ACCUMULATION, DISTRIBUTION AND EMPLOYMENT: A STRUCTURAL VAR APPROACH TO A POST-KEYNESIAN MACRO MODEL

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Abstract
The paper investigates the relation between effective demand, income distribution and unemployment empirically. Its aim is to evaluate Keynesian, Kaldorian and neoclassical hypotheses about the determination of labor market variables. To do so, a vector autoregression model consisting of capital accumulation, capacity utilization, the profit share, unemployment and the growth of labor productivity is estimated. A general post-Keynesian model following the lines of Kalecki and Kaldor is presented and provides the specification for a structural VAR. The model is estimated for the USA, UK and France.

JEL classification: E1, E12, E2, E3

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1. Introduction

This paper investigates the relation between effective demand, income distribution and unemployment empirically. The econometric model is used to evaluate the empirical validity of Keynesian, Kaldorian and neo-classical hypotheses about the labor market. Keynesians posit that goods market demand determines labor market outcomes. Thus the idea of a hierarchy of markets is implied. Neo-classicals, on the other hand, argue that wage reductions decrease unemployment via factor substitution. Both Keynesian and neo-classical theories have been developed further and are much more sophisticated in present formulations. However, the basic propositions still hold. In giving more nuanced accounts of the theories, the focus of this paper lies on developments in Post-Keynesian theories, whereas the treatment of neo-classical theories remains simplistic. In particular neo-Kaleckian hypotheses about the relation between the profit share and capacity utilization (Bhaduri and Marglin 1990, Blecker 1999) and neo-Kaldorian hypotheses about wage indexation to productivity growth and technological unemployment are explored (Boyer 1988, 2000).

A general post-Keynesian model following the lines of Kalecki and Kaldor is presented and estimated by means of a structural vector autoregression (VAR) approach. The VAR consists of accumulation, capacity utilization, the profit share, unemployment and the growth of labor productivity. The model is deliberately a general one and so is the econometric method employed, allowing for various effects, including some non-Keynesian ones. In the VAR methodology each dependent variable is regressed on the lagged values of all other variables in the system. This flexible modeling makes VAR an appropriate tool for comparing different theories. Only in the contemporaneous interactions of the variables it's the Post-Keynesian model imposed. Granger causality tests are used to determine the directions of the contemporaneous relations and guarantee that it is identified. The model is estimated for the USA, UK and France, which are the major OECD economies.[1] The time period under investigation ranges from the early 1960s to the late 1990s.

As the reader may have noticed, the variables included in the VAR system consist only of real variables, and indeed, the model to be proposed does not include a monetary sector. This may seem surprising for a model that claims to be Post-Keynesian, but it is justified by three reasons. First the model is based on the Kaleckian and Kaldorian traditions, which focus on the real sectors of the economy. Second, the focus of the paper lies on the interaction between effective demand, income distribution and unemployment; and third, the VAR methodology requires a parsimonious specification.

The paper is structured as follows. Section two presents the model. Section three summarizes the hypotheses to be investigated. Section four discusses the econometric method and various data issues. Section five presents the econometric results for the tests performed. Section six derives conclusions.

2. The model

The macroeconomic model proposed is deliberately a general one. This corresponds to the VAR methodology employed in the empirical part that imposes no restrictions on the effects

[1] Problems in data availability and German unification made the estimations for Italy and Germany, which was originally intended, unfeasible.

of past variables. The goods market part of the model consists of behavioral functions for investment, savings, and net exports, and is based on Marglin and Bhaduri (1990), who proposed a flexible neo-Kaleckian model that allows for profit-led as well as for wage led growth regimes. We will explicitly derive the conditions of profit-led vs. wage led growth regimes in our extended model, once we have introduced the full structure. The goods market block of the Marglin-Bhaduri model is complemented by a distribution function, a labor productivity function and an unemployment function. The distribution function exhibits a procyclical mark-up pricing behavior, a negative effect of unemployment on real wages and imperfect indexation of wages to productivity growth. The growth of labor productivity in a Kaldorian fashion is assumed to respond positively to capital accumulation and capacity utilization. Since the purpose of the paper is to evaluate theories of unemployment, the employment function used is rather general and allows for hysteresis, demand effects as well as neoclassical wage effects.

