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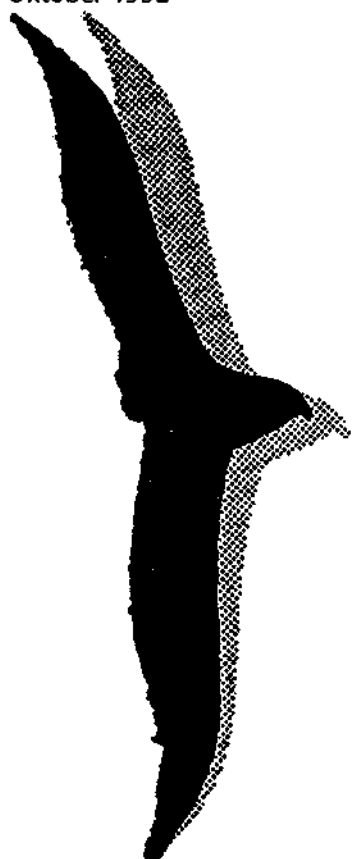
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Profits and Employment in the United States 1970 - 1991

L. Broersma

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PROFITS AND EMPLOYMENT IN THE UNITED STATES 1970-1991

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SUMMARY

In this paper we have studied some implications of Baumol's (1959) managerial model of the firm. Central in this model is a bankruptcy constraint in which production, wage costs and interest costs are important. It can be derived from this model that the usual decomposition of national income in a labor income share and a capital income share might better be replaced by a labor income share, a interest share and a profit share. Second, this theory predicts a positive relation between the real interest rate and unemployment, whereas the standard neoclassical theory of the firm predicts a negative relationship. Moreover, the concept of profit also differs from the neoclassical theory. There profits are usually defined as revenue minus wage costs, i.e., capital income, whereas here profit is defined as revenue minus wage *and* interest costs. When applied to actual U.S. data, these implications could not be rejected.

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1. INTRODUCTION

In the thirty or so years since the development of managerial theories of the firm by Baumol (1959), Marris (1964) and Williamson (1964), only recently a number of issues stressed by these authors have gained renewed theoretical interest. The existence of a bankruptcy constraint to which these firms are subjected and the capital structure of firms concerning equity and debt are mentioned by Farmer (1985), Bernanke and Getler (1989) and Stiglitz (1992) among others. The self-interested manager, who is considered not only to act on behalf of the stockholders, but also in his own interest, is a central issue in Hart (1991). Since many of the present-day firms are of the managerial type, where ownership is diffuse and spread among a large number of anonymous shareholders and professional managers are in control, theories in which these phenomena are incorporated are likely to give a better explanation for observed firm behavior, than theories that do not incorporate these phenomena. Cf. Hart (1991).

Most of these theories are developed to provide an explanation of the financial structure of the firm, more specifically the equity-debt ratio, its property rights or investment decisions. Cf. Bernanke and Getler (1989), Hart and Moore (1990), Hart (1991), Stiglitz (1992) and see also Jensen and Meckling (1976) for an early reference on this matter. However, few studies have focused on the employment decisions of such firms. Farmer (1985) has developed a model in an implicit contract approach with asymmetric information, limited collateral and a bankruptcy constraint. This model implies a positive relation between

the real interest rate and layoffs.

Central issue in this paper is the question whether we can find empirical support for the implications of these managerial theories of the firm concerning (un)employment. It is not our intention to enter into the specifics of the many new theoretical developments in this area, but we simply look at the empirical implications for employment. We start from the 'old' managerial theory of Baumol (1959). Instead of maximization of profit, a firm in the sense of Baumol maximizes total revenues, subject to a bankruptcy constraint: the firm should make a minimum amount of profit to safeguard its viability and continuity.

Violation of this constraint implies reorganizations and layoffs. The bankruptcy constraint may not only become binding due to wage costs that are too high, but also due to high interest costs on debts, caused by a high interest rate. This result has a number of implications.

First, the usual neoclassical decomposition of national income in a labor income share and a capital income share, might better be replaced by a decomposition in a labor income share, an interest income share and a profit share. Instead of the usual positive relation between the capital income share and employment, we should find a more pronounced relation between the profit share and employment.

Second, this theory implies that the interest rate has a positive relation with unemployment, whereas the neoclassical theory predicts a negative relationship. The first stresses the fact that the interest rate influences the interest costs, which in its turn affects the risk of bankruptcy and hence reorganizations and layoffs. The latter stresses the possibility of substitution between labor and capital: if

interest rates increase it is profitable to substitute the relatively expensive capital for relatively cheap labor, which in its turn decreases unemployment.

Third, we try to test this very simple theory directly by modeling a relation between profits and employment, where profits are not defined in the usual way as revenue minus wage costs, but as revenue minus wage *and* interest costs. It appears that in all these three cases the implications of this theory with bankruptcy constraint cannot be denied. The possibility of bankruptcy appears to be important. See, Stiglitz (1992). This provides evidence against the standard neoclassical theory of the firm. See also Bierens and Broersma (1991).

2. MANAGERIAL THEORY WITH BANKRUPTCY CONSTRAINT

In this section we discuss the managerial theory of Baumol (1959), augmented with a flexible labor effort rate. This theory stresses the separation of ownership and control of modern, large and medium-sized firms. These firms are led by managers instead of the owners and the objectives of managers differ from the ones of the owners.

