A POST-KEYNESIAN MODEL FOR ANALYZING THE RELATIONSHIP BETWEEN DISTRIBUTION AND GROWTH

Engelbert Stockhammer* Özlem Onaran**

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* Corresponding author
Dept. of Economics, VWL 1
Vienna University of Economics and Business Administration
Augasse 2-6
1090 Vienna
Austria

** Department of Economics
Istanbul Technical University
ITU Macka 80680 Istanbul
Turkey

Abstract

This paper analyses of the impact of distribution on accumulation, capacity utilization and employment, and presents a Post-Keynesian model in order to answer the question whether accumulation and employment are wage-led or profit-led.

The impact of distribution on growth, accumulation and employment continues to be the focus of an ongoing debate within the discipline of macroeconomics. Does a pro-capital redistribution of income stimulate growth, accumulation and consequently employment? Post-Keynesian macroeconomics answers this question by pointing out the dual function of wages as a component of aggregate demand, as well as a cost item. Depending on the relative magnitude of these dual effects, Marglin and Bhaduri (1990) distinguish between profit-led and wage-led regimes, where the latter leads to a low rate of accumulation accompanied by a high profit share. This is a more general formulation of earlier neo-Kaleckian models analyzing the impact of distribution on growth by Rowthorn (1982), Dutt (1984), Taylor (1985) and Blecker (1989). However, the theoretical debate in the post-Keynesian tradition still needs to be improved in order to capture the dynamics within the system and has to be supplemented by empirical research. The lack of empirical research about the relationship between distribution and growth is even more pronounced in the case of developing countries, where the pro-capital incomes policies of structural adjustment programs implemented in the last two decades are still far from fulfilling their promises in many cases.

The model presented here is a post-Keynesian open economy model. It consists of behavioral functions for investments, savings, and international trade defining the goods market; the producer's equilibrium curve, which relates capacity utilization and labor market pressures to the distribution of income; and an employment equation. The two important contributions of the model presented here, compared with previous work, are employment and its effect on income distribution. Firstly, producer's equilibrium, i.e. income distribution, is determined not only by the pricing behavior of firms, but also by a bargaining relationship. Secondly, employment is explicitly modeled by a version of Okun's Law. These two extensions incorporates the labor market to the analysis, allowing an interaction between distribution, accumulation, capacity utilization and employment, rather than implicitly defining labor demand as a passive outcome of the system.

The second motivation behind this study is to model the dynamic relationship between distribution, accumulation, capacity utilization and employment considering both lagged and contemporaneous interactions within a systems approach, that goes beyond the limited framework of comparative statics. Consequently we present a structural vector autoregression (SVAR) method to estimate the analytical model for selected advanced capitalist countries. This estimation, which is a novel application within the post-Keynesian literature, is, implicitly, the second aim of the paper in order to point out the driving force behind accumulation and employment.

JEL classification: E 1, E 12, E 2, E 3

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1. Introduction

Over the past two decades post-Keynesian macroeconomics has made significant progress. On the one hand, reformulations of Kaleckian growth models have allowed for flexible modelling of the goods market, while maintaining the central claim of the paramount importance of capital accumulation and income distribution in the growth process. In particular the Marglin-Bhaduri model (Marglin and Bhaduri 1990, Bhaduri and Marglin 1990) has generalized earlier formulations (Rowthorn 1982, Dutt 1984, Taylor 1985) allowing for profit-led as well as wage-led growth regimes. This shifts the actual relation between distribution and growth to the empirical terrain such that the aggregate effect of the profit share on accumulation depends on the relative magnitude of demand and profitability effects. On the other hand, post-Keynesians have, theoretically as well as empirically, pointed to the crucial role of accumulation in the determination of the level of unemployment (Rowthorn 1995, Davidson 1998, Glyn 1998, Dumenil and Levy 1999).

However, so far there is lack of empirical research. In particular those two streams of debate are hardly combined. Moreover, the existing works fail to address the issue of simultaneity. Bowles and Boyer (1995) as well as Gordon (1995) employ essentially single equation approaches; Rowthorn (1995) and Glyn (1998) focus exclusively on the link between employment and accumulation without an explicit treatment of the goods market.

The present paper is an attempt to fill this gap. The aim is to test a post-Keynesian macro model of an open economy by means of a structural VAR model based on evidence from major advanced capitalist countries, i.e. France, Germany, UK and USA. We wish to explore the following features: Does accumulation play a critical role in determining capacity

utilization? Is employment determined by the cost of labor or by demand conditions? Are accumulation, capacity utilization and employment wage-led or profit led?

The paper is structured as follows. Section two presents the model to be estimated and section three reviews the previous empirical work. Section four discusses the econometric method. Section five presents the econometric results for the tests performed. Section six discusses the results and questions for further research, and section seven concludes.

2. The model

The model is a neo-Kaleckian model for an open private economy that allows for profit-led as well as wage led growth regimes. The goods market part is the linearized Marglin-Bhaduri (1990) model, which is complemented by an unemployment function that allows for hysteresis and a distribution function that exhibits a negative effect of unemployment on real wages, as well as a pro-cyclical mark-up pricing behavior. A somewhat simpler version of this model is discussed analytically by Stockhammer (1999 and 2000a).

