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# Wage Formation in Europe

## Comparison of Modelling Strategies

by Gustav A. Horn\*

### 1. Introduction

Macroeconomic analysis has shown the important role wage determination plays for economic activity. Hence it is not surprising that especially in the aftermath of the micro-founded macroeconomic approaches empirical investigation about nature and impact of wage flexibility has become a key issue.

It seems interesting to analyse wage determination in major European countries with different institutional settings of the wage bargaining process. The investigation should show whether there are common European features of wage determination or if there are possible differences. The answer to these questions is particularly important in the light of the ongoing efforts to achieve a European currency union. Large wage differentials between countries which lead to differences in unit labour costs then will immediately affect the competitiveness of each national economy.

The econometric analysis of wage formation proves to be difficult. The reason behind this is the complex nature of wage determination which is partly influenced by quasi centralized bargaining between trade unions and employers and partly by individual or firm specific behaviour. In some countries like France even legal restrictions with respect to minimum wages are also of importance. The differing channels of wage formation may lead to different behavioural patterns, making it rather difficult to get a constant structure to be derived from econometric analysis. It is obvious that under these circumstances an empirical test of sophisticated macroeconomic hypotheses is not an easy task to cope with. These considerations may explain why the statistical properties of some of the equations to be discussed in the following sections are not completely satisfying. This is indicated by the number of imposed coefficients to meet theoretical a priori conditions.

The wage equations are part of larger macro models some consisting of more than 1000 equations per country. This raises the question of how to analyse the specific impact of wage equations within such a framework. Beyond doubt their overall influence can only be correctly assessed

by running simulations with the complete model. Doing this the interdependencies between wages and the rest of the model is fully taken into account. Some diagnostic simulations presented in other papers follow this line<sup>1</sup>. The reasons for differences between models then can result from two sources. Firstly the wage equation itself may have a different specification induced by empirical or theoretical considerations. Secondly even if the wage equations are more or less identically, a differing framework may produce differing outcomes. Or it may compensate for varying wage equations thus providing the same results although in fact there is considerable disagreement about wage formation. To avoid these ambiguities and confusions, this paper focuses on the wage equations discussing the underlying theoretical concepts and assessing the empirical results. Doing this, one can at least draw conclusions on model differences originating from the wage formation process. This corresponds to the applied estimation procedures. All models incorporate wage equations which were estimated by single equation methods thus neglecting possible interdependencies with other parts of the model.

The results in the following sections are based on the analysis of five European models for which complete descriptions of wage formation were available. These are MIMOSA (CEPII/OFCE), INTERLINK (OECD), GEM (NIESR/LBS), OXFORD ECONOMIC FORECASTING MODEL (OEF) and QUEST (EC/DIW).

The paper is organized as follows. In the next section some remarks on the theoretical background of the wage equations are made. The third part deals with a comparison of the econometrically derived impact of prices, productivity and unemployment on wages within different model frameworks. The paper ends with a conclusion.

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<sup>1</sup> See Whitley (1991).

## 2. Theoretical background

At the first glance the theoretical approaches which inspired the modelling of wage equations seem to be quite similar. Specifications show the usual Phillips curve approach enriched by expectation terms. This almost „classical” way of determining wages can be found most clearly in INTERLINK and MIMOSA models. Thereby nominal wage growth is seen as predominantly determined by inflation expectations and excess demand on the labour market.

Following Grubb, Jackman and Layard (1983) this approach yields insight into nominal as well as real wage rigidities. Former are defined as the elasticity of wage growth on inflation and the latter as the elasticity of wage growth on unemployment. Higher nominal wage rigidity occurs if the first elasticity approaches unity. In this case it follows that real wages remain unaffected by inflation. There is no money illusion. This can easily be derived as an economically rational union or employee behaviour. Real wage flexibility is expressed by a higher elasticity of wages on unemployment. In this case excess demand on the labour market leads to lower wage growth. In a neoclassical framework this should result in higher employment and thus can be considered as economically rational, too. However in a Neo-Keynesian setting this string of reasoning is not as clear cut. There may well occur economic situations where unemployment is not caused by wages being too high but rather by the lack of demand. Then wage reaction on unemployment merely reflects a diminished bargaining power of trade unions or employees. Hence this kind of behaviour may prove economically suboptimal in a Neo-Keynesian regime of slack demand. Whether the former or the latter interpretation holds, cannot be derived from the wage equation but is determined by the theoretical philosophy underlying the rest of the model. Thus policy recommendations derived from models may differ despite a similarly specified wage equation.

