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Do Taxes Cause Unemployment?*

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Abstract

In the long run the economic incidence of a tax is unaffected by whether a tax is levied on workers, consumers or firms. In the short run, however, with wages and prices not fully flexible the incidence may be different. We test this hypothesis using aggregate time series data and examine the implications of tax incidence for the level and persistence of unemployment.

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1 Introduction

Are high taxes responsible for high unemployment in Europe? Many commentators take it for granted that they are. In a leading article reviewing the performance of the French economy, the *Economist* commented that “[The French tax system] still relies far too much on employment-killing payroll taxes”.¹ Professional economists have tended to be a little more sanguine, recognising that the multiplicity of interacting effects in general equilibrium means that the identification of any causal relationship is very difficult (see Bean, 1994). Nevertheless taxation has often been cited in the literature as one of a number of possible causes of unemployment (see Layard, Nickell & Jackman, 1991).

The question of whether taxes cause unemployment is intimately related to the question of what is the incidence of those taxes and how that incidence varies over time. If it is the case that the burden of the taxes falls entirely on the workers, then the cost of labor is unaffected and the tax has no implications for unemployment. Taxes may still induce a labour supply response (i.e. a reduction in labour force participation or in hours worked), but this is distinct from any change in involuntary unemployment. Thus the quote from the *Economist*, and the conventional wisdom it represents, are wrong unless it can be shown that the burden of taxes is shifted, to some extent, onto employers.

The extent to which the burden of taxes is shifted from one group to another, can itself vary over time. For example an income tax may be formally levied on workers. Following any increase in that tax, we would expect to see take-home wages fall. But over time, if labour market conditions are favourable, workers may succeed in passing the burden of taxes to firms via wage increases higher than would otherwise have been the case.

The interest of both pundits and economists in the possibility of a causal link between taxation and the level and persistence of unemployment, has been stimulated by recent OECD experience. There appears to be a correlation between high taxation and high unemployment, both across countries and through time. For example, Blanchard & Katz (1997) have commented, the low tax and low unemployment US economy is often cited as *prima facie* evidence that taxes cause unemployment.

During the 1980s and 1990s a substantial literature sought to measure the causal link between taxes and unemployment via the estimation of small scale models of the macro economy using aggregate data.² The empirical re-

¹*The Economist*. December 1996

²See for example Bean & Dreze (1990), Bean, Layard & Nickell (1986), Layard & Nickell (1986), Layard, Nickell & Jackman (1991), and Whelan (1995). The various papers co-

sults were ambiguous, with the size and significance of the estimated effects of the tax system varying across countries. For example, Layard, Nickell & Jackman (1991) find that the effect of taxes on unemployment is statistically insignificant in eight countries (Belgium, Germany, Italy, Canada, USA, Japan, Austria, Switzerland) and positive and significant in four (France, Ireland, Finland, UK).

In this paper we adopt an alternative approach. We estimate parsimonious dynamic reduced form models in order to see whether unemployment and wages respond to exogenous changes in tax policy in a way consistent with theory. By estimating reduced forms we avoid the problem of having to specify exclusion restrictions necessary to identify a full structural model. We place just enough structure on the data to deal with the reverse causality from activity to taxation. The cost of this procedure is that the model is vulnerable to the Lucas Critique. Furthermore, a reduced form model cannot identify the mechanism by which tax affects unemployment. We address these issues later.

A similar procedure was used by Poterba, Rotemberg & Summers (1986) to test for the presence of nominal rigidities. They treated changes in tax policy as being exogenous shocks to the price structure and used them to identify the effect of money on output. In effect we treat the tax changes as shocks to the structure of real wages and use this to test for the presence of real wage rigidities.

More recently related topics have been examined by other authors. Alesina and Perotti (1995) use panel data for a sample of OECD member states, to show that countries' unit labour costs, relative to trading partners, tended to increase as direct taxes rose. They suggest that about one third of direct taxes were passed on to firms. Blanchard and Perotti (1999) also examined a related issue. They looked at the effect of taxation (and government expenditure) on output. They found that multipliers were positive, but typically small i.e. close to one.

The paper is organized as follows: Section two outlines a simple model of the interaction of taxes and unemployment. Section three discusses the methodology and the data. Section four presents the results. Section five concludes.

2 A Review of the Theory

The question of whether labor market taxes cause unemployment is essentially a question of the incidence of those taxes. If it is the case that the

authored by Layard, Nickell, Jackman and Bean are typical and much imitated.

burden of the taxes falls entirely on the workers, then the cost of labor does not rise and the tax has no implications for unemployment. Thus the question reduces to one of whether, and to what extent, the burden of taxes is shifted onto employers.

In order to fix ideas, consider the following simple model. Assume that the presence of some inefficiency prevents the market from clearing to the point where workers reservation wage equals the value of the marginal productivity of their labor to firms. The market wage is some multiple of the reservation wage as in (1a) where W is the market wage, W^R is the reservation wage (the worker's outside option), P is the consumer price index and τ is the income tax rate and $B()$ is the markup function decreasing in unemployment, u , and increasing in other variables, X . Firms then set employment, given the wage, according to (1b) where g is an increasing function of the product wage (s being the producer price) and other variables.

$$\frac{W}{P}(1 - \tau) = \frac{W^R}{P}B(u, X) \quad (1a)$$

$$u = G\left(\frac{W}{s}, Z\right) \quad (1b)$$

The precise form of $B()$ depends on the precise nature of the inefficiency generating unemployment. Models such as Diamond (1982), Pissarides (1990) and Shapiro & Stiglitz (1984) as well as the model estimated by Layard et. al. (1991) all include a "wage setting" equation of the form (1a).