Baumol (1959) postulates that these firms maximize sales revenues instead of profits. Profits only play a role as a constraint: a certain minimum profit is required in order to safeguard the viability and continuity of the firm. This is the bankruptcy constraint. Let $R(X) = PX$ be the revenue function, with X the output, and let $C(X) = WL + RP_k \bar{K}$ be the cost function, which consists of wage costs, WL , and interest costs, $RP_k \bar{K}$, with P_k the price level of capital goods and \bar{K} is the capital

stock, which is assumed fixed in the short run. The other variables are defined as in the previous section. We assume a Leontief production function, hence $X = \min\{\alpha lL, \beta K\}$, where α and β are positive parameters and l is the labor effort rate, which is bounded to a maximum \bar{l} , $0 < l \leq \bar{l}$. Finally, π and $\bar{\pi}$ denote actual and minimum required profit, respectively. The model of Baumol can be written as

$$\begin{aligned} \max. \quad & R(X) = PX \\ \text{s.t.} \quad & \pi(X) = R(X) - C(X) \geq \bar{\pi} \end{aligned} \quad (1)$$

We start from the situation where the bankruptcy constraint (1) is not binding. Let L_0 be the initial labor force and X^* be the revenue maximizing output level. We only consider the employment L of the firm. In this initial stage we have

$$L = L_0 \quad \text{if} \quad R(X^*) - WL_0 - RP_k K \geq \bar{\pi}. \quad (2)$$

Consider next an interest rate increase from R to R' . Thus, the firm faces higher fixed costs. Assume that constraint (2) is no longer satisfied. Then some workers might be laid off and the remaining labor force should increase its effort, so that the optimal output level X^* can be restored. If the labor effort rate is increased to its maximum level \bar{l} , then employment of the firm drops from L_0 to $X^*/(\alpha\bar{l})$, so

$$L = X^*/(\alpha\bar{l}) \quad \text{if} \quad \begin{cases} R(X^*) - WL_0 - R'P_k K < \bar{\pi} \\ R(X^*) - WX^*/(\alpha\bar{l}) - R'P_k K \geq \bar{\pi}. \end{cases} \quad (3)$$

Consider next that the interest rate increase is so large that the optimal output level can no longer be reached, even when workers are laid off and $l = \bar{l}$. In that case more workers are laid off until an output level X' is reached for which the bankruptcy constraint is just satisfied. Hence

$$L = X' / (\alpha \bar{l}) \quad \text{if} \quad \begin{cases} R(X^*) - WX^* / (\alpha \bar{l}) - R'P_k \bar{K} < \bar{\pi} \\ R(X') - WX' / (\alpha \bar{l}) - R'P_k \bar{K} = \bar{\pi}. \end{cases} \quad (4)$$

Finally, we can also imagine the situation where there is no output level for which the bankruptcy constraint (2) is satisfied. In that case the firm is no longer viable and it has to shut down. Employment will then drop to zero

$$L = 0 \quad \text{if} \quad R(X) - WX / (\alpha \bar{l}) - R'P_k \bar{K} < \bar{\pi}, \quad \text{for all } X. \quad (5)$$

Notice that an increase in the wage rate or a decrease in production will have a similar effect as the interest rate increase described above. If W increases to W' the bankruptcy constraint may become binding with the same consequences for employment as (3), (4) and (5).

In this theory the level of employment in a firm is related to the wage costs, via the wage rate, to the interest costs, via the interest rate and to the output. Or in other words, employment depends on the actual profit made in relation to a certain specified minimum amount of profit. Notice that in this case profit is not equal to the

return on capital, its definition in the neoclassical theory. Here profits are defined as the revenue minus wage *and* interest costs.

Essential feature in this model, which is also present in the theories of Marris (1964) and Williamson (1964), is the presence of a bankruptcy constraint. It not necessary to only consider alternative theories of firm behavior. This bankruptcy constraint might also be included in the standard neoclassical theory of the firm to give similar results. The probability and costs of bankruptcy are an important phenomenon in the discussion about the micro foundations of macroeconomics. Cf. Stiglitz (1992).

3. IMPLICATIONS

3.1 Decomposition of value added

In this section, we look at data that might confirm the implications of the theory of Baumol presented above. Since interest costs are important and only managerial firms are considered, we exclude banks and financial institutions, as well as the government sector from our analysis and restrict attention to nonfinancial corporations. We focus attention to the relation between employment and the capital income share and employment and the profit share. The first is connected to the usual neoclassical theory of the firm and the latter to our managerial theory with bankruptcy constraint.

In figure 1, we show the percentage change of employment of nonfinancial enterprises (PEMPnf) and the usual decomposition of the

value added of nonfinancial enterprises in a labor income share (LISnf) and capital income share (CISnf). The latter corresponds to the neoclassical concept of profit. According to this theory there is a negative relation between LISnf and PEMPnf and hence a positive relation between CISnf and PEMPnf. It is obvious from figure 1 that there is some resemblance between CISnf and PEMPnf, but the evidence is not overwhelming.

- insert figure 1 somewhere around here -

In figure 2, we present the same PEMPnf, but now the value added of nonfinancial enterprises is decomposed into a labor income share (LISnf), a profit share (PSnf) and a rest share (RSnf). This rest share consists for the largest part of interest costs of firms. The profit share is 100% minus labor income and rest share. It is obvious from figure 2 that there is a clear similarity in the pattern of PEMPnf and PSnf and that this resemblance is much more pronounced than the one between CISnf and PEMPnf of figure 1.

- insert figure 2 somewhere around here -

The bankruptcy constraint (1) can be interpreted in the same way as the decomposition of the value added in figure 2. When (1) is divided by PX we have

$$\pi/PX = 1 - WL/PX - RP_k\bar{K}/PX \geq \bar{\pi}/PX. \quad (6)$$

In (6) π/PX is PSnf, WL/PX is LISnf and $RP_k\bar{K}/PX$ is RSnf. Since in this theory, employment depends not only on the wage costs, but also on the interest costs, we can state that labor demand and hence also unemployment is a function of sales revenue, wage costs and interest costs.