There is little disagreement in the literature that investment depends on expected profitability, however there is little consensus on how 'expected profitability' can be operationalized for either theoretical or empirical modeling. We follow Marglin and Bhaduri (1990), who proposed to decompose the profit rate (r) into the profit share (π), capacity utilization (z) and (technical) capital productivity (k).

$$r = \frac{R}{K} = \frac{R}{Y}\frac{Y}{\overline{Y}}\frac{\overline{Y}}{K} = \pi z k \qquad (1)$$

Thus expected profitability, i.e. the expected profit rate, will be composed of expected profit share, or the mark-up, and capacity utilization, assuming that technical capital productivity is not expected to change (as will be done throughout the paper for simplicity). We abstain from building an explicit model of how expectations are formed and assume that expectations are formed on the basis of past values of these variables. Linearizing we get:

$$g_t^{\,I} \equiv \frac{I_t}{K_t} = a_0 + a_1 z_{t-1} + a_2 \pi_{t-1} \tag{2}$$

where all coefficients are positive numbers. Investment is normalized by capital stock, as will be savings. This is for convenience. This investment function is close to, but not identical to the one estimated by Bhaskar and Glyn (1996). Compared to the standard empirical literature on investment behavior (e.g. Kopcke 1985, Ford and Poret 1991), this is a profit and accelerator model, with a_1 being the accelerator effect and a_2 the profit effect. What is missing compared to standard formulations is the interest rate, which is excluded, because in our model the financial sector is not treated explicitly. Thus changes in the interest rate may show up as innovations to accumulation.

It is a standard assumption in post-Keynesian growth theories that savings depends on the distribution of income, because workers and capitalists have different savings propensities (Marglin 1984, Lavoie 1992). We again make use of the decomposition of the profit rate and linearize the savings function

$$g_t^{\,S} = \frac{S}{K} = b_1 z_t + b_2 \pi_t \tag{3}$$

Thus savings depend on capacity utilization and the profit share. b_1 indicates the responsiveness of savings to capacity utilization, i.e. the marginal propensity to save for a given income distribution. b_2 measures the differences in savings propensity between profit incomes and wage incomes. This formulation is fairly general. For example the standard textbook Keynesian saving function posits that savings depends on the level of income, but not its distribution. This is just a special case of Eq. (3) with $b_2 = 0$.

In equilibrium, savings have to equal investment (Eq. 4). 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 4) to get the following expression for capacity utilization (Eq. 5).

$$g^I = g^S \tag{4}$$

$$z_t^{IS} = \frac{1}{b_1}\left[g_t - b_2\pi_t\right] \tag{5}$$

In a closed economy, the effect of an increase in the profit share on capacity utilization will depend on the relative responsiveness of consumption and investment to profits. Contemporaneously this effect will be negative, since investments do, in this model, not respond to profits simultaneously. Thus: $\frac{\partial z}{\partial \pi} = \frac{-b_2}{b_1} < 0$, because of the positive savings differentials. Such a regime is called 'stagnationist' (Marglin and Bhaduri 1990). However, with a longer time horizon, i.e. including the lagged effects, the overall effect of the profit share on capacity utilization is ambiguous, because investment will also change. The net effect depends on the relative magnitude of its positive direct effect on investment and the negative effect on domestic consumption. Moreover, in an open economy there are further reasons for a deviation from a stagnationist regime. For illustration assume that net exports (again normalized by capital stock) are a negative function of capacity utilization and a positive function of the profit share. The proposition that it is a negative function of capacity utilization is derived from demand for imports being positively related to domestic demand and is standard. The effect of international competitiveness on net exports can be modeled via a positive effect of the (domestic) profit share. Imagine the case of wage dumping of a small country: a decrease in domestic wages that is expressed as an increase in the profit share, will partly be passed on as a reduction in export prices and thus boost exports (see also Blecker 1989, 1999; Bowles and Boyer, 1995). Thus assuming that net exports is given by

