth rates of employment



Note: Predicted and simulated growth rates are derived from the dynamic labour demand equation in Table 4; the dynamic simulation starts in 1970.

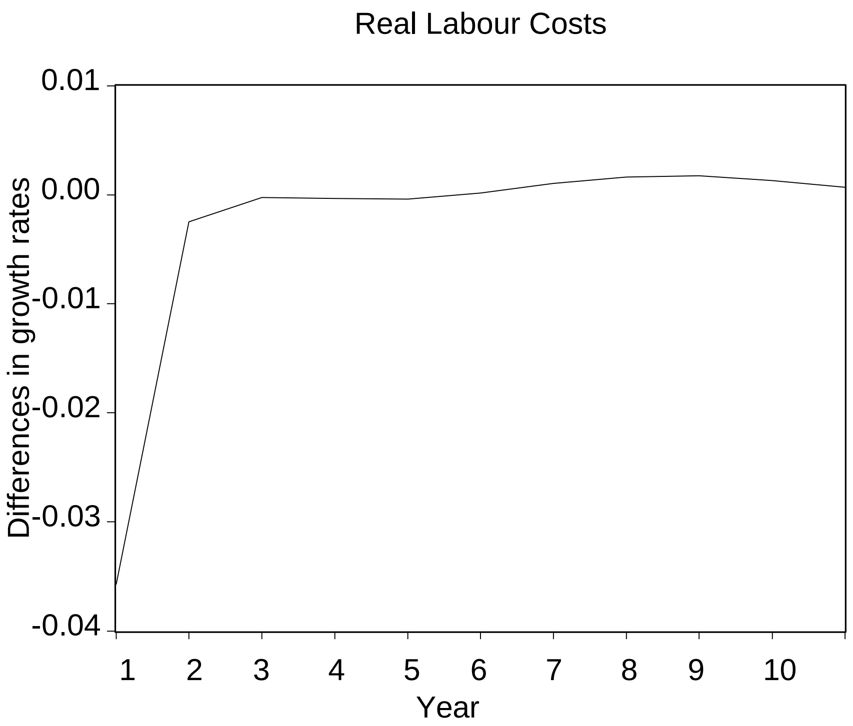
5 Policy Simulations

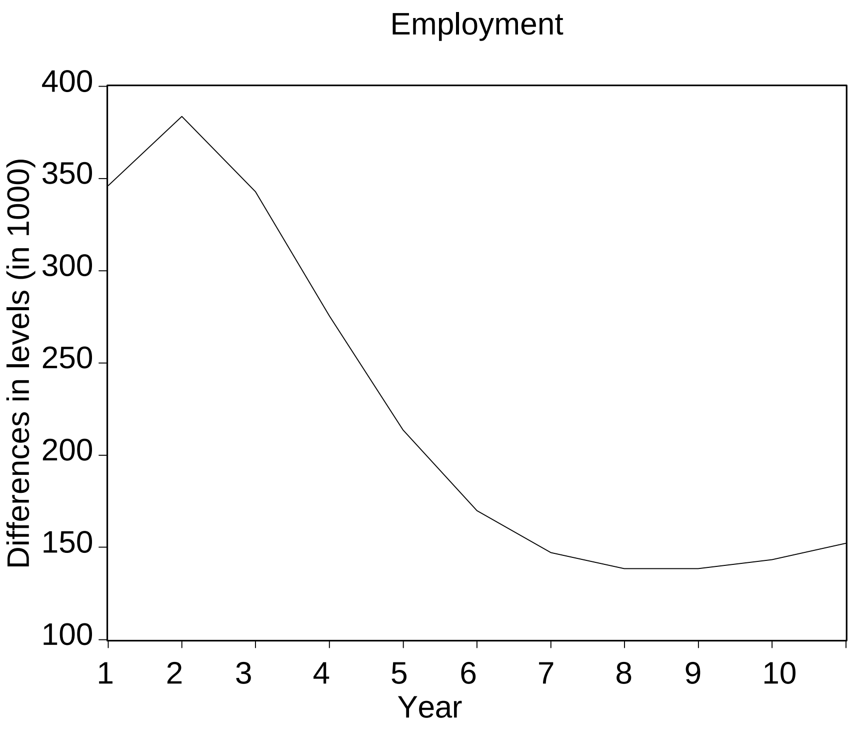
In this section, the dynamic wage and labour demand equations are combined to perform some policy simulations. The main reason for not simply relying on the estimated long–run elasiticities is that for economic policy making the short–run effects of some policy change are usually at least as important as its long–run impact. A methodological reason relates to the fact that standard errors of parameters from the static (long–run) wage and labour demand models are upward biased. In this context, the estimated wage elasticity with respect to the income tax and the employees' contribution rate derived from the static wage equation poses a special problem, as discussed above. On the other hand, these effects seem much better determined in the dynamic wage and labour demand equations.