Equation (1) is the investment function (g^I), proposed in Marglin and Bhaduri (1990) that reacts positively on capacity utilization (z) and on profit share (π). a_1 is known as the accelerator effect. a_2 is the positive effect of profits on accumulation. By combining these two effects, the dual role of wages as costs and as a source of demand is integrated into the investment function. Higher wage share will lead to higher capacity utilization, but to a lower profit share. The net effect of an increase in the wage share on investment is thus ambiguous.

$$g_t^{\ I} = a_0 + a_1 z_{t-1} + a_2 \pi_{t-1} \qquad (1)$$

Note that we have already imposed a certain time structure in the accumulation function: investment is supposed to react to changes in capacity utilization and profitability only with a

time lag. We consider this to be the appropriate specification according to Keynesian theory. In the short run, investment is given, because today's investment is yesterday's investment decisions[1]. This specification introduces the time dimension to the timeless theoretical model of Marglin and Bhaduri.

Equation (2) is a linearized form of the savings function (g^S) where capacity utilization and the profit share determine the rate of savings. b_1 indicates the responsiveness of savings to capacity utilization, i.e. the marginal propensity to consume for a given income distribution. b_2 is a positive function of the differences in savings propensity between wage incomes and profit incomes.

$$g_t^{\ S} = b_1 z_t + b_2 \pi_t \qquad (2)$$

Equation (3) is a profit share function where profits depend on capacity utilization and on unemployment (u). d_1 indicates the pro-cyclicality of the mark up. d_2 is the reserve army effect, i.e. higher unemployment weakens labor's bargaining position and therefore leads to higher profits.

$$\pi_t = d_0 + d_1 z_t + d_2 u_t \qquad (3)$$

The profit equation deviates from earlier formulations by separating the capacity effect and the unemployment effect. E.g. Marglin and Bhaduri (1990) and Rowthorn (1979) assumed that unemployment and capacity move in parallel, and Bowles and Boyer (1995) take the unemployment rate as an indicator for capacity utilization. If unemployment exhibits a high

[1] Sims (1986), who was interested in money supply and demand, also chooses to have investment contemporaneously exogenous.

degree of persistence, as is the case in most European countries, then it is analytically important to distinguish between the two effects. [2]

Equation (4) is an employment function that includes Okun's law as a special case. Accumulation and the change in capacity utilization enter separately, capacity utilization is captured by capital productivity so that output is equal to capacity utilization times capital stock ($y \equiv zK$). e_1 is the effect of accumulation on unemployment. e_2 the effect of capacity utilization on unemployment. e_3 is unemployment persistence. If e_3=1 than (4) reduces to Okun's law.

$$u_t = n - e1g_t - e2\Delta z_t + e_3 u_{t-1} \qquad (4)$$

Equations (3), and (4) can be combined to the analogue of Marglin and Bhaduri's "producers' equilibrium curve".

Net exports (NX) are assumed to vary counter-cyclically and to be a positive function of the profit share, which is taken as a proxy for unit labor costs and thus an indicator of international competitiveness (Bowles and Boyer, 1995).

$$nx_t = -h_1 z_t + h_2 \pi_t \qquad (5)$$

With the assumption that investment is determined by lagged variables only, i.e. that accumulation is given in the current period we can reformulate the goods market equilibrium condition (Equation 6) to get the following expression for capacity utilization, which we will also refer to as effective demand function (Equation 6').

$$g^I + nx = g^S \qquad (6)$$

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[2] Analytically this distinction allows to identify a second equilibrium condition (equation 6) as a long run

$$z_t = \frac{1}{b_1 + h_1}[g_t + (h_2 - b_2)\pi_t] \qquad (6')$$

We are now in a position to clarify the notion of profit-led vs. wage-led demand regime. Substituting Equation (6') in (1) we get the following equilibrium growth curve as a function of income distribution.

$$g_t^I = a_0 + \frac{a_1}{b_1 + h_1} g_{t-1} + \left(a_2 + a_1 \frac{h_2 - b_2}{b_1 + h_1} \right) \pi_{t-1} \qquad (7)$$

Depending on the sign of $\left(a_2 + a_1 \frac{h_2 - b_2}{b_1 + h_1} \right)$ the total derivative $\frac{dg_t^I}{d\pi_{t-1}}$ is either positive or negative, i.e. accumulation is either profit-led or wage-led. The sign depends on the relative magnitudes of the direct positive effect of the profit share on accumulation (the partial $\frac{\partial g_t^I}{\partial \pi_{t-1}} = a_2$), the positive international demand effect ($\frac{\partial g_t^I}{\partial z_{t-1}} \frac{\partial z_{t-1}}{\partial nx_{t-1}} \frac{\partial nx_{t-1}}{\partial \pi_{t-1}} = \frac{a_1 h_2}{b_1 + h_1}$) and the negative domestic consumption effect ($\frac{\partial g_t^I}{\partial z_{t-1}} \frac{\partial z_{t-1}}{\partial \pi_{t-1}} = \frac{-a_1 b_2}{b_1 + h_1}$). If the profit effect on accumulation and net exports is high enough to offset the decline in consumption, then accumulation is profit-led, otherwise it is wage-led.

The contemporaneous relationship between capacity utilization and profit share is also ambiguous depending on the relative magnitudes of the domestic and international demand effects of a higher profit share, i.e. depending on the relative magnitudes of h_2 and b_2. If

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equilibrium (note that equilibrium here refers to a point of rest rather than to market clearing).