Usually the Non Accelerating Inflation Rate of Unemployment (NAIRU) plays a major role for policy recommendations. It should yield insight into the built in unemployment level of an economy, sometimes erroneously referred to as natural. Up to NAIRU level unemployment may be reduced by demand policy without inducing additional inflation. This concept has been seriously questioned during recent years. It has turned out that the NAIRU supposedly close to a constant in fact has been a moving target changing significantly with estimation periods varying only slightly. Thus it does not seem appropriate for policy recommendations and does not deserve too much attention. Only MIMOSA and INTERLINK explicitly include a weighted average of past unemployment for the UK which may be interpreted as a kind of NAIRU.

More interest should be paid to the question whether the wage equation shows hysterical features. Thereby it is assumed that wage formation is path dependent on

unemployment. Longer spells of high unemployment then lead to lower wages than shorter but more frequent spells of an identical level of lay offs. All models except OEF for UK and Italy assume path dependency. From this it may be concluded that the hysteresis phenomenon is considered as relevant for most European economies.

Among other variables considered is productivity growth. Its consideration is mainly based on the perception of bargaining rules applied by trade unions. Especially in Germany trade unions explicitly announce their wage requests in terms of inflation expectations plus productivity growth. Thus all models include this variable for Germany. Following the usual wage bargaining approaches it seems quite convincing that employees measure their achievements by productivity which is then consequently reflected by their pay demand. In addition to that, firms showing a relatively high productivity level can afford to pay higher wages without losing their competitiveness. Hence there should be some connection between both variables.

Furthermore institutional settings like minimum wages are taken into account in some models (MIMOSA, INTERLINK) for France. Three out of the five models (GEM, OEF, QUEST) incorporate an Error Correction Mechanism (ECM)<sup>2</sup>. Thereby the assumption is made that wages aim at a long term target level calculated by the specification of the ECM. With the exception of the QUEST model for France this long term level is defined by equality of real wages and productivity level, ie. the real product wage. The difference between both variables may be interpreted as a simple form of wage gap approach. If the gap widens during one period e.g. due to wrong inflation expectations, unions would bargain for higher wage rises during next period in order to close it again and vice versa. Hence the actual wage development also results from medium or long term considerations.

## 3. The empirical results

### 3.1 The dependent variable

Looking at the specification of the dependent variable one detects only minor differences between the respective models (table 1). In most models wage earnings per employee are used. The exception being OEF taking earnings per hour for some countries as endogenous variable. Differences between models occur as far as the coverage of the economy is concerned. Beyond doubt, wage formation varies significantly according to the sectors where it takes place. This is especially obvious for the public sector. In most countries the influence of unions in the service sector is very limited such that wage formation may follow different rules than in other parts of the economy.

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<sup>2</sup> OEF does so for Italy only.

Table 1

## General Features of the Wage Equation

Model	Dependant Variable	Sectors	Estimation Approach
MIMOSA	Wage Earnings per Employee	Manufacturing	OLS, Zellner
INTERLINK	Wage Earnings per Employee	Private Sector	OLS
OEF	Wage Earnings per Employee (UK, GE, FR) Wage Earnings Hour (GE, UK)	Manufacturing (UK, FR) Industry (GE) Whole Economy (IT)	OLS, Cointegration Error Correction Mechanism (IT)
GEM	Ratio of Compensation to Employment	Whole Economy (GE, FR, UK) Manufacturing (IT)	OLS Cointegration Error Correction Mechanism
QUEST	Compensation per Employee	Whole Economy	OLS Cointegration Error Correction Mechanism

Hence it is not surprising that some models focus on wage formation in the manufacturing or industry sector where the „normal” pattern of bargaining may occur in its purest way. This notion applies to OEF for all countries except Italy and GEM for Italy. For MIMOSA the manufacturing sector plays an important role in determining the overall wage process. To avoid the intricacies of public sector wage determination, INTERLINK analyses private sector earn-

ings only. So just OEF for Italy, GEM for all countries except Italy and QUEST concentrate on whole economy wage determination thereby neglecting the potential structural differences between the main sectors of the economy. From the available information on the statistical properties of the different models one cannot draw a firm conclusion with respect to superiority of one or the other approach (table 2). Estimation periods vary significantly between