These simple figures with decompositions and employment cannot reject the implications of the bankruptcy constraint in our theory. In fact, the evidence of a positive relation between profits and employment is stronger from figure 2 than from figure 1. This favors our theory of section 2.

3.2 Multivariate analysis

In this subsection we will test the implications of the theory of section 2 in yet another way. This theory implies that unemployment depends on the wage rate, the interest rate and production. Our simple static theory does not specify a dynamic relationship. Hence on a macro level, it is not capable of representing adjustment costs, habit persistence, decision lags and aggregation over firms with different dynamic responses. Hence, the lag structure has to be determined empirically. To capture as much of the interdependencies of the time series involved, we will construct a VAR and a VARMA model and we will concentrate on the variables that are Granger causing unemployment.

As a first step in building these models, we examine whether the macroeconomic time series variables that we use contain a unit root. We apply the unit root test of Dickey and Fuller (1979, 1981). We use quarterly, seasonally adjusted data from 1970.1 to 1991.4, which are

obtained from the OECD, *Main Economic Indicators*. All variables, except unemployment are deflated with the producers price index of finished goods in order to get the real variables. See appendix 1. The Dickey-Fuller procedure is to estimate the model

$$\Delta X_t = a + bt + cX_{t-1} + \sum_{j=1}^p d_j \Delta X_{t-j} + \varepsilon_t. \quad (7)$$

The null hypothesis of a unit root is equivalent to $H_0: c=0$. The critical values of the t -statistic of \hat{c} , $t(\hat{c})$, are in Fuller (1976, pp. 373). For a model which includes a trend, the 5% and 10% critical values are -3.45 and -3.15 respectively, when the number of observations is about 100. The results of this test procedure are presented in table I. In our case, a value of $p=1$ is sufficient for an adequate representation, except for the real interest rate where $p=0$ yields adequacy.

The power and size properties of unit root tests has recently been questioned by several authors. Cf. Blough (1989), Cochrane (1991). From the results of table I, we find that a unit root in the log of real output and the log of real wages cannot be rejected. However, the presence of a unit root in unemployment and the real interest rate is ambiguous. The test statistic for unemployment is significant at 10% but not at 5%. The statistic for the real interest rate is just insignificant at 10%. Both unemployment and the real interest rate are bounded variables and we cannot imagine a time trend converging to infinity to be present in these series. Moreover, both series are assumed to have zero steady state growth rates or constant steady state

levels. A genuine unit root can therefore not be present in these series for reasons of logical consistency. The test results point toward the presence of a near-unit root. Hence, we assume a unit root in the log of real output and real wages, but no unit root in unemployment and real interest rate.

Table I. Unit root test results of the Dicky-Fuller test, $t(\hat{c})$.

	$t(\hat{c})$
<i>unemployment rate (u)</i>	-3.38
<i>real interest rate (r)</i>	-3.05
<i>log of real output (lny)</i>	-1.54
<i>log of real wages (lnw)</i>	-1.27

Our models contain dummies to represent structural breaks. First, due to the unanticipated price increase in 1974.1, caused by the oil crisis of late 1973, the growth rates of real output and real wages exhibit a large trough in 1974.1. Hence a dummy $D74q1$ was included in $\Delta_1 \ln y$ and $\Delta_1 \ln w$, which is 1 for 1974.1 and zero elsewhere.

The recession that followed these events about a year later caused an upward shift in the natural rate of unemployment in 1975. Cf. OECD, *Economic Surveys* 1983 and 1985. Therefore a dummy $D75q1$ being 1 in 1975.1 and zero elsewhere was included. In addition there was also a change in the path of real industrial production from 1975 onwards. Hence, $D75q1$ was also included in the model for $\Delta_1 \ln y$.

Finally, we mention that at the beginning of the 1980's there was

a regime shift to a tight monetary rule in the USA. However, in 1980 this rule had the character of a stop-go policy. In 1980.1 the discount rate was increased from 12% to 13%. In 1980.2 it was decreased 2 percentage points to 11% and in 1980.4 it was raised again to 13%. Cf. OECD, *Economic Surveys*, 1982. We included a dummy $D80q24$ in the model, with 1980.2 equal to 1 and 1980q4 equal to -1 and zero elsewhere.

As a first data summary we start with the usual VAR model of the four variables involved and conduct tests of causality in the sense of Granger (1969). The VAR setting in which these tests are performed is characterized as a VAR model with five lags. The aforementioned dummy variables were also included. Hence,

$$\Phi(L)z_t = \mu + \epsilon_t, \quad (8)$$

where $\Phi(L) = I - \sum_{j=1}^p \Phi_j L^j$, $L^j z_t = z_{t-j}$, μ is the constant including the various dummies, ϵ_t is a zero mean, serially uncorrelated error process and $z_t = (u, r, \Delta_1 \ln y, \Delta_1 \ln w)'$. It is imperative that the specification of (8) is correct in order to draw valid conclusions from it. Model correctness is implied by the property that the conditional expectation of the error process relative to the entire past of the time series process equals zero with probability one. Hence

$$E[\epsilon_t | z_{t-1}, z_{t-2}, \dots] = 0, \text{ a.s.} \quad (9)$$

Notice that the usual assumption of normally distributed errors is not implied by this property. However, the usual assumption of absence of

autocorrelated disturbances is implied by (9). Hence, this is an important property, which we test for using the Lagrange Multiplier test on autocorrelated disturbances of the separate equations of (8). If these tests do not accept the absence of autocorrelation, then (9) will also not be satisfied. Property (9) implies that we have first order model correctness in the sense of Domowitz and White (1982) and if (9) is satisfied we have a mean innovation process in the sense of Hendry and Richard (1982). We also apply the ARCH test of Engle (1982), the Jarque and Bera (1980) normality test, even though it is not essential for model correctness, and the Chow predictive failure test. As Granger causality test we use an F -test to assess the validity of excluding lagged variables from (8).