We can use this toy model to analyse the effect of an increasing taxes. From equation (1a), we see that an increase in τ will result in higher unemployment. The imposition of a tax on wage income will initially reduce workers take-home pay. As soon as contracts can be renegotiated workers will seek to shift the burden to firms in the form of a higher gross wage. If they succeed, firms will respond by cutting back on hires.³

If there was some way that the income tax could be levied on the workers' outside option also, it would lead to less of an effect on unemployment. In fact if the tax rates on inside and outside options were the same then τ would factor out of (1a) and the tax would have no effect on the markup over the reservation wage.⁴ The incidence of the tax would fall entirely on

³Using the implicit function theorem and $P = (1 + \theta)s$ we find $\frac{du}{d\tau} = -\frac{G_1}{s} \frac{dW}{d\tau}$ and $\frac{dW}{d\tau} = -\frac{W/P}{\psi}$ where $\psi = [G_1 B_1 W^R/s - (1 - \tau)]/p < 0$ and F_1 is the partial derivative of the function F with respect of its first argument.

⁴For example, if the reservation wage is equal to unemployment benefits and if benefits are taxable at the same rate as wage income, then $W^R = (1 - \tau)b$.

the workers and there would be no effect on unemployment. An important practical example of this is a general sales tax. This would, in effect, be a tax on income both in and out of employment (via an increase in θ) and so would have no effect on bargained wage or unemployment.⁵ For this reason most empirical papers assumed that sales taxes do not have an effect on unemployment (see Layard et. al.,1991).

Bean (1994) points out that we might expect that the workers bear the entire burden of the tax in the long run. A permanent increase in taxation will reduce permanent income and consumption. This will increase the marginal utility of consumption relative to the marginal utility of leisure, implying that the reservation wage will fall. It is not hard to design a specific set up where the net result is no change in the mark-up and therefore the wage.⁶ Thus the incidence of the tax falls completely on workers.

This would imply that even a permanent increase in taxes would have only a temporary (although possibly long lasting) effect on unemployment. (A fact explicitly assumed by many researchers who include only the change in taxes in their regressions). There is still scope for taxes to have a long run impact on unemployment, however, if the reservation wage reflects, not just the value of leisure, but workers aspirations also. Precisely how long it takes for reservation wages to adjust (if ever) will determine how long it takes for the incidence of taxes to shift and for unemployment to adjust.

To take an extreme example, suppose that pride ensures that an unemployed individual will never accept a job at a wage lower than the wage he received during a previous period of employment i.e. the reservation wage is fixed $W_t^R = W_0$. The burden of the tax shifts entirely to firms, implying that permanent increases in taxation will have a permanent effect on unemployment. Following a tax increase, a worker still seeks the same after tax wage as he had before, despite the fact that this wage is now economically infeasible for the (marginal) employer. Unemployment results and will last for as long as aspirations fail to adjust to the new reality.

Hogan (1999b) examined this possibility using micro data and found that the wage in the pervious job had a small but significant effect on reservation wages even controlling for current market wages and individual unobserved effects. Other things being equal, those unemployed, who previously had a job paying a wage one percent above average now had a reservation wage 0.15 percent higher than otherwise identical unemployed individuals. The

$$^5 \frac{dW}{d\theta} = \frac{[W(1-\tau) - W^R B(u, X)] / (s(1+\theta))^2}{P^2 \psi} = 0$$

⁶Suppose that W^R equals the marginal rate of substitution of consumption (c) for leisure (l) where utility is $u(c_t, l_t) = \ln c_t + \ln l_t$ and $c_t = rY(1-\tau)$ with Y being permanent income. Substituting into (1a) will yield an expression independent of the tax rate.

size of this previous wage effect tended to diminish with increasing length of unemployment spell.

In summary, there are two points to take from this model. Firstly the incidence of a tax depends on to what extent the tax effects the workers outside option – the reservation wage. In particular a sales tax will probably have less of an effect on the labour market because it taxes the outside option also. Secondly the long term effect of any tax depends on how the reservation wage adjusts. There is no reason to expect that adjustment to take place quickly. Indeed complete adjustment may never take place, raising the possibility that changes in taxes could have permanent effects on unemployment.

3 Methodology & Data

3.1 Identification

In essence we want to estimate a dynamic system such as (2), where $A(L)$ is a matrix of lag polynomials, U is the natural logarithm of the unemployment rate, W is the natural log of wages, τ is the income tax rate and θ is the sales tax rate.

$$A(L)Y_t = \varepsilon_t \tag{2}$$

$$Y_t = (U_t, W_t, Surplus_t, \tau, \theta)'$$

The system (2) can be viewed as the reduced form of (1a) if we note that $p = (1 + \theta)s$ and model the potentially slow adjustment of reservation wages by making W^R a distributed lag of the other variables. We model τ and θ as the share of taxes in GDP as the tax system is too complicated for us to think in terms of a single tax rate observable in aggregate data. We also include budget balance as a share of GDP , $surplus$, to account for the cyclical and demand side effects and also to allow us to focus on balanced budget changes in taxation.