Table 2

## General Statistical Properties

Model	Estimation Period	R <sup>2</sup>	SEE	DW	
MIMOSA:	FR:	72 - 89	0.96	0.82	1.76
	UK:	66 - 86	0.96	1.26	1.79
	IT:	66 - 84	0.76	2.48	2.23
	GE:	65 - 85	0.94	0.92	2.01
INTERLINK:	FR:	64 II - 88 II	—	0.7	1.47
	UK:	64 II - 88 II	—	1.43	1.43
	IT:	64 II - 88 II	—	1.54	1.54
OEF:	FR:	?	0.45	0.3	1.47
	UK:	70 I - 87 IV	0.75	0.9	2.45
	IT:	72 I - 89 IV	0.65	1.3	2.13
	GE:	80 I - 90 II	0.71	0.8	1.59
GEM:	FR:	75 I - 88 IV	—	—	—
	UK:	75 I - 89 III	—	—	—
	IT:	73 I - 88 IV	—	—	—
	GE:	74 I - 89 III	—	0.7	—
QUEST:	FR:	75 I - 87 IV	0.97	—	1.56
	UK:	75 I - 87 IV	0.53	—	1.84
	IT:	75 I - 87 IV	0.54	—	2.28
	GE:	75 I - 87 IV	0.58	—	2.16

Table 3

## Wages and Prices

Country	Model	Variable	Coefficient	
			Short Term	Long Term
France	MIMOSA	CED	0.76 (7.2)	1.0 *
	INTERLINK	CED-Average	0.5 *	1.0 *
	OEF	RPI-Average	0.17 *	0.55 *
	GEM	CED	0.45 (3.5)	1.0 C
	QUEST	CED	0.76 (9.5)	-
UK	MIMOSA	CED	0.75 *	1.0 *
	INTERLINK	CED-Average	0.33 *	1.0 *
	OEF	RPI	0.48 (5.6)	1.0 C
	GEM	CED	0.56 (5.1)	1.0 C
	QUEST	CED	0.28 (1.3)	1.0 C
Italy	MIMOSA	CED	0.65 *	1.0 *
	INTERLINK	CED-Average	0.60 *	1.0 *
	OEF	CED	0.87 (6.5)	1.0 C
	GEM	CED	0.91 (5.8)	1.0 C
	QUEST	CED	0.67 (4.0)	1.0 C
Germany	MIMOSA	CED	0.75 *	1.0 *
	INTERLINK	CED-PGDP	0.53 (3.0)	0.71 (3.7)
	OEF	COL	0.32 (1.5)	1.0 C
	GEM	CED	0.45 (2.5)	1.0 C
	QUEST	CED	0.91 (2.1)	1.0 C

CED Consumer Expenditure Deflator — RPI Retail Price Index — COL Cost of Living Index — PGDP GDP-Deflator — () t-values  
— \* Imposed coefficient — C Cointegration Result.

models. MIMOSA and INTERLINK feature the longest periods which is certainly partly due to the fact that these are annual resp semiannual models. Nevertheless it is quite surprising that the wage formation process should have a constant structure from mid sixties to the late eighties, a period in which the economies were hit by some shocks. It is not surprising that the quarterly models all indicate structural changes for time periods around the two oil price shocks.

### 3.2 Wages and prices

There is no disagreement that inflation expectations play a dominant role for the determination of wages (table 3). In most models the consumer expenditure deflator (CED) is considered as the best indicator<sup>3</sup> on which inflation expectations should be based upon. This seems reasonable as far as unions are concerned, because employees will spend their money mainly for consumption goods. So the relative price between labour and consumption is determined exactly in this manner. For the employers however the CED is of less importance. Instead either capital costs or if firms are price takers, the producer prices should be applied as indicator for inflationary pushes. Only INTERLINK accounts for this asymmetry in the bargaining process by using a differential of consumer and producer prices for some countries.

As far as long term impact of inflation expectation is concerned, there is total agreement on the absence of any money illusion in the European economies. Thus a long term vertical Phillips curve is implied. Although being derived by well founded theoretical considerations, empirical analysis should not renounce on a test of this hypothesis. However only OEF, GEM and QUEST do this on a regular basis by running cointegration tests between wages and prices. Their results justify the imposition of a unity coefficient for the long term inflation variable as it can be found in the MIMOSA and INTERLINK approaches<sup>4</sup>.