We started this analysis with a VAR model with five lags and tested whether this number could be decreased. Using an F -test on parameter restrictions, we found that a VAR(3) is sufficient. With this model we conducted tests on Granger causality. See table II.

As a second, more parsimonious data summary, we consider a VARMA instead of a VAR model. So instead of (7) we have

$$\Phi(L)z_t = \mu + \Theta(L)\epsilon_t, \quad (10)$$

where $\Phi(L) = I - \sum_{j=1}^p \Phi_j L^j$, $\Theta(L) = I + \sum_{j=1}^q \Theta_j L^j$ and ϵ_t should again be a mean innovation process as in (9). In practical applications it is complicated to identify this model and estimate its parameters. This is usually done by maximum likelihood estimation, see, e.g., Hannan (1970), Akaike (1973) and Hillmer and Tiao (1979). This implies that the

Table II. Granger causality tests based on a VAR(3) model.

Test for Granger causality of	by	test statistic			
u	r	$F(3, 71) = 6.39^\dagger$			
	$\Delta_1 \ln y$	$F(3, 71) = 3.89^\dagger$			
	$\Delta_1 \ln w$	$F(3, 71) = .973$			
r	$\Delta_1 u$	$F(3, 71) = 1.34$			
	$\Delta_1 \ln y$	$F(3, 71) = .069$			
	$\Delta_1 \ln w$	$F(3, 71) = .710$			
	$\Delta_1 u, \Delta_1 \ln y, \Delta_1 \ln w$	$F(9, 71) = .966$			
$\Delta_1 \ln y$	u	$F(3, 71) = 4.14^\dagger$			
	r	$F(3, 71) = 5.64^\dagger$			
	$\Delta_1 \ln w$	$F(3, 71) = .513$			
$\Delta_1 \ln w$	u	$F(3, 71) = 5.45^\dagger$			
	r	$F(3, 71) = 2.55$			
	$\Delta_1 \ln y$	$F(3, 71) = 3.60^\dagger$			
Misspecification tests	u	r	$\Delta_1 \ln y$	$\Delta_1 \ln w$	
Autocorr.	$F_{AR}(4, 67)$.678	2.65 [†]	.716	.639
	$F_{AR}(8, 63)$	1.16	1.51	.711	.703
ARCH	$F_{ARCH}(1, 83)$.325	.015	.152	1.08
Normality	$\chi_{norm}^2(2)$	7.83 [†]	.350	.036	4.15
Chow	$F_{Chow}(12, 59)$.736	1.21	1.50	1.44

[†] significant at 5%

distribution of the data is assumed to be known, usually a normal distribution. However, in practice this distribution is usually not known. Moreover, normality is not implied by (9), hence it is not a

necessary prerequisite for model correctness.

We suggest a more simple way of identifying and estimating these VARMA models. Our method is based on the fact that a VARMA model can be considered as a system of ARMAX models. See, e.g., den Butter and van de Gevel (1989), where a similar procedure is applied. If we define, $\mathbf{z}_t = (x_{1t}, \dots, y_t, \dots, x_{kt})'$ and $\Phi = (\alpha_1, \dots, \phi, \dots, \alpha_k)'$ is a corresponding division, then an ARMAX model is

$$\phi(L)y_t = \mu + \alpha(L)x_t + \theta(L)\varepsilon_{it}, \quad (11)$$

where y_t is the dependent variable and x_t is the vector of explanatory variables, $\phi(L) = 1 - \sum_{j=1}^p \phi_j L^j$, $\alpha(L) = \sum_{j=1}^p \alpha_j L^j$, $\theta(L) = 1 + \sum_{j=1}^q \theta_j L^j$ and ε_{it} is the i -th element of $\boldsymbol{\varepsilon}_t$ in (10), which also satisfies (9). Hence

$$E[\varepsilon_{it} | (y_{t-1}, \mathbf{x}'_{t-1}), (y_{t-2}, \mathbf{x}'_{t-2}), \dots] = 0 \text{ a.s.} \quad (12)$$

It is obvious that a VARMA can be written as a system of ARMAX models if $\Theta(L)$ is diagonal. But also if not each equation in (10) can be written as an ARMAX model. To see this we use the fact that

$$\Theta(L)^{-1} = [\det \Theta(L)]^{-1} \Psi(L),$$

where $\Psi(L)$ is the matrix of cofactors of $\Theta(L)$. Premultiplying both sides of (9) with $\Psi(L)$ yields

$$\Psi(L)\Phi(L)\mathbf{z}_t = [\det \Theta(L)]\boldsymbol{\varepsilon}_t. \quad (13)$$

Thus every VARMA model can be written as a system of ARMAX models. Since we make no assumptions about the distribution of the data $Z = (z_1, z_2, \dots, z_t, \dots, z_T)'$, we do not use maximum likelihood estimation. Instead, we estimate the consecutive ARMAX models with nonlinear least squares, with the presample data set equal to the mean value of the corresponding observable values. An ARMAX model like (11) can easily be written as an ARX(∞) model, i.e., $y_t = g_t(\beta) + \varepsilon_t$, where

$$g_t(\beta) = \mu(\beta) + \sum_{j=1}^{\infty} \eta_j(\beta) \tilde{z}_{t-j},$$

and $\tilde{z}_t = z_t$ if $t \geq 1$ and $\tilde{z}_t = \bar{z} = 1/T \sum_{j=1}^T z_j$ if $t < 1$. In this case the least squares estimator $\hat{\beta}$ of β is defined by

$$Q(\hat{\beta}) = \inf_{\beta \in B} 1/T \sum_{j=1}^T [y_t - g_t(\beta)]^2,$$

where B is the parameter space. Consistency and asymptotic normality of the least squares estimator is proved by Bierens (1991).