Estimates of (2) will be biased due to the feedback from activity to taxes i.e. the unwanted effects of unemployment on measured tax rates. Because the true tax rates are not proportional and are not levied on all of GDP , and because recessions do not effect all the income distribution uniformly, it is probable that the measured tax/ GDP ratios, τ and θ , will vary over the business cycle as a result of compositional effects.⁷

⁷For example, if a recession reduces the incomes of lower paid workers more than higher paid workers, and if the true tax system is progressive, we could observe tax share to rise while unemployment is also rising. Similarly, if sales taxes are levied more on luxury goods

Poterba, Rotemberg & Summers (1986), developed a simple way of combating this reverse causality. They calculate a “tax policy mix” variable, $tmix$, which is equal to the difference between the aggregate income tax rate, τ , and the aggregate sales tax rate, θ and use this as a regressor in place of τ and θ . The idea is that $tmix$ is more likely capture true exogenous changes in policy than are the aggregate tax rates. These aggregate tax rates vary over time as the result of both policy shocks and in response to (endogenous) cyclical variation in GDP such as the automatic stabilizer identified above. If the elasticity of τ with regard to GDP has the same sign as elasticity of θ , $tmix$ will offset the two sources of bias. To the extent that reverse causality still exists, the results will suffer from simultaneous equation bias. Nevertheless, such as bias will be smaller than that which would result from using the aggregate tax rates as separate regressors.

In any case the tax policy mix variable is particularly appropriate for a model of labour market. As we saw in the last section, we expect that direct and indirect taxes would have very different effects on the labour market. In particular we would expect that a shift away from direct taxation to indirect taxation that leaves the budget balance unaffected, would tend to decrease the level of unemployment. We estimate the reduced form (3)

$$\begin{aligned}
 Y_t &= \alpha(L)Y_{t-1} + \gamma(L)Tmix_t + \varepsilon_t \\
 Y_t &= (U_t, W_t, Surplus_t)'
 \end{aligned}
 \tag{3}$$

Poterba, Rotemberg and Summers justify their assertion that $tmix$ is exogenous in their model by presenting evidence that it is not Granger caused by other variables in the model. In our setup output, unemployment and the wage fail to Granger cause $tmix$.⁸ They also noted that their results were relatively unchanged when only the lagged $tmix$ was included in the regressions. Similarly, our point estimates are also unaffected by dropping contemporaneous value of $tmix$, but the error bands are much wider.

In their study of the dynamic effects of taxation and government expenditure on output, Blanchard and Perotti (1999) use institutional information to combat the reverse causality from activity to taxation. They carefully examine each separate class of taxes and use information regarding the tax code to calculate the size of the bias resulting from the reverse causality. In essence their approach boils down to using the elasticity of tax revenue to

i.e. on goods with high income elasticities, we would observe a fall in sales taxes coincident with a rise in unemployment.

⁸For the null hypothesis that X does not Granger cause $tmix$, the p-values are: 0.3 where X is Wage, 0.06 where X is unemployment, 0.77 where X is $Surplus$ and 0.39 where X is GDP . The test regressions included two lags of each variable.

calculate the size of the impact of changes in output on tax revenue. These elasticities were calculated by Giorno et. al. (1995) by simulating the effect of changes in GDP on a model of each OECD member's tax system. These elasticities are not estimated econometrically, but are calculated from a simplified version of each country's actual tax code. Giorno et. al. report that the elasticity of income tax with respect to GDP in the UK was 1.3 over our sample period. They also report that the elasticity of indirect taxes was unity. It is important to note however, that this value of unity was simply assumed and did not result from a simulation of the tax system. On this evidence, to the extent that we accept the assumed value of unity for sales tax elasticity, there would be a slight bias in (3). For every one percent increase in activity there would be a 0.3 percent increase in the tax mix variable.

Alesina and Perotti (1995) also looked at similar issues to our paper. They took a different approach, regressing the Unit Labour Costs on the share of labour market taxes in GDP for a panel of OECD member states. They argue that endogeneity of taxes is not a serious problem in practice because the bias induced by supply and demand shocks would tend to cancel each other out. They also argue that the endogeneity would be accounted for by the inclusion of an output gap variable or some other variable to take account the business cycle (such as the *Surplus* in our setup).

The reduced form approach is open to the Lucas critique. However, we would argue that the Lucas critique is not that relevant in so far as we are not particularly interested in estimating behavioural relationships. In so far as we are concerned with measuring the incidence of taxes and how it varies over time, the only issue is whether our tax variable truly represents changes in taxation or is contaminated by feedback from activity to tax revenue. Once we have dealt with the reverse causality issue, we simply track the effect of exogenous tax changes on the labour market through time. However, we can make predictions for the effect of tax changes only to the extent that future changes are drawn from the same distribution as those in our estimation sample. On the other hand if the tax changes contemplated are fundamentally different from those that occurred in the past we cannot be confident in our prediction regarding their future economic incidence because we cannot be confident that the reaction of agents will be the same as in the past. In order to make prediction in this sort of situation we would have to estimate a structural model of behavioural equations.

Finally note that the impact of taxes has been well analysed in detail in the context of competitive labour markets by many authors.⁹ These pa-

⁹See Blundell et. al (1999) for a recent example and Pencaval (1986) for a survey of techniques.

pers usually involve explicit welfare analysis facilitated by estimation of behavioural equations, but do so in the context of zero unemployment. In this paper we focus on the dynamic effect of taxes on unemployment and wages. As we use a reduced form no explicit welfare analysis along these lines is possible, other than to note that an reasonable welfare function would presumably be declining in unemployment and increasing in wages. Hogan (1999a) went some way towards reconciling the two approaches.

3.2 Data

We conduct the analysis using data on the UK economy (1961-1999) drawn from the *International Financial Statistics* of the IMF and *Economic Outlook* of the OECD. Table 1 reports the precise variables and gives details of transformations applied to the data. Several points are worth noting about the data. Firstly we follow Poterba, Rotemberg and Summers (1986) and transform the empirical tax shares to take account of the fact that GDP is reported at market (i.e. after tax) prices. Secondly, direct taxes does not include social security taxes because the data is unavailable for most of the sample period. Indirect taxes includes the VAT, excise taxes and other duties levied on goods and services. We do not net transfers out of direct taxes nor do we subtract subsidies from indirect taxes as much of the data is missing.