$h_2 > b_2$, growth regime is exhilirationist, and is stagnationist otherwise. The lagged response of capacity utilization to profit share also depends on both the regime of accumulation and the relative magnitude of international and domestic demand effects[3].

After experimentation, it was assumed that net exports effect capacity utilization only with a time lag and so does the profit share in the net exports equation. Net exports very often had a negative sign in the demand equation; similarly the profit share often had a negative sign in the net exports equation. Thus, these effects were dropped from the contemporaneous interactions, but will still show up in the impulse responses.

3. Review of previous empirical work

The major reference point of empirical work in this area is Bowles and Boyer (1995). Bowles and Boyer (1995) have estimated a similar model by means of a single equation approach. The main differences between their approach and the one taken here is in the econometric method, but there also exist differences in the model.

Bowles and Boyer (1995) use unemployment as the indicator for capacity utilization. This is inappropriate, especially when analyzing European unemployment, because the capacity utilization-unemployment curve has shifted for European countries in the 1980s (Bean 1994), which was the inspiration for capital shortage literature (Bean and Dreze 1990, Rowthorn 1995, Stockhammer, 2000b). Bowles and Boyer (1995) do extend the model to include the state and net export.

[3] See also Bhaduri and Marglin, 1990; Bowles and Boyer, 1995; Blecker, 1989 and 1999 for analytical discussions about the consequences of openness on the regime of accumulation and growth, decreasing the likelihood of a wage-led regime.

Bowles and Boyer (1995) estimate each of the equations separately and address the problem of simultaneity by using lagged values for the independent variables. They do not discuss time series properties of the variables or lag structure in any detail. But it is the problem of simultaneity that has motivated the present study. By their approach, Bowles and Boyer (1995) eschew the issue of simultaneity completely. Since the underlying model is an equilibrium model, at least as far as the goods market is concerned, the appropriate way to estimate the model is a systems approach.

In another empirical work, Gordon (1995) controls for financial variables, and cost of capital, as well as variables that affect the relative bargaining power of labor and capital. Hein and Krämer (1997) also adress the issue of distribution, accumulation and growth but present no rigorous test, and are unprecise about identification issues.

4. Econometric method: Structural VAR

VAR methodology has become popular among economists since the early 1980s. Originally it had been developed as an alternative to theory-based structural estimation. Sims (1980) presented VAR analysis as atheoretical because it had no restrictions on the explanatory variables and did not rely on strict exogenous-endogenous distinction. However, few economists and econometricians hold on to such far-reaching claims. The importance of ordering for impulse response functions has demystified the atheoretical nature of the approach and the development of structural VAR (SVAR) has reconciled theory guided modeling with the VAR approach.

The VAR approach is employed here for several reasons: It is a systems approach. Thus simultaneous effects are modeled explicitly.It contains an unrestricted structural form estimation. E.g. the Bowles and Boyer (1995) estimates are a special case of the VAR

estimation.Finally, it is has desirable time series properties. In particular it performs well even in the presence of unit roots.

However, it also has shortcomings.First, the number of variables that can be integrated is limited because VAR is an unrestricted auto-regressive distributed lag (ADL) model that quickly runs out of degrees of freedom. Second, because it is a systems approach we do not control for variables other than the ones in the system (this is a major difference compared to the specifications used by Gordon 1995). Finally, the impulse response consists of short-term reactions that cannot be readily interpreted as derivatives that we know from comparative statics. However, they have the advantage of incorporating the joint effects of distributional changes on accumulation and growth, which makes it possible to define whether the regime is wage-led or profit-led.

The standard VAR approach regresses all variables on its own lags and the lags of all other variables (Equation 10). No contemporaneous effects are treated explicitly.

Standard VAR: $y_t = d_t + Cy_{t-1} + u_t$ (10)

where

- y vector of variables
- d deterministic variables (constant, trend)
- u vector of innovations

(For simplicity the presentation will use only one lag, whereas in the empirical estimations two lags will be used)

The covariance matrix of the vector u_t will in general not be “well behaved”, i.e. the innovations will be contemporaneously correlated. In fact, this covariance captures the contemporaneous interactions among the variables. To illustrate, take the following specification, sometimes called “primitive VAR” (Endres 1995).

Primitive VAR : $$By_t = d_t + Ay_{t-1} + \varepsilon_t \qquad (11)$$

In this system of equations contemporaneous interactions are represented explicitly in the matrix B. Contrary to u_t in (10), ε_t in (11) will not be cross-correlated. Note that $C = B^{-1}A$ and $u_t = B^{-1}\varepsilon_t$, the latter explains the nature of cross-correlation among the errors in u.