We specify our ARMAX models as follows: in (11) we set $p=1$ and $q=2$ and hope that this specification is general enough to represent the data generating process giving rise to y_t . This model specification is tested extensively using a number of misspecification tests. We apply tests on autocorrelated residuals, a normality test, an ARCH test, and a predictive failure test. If this initial specification is not rejected by any of these tests, it may be simplified by testing if we can delete variables with insignificant parameters from the model. The ultimate results of this specification analysis are in table III.

Granger causality between variables can directly be observed from table III. We only present the variables with parameters significantly different from zero and precisely these variables are Granger causing the dependent variable y_t . It appears that the difference between our method and the usual VAR approach is very small. From table II, we find that unemployment is Granger caused by the real interest rate and real output growth. From table III, it appears that also the real wage growth is important for unemployment. However, if we substitute the ARMAX model of the real wage rate into the unemployment model, we eventually find a model with only interest rate and output as Granger causing variables. We can also derive from table II that all three variables appear important for the real wage rate, whereas from table III only unemployment and interest rate are. However, if the unemployment and interest rate equations of table III are substituted into the wage model, then the real wages are also Granger caused by all three variables. Thus, the two model specifications yield very similar results.

In both the VAR and the VARMA model, we find a significant positive Granger causal relation between unemployment and the real interest rate. This relation is confirmed when we consider the impulse response functions based on the VAR(3) of table II and the VARMA model of table III. The impulse response function of a one percentage point real interest rate shock on unemployment is very similar for both specifications. The response function of the VAR model, which exhibits slow dampening, is presented in figure 3, whereas that of the VARMA model is given in figure 4. The peak of both functions is reached after

Table III. Estimation and test results ARMAX models.

y_t :	u		r		$\Delta_1 \ln y$		$\Delta_1 \ln w$	
μ	.184	[1.03]	1.21	[1.79]	-1.19	[-1.27]	-.512	[-.522]
$D74q1$							-5.04	[-11.9]
$D75q1$	.901	[10.7]						
$D80q2q4$			-7.83	[-8.06]				
$D74q1 + D75q1$					-6.35	[-15.4]		
u_{-1}	.903	[33.4]			.578	[4.54]	.275	[1.95]
r_{-1}	.043	[3.13]	.880	[11.4]	-.291	[-4.79]	-.102	[-2.14]
$\Delta_1 \ln y_{-1}$	-.084	[-5.94]			.330	[4.94]		
$\Delta_1 \ln w_{-1}$	.080	[3.99]	-.195	[-2.52]			-.305	[-2.38]
θ_1	.318	[2.49]	.562	[3.95]			.452	[3.28]
θ_2								
<i>S.E.</i>	.223		1.01		1.57		1.15	
R^2	.973		.913		.619		.283	
T	87		87		87		87	
$\chi_{par}^2(k)$	1.51	($k=1$)	7.33	($k=3$)	4.13	($k=3$)	.962	($k=2$)
$\chi_{norm}^2(2)$	3.82		8.45 [†]		.464		5.05	
$F_{AR}(4, n)$	1.42	($n=76$)	1.14	($n=78$)	.539	($n=78$)	1.52	($n=77$)
$F_{AR}(8, n)$	.891	($n=72$)	1.43	($n=74$)	1.52	($n=74$)	.755	($n=73$)
$F_{ARCH}(1, 85)$	.173		3.85		.163		3.09	
$\chi_f^2(12)/12$	.071		.435		1.27		1.56	

Note: *S.E.* is the standard error of the regression, R^2 is the correlation coefficient, T is the number of observations used (1970.3–1991.4). The t -values based on the heteroskedasticity-consistent covariances of White (1980) are denoted in squared brackets. $\chi_{par}^2(k)$ is a Wald test on parameter restrictions with a χ^2 distribution with k degrees of freedom under the null. χ_{norm}^2 is the test on normally distributed errors of Kiefer and Salmon (1983), which is equivalent to the familiar Jarque and Bera (1980) test and follows a $\chi^2(2)$ distribution under the null. F_{AR} is an F -version of the LM residual autocorrelation test of Cumby and Huizinga (1990) and follows an $F(m, n)$ distribution under the null. F_{ARCH} is the familiar ARCH test of Engle (1982) and has a $F(s, t)$ distribution under the null. Finally, $\chi_f^2(l)/l$ is the predictive failure test of Hendry (1979) divided by its number of degrees of freedom l . This is an index of predictive failure, where values exceeding 2 imply a poor forecasting performance. Values marked [†] are significant at 5%.

about two years and its value is around 0.25 percent of the civilian labor force. This corresponds to a rise in unemployment of roughly 300,000 persons.

- insert figures 3 and 4 around here -

Thus, this multivariate analysis of macroeconomic time series cannot reject the implication of the theory of Baumol of section 2, namely that there is both a positive relation between the wage rate and unemployment and a positive relation between the interest rate and unemployment. The neoclassical theory however, predicts a positive relation between the wage rate and unemployment and a negative relation between the interest rate and unemployment. Hence, the latter theory cannot be confirmed.