We applied a battery of tests to determine whether the series used ($\ln W$, $\ln U$, Surplus, $tmix$) contained unit roots. Standard ADF test could not reject the null hypothesis that the series had unit roots. This result was robust even when deterministic trends were included in the testing equations. We might have strong priors that the surplus (as a share of GDP) and unemployment rate do not have unit roots as theory would suggest that both should be mean reverting. However, the formal tests suggest otherwise.¹⁰ For this reason we remain agnostic about the order of integration of these variables and do not force them to have unit roots by including only their first differences in the regressions. This also allows us to test for possibility that taxes could have permanent effects on the labour market.

The only obviously trending series is the wage rate. We could model the trend in wages by including a linear trend in the regression or by forcing a unit root by including the wages as a first difference. However theory suggests that productivity is likely to be the major determinant of the long run behaviour of real wages, so we model the trend in (log) wages by subtracting from

¹⁰Blanchard and Perotti report that they could not reject the hypothesis that the US deficit had a unit root at below the 5% significance level. They also cite other recent evidence along the same lines. Presumably these are all examples of low power of the ADF tests when the true process $I(0)$ but with slow mean reversion.

the wage variable it the Hodrick-Prescott filtered productivity (A).¹¹ The resulting transformed variable is still $I(1)$ but does not exhibit any obvious trend.¹² This adjusted wage variable is tantamount to using a unit labour cost variable as in Alesina and Perotti (1995). The transformation does not really affect the empirical results in the sense that the point estimates are more or less the same but the confidence bands are slightly wider when log wages are used.

4 Empirical Results

Equation (3) was estimated where $Y = (\ln w, \ln U, Surplus)$ and $tmix = \ln \tau - \ln \theta$, where the variables are defined in Table 1. The inclusion of two lags of Y and two lags of $tmix$ (in addition to the contemporaneous value) was sufficient to generate white noise residuals.¹³ It is important to note that our model is specified in the levels of variables. Most studies (for example, Alesina and Perotti, 1995) include the change in the tax rate as a regressor rather than the tax rate itself. This specification implicitly accepts the idea that taxes have only short run effects on unemployment and wages.

The estimated coefficients from (3) can be used to calculate the impulse response of Y to permanent and temporary shocks to $tmix$. Figure 1 plots the response of the system to a temporary (i.e. lasting one period only) increase in $tmix$. This shock represents a one percentage point increase in the share of direct taxes in GDP relative to the share of indirect taxes in GDP. For illustrative purposes, we can think of an increase in $tmix$ as an increase in direct taxes by one percentage point.¹⁴ As we are interested in the incidence of taxes, we do not report the response of $\ln w$ itself, but instead the response of the consumption wage ($cwage$) and the producer wage ($pwage$) calculated from the response of $\ln w$ where $cwage = \ln w + \ln(1 - \tau)$ and $pwage = \ln w + \ln(1 + \theta)$. The dotted lines in the graph represent 90% confidence bands that were constructed using a bootstrap with 1,000 draws with replacement from the estimated residuals.¹⁵

¹¹We use Holdrick-Prescott filtered productivity because measured productivity is likely to be endogenous in the short run due to labour hoarding and measurement error.

¹²A formal test of this hypothesis $H_0 : \delta = 0, \rho = 1$ in $y_t = \alpha + \delta t + \rho y_{t-1} + \varepsilon_t$ produces an F-statistic of 3.61. The critical value of this (non-conventional) distribution is 5.61 at 10% significance level (see Hamilton, 1994, pp.764)

¹³The Q statistics on the residuals produced p-values 0.14 for the $\ln U$ equation, 0.66 for the *surplus* equation and 0.4 for the $\ln w$ equation.

¹⁴As we are using logs we need to assume an initial level for τ and θ . We use the sample averages of 17% and 15% respectively.

¹⁵Confidence bands were also constructed by drawing from a multivariate normal dis-

Figure 1 shows that the increase in that income tax rate of one percentage point results in an immediate decline in the workers' consumption wage. Note however, that the take-home wage falls by less than the full amount of the tax even in the initial period. Some of the burden of taxes is passed on to employers, as is evident from the second panel which shows the response of the producers wage. As expected, the increase in labour costs leads to an increase in unemployment, as can be seen from the third panel. Note that the increase in unemployment occurs with a lag. Over time the market returns to its initial equilibrium position. Within two years we cannot reject the hypothesis (at the 10% significance level) that the the consumption wage is back to its initial level. The producer wage also drops very quickly, in fact it seems to overshoot (although the overshoot is not statistically significant at the 10% level).

Unemployment seems to react with a lag. by the time it has reached its maximum value, the producer wage has already returned to its initial value. Note also that the size of the effect on unemployment is small even though it is significant. Even at its maximum point, unemployment rose only by seven percent.¹⁶ Overall the effect of the temporary tax change is small and not long lasting – but it is statistically significant.

The above simulations were for the case of temporary changes in tax policy. Probably of more interest is what happens when there is a permanent change in the tax policy mix. As explained in section two theory would suggest that permanent changes in the tax system could have long lasting effects on unemployment and producer wages, but we would expect the reservation to adjust eventually leading to neutrality in the long run. The null hypothesis that taxes are neutral in the long run can also be tested by testing the hypothesis that the coefficients on *tmix* sum to zero in each equation. This hypothesis can actually be rejected at reasonable significance levels.¹⁷

We can also get an idea for this long run behaviour by examining the co-integration between the variables. A Johansen test (assuming no deterministic trends in the data) cannot reject the hypothesis that there are at most two co-integrating vectors at the 5% significance level.