The standard Choleski decomposition ("orthogonalization of the error covariance matrix") imposes a triangular structure on B that is convenient to solve, but does implicitly impose a certain structure of contemporaneous interactions. Structural VAR makes these interactions explicit. A necessary condition for identification is that the number of non-zero elements in the B matrix has to be equal to or less than $(n^2-n)/2$[4]. However, in practice it turns out that computational problems quickly arise if the number of the simultaneous contemporaneous interactions increases. [5]

In our case the vector y and the matrix B for the open economy case are:

$$y = \begin{bmatrix} g \\ z \\ \pi \\ u \\ nx \end{bmatrix} \text{ and } B = \begin{bmatrix} a_{11} & 0 & 0 & 0 & 0 \\ a_{21} & a_{22} & a_{23} & 0 & 0 \\ 0 & a_{32} & a_{33} & a_{34} & 0 \\ a_{41} & a_{42} & 0 & a_{44} & 0 \\ 0 & a_{52} & 0 & 0 & a_{55} \end{bmatrix}, \text{ with the expected signs being } \begin{array}{l} a_{21} > 0 \\ a_{23} < 0 \\ a_{32} > 0 \\ a_{34} > 0 \\ a_{41} < 0 \\ a_{42} < 0 \\ a_{55} < 0 \end{array}.$$

and all the diagonal elements are positive by definition.

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[4] See Sims 1986, Bernanke 1986; Endres 1995 as an accessible textbook presentation.

[5] The econometrics software used, EasyReg by Bierens, frequently crashed when more than 4 variables and more than 2 simultaneous contemporaneous interactions were being modeled.

The structural VAR approach proceeds in three steps. First the VAR as it is formulated in Equation (10) is estimated. This gives coefficient estimates on lagged values and estimated errors. In the second step these estimated errors are used to obtain estimates of the B matrix by FIML (full information maximum likelihood) estimation. Third, impulse responses (IR), i.e. reactions of the system to simulated exogenous shocks to each of the endogenous variables, are calculated that combine information from both steps.

The SVAR will thus provide us with three types of information: First, the results of the VAR itself, i.e. an unrestricted structural form in lags[6]. Second, the results of the contemporaneous interactions of the error terms, which we will refer to as SVAR. Third, impulse response functions.

The data are from the OECD Economic Outlook database. Accumulation (ACCU) is the growth rate of the business gross capital stock, the profit share (PS) the profit share of the business sector; unemployment (U) the national unemployment rate; net exports (NX) the current account normalized by the capital stock of the business sector.

The measure for capacity utilization (Z) as suggested by the model is capital productivity in the business sector. Since this is a somewhat unconventional measure of capacity utilization, two other measures were also tried: the growth of output in the business sector (Growth) and the output gap (GAP) as estimated by the OECD. Data Appendix presents a detailed definition of the variables.

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[6] Because every variable will enter twice, with one and with two lags, multicollinearity problems will almost inevitably arise here (Bowles and Boyer (1995) specification will be a special case of the VAR).

The VAR consists of the five variables. A (linear) trend was added for pragmatic reasons.[7] VAR analysis is appropriate for short-term analysis and the trend was statistically significant when added. The trend captures long terms effects that are not appropriately captured in the variables. However, the trend, though itself statistically significant, has little impact on the parameter estimates for the other variables. It does increase some standard errors.

5. Empirical results

This section summarizes the econometric results. First, we have, as a preliminary test, estimated the closed economy model, excluding the trade block with annual data and present the SVAR results thereof. Second, the model is estimated for the open economy model with semi-annual data. This will be discussed in some depth, including some tests for robustness and impulse responses for the model with semi-annual data will be presented.

In a first step the closed economy model was estimated with yearly data for Germany, France, UK and USA. This was done to get a simple benchmark. Results of the SVAR estimations are summarized in Table 1.

[7] Similarly Blanchard 1989 adds a trend because he cannot otherwise explain the rise in unemployment, without further theoretical justification.

Table 1: Structural VAR estimation for the closed private economy model (with trend)

	USA	France	Germany	UK
ACCU				
Innovation	0.0041 ***	0.0022 ***	0.0026 ***	0.0022 ***
	(4.3352)	(5.8944)	(5.5529)	4.8858
Z				
ACCU	2.2712 ***	1.7972 ***	1.5422 ***	0.6024
	(4.1949)	(3.7791)	(2.1612)	(0.7855)
PS	0.0012	-0.0002	0.0001	-0.0002
	(0.2002)	(-0.0728)	(0.0107)	(-0.0140)
Innovation	0.0099 ***	0.0023 **	0.0038 ***	0.0058
	(3.1763)	(2.0067)	(4.8450)	(0.9314)
PS				
Z	70.3829 ***	175.8407 *	38.6621	78.3122
	(3.5460)	(1.7544)	(0.8332)	(0.6645)
U	0.9607 ***	1.0064	0.4112	-0.0174
	(3.5460)	(1.1750)	(1.2077)	(-0.0542)
Innovation	0.3986 ***	0.5660 ***	0.4488 ***	+0.5493 ***
	(4.7526)	(5.0267)	(4.0058)	(5.7073)
U				
GK	-29.0152	-128.0210 *	49.4500	-108.7824 *
	(-1.5804)	(-1.6992)	(1.1527)	(-1.8105)
Z	-37.4880 ***	-0.2999	-63.9175 ***	-53.0003 ***
	(-4.6227)	(-0.0079)	(-2.4923)	(-2.4157)
Innovation	0.2407 ***	0.2153 ***	+0.3059 ***	+0.3668 ***
	(3.1763)	(4.9003)	(5.0632)	(5.8192)

Period: 1960-98
Estimations by Easyreg, Bierens (2000). t-values in parenthesis

Accumulation has a strong positive and statistically significant impact on capacity utilization. In three of the four countries it is significant at the 1% level. The profit share has very little impact on capacity utilization. t-values are close to zero; twice the sign is negative and twice it is positive.