$$nx_t = -h_1 z_t + h_2 \pi_t \tag{6}$$

Eq. 5 modifies to 5'

$$z_t^{IS} = \frac{1}{b_1 + h_1}\left[g_t + (h_2 - b_2)\pi_t\right] \tag{5'}$$

Consequently the sign of $\frac{\partial z}{\partial \pi}$ will be indeterminate even contemporaneously. A situation where $\frac{\partial z}{\partial \pi} > 0$ is called exhilarationist. This can arise if exports react strongly to the profit share, whereas domestic demand contracts only mildly, i.e. if savings differentials are small.

In the model estimated, the capacity utilization function based on equations 5 or 5' is included. Since foreign trade is not modeled explicitly, the estimated coefficients and impulse responses of the profit share on capacity utilization (and of course other variables) will include indirect effects via export demand. Moreover, innovations to capacity utilization do include shocks coming from fiscal policy, monetary policy and the foreign sector; in fact they include all shocks to effective demand other than investment.

We are now in a position to clarify the notion of profit-led vs. wage-led accumulation regime. Substituting Equation (5') in (2) 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.

Next, we model income distribution. Distribution is in part determined by the bargaining balance between capital and labor, which strongly depends on the rate of unemployment, and in part it is the outcome of macroeconomic activity. The former approach was pioneered by Marx and has recently been taken up by theories of labor market bargaining (like efficiency wage theories and the NAIRU theory), whereas the latter has been at the core of Keynesian economics. In particular Kaldor (1960) argued that effective demand determines the level of output in the short run and income distribution in the long run (similarly Robinson 1956, 1962).

With Equation (8) we aim at a formulation that is sufficiently general to allow for both effects. The profit share depends on capacity utilization, reflecting demand conditions, and on unemployment (*u*), reflecting labor's bargaining position. d_1 indicates the pro-cyclicality of the mark up. d_3 is the reserve army effect, i.e. higher unemployment weakens labor's bargaining position and therefore leads to higher profits. Finally the growth of labor productivity will effect the profit share if wages are imperfectly indexed to productivity growth as it seems to have been the case in continental Europe since the mid 1980s. If wages grow in line with productivity, d_4 will equal zero.[2]

$$\pi_t = d_0 + d_1 z_t + d_3 u_t + d_4 x_t \quad (8)$$

In describing the growth of labor productivity we follow Kaldorian lines. Equation 9 posits that growth of labor productivity (*x*) is determined by accumulation and capacity utilization. Many forms of technological progress have to be implemented via new machinery, thus accumulation, which in turn increase the capital/labor ratio. Moreover measured labor productivity will depend on the extent to which existing machinery is put to use, thus capacity utilization. Exogenous technical progress is captured by τ_0.

$$x_t = \tau_0 + \tau_1 g_t + \tau_t z_t \quad (9)$$

[2] This profit equation deviates from earlier formulations by Marglin and Bhaduri (1990) and Rowthorn (1979) by separating the capacity effect and the unemployment effect. They, as well as Bowles and Boyer (1995), had assumed that unemployment and capacity utilization move in parallel. However, if unemployment exhibits a high degree of persistence (Bean 1994), as is the case in most European countries, then it is analytically important to distinguish between the two effects. The above formulation is also indebted to various models developed by Boyer (e.g.1988) who emphasized the issue of wage indexation to productivity growth for macro dynamics.