In order to illustrate the neutrality of the tax policy mix in the long run

tribution with the same covariance matrix as the estimated residuals. The two are sets of bands are almost identical reflecting the fact that the estimated residuals are approximately normal. Jarque-Bera statistics have p-values in excess of 0.6 for all three residual series.

¹⁶i.e. if unemployment was initially 10% of the labour force, the tax change would cause it to rise to 10.7%

¹⁷A Wald test produces a test statistic of 7.165, which is distributed under the null as χ^2 with three degrees of freedom leading to a p-value of 0.07.

we need to look at the impulse response of the variables to a permanent one percentage point increase in *tmix*.¹⁸ The results are shown in figure 2 which mirrors figure one in its construction. Unsurprisingly the initial effect of the tax increase is to cause the consumption wage to fall. But the producer wage also exhibits a statistically significant increase, indicating that workers shift some of the burden of income taxes to firms quite quickly. Over time the producer wage falls back so that it is not significantly different from its initial level. Again the producer wage seems to overshoot for some reason, but the overshooting is not statistically significant. The consumer wage remains permanently (and significantly) below its initial value indicating that workers bear the burden of taxation in the long run.

The unemployment rate rises in response to the increase in taxes, which is not surprising given the behaviour of the producer wage. What is more surprising is that it does not fall back at any stage. This is curious given that the burden of taxes is shifted completely to the workers within a few years. Unemployment stabilises at about a 50% increase. This is a huge effect from what was a relatively small change in the tax system. This result – a large and persistent increase in unemployment – is robust to different specifications of trend, different number of lags and other changes in specification. But it is too large to be fully credible. It goes against common sense and most of the rest of the literature (although much of that literature simply assumed that taxes could not have a long run effect). One can only speculate what generates this effect, some sort of hysteresis perhaps. I suspect that problem is that there have been relatively few permanent changes in tax policy in the estimation sample. The reduced form can only retrieve those correlations that occur in the data. This is where we could really benefit from having a credible structural model. If we could estimate genuine behavioural equations then we could simulate agents' reactions to permanent changes in tax policy, providing we could be sure that those changes did not affect the structure of the model.

5 Conclusions

We set out to measure the incidence of taxes in the labour market. The results were pretty striking. A shift in tax policy away from indirect to direct taxes seems to have the effects predicted by theory. The burden of the tax is shared by the workers and employers and as a result unemployment rises. Even a temporary tax change, which itself disappears after 1 year, has real effects which persist for up to 4 years. The effects on unemployment

¹⁸The sample average size of a change in *tmix* was 0.8 percentage points.

last a couple of years longer than the effects on the consumer and producer wages indicating the presence of some persistence in unemployment.

The persistence of the real effects of taxes is even more starkly illustrated by the reaction to a permanent shock to taxes. It appears that a permanent shock has permanent effect on unemployment and the consumption wage, but a temporary effect on the real product wage. This result is consistent with theory, but is nevertheless unusual. The size of the effect on unemployment is very large. Why we get this result needs further research, but it does cast doubt on the specification often used in the literature that impose long run neutrality on the estimates.

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Table 1: Data

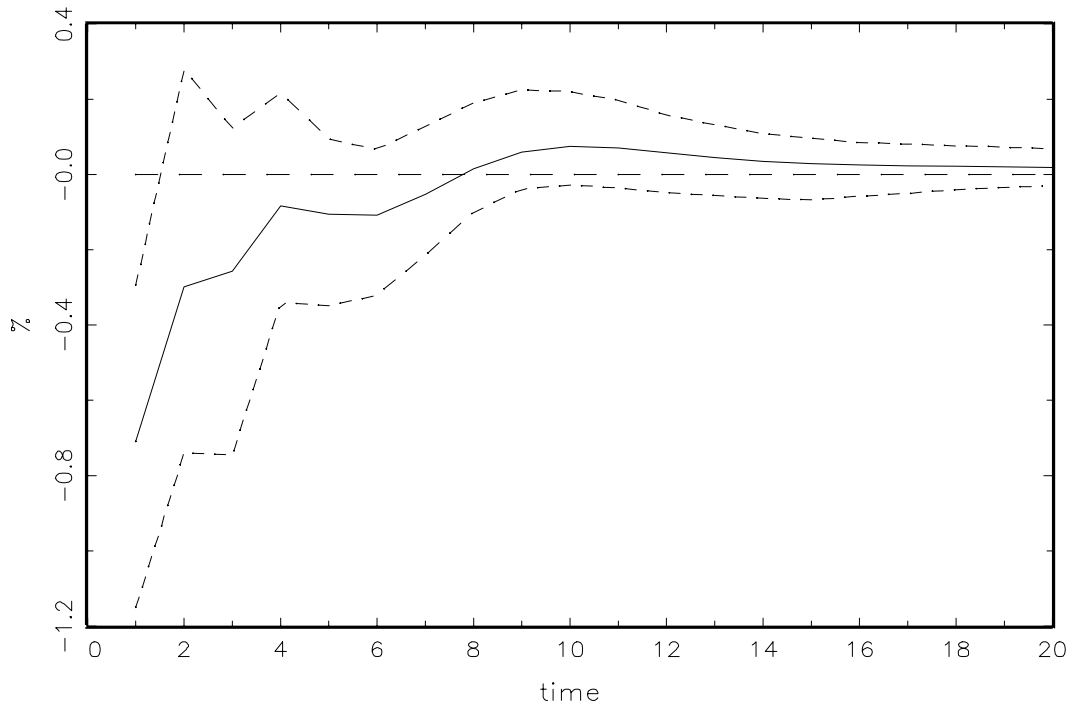
Variable	Definition	Source³& Construction	Code
<i>SURP</i>	Government Surplus	IFS	80...ZF...
<i>Y</i>	Nominal GDP	OECD EO	GDP
<i>A</i>	Labour Productivity	OECD EO	PDTY
<i>P_C</i>	Consumption Price Deflator	OECD EO	PCP
<i>U</i>	Unemployment Rate	OECD EO	UNR
<i>WRB</i>	Wage Rate in Business Sector	OECD EO	WR
<i>S</i>	Indirect Taxes	OECD EO	IND
<i>T</i>	Direct taxes levied on households	OECD EO	TYH
$\bar{\tau}$	Direct tax share	T/Y	-
$\bar{\theta}$	Indirect Tax share	S/Y	-
τ	Direct tax share (adjusted) ¹	$(1 + \bar{\theta}) * \bar{\tau}$	-
θ	Indirect tax share (adjusted) ¹	$\bar{\theta}/(1 - \bar{\theta})$	-
<i>Surplus</i>	Surplus as share of GDP	$SURP/Y$	-
<i>tmix</i>	tax policy mix	$\ln \tau - \ln \theta$	-
<i>W</i>	Real wage	WRB/P_C	-
<i>lnw</i>	log Real wage adjusted for productivity ²	$\ln W - HP(\ln A)$	-