As mentioned in the introduction, reducing social security contributions in order to increase employment seems to have obtained high priority on the policy agenda in Germany. On the financing side, increasing direct and/or indirect taxes are considered as policy options, for which there are basically two arguments. The first relates to a "broadening" of the financing base by bringing in new contributors. The second, and economically more interesting policy relies on the idea that labour costs will be lowered by reducing employers' social security contributions.

Figure 4: Simulation of the effects of a reduction of employers' social security contributions by 20% (=3 percentage points) on real labour costs and employment

- without a compensating increase in taxes -

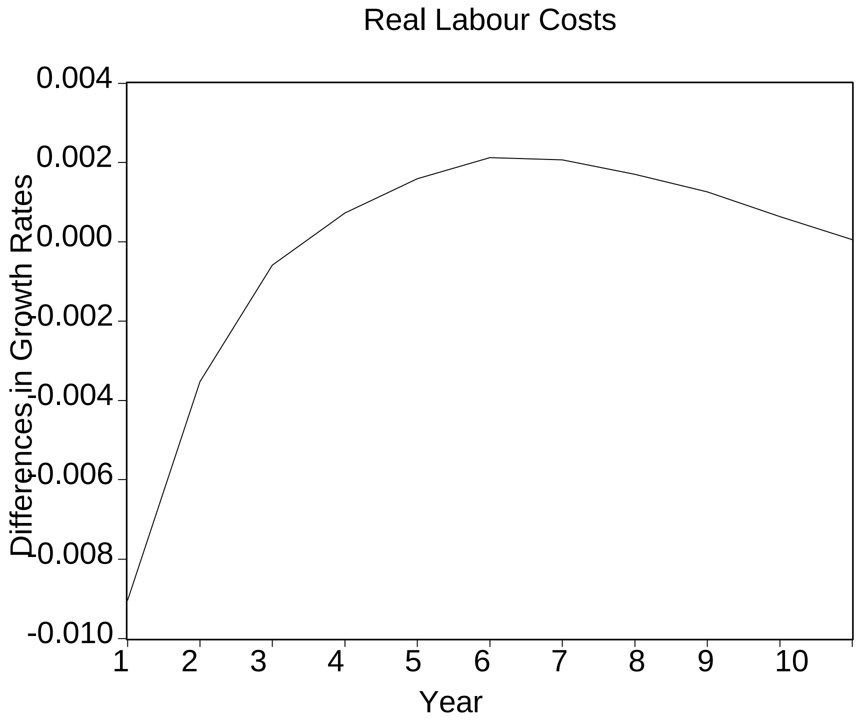


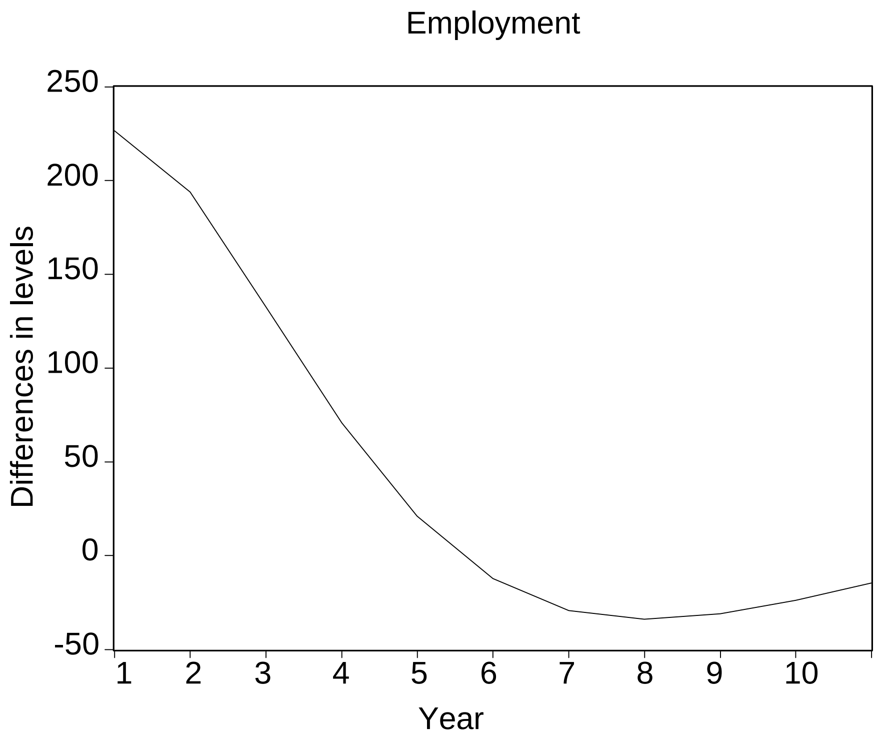


Note: Simulations are based on the dynamic real wage and labour demand equations in Tables 3 - 4.

Figure 5: Simulation of the effects of a reduction of employers' social security contributions by 20% (=3 percentage points) on real labour costs and employment

- with an increase of the value-added tax by 3 percentage points -





Note: Simulations are based on the dynamic real wage and labour demand equations in Tables 3 - 4.

From this point of view, the hope is that the resulting positive employment effect will exceed any potential negative effects from raising taxes to finance the cut in the contribution rate. Since higher direct taxes seem presently not to be on the policy agenda, increasing indirect taxes, especially the value–added tax which is at a relatively low level compared to most other EU member states, has recently become a policy option in Germany.

The first simulation exercise refers to a reduction of the employers' contribution rate to social security by 20 percent, which would reduce the contribution rate by about 3 percentage points, without raising taxes. In the simulation, it is assumed that in 1980 the contribution rate would have been permanently reduced by 3 percentage points. The effect of this reduction on the growth rate of labour costs (=real wages plus employers' social security contributions) and the level of employment within a period of ten years is shown in Figure 4.