The profit share moves pro-cyclically, but at moderate significance levels (once at the 1% once at the 10% level, but the signs are consistently positive). Unemployment has a positive effect on the profit share, but only in the USA is the effect statistically significant.

Capacity utilization has a strong negative effect on unemployment that is statistically significant at the 1% level in three countries. Accumulation has a negative effect on unemployment, but at much lower levels of statistical significance (close to the 10% level in three countries, insignificant “wrong sign” once).

It turns out that the results are similar to those that we get with the open economy model using semi-annual data. The open economy model is estimated with semi-annual data for France, UK, and USA. Germany is dropped because the combination of the structural break of unification and the lack of availability of current account data before 1973 diminished the number of observations.

Again a time trend was added in the VAR. Seasonal dummies were not significant and excluded. Two lags were used in the VAR after some experimentation with lag length. Some of the longer lags were statistically significant, but first the OLS residuals seemed well behaved already with two lags and secondly the correlation matrices of the OLS residuals are very similar in the 2 lags and the 4-lag case.

Due to either the complexities of the model or the software package used, the number of simultaneous contemporaneous interactions, (such as Z depending on PS and PS depending on Z) had to be small. This led us to drop NX from the demand function. NX therein was insignificant and often had a negative sign, which makes no sense theoretically, but rather indicates the negative effect of demand on net exports is captured in the demand function. For the same reasons (low levels of significance and wrong signs) PS was not included in the NX function. However, both the effect of NX on Z and the effect of PS on NX are visible in the IR’s in a way consistent with theory.

Originally budget deficit (as a percentage of GDP) was added to test for robustness but it had little impact on significance levels as well as IR's of other variables and also the other endogenous variables in the system weren't able to explain budget deficit, so it was dropped again.

Testing for structural breaks in the SVAR was not possible. But minor experimentation with sub-periods (especially 1960-1975 and 1980-1999) did not indicate a change in parameters.

Since capital productivity is an unconventional measure for capacity utilization, we tested the model also with the rate of growth of real GDP and with the output gap (as calculated by the OECD). Neither of the latter two variables is satisfying theoretically. GDP growth conflates the theoretically important distinction between growth and capacity utilization. The output gap has an implicit NAIRU assumption that does not go well with a Keynesian model. However, empirically, the measure of capacity utilization makes no big difference.

Table 2 summarizes the SVAR results for France. CAPUT refers to the three different variables that measure capacity utilization in general. ACCU has a strong impact on CAPUT that is statistically significant at the 1% level in all three specifications. PS has no statistically significant effect on CAPUT, but consistently has a negative sign. PS reacts positively to CAPUT (twice at the 1% level, once at the 10% level). U has a positive effect on PS twice, but not at conventional levels of statistical significance. ACCU has a negative strong effect on U (twice at the 1% level). CAPUT has no statistically significant effect on U.

Table 2: Structural VAR estimation for the open private economy model for France

	Z	gap	growth
ACCU			
Innovation	0.0006 ***	0.0006 ***	0.0005 ***
	(13.7876)	(12.54)	(15.6399)
CAPUT			
ACCU	2.6189 ***	849.1297 ***	6.7882 ***
	(5.8736)	(4.8562)	(5.1234)
PS	-0.0001	-0.4319	-0.0002
	(-0.1703)	(-1.0621)	(-0.0740)
Innovation	0.0019 ***	0.6317 ***	0.0051 ***
	(6.3275)	(2.7399)	(6.054)
PS			
CAPUT	92.1946 *	0.7049 ***	42.1536 **
	(1.7354)	(3.4694)	(2.3544)
U	-0.0364	0.6766	0.5635
	(-0.0596)	(0.9806)	(1.0594)
Innovation	0.5012 ***	0.5116 ***	0.4706 ***
	(12.7924	(5.9288)	(13.9234)
U			
ACCU	-184.4679 ***	-231.2397 ***	
	(-5.0278)	(-5.0502)	
CAPUT	0.0075	0.0585	0.9956
	(0.0007)	(0.8628)	(0.2584)
Innovation	0.1478 ***	0.1746 ***	0.1745 ***
	(12.2135)	(8.1676)	(11.3821)
NX			
CAPUT	50.8216	-0.1377	21.6249
	(1.3316)	(-1.0687)	(1.2785)
Innovation	0.6102 ***	0.5598 ***	0.6383 ***
	(9.315)	(10.0983)	(8.9667)

Period: 1960-98

Estimations by Easyreg, Bierens (2000). t-values in parenthesis

The results for the UK are summarized in Table 3. ACCU has positive impact on CAPUT (twice at 1%, once at 10%). PS has no statistically significant effect on CAPUT. PS reacts positively to CAPUT, but not at conventional levels of statistical significance. U has no statistically significant effect on PS, but consistently a negative sign. CAPUT has a statistically significant impact on U at 1% an all three specification. ACCU also has statistically significant effect on U.