3.3 An empirical labor demand model

As a final test of the implications of our theory of section 2, we consider the fact that this theory implies that employment of the firm is determined by the actual profit in relation with a certain minimum profit level. Hence, labor demand is a function of profit, defined as sales revenue minus wage and interest costs, or equivalently of the profit share, PS_{nf} . However, this function is unlikely to yield an adequate specification, since it is static. We therefore determine the lag structure empirically, by starting with a general distributed lag model that better represents the dynamic properties of the data.

$$\phi(L)\ln EMPnf = \mu + \alpha(L)PSnf + \varepsilon_t, \quad (14)$$

where $\phi(L) = 1 - \sum_{j=1}^p \phi_j L^j$ and $\alpha(L) = \sum_{j=0}^r \alpha_j L^j$. This general model could be simplified to the model presented in table IV. A dummy is included to represent the fall in the natural rate of employment; see section 3.2. This model specification is subjected to quarterly data from 1970.1 to 1991.4, collected from the *Survey of Current Business*; see appendix 1. The sum of autoregressive coefficients in $\phi(L)$ of (14) was very close to unity, which is why we took the first difference of the log of employment. It appears that this model does not reject the theory of Baumol on which it is based. Moreover, the model also satisfies a large number of other statistical properties being tested for. There is no residual autocorrelation, no heteroskedasticity or functional form misspecification, no ARCH and no evidence of omitted variables. Other important properties our model satisfies are parameter constancy and absence of predictive failure. Two large outliers in the early eighties imply high excess kurtosis, hence normality is not accepted. However, as argued in section 3.2, normality is not essential for model correctness (9) or (12). Moreover, inclusion of two additional dummies yields a model virtually the same as that of table IV, which no longer suffers from nonnormality, hence our results seem quite robust.

So also this simple empirical employment model, with the profit share as percentage of the value added of nonfinancial enterprises as explanatory variable provides corroborating evidence in favor of our theory of section 2.

Table IV. Estimation and test results of (14)

$$\Delta_1 \ln EMPnf_t = -1.45 \quad -2.93 \quad D75q1 + .254 \Delta_1 \ln EMPnf_{t-1} + .201 PSnf_t + \varepsilon_t$$

[.511]
(.639)
[.084]
[.057]

S.E. = .635 R^2 = .426 T = 86 (70.3-91.4) DW = 2.05

Normality:	$\chi_{norm}^2(2) = 27.5^\dagger$	
Autocorrelation:	$F_{AR}(4,78) = .60$	$F_{AR}(8,74) = 1.26$
ARCH:	$F_{ARCH}(1,80) = .072$	
Heteroskedasticity:	$F_{X_i^2}(5,76) = .550$	
Functional form:	$F_{X_i * X_j}(6,75) = .472$	
RESET:	$F_{RESET}(1,81) = .027$	
Forecast:	$\chi_f^2(16)/16 = .340$	
	$F_{CHOW}(16,66) = .320$	

Note: Estimation and testing was performed using PC-GIVE. Estimation is by least squares and the standard errors based on the heteroskedasticity consistent covariance estimator of White (1980) are in square brackets, except for the dummy where the usual standard error is presented. F_{AR} is the LM test on residual autocorrelation, F_{ARCH} is Engle's ARCH test. The normality test is due to Jarque and Bera (1980). $F_{X_i^2}$ tests on heteroskedasticity due to squares of regressors and $F_{X_i * X_j}$ is the heteroskedasticity test of White (1980). F_{RESET} is the RESET test. $\chi_f^2(16)/(16)$ is the predictive failure test advocated by Hendry (1979), cf. table III, and F_{CHOW} is the familiar Chow test on predictive failure. Finally, † means significance at 5%.

6. CONCLUSIONS

In this paper, we have studied some of the implications of an alternative theory of the firm, based on Baumol (1959). We found that these implications could not be rejected by data for the USA. We do not claim that our theory provides the only interpretation for our empirical models. However, considering the renewed interest of a number of

authors in alternative theories of the firm, where managerial discretion, agency costs, capital structure and the risk of bankruptcy are important, we feel that our empirical results might provide corroborating evidence in favor of these theories. Not only wage costs, but also interest costs, i.e., costs connected to the financial structure of the firm, are important for the employment decisions of those firms.

This also implies that the usual policy of wage moderation might not be enough in reducing unemployment. From figure 2, it is obvious that the effect of wage moderation, which results in a lower labor income share (LIS_{nf}), can be disposed of by increasing interest costs of firms. If the increase in interest costs (RS_{nf}) is large enough, it may offset the lower LIS_{nf} and causes profits PS_{nf} to decrease. Lower profits lead to lower employment and hence higher unemployment. In this way an increase in the interest rate might lead to a fall in profits, via increasing interest costs, and hence to lower employment. An increase in the wages or wage costs might have a negative effect on employment for the same reason of lower profits.

Hence, we not only emphasize the role of wages and wage costs on employment, but we also point out that the interest rate and interest costs might be important in determining employment. In the same way, this implies a different concept of profits. Usually profits are considered to be equal to revenue minus wage costs. We have argued that also the interest costs might be important, which implies that profits should be defined as revenue minus wage *and* interest costs. The positive relation between employment and this concept of profit can also not be rejected by data for the USA.

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APPENDIX 1. DATA

The data we used for the VAR and VARMA model were obtained from the *Main Economic Indicators* of the OECD. The sample period considered was 1970.1–1991.4 and we used seasonally adjusted data.

u: unemployment rate as percentage of the civilian labor force,
seasonally adjusted

R: prime interest rate in percentage per annum

Y: index of total industrial production, seasonally adjusted

W: index of hourly earnings in manufacturing

P: index of producers prices for finished goods

The interest rate, output and wages were deflated with *P* as follows:

$$r = R - [100*(P - P(-4))/P(-4)]$$

$$\ln y = (\ln Y - \ln P)*100$$

$$\ln w = (\ln W - \ln P)*100$$

The data we used for figures 1 and 2 and estimation of equation (14) are taken from the US Department of Commerce, *Survey of Current Business*, Washington DC, various issues. They were taken from the following tables:

Gross Domestic Product of Corporate Business in Current Dollars and
Gross Domestic Product of Nonfinancial Corporate Business in Current
and Constant Dollars:

series: Corporate profits with inventory valuation and capital
consumption adjustment (*Pnf*)

GDP of nonfinancial corporate business (*GDPnf*)