Wage formation in France seems to be a particularly complicated process which is difficult to analyse using econometric methods. Some teams report major difficulties deriving a constant structure for the French wage process. Cointegration tests carried out for the QUEST model rejected any long term inflation impact. The OEF team faced considerable difficulties to get stable coefficients. Hence the number of coefficient impositions is particularly high for the French wage equation. The main reason for these finding may consist in the fact that wage

<sup>3</sup> In some cases an average of past CED is used.

<sup>4</sup> The long term effect of retail prices and producer prices are considered as lower than unity. This may be due to the reason that these indicators are not completely accepted by the trade unions in the bargaining process.

Table 4

## Wages and Productivity

Country	Model	Variable	Coefficient	
			Short Term	Long Term
France	MIMOSA	—	—	—
	INTERLINK	—	—	—
	OEF	—	—	—
	GEM	LPROD-Average	—	1.0 C
	QUEST	LPROD	—	1.0 C
UK	MIMOSA	—	—	—
	INTERLINK	—	—	—
	OEF	TPMF	—	1.0 C
	GEM	LPROD-Average	—	1.0 C
	QUEST	LPROD	—	1.0 C
Italy	MIMOSA	—	—	—
	INTERLINK	—	—	—
	OEF	LPROD	—	1.0 C
	GEM	LPROD-Average	—	1.0 C
	QUEST	LPROD	—	1.0 C
Germany	MIMOSA	LPROD	0.62 (5.2)	—
	INTERLINK	PROD-Average	0.61 (6.0)	—
	OEF	LPROD	—	1.0 C
	GEM	LPROD-Average	—	1.0 C
	QUEST	LPROD	0.33 (2.4)	1.0 C

LPROD Labour Productivity — TPFM Total Productivity manufacturing — PLPROD Private Sector Labour Productivity —  
( ) t-values — C Cointegration Results.

bargaining in France is more prone to political pressures than it is the case in other countries. Thus the bargaining result does not only reflect preferences of unions and employers but also those of political agents. Frequently changing political targets then may lead to a rather instable wage process.

Generally it can be observed that estimations of short term coefficients show a disturbingly high variety of outcomes. For Germany OEF gets a hardly significant 0.3 whereas QUEST shows an 0.9 which is even not significantly different from unity. This cannot exclusively result from using different indicators for inflation and wages. Estimation periods as well as the divergencies with respect to productivity and unemployment must be held responsible for it.

### 3.3 Wages and productivity

There is some disagreement between modelling teams about productivity impact on wages. MIMOSA and INTERLINK do not have any long term effects for any country whereas the other three do have. From their results it seems quite clear that wages and productivity are in fact cointegrated which for the theoretical reasons outlined above seems quite plausible.

A special case in this respect is Germany. Three out of the five models (MIMOSA, INTERLINK, QUEST) incor-

porate a short term productivity variable which in each case proves to be highly significant. This result is not surprising since German trade unions as well as employers use productivity growth as a benchmark during wage negotiations.

### 3.4 Wages and error correction

Three models (OEF, GEM, QUEST) are based on an Error Correction approach. First thing to be mentioned is that there is a widespread agreement about its specification for most European countries. In general it is assumed that nominal wage growth reacts on a difference between the real wage level and productivity. The results do not reject this hypothesis. Hence there is a long term relationship between real wages and the productivity level (table 5).

One should keep in mind that there is no causality direction involved with this statement. Beyond doubt prices are also influenced by the wage and productivity level. So it must remain unsettled whether the gap between real wages and productivity opens due price or due to wage movements. The results first confirm the notion that there is a reaction of wage growth on an existing gap notwithstanding the developments by which it has been created.

The extend to which nominal wage growth reacts is quite similar in all models. The respective coefficient varies between 0.12 (GEM) and 0.19 (QUEST). The small differences

Table 5  
Wages and Error Correction Mechanism

Country	Model	Coefficient
France	OEF	— —
	GEM	-0.12 (3.4)
	QUEST	-0.01 (6.5)
UK	OEF	— —
	GEM	-0.12 (3.1)
	QUEST	-0.15 (2.3)
Italy	OEF	-0.05 (4.1)
	GEM	-0.13 (4.4)
	QUEST	-0.15 (2.2)
Germany	OEF	— —
	GEM	-0.12 (1.8)
	QUEST	-0.19 (2.4)

( ) t-values.

not only between models but also across countries indicate that there exists a fairly general behaviour in this respect. About 12 to 19 pc of a deviation of real wage from productivity level will be overcome already during the first quarter.