Compared to the baseline solution (historical contribution rates), the immediate effect of this policy would have been a quite strong reduction in the growth rate of real labour costs and an increase of employment by about 350 thousand persons in the first year. The effect of this reduction on the growth rate of real labour costs virtually vanishes after the second year. The maximum employment increase is reached in the second year; it then declines continuously and eventually reaches a stationary level of about 150 thousand persons after 6 – 7 years.

The second policy simulation refers to a reduction of the employers' rate to social security by 3 percentage points financed by a revenue neutral increase in the value added tax. Since revenues from this source are approximately equal to employers' social security contributions (DM 222.5 and 230.8 billions in 1994, respectively), this would imply an increase in the value–added tax of roughly 3 percentage points as well. The effects of this revenue neutral shift of financing social security from employers' contributions to value–added taxes on real labour costs and employment are shown in Figure 5.

The immediate effect of this policy is to reduce real labour costs and to increase employment. However, after 3 – 4 years such a policy leads to higher growth rates of labour costs for some years than under the historical policy regime. In the long–run, there seems to be no effect of this revenue neutral shift on the growth rates of real labour costs. Consequently, starting from a maximum employment increase of about 220 thousand persons, the effect on employment decreases rapidly and vanishes altogether after 5 – 6 years.The immediate effect of this policy is to reduce real labour costs and to increase employment. However, after 3 – 4 years such a policy leads to higher growth rates of labour costs for some years than under the historical policy regime. In the long–run, there seems to be no effect of this revenue neutral shift on the growth rates of real labour costs. Consequently, starting from a

maximum employment increase of about 220 thousand persons, the effect on employment decreases rapidly and vanishes altogether after 5 – 6 years.