Compensation of employees (of nonfinancial corporate business)
(*Wnf*)

Current Business Statistics: Labor Force, Employment and Earnings:

series: Total employees, private sector (excl. government sector) (E)

Total employees financial, insurance and real estate sector

(E_f)

The variables we use are defined as

$$EMP_{nf} = E - E_f$$

$$LIS_{nf} = 100 * (W_{nf} / GDP_{nf})$$

$$PS_{nf} = 100 * (P_{nf} / GDP_{nf})$$

$$RS_{nf} = 100 - LIS_{nf} - PS_{nf}$$

$$CIS_{nf} = 100 - LIS_{nf}$$

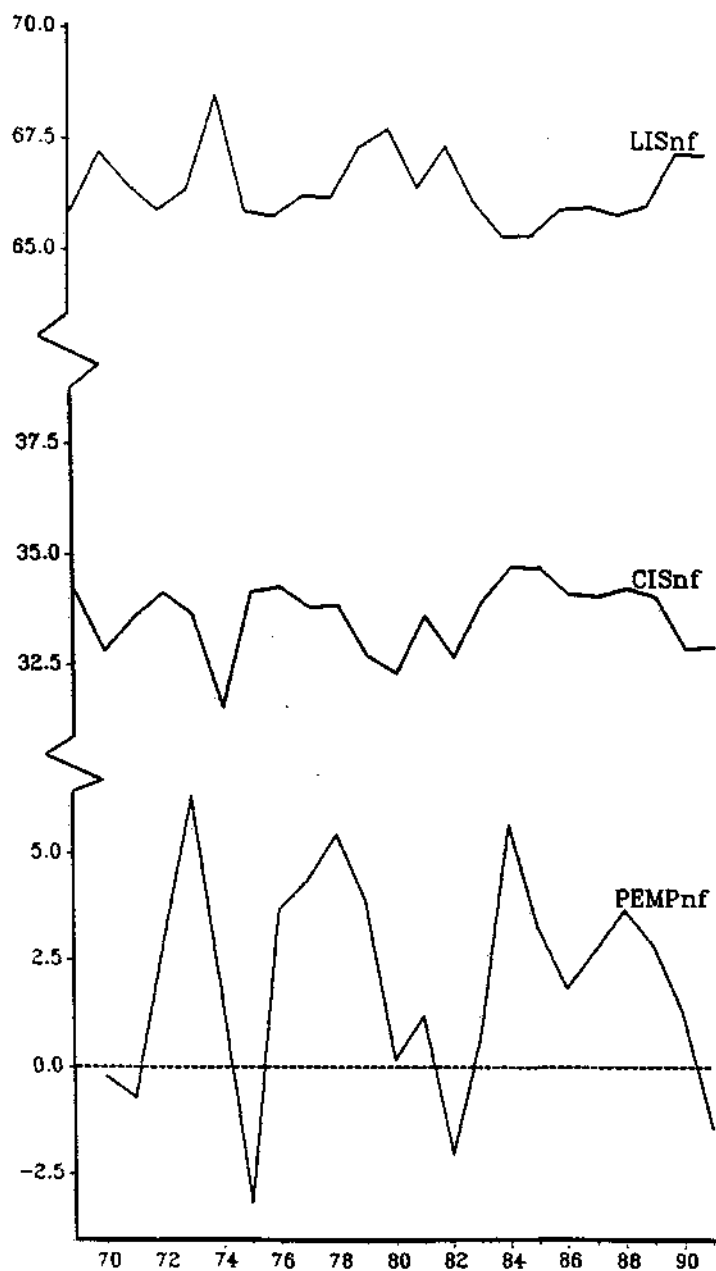


Figure 1. Percentage change in employment of nonfinancial enterprises (PEMPnf) and decomposition of the value added of nonfinancial enterprises in labor and capital income shares (LISnf and CISnf)