1. Adjusted because GDP is measured in after tax prices

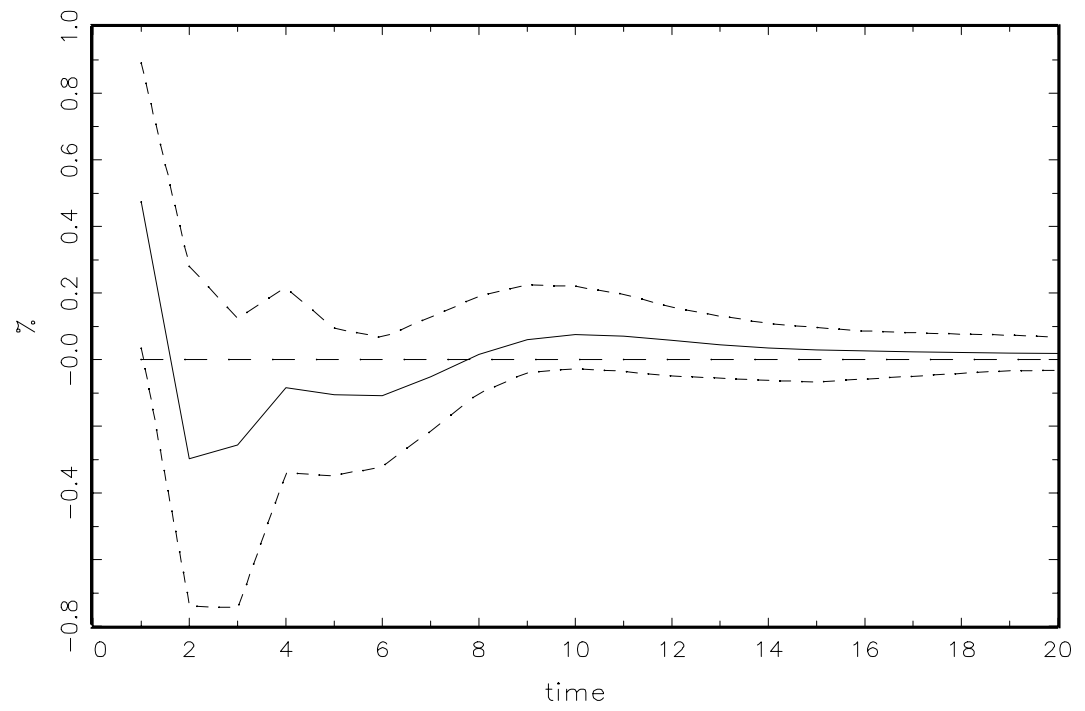
2. HP: Hodrick-Prescott Filtered

3. EO: OECD Economic Outlook. IFS: International Financial Statistics, IMF