Table 3: Structural VAR estimation for the open private economy model for UK

	Z	growth	gap
ACCU			
Innovation	0.0007 ***	0.0008 ***	0.0007 ***
	(7.7738)	(6.9954)	(6.714)
CAPUT			
ACCU	1.832 *	6.4343 ***	664.91 ***
	(1.718)	(2.6451)	(2.9894)
PS	0.0001	0.0005	0.1739
	(0.0317)	(0.0696)	(0.3206)
Innovation	0.0034 ***	0.0093 ***	0.8498 ***
	(3.0369)	(3.6989)	(5.9171)
PS			
CAPUT	46.632	27.2594	0.0713
	(0.4903)	(1.0712)	(0.2518)
U	-0.4798	-0.1296	-0.4575
	(-0.7832)	(-0.2914)	(-0.7588)
Innovation	0.5444 ***	0.521 ***	0.5508 ***
	(7.1131)	(7.8178)	(7.714)
U			
ACCU	18.4381		20.0557
	(0.4687)		(0.398)
CAPUT	-55.9417 ***	-19.8928 ***	-0.2094 ***
	(-4.4714)	(-4.4935)	(-3.9271)
Innovation	0.2238 ***	0.2557 ***	0.2318 ***
	(7.7605)	(6.4535)	(7.0669)
NX			
CAPUT	50.0959	0.0772	-0.1711
	(1.0035)	(0.0055)	(-1.4074)
Innovation	0.7282 ***	0.6865 ***	0.7085 ***
	(6.8214)	8.8794)	8.8271)

Period: 1960-98
Estimations by Easyreg, Bierens (2000). t-values in parenthesis

The results for the USA are summarized in Table 4. ACCU has strong and statistically significant effect on CAPUT. PS has no statistically significant effect on CAPUT. It is once positive, once negative. PS is pro-cyclical (at 1% significance). Higher U translates into higher PS (at 1%significance).ACCU as well as CAPUT have statistically significant negative impact on unemployment (at 1% significance).

Table 4: Structural VAR estimation for the open private economy model for USA

	z	growth
ACCU		
Innovation	0.0012 ***	0.001 ***
	(11.6274)	(14.8563)
CAPUT		
ACCU	4.7187 ***	5.6676 ***
	(6.7156)	(5.3642)
PS	-0.0003	0.0018
	(-0.0872)	(0.4705)
Innovation	0.0061 ***	0.0073 ***
	(5.3806)	(6.1456)
PS		
CAPUT	65.2592 ***	53.7578 ***
	(6.098)	(7.833)
U	0.8452 ***	0.7491 ***
	(4.718)	(4.4706)
Innovation	0.3065 ***	0.3287 ***
	(11.6832)	(12.8218)
U		
ACCU	-87.1911 ***	
	(-2.3399)	
CAPUT	-25.6033 ***	-24.6797 ***
	(-3.9084)	(-5.7435)
Innovation	0.214 ***	0.2593 ***
	(12.1422)	(11.4057)
NX		
CAPUT	-9.5422	-14.3674 ***
	(-1.1609)	(-3.0512)
Innovation	0.402 ***	0.3781 ***
	(15.5987)	(17.3825)

Period: 1960-98
Estimations by Easyreg, Bierens (2000). t-values in parenthesis

Next we turn to the impulse responses (IR). Since we have five variables, three specification and three countries, it is impractical to give a complete presentation of the IR's. Instead, the main results are summarized and, thereafter some IR's are presented for France and the USA in Figure 1 and 2.

Insert Figure 1 and 2

Table 5: Summary of impulse responses

	France	UK	USA
Accumulation			
Accelerator dACCU/dZ	yes	yes	yes
Accumulation regime dACCU/dPS	wage-led (4 periods), then profit-led	zero (weakly wage-led)	zero (weakly wage-led)
Demand			
Effect of ACCU on CAPUT dZ/dACCU	yes	yes	yes, but short
Demand regime dZ/dPS	stagnationist	zero	zero
Distribution			
Reserve army effect dPS/dU	no in SR (yes in LR)	no in SR (yes in LR)	yes
Procyclical profits dPS/dZ	yes	yes	yes
Employment			
Effect of PS on U (dU/dPS)	yes, significant positive wage-led	zero	zero
Effect ofdemand on U dU/dZ and dU/dACCU	yes	yes	yes

Note. Table refers to periods 0-4, i.e. 2.5 years.
"zero" is used if 0 is within the 1 standard error confidence interval in all specifications.
SR= short run; LR= long run

In compiling the table, the "short run" was, somewhat arbitrarily defined as up to the 4th period after the shock, i.e. 2.5 years. In the later periods indirect effects will be very strong and the system may tend to return to equilibrium. Confidence intervals are generally disappointingly large, i.e. the estimates are not very precise. However, most patterns are remarkably clear.

On the goods market a standard Keynesian analysis is confirmed: CAPUT has strong impact on ACCU (unambiguously in all countries); and ACCU is an important determinant of CAPUT (in all countries, with US only displaying a short effect). Overall, investment drives the system, though the length of the effect varies by country and by specification.

On the labor market, too, the impulse responses correspond to a Keynesian story. CAPUT and ACCU in all countries have a strong and long lasting effect on U in all countries. In many cases a one-time shock to capacity utilization will have an employment effect for 5 years. The profit share, on the other hand, has no effect (UK and USA) or even a positive effect on U in the case of France. In other words, wage moderation does not decrease unemployment. One-time shocks, however, do not have a permanent effect, i.e. we find no support for full hysteresis. For practical analysis, however, this is of secondary matter.