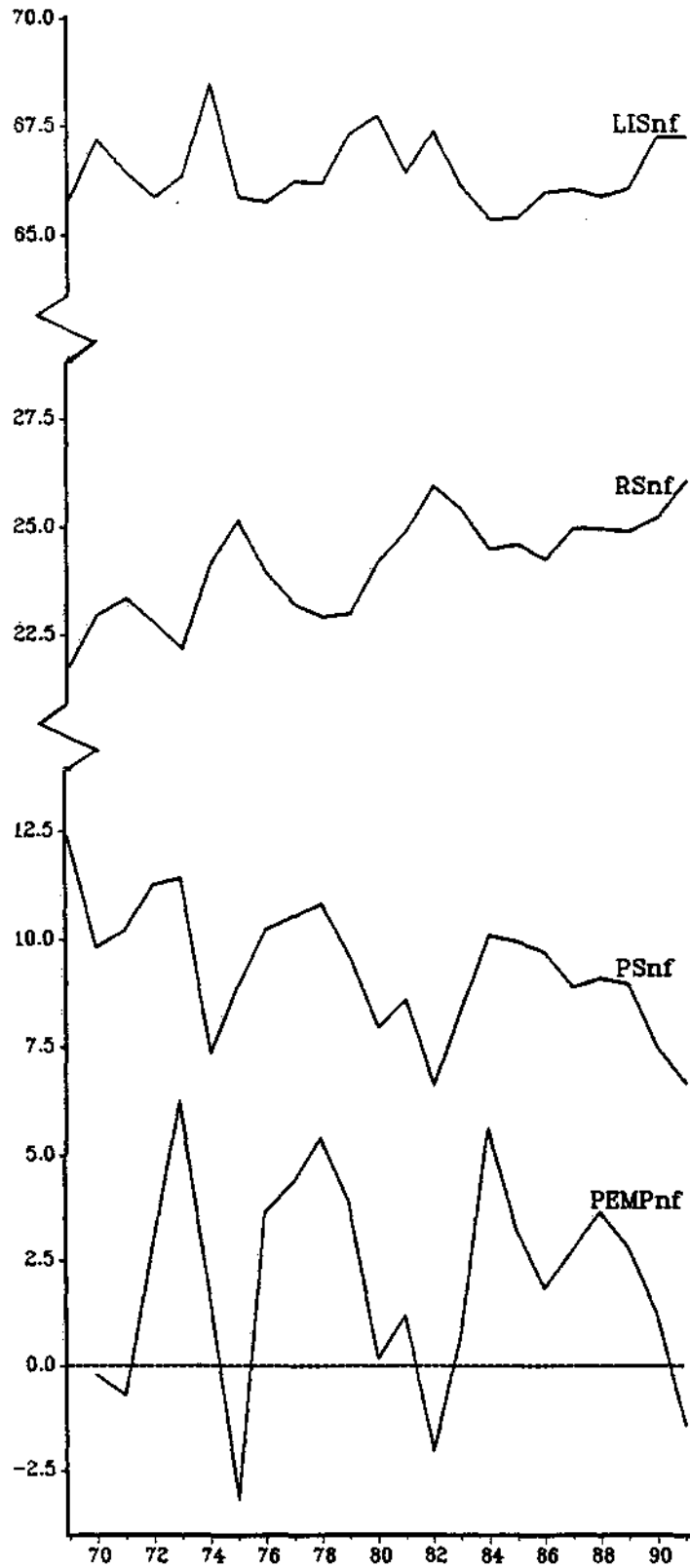


Figure 2. Percentage change in employment of nonfinancial enterprises (PEMPnf) and decomposition of the value added of nonfinancial enterprises in a labor income share (LISnf), a rest share (RSnf) and a profit share (PSnf).

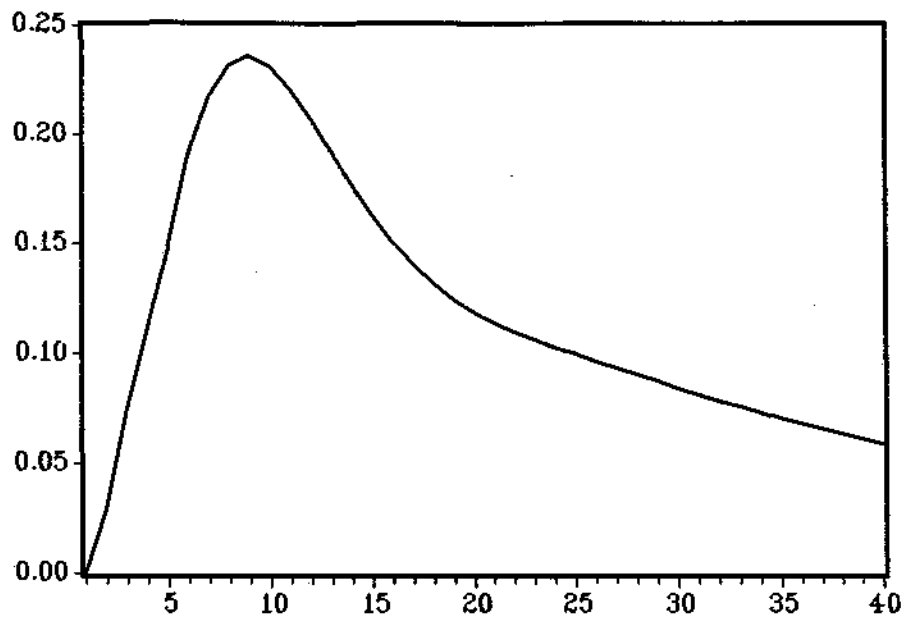


Figure 3. Impulse response of unemployment rate to a unit interest rate shock, based on a VAR(3) model.

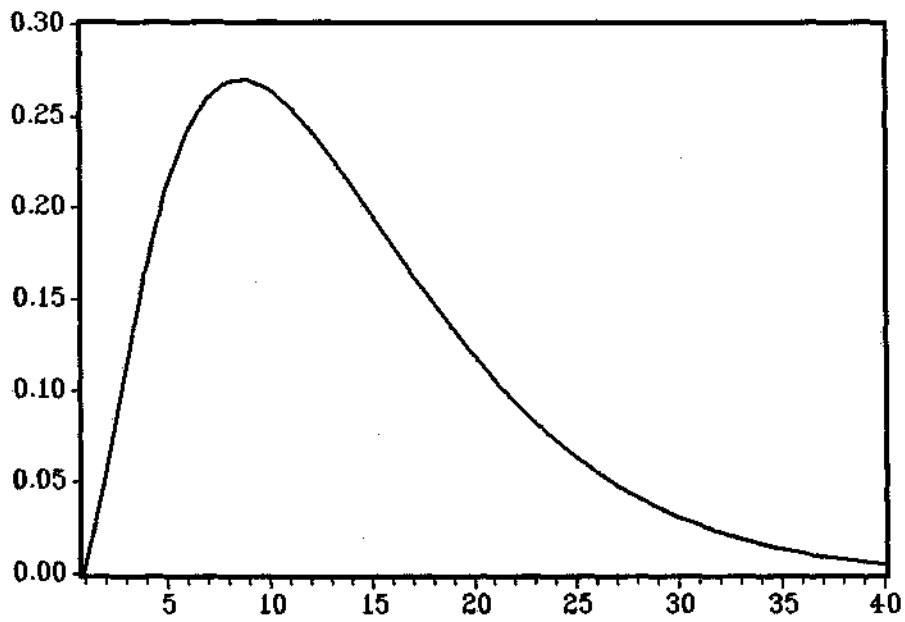


Figure 4. Impulse response of unemployment rate to a unit interest rate shock, based on a VARMA model.

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