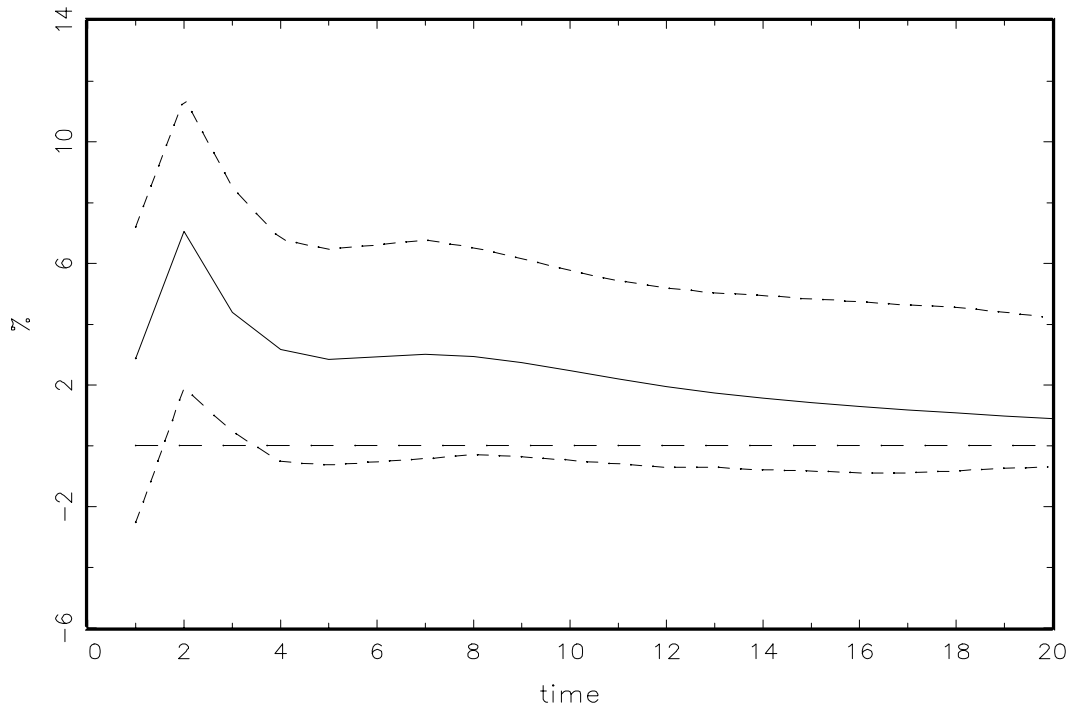
Response of CWAGE



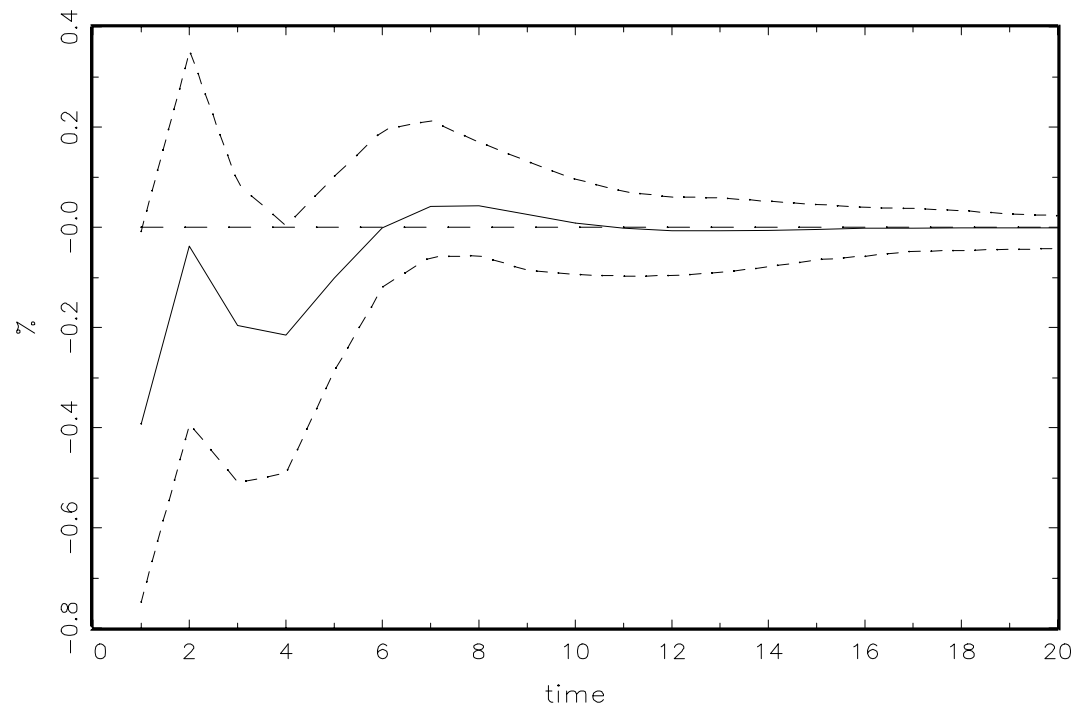
Response of PWAGE



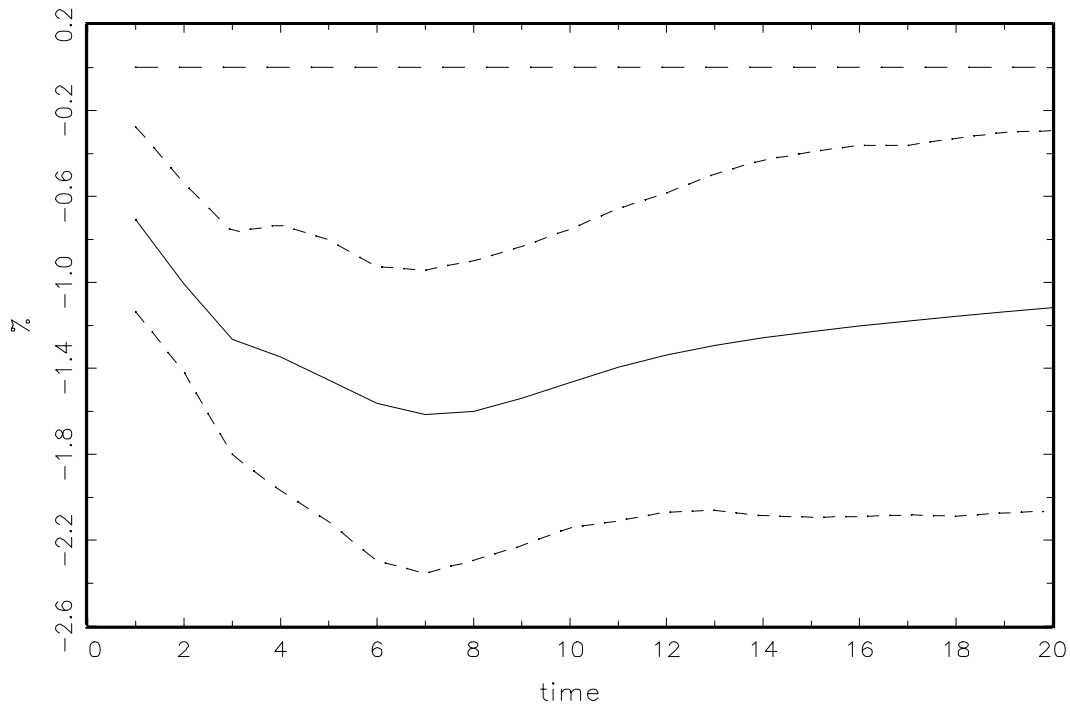
Response of LNUNR