Looking at the results for the effects of income distribution on accumulation and capacity utilization, the results are less clear,. Neither for accumulation nor for capacity utilization are the results significant. In most cases the one standard deviation confidence interval includes zero. There is practically no effect of income distribution on either accumulation or capacity utilization in the USA and the UK. For France we find some indication of a wage-led regime, but only at modest levels of statistical significance. In other words, the model estimated failed

to provide us with a clear answer to whether growth is wage-led or profit-led. Potential reasons for this failure will be discussed below.

There are, however, some interesting aspects to this failure. First, and, most surprising, is the fact that we failed to provide evidence of the savings differential between wage income and profit income. This should have appeared as a negative short run effect of PS on CAPUT. It would have been unsurprising if the effect had not lasted for long. The higher PS should have raised ACCU and NX. But in either case one had expected that these changes take more time than the consumption effect. Moreover, the estimates for the contemporaneous effects are positive, even if close to zero for the UK and USA. Second, the profit effect does not show up in the IR of ACCU at all in UK and USA, and with a lag of 4 periods in France. The fact that we get insignificant results about the causes of investment is perhaps less surprising, given the long-standing problems in explaining investment. If the negative demand effect of high profits were found to be significant, there would be stronger evidence to explain the mechanism behind the irresponsiveness of investments to an increase in the profit share. This point will be further discussed below.

A companion study (Onaran and Stockhammer 2001), which applied a similar model to the Turkish case, did yield similar results. Together with the robustness of our results this suggest that the results are not coincidental.

6. Open questions

There certainly are limitations of the VAR for estimating a model like the Marglin-Bhaduri model. First, VAR methodology restricts the number of variables. Furthermore it is impractical to add control variables, because the strength of VAR analysis is to break with a

clear endogenous-exogenous dichotomy, which would be resurrected by adding control variables. Note that Gordon (1995) adds an abundance of control variables, whereas Bowles and Boyer (1995) work with specification very similar to ours (but do use a single equation approach).

Second, we did not test systematically for changes in the parameters, by estimating the system for sub-periods. There is nothing in the Marglin and Bhaduri model that assumes that there is no regime switch, and indeed Marglin and Bhaduri (1990) make the argument that the slowdown of growth since the mid 1970s may be due to such a regime shift[8]. However, we have casually estimated the system for sub periods, which gave no indication of strong changes in parameter values or level of statistical significance. In particular, there was no indication that the estimates of PS would improve.

Third, we have not modeled the financial sector at all. For example, if interest rates were correlated with some of the variables employed here, which is what one would expect, the estimates may be biased. However it is not obvious, why such a misspecification should affect coefficients relating to income distribution more than others.

Fourth, we expected that the savings differential would become visible in the SVAR (and early on in the IR's), because we assumed that consumption would adjust faster than net exports and accumulation to changes in PS. This assumption may be flawed. It is conceivable that both consumption and, say, net exports respond with the same lags and have the same magnitude, thus cancel out.

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[8] Again note that Bowles and Boyer (1995) roughly use the same time period as we do.

Fifth, technological change is not modeled explicitly, it will thus be hidden in some other innovations. If the technical change is Harrod neutral, it may effect the innovation to income distribution and also innovations to employment. This might be part of the reason, why the profit share variable performs unsatisfactorily.

Sixth, the distribution variable, PS, may be imprecise. This is possible, especially since it is basically the residuum of value added after wages. It thus includes financial income and imputations for self-employment. Financial income has been rising strongly since the 1960s. But still, the profit share is a fairly reliable indicator of the wage share and thus, assuming that rentiers and capitalists have similar savings propensities, it should affect savings propensities.

Thus qualifications are necessary when interpreting the results with respect to the Marglin and Bhaduri model. Overall the results hardly confirm the central role that Marglin and Bhaduri assign income distribution, whereas they do confirm the crucial role of accumulation. Thus our results confirm the finding by Bowles and Boyer (1995) that changes in income distribution are unlikely to have a big effect on employment and growthay. While we get insignificant results, Bowles and Boyer (1995) get point estimates that roughly cancel out in the open economy case.

7. Conclusion

The aim of the paper was to test a post-Keynesian macro model of a real economy by means of SVAR method. This method was chosen, because it is a systems approach that allows addressing the issue of simultaneity, and simulating shocks to the system. Particular points of interest were the role of accumulation and the role of income distribution.

The model employed is based on the one proposed by Marglin and Bhaduri (1990), but was developed further by explicitly modelling the labor market and allowing for a richer determination of income distribution. At the core of the model is the distinction between profit-led and wage-led growth.

The results of the estimation confirmed general Keynesian assertions. Accumulation is a crucial determinant of demand (capacity utilization) and the accelerator is key determinant of accumulation. The level of unemployment strongly reacts to the goods market, but hardly to changes in factor costs (here proxied by income distribution). Thus the mainstream notion that wage moderation by itself would increase employment was clearly rejected.

However, the results fail to confirm the crucial role that Marglin and Bhaduri attribute to functional income distribution. Neither savings differentials turned out to be statistically significant, nor the effect of profits on accumulation. Future research needs to clarify, whether these findings are due to the specificities of the present model or to measurement problems in the profit share variable—or whether, indeed, income distribution has little economic effects due to international and domestic demand effects canceling out each other.