6 Conclusion

In view of the high level of unemployment in Germany and the looming problems of financing the expensive German social security system there seems to be a growing consensus that the reduction of the high contribution rates to social security is a promising policy measures to reduce labour costs and increase employment. Such a view has recently also become popular among policy advisers, such as the EU Commission and the OECD.

Following up recent econometric work on employment and wage effects of social securtiy financing contained in the OECD Jobs Study, I find support for some of the results for Germany. In particular, my estimation results show that higher income tax and employees' social security rates increase real wages at least proportionally in the long–run. Although my estimate of the long–run elasiticity of labour demand with respect to real wages and employers' social security contributions is considerably lower than the one reported in the OECD study, higher real labour costs have strong negative employment effects. In the long–run, proportionate increases of indirect taxes, the income tax, employees' and employers' contribution rates all seem to raise real labour cost and reduce employment to the same extent.

A reduction of employers' as well as employees' contribution rates has substantial positive employment effects even in the long-run if not compensated for by higher taxes. On the other hand, the long–run effects of revenue neutral shifts of financing social security from contribution rates to direct or indirect taxes will be small, except they are accompanied by a broadening of the revenue base. However, in the short–run real wages and employment depend on the way social security is financed, and there may therefore be some positive short–run employment effects from revenue neutral shifts of financing social security. Since this would also raise social security contributions such a policy could be partially self–financing. These indirect effects are not modelled here, but would have to be taken into account before a final conclusion on the overall effects of changes in social security financing can be drawn.

Data Appendix

Symbol	Variable	Source
w	Index of monthly contract wage, national economcy, base year = 1991 (since 1986 including fringe benefits, for details see Deutsche Bundesbank, 1994a)	DB (1975: 67*; 1980: 69*; 1992: 73*; 1994a: 33; 1994b: 83*; 1995: 67*), own calculations
y^n	Nominal gross national product	SVR (1995: 390)
p^b	Price deflator for gross national product, base year = 1991	SVR (1995: 462)
l	Employees, concept = national accounts	SVR (1995: 373)
u	Unemployment rate	SVR (1995: 369)
pc	Consumer price deflator, including indirect taxes, all private households, base year = 1991	SVR (1995: 460)
po	Consumer price deflator, excluding indirect taxes, all private households, base year = 1991; pc divided by (1+ti), where ti is the indirect tax rate	SVR (1995: 390, 460), STABU (1991: 65), STABU, BMF (1995: 214–217), own calculations (revenues from excise and value–added taxes 1992–1994)
tc	Indirect (consumption) tax rate: ratio of total revenues from excise and value added to private consumption, concept = national accounts	SVR (1995: 390), STABU (1991: 65), STABU, BMF (1995: 214–217), own estimate (revenues from excise and value–added taxes 1992–1994)
ti	Income tax rate: ratio of total revenues from earnings tax (wages and salaries) to total gross earnings of dependently employed, concept = national accounts	STABU, SVR (1995: 388), own calculations
se	Employers' social security contribution rate: ratio of social security contributions actually paid by employers to total gross earnings, concept = national accounts	STABU, SVR (1995: 388), own calculations
sw	Employees' social security contribution rate: ratio of social security contributions actually paid by employees to total gross earnings; social security contributions are calculated as difference between gross earnings and the sum of net earnings and revenues from the earnings tax, concept = national accounts	STABU, SVR (1995: 388), own calculations

Notes: DB = Deutsche Bundesbank, SVR = Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung (German Council of Economic Advisers), STABU = Statistisches Bundesamt (Federal Statistical Office), BMF = Bundesministerium der Finanzen (Federal Finance Ministry); in case STABU is given as source without year and page number, information was provided by phone.

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