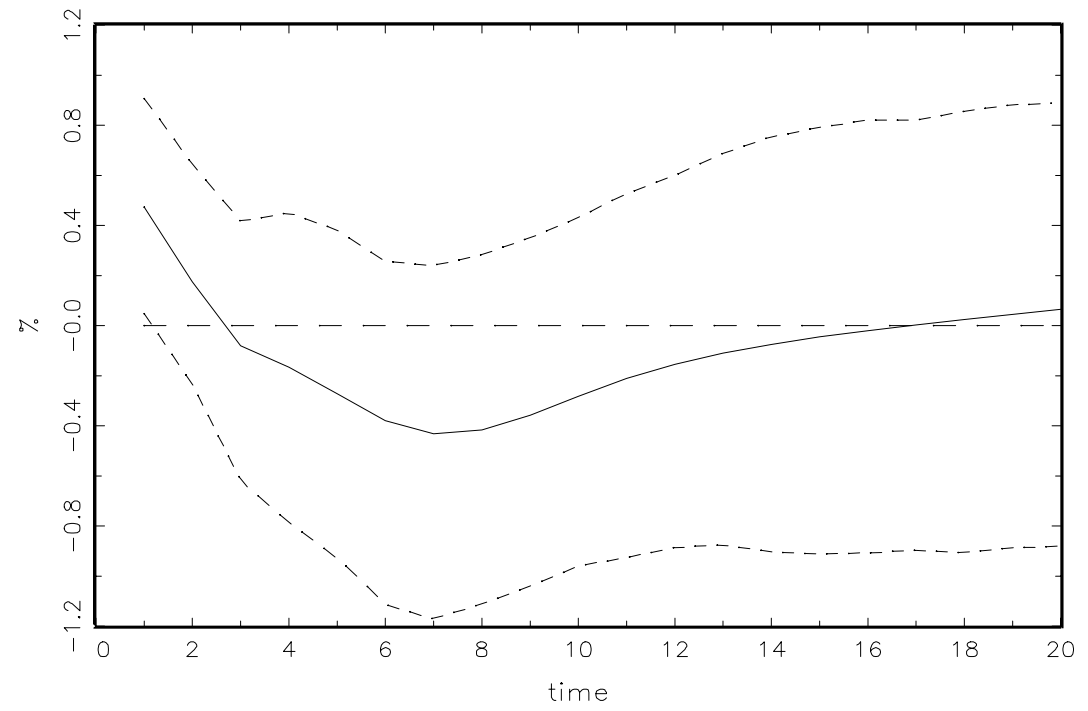
Response of SURPLUS



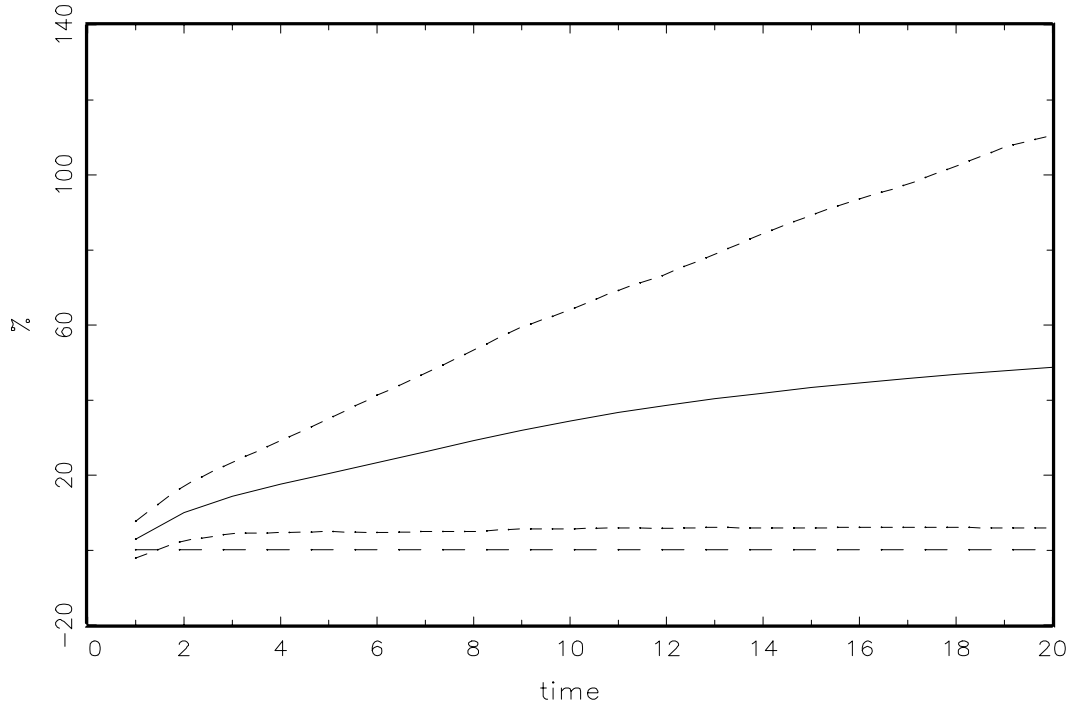
Response of CWAGE



Response of PWAGE



Response of LNUNR



Response of SURPLUS