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Figure 1: Impulse responses for France (specification with Z)

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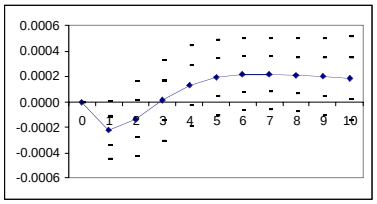	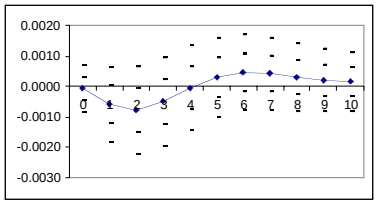	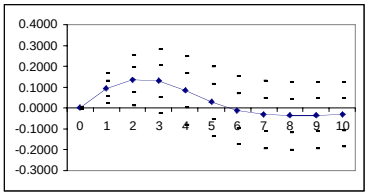
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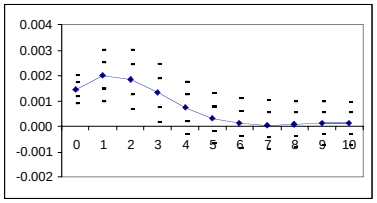	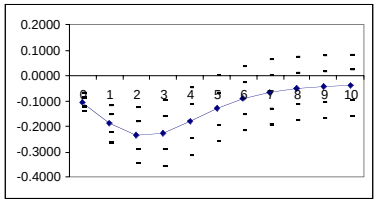	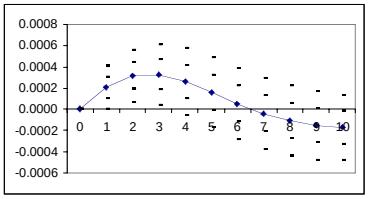
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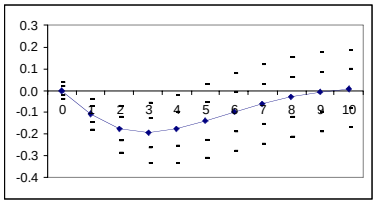	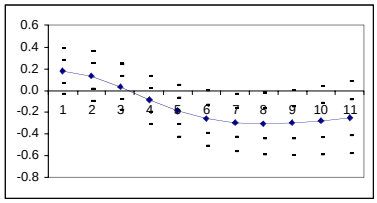	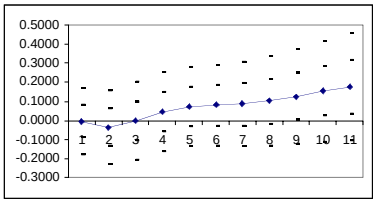

Figure 2: Impulse responses for USA (specification with Z)

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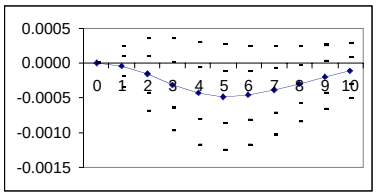	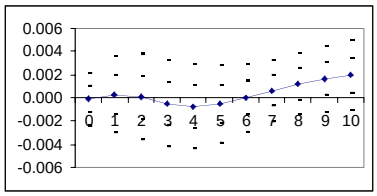	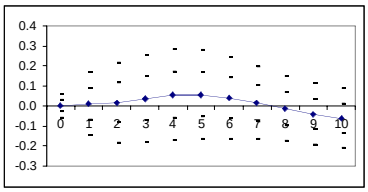
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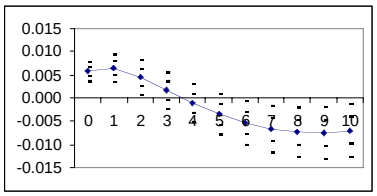
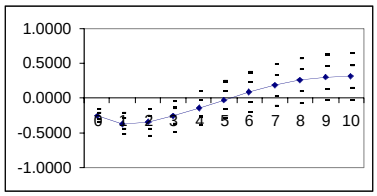
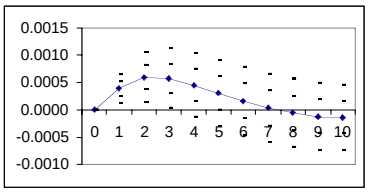
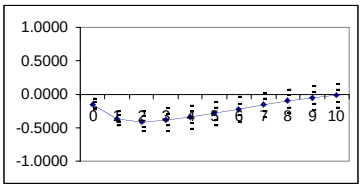
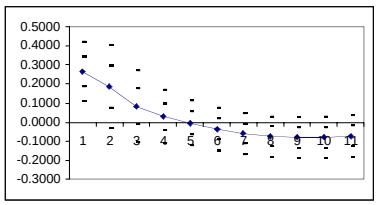
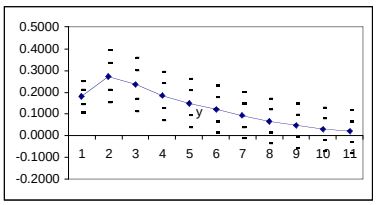
		
Reponse of U to Z	Reponse of PS to Z	Reponse of PS to U
		

Data Appendix: Definition of variables

ACCU: rate of growth of business sector real gross capital stock (excludes residential capital stock)

Z: capital productivity in the business sector

Growth: real GDP

GAP: OECD output gap

PS: profit share of the business sector

U: unemployment rate (national defintion)

NX: current account as percentage of GDP (highly correlated with current account normalized by capital stock; correlation coefficient >.95)

Source: OECD