An exception from these findings occurs for France. Only GEM succeeds in deriving a result with a specification as well as a coefficient as in other countries. OEF did not find

any cointegration of the respective variables and QUEST did only find a cointegration between nominal wages, the wedge and productivity. The latter result leads to supposition that the wedge variable catches a lot of the inflationary impacts. However, again the French wage formation seems to be different from that of other European countries.

### 3.5 Wages and unemployment

From the theoretical point of view the relationship between unemployment and wages is the most important one, which serves as well used argument in discussion on the optimal wage reactions. If such a relationship is generally taken as given in theory, one should expect fairly stable results which should not differ too much across models. In fact the contrary is the case. Although all models with the exception of OEF for Italy and Germany try to capture the influence of unemployment in some way, the variety of transformations and variables used casts doubt on a well founded relationship. At least quite a few uncertainties about its nature remain.

All models except GEM use some transformation of the unemployment variable. Generally it can be stated the way it is incorporated into models leads wage equations to show hysterical features. Thus there is agreement that unemployment will influence the path, wages follow. However the way this is done differs varying from taking the

Table 6  
Wages and Unemployment

Country	Model	Variable	Coefficient	
France	MIMOSA	LOGUR	-0.017	(1.9)
	INTERLINK	LEVUR	-0.003	(7.3)
	OEF	LOGUR	-0.003	(5.6)
	GEM	GDP	0.32	(2.9)
	QUEST	LOGUR	-0.003	(4.3)
UK	MIMOSA	DEVUR	-0.59	(2.8)
	INTERLINK	DEVUR	-0.004	(2.6)
	OEF	DLOGUR	-0.17	(6.2)
	GEM	GDP	0.25	(3.1)
	QUEST	LOGUR	-0.01	(1.8)
Italy	MIMOSA	LOGUR	-0.11	(3.6)
	INTERLINK	INVUR	0.20	(1.9)
	OEF	—	—	—
	GEM	GDP	0.49	(2.7)
	QUEST	LOGUR	-0.02	(2.2)
Germany	MIMOSA	LEVUR/DIFUR	-0.29 (3.7)	-0.65 (3.2)
	INTERLINK	LOGUR	-0.004 (3.0)	—
	OEF	—	—	—
	GEM	EMP	0.28 (2.1)	—
	QUEST	LOGUR	-0.02 (2.6)	—

LOGUR Logarithm of Unemployment Rate (UR) — LEVUR Level of Unemployment Rate (UR) — DEVUR Deviation of UR from Smoothed Trend — DLOGUR Difference of logarithm of UR — DIFUR Difference of Levels of UR — INVUR Inverse of UR — EMP Employment — ( ) t-values.

logarithm of levels, the level itself or a deviation of unemployment from a smoothed trend.

A different approach is taken by GEM. Here GDP is included as a variable into wage equations. Only for Germany the employment is used. This means GEM is based on a different philosophy than the other models. Trade unions and employers do not take into account unemployment they rather focus on the economic activity level as reflected either by GDP or employment. So the underlying theoretical approach is the insider-outsider theory. According to this approach trade unions and employers do not take into account the interest of those who are unemployed but rather focus on those who still are employed. The connection of wages to unemployment then is quite loose. Under these assumptions this variable is only in that respect of importance that it moves in line with the economic activity level. It is not an argument during the wage bargaining process. All in all the results indicate that this way of modelling seems to be quite promising for further research.

#### 4. Conclusion

The empirical investigation of wage formation in Europe shows that there are some common features to be observed across countries and what may even more difficult to achieve across models. There is a quite uniform reaction of wages on inflation in the different countries. Hence one can assume the absence of any money illusion in the major European economies.

However there are still some fundamental differences. A particularly important one occurs with respect to productivity developments. Taking into account that this relationship determines unit labour costs and thus to a large extent the competitiveness, a very flexible reaction of wages with respect to productivity movements is desirable. A coefficient of close to one would reflect such a result. In the long run this seems more or less to be the case for all economies except France. In the short run only in Germany a flexible reaction of this kind can be observed. This implies that Germany would have an advantage in a single currency Europe since wage movements will follow productivity movements very closely and not diminish Germany's competitiveness.

Furthermore the results show that the wage determination process in France features quite a few specialities like the impact of minimum wages and the quite unclear long term reactions not met in the other European countries. It is difficult to derive a general conclusion about its benefits under these circumstances. Maybe the understanding of French wage bargaining process is not yet at a sufficiently high level. Further research seems necessary.

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