Finally there is the unemployment function (Eq. 10), which is modeled in a general way such as to allow for Keynesian as well as non-Keynesian effects. First it depends on the two goods market variables, accumulation and capacity utilization, then there is past unemployment, the growth of labor productivity and finally the profit share. Keynesians would expect the first three variables to be the important ones: e_1 and e_4 measure the effect of goods market variables and e_3 unemployment persistence. If labor demand primarily depends on wages, as neo-classical economics assumes, e_2 should be the important coefficient, which captures the effect of real wage per worker after controlling for labor productivity. Finally, if technological progress is not matched by a rise in effective demand, then it will lead to unemployment. This neo-Kaldorian theme crystallizes in the effect of e_5.

$$u_t = n - e_4 g_t - e_1 \Delta z_t + e_3 u_{t-1} + e_5 x_t - e_2 \pi_t \qquad (10)$$

The VAR system to be estimated consists of accumulation (eq. 2), capacity utilization (eq 5'), the profit share (eq. 8), productivity growth (eq. 9) and unemployment (eq. 10). However, in its present formulation it is too rich to be estimated. Granger causality tests will be used to narrow down the specification in case of two way causations, such that the model is identified.

3. Hypotheses

The model estimated is a VAR model, thus past values of all variables are allowed to influence present values of any variable. Thus results that are not in accordance with the structural model outlined above are possible due to lagged effects. The structural model provides the motivation and shapes the interaction of the contemporaneous effects only. Thus it will be useful to summarize the hypotheses to be explored empirically.

H1. *The Keynesian labor market hypothesis*: Keynesians have long argued that goods market variables, namely effective demand, largely determine labor market outcomes. Thus H1 posits that an innovation to accumulation or capacity utilization will have a negative impact on unemployment, i. e. that $du/dz < 0$ and $du/dg^I < 0$.

H2. *The neoclassical labor market hypothesis*: Neoclassical labor market analysis holds that employment will be a negative function of real wages. In our model the proxy for real wages is one minus the profit share. H2 posits that an innovation to the profit share will decrease unemployment, i.e. that $du/d\pi < 0$.

H3. *Substitution hypothesis:* The mechanism by which higher wages are supposed to lead to lower employment is via substitution. In case of higher wages, firms will substitute capital for labor, thus increase labor productivity. Thus H3 posits that an innovation to the profit share leads to a decrease in labor productivity, i. e. that $dx/d\pi < 0$.

H4. *Kaleckian distribution-led growth regimes*: Kalecki argued that a high profit share would depress the economy because of the high savings propensity of capital incomes (more recent formulations are Dutt 1984 and Rowthorn 1982). However, as shown earlier this need not be the case in open economies There the effect of changes in the profit share on capacity utilization will depend on the magnitude of the effect of profitability on accumulation and net exports relative to that on domestic demand. Thus H4 posits that if the regime is stagnationist (exhilarationist)an innovation to the profit share will decrease (increase) capacity utilization and ifaccumulation is wage-led (profit-led), an innovation to the profit share has a negative (positive) effect on accumulation.

H5. *The reserve army hypothesis*: Marxists as well as recent bargaining theory posit a negative relation between unemployment and real wages (the seminal reference for recent research on this of course is Blanchflower and Oswald 1994), thus in our model a positive relation between unemployment and the profit share. Keynesian economists, on the other hand have usually downplayed the role of unemployment in determining real wages, emphasizing that bargained wages are first of all nominal wages and whatever real wages turn out to be depends on effective demand via price changes. H5 posits that an innovation to unemployment raises the profit share, i e. that $d\pi/du > 0$.

H6. *Imperfect wage indexation to labor productivity*. If wages are imperfectly indexed to labor productivity growth, as has been at the center of the models by Boyer (1988, 1993), then we expect an innovation to labor productivity growth to effect the profit share positively, i.e. that $d\pi/dx > 0$.

H7. *Technological unemployment*. If an increase of labor productivity is not matched by an increase in effective demand, then an innovation to labor productivity will have a positive effect on unemployment, i. e. that $du/dx > 0$.

4. Econometric method

VAR methodology has become popular among economists since the early 1980s. Originally it had been developed as an alternative to theory-based structural estimation. In a seminal paper Sims (1980) presented VAR analysis as an atheoretical tool because it had no restrictions on the explanatory variables and did not rely on strict exogenous-endogenous distinction.

However, few economists and econometricians today hold on to such far reaching claims. The importance of the ordering of variables for impulse response functions has demystified the atheoretical nature of the approach and the development of structural VAR has reconciled theory guided modeling with the VAR approach (Sims 1986, Amisano and Giannini 1997). Over the past 20 years VAR analysis has become a standard tool in empirical research.

For the questions we seek to answer the VAR approach is attractive for several reasons. First, it is a flexible way of modeling since it allows all past variables to effect any present variable. Thus it does not force a certain theoretical structure upon the data (as far as past values are concerned). Many specifications, in particular standard OLS can be seen as special cases of a VAR specification. Second, it is a systems approach that takes into account the interaction of variables. In particular the impulse responses calculated from the VAR trace an innovation to one variable through the entire system.

Third, it is has desirable time series properties. In a seminal paper Sims, Stock and Watson (1990) have shown that "... the common practice of attempting to transform models to stationary form by difference or cointegration operators whenever it appears likely that the data are integrated is in many cases unnecessary." (Sims, Stock and Watson 1990, 136). Any coefficient that can be written as a coefficient on an I(0) variable, and in a VAR model these are all estimated coefficients other than those on the constant and the trend, are consistent and have standard distributions (see also Watson 1994, Hamilton 1994). Thus VAR analysis is a convenient tool, when one has doubts about the order of integration of the variables, as is often the case with macro economic data.

Unsurprisingly, these advantages come at a price. First, the number of variables that can be included in the VAR is limited because due to its unrestricted nature the model runs out of degrees of freedom quickly. "In practice, VAR modeling for more than four variables is rarely feasible" (Charemza and Deadman 1997, 213). Second, since it is a systems approach that rejects the standard endogenous-exogenous distinction, it is against the grain of the model to include exogenous control variables. Thus we do not control for variables other than the ones in the system except for a time trend.

The standard VAR approach regresses all variables on its own lags and the lags of all other variables (equation 11). No contemporaneous effects are treated explicitly.

Standard VAR: $y_t = d_t + Cy_{t-1} + u_t$ (11)

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 more 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 : $By_t = d_t + Ay_{t-1} + \varepsilon_t$ (12)

In this system of equations contemporaneous interactions are represented explicitly in the matrix B. Contrary to u_t in (11), ε_t in (12) 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 Cholesky decomposition, which was used to calculate the impulse responses imposes a triangular structure on B ("orthogonalization of the error covariance matrix") 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 $(n^2-n)/2$ (Sims 1986, Bernanke 1986; see Endres 1995 as an accessible textbook presentation).

The structural VAR approach proceeds in three steps. First the VAR as it is formulated in Equation (11) 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 data are semiannual and all from the OECD Economic Outlook data base. Accumulation (ACCU) is the growth rate of the business gross capital stock, capacity utilization is the output gap (GAP), the profit share (PS) is the profit share of the business sector; unemployment (U) is the national unemployment rate; productivity growth (GX) is the growth rate of labor productivity of the total economy. In the estimation results the variable names are augmented by the country names as suffixes.

Thus the VAR consists of the five variables. A (linear) trend was added for pragmatic reasons. VAR analysis is appropriate for short term analysis and the trend was statistically significant when added. The trend captures long term effects that are not appropriately captured in the variables. However, the trend, though itself statistically significant, has little impact on the results.

It was decided to test the identical specification for all three countries. This procedure is somewhat rigid because the model cannot be fitted to country specifics, but it guarantees comparability. However, it turns out that the Granger causality tests do not indicate major differences in any case.

In order to keep the model simple and manageable the number of contemporaneous interactions has to be kept small. In cases where theory was an insufficient guide, we resort to Granger causality tests to decide which parameter should stay in the SVAR specification of the contemporaneous effects.[3]

In particular there are four contemporaneous interactions that we wish to decide upon: the interactions between the profit share and capacity utilization; between unemployment and capacity utilization; and between unemployment and the profit share. The results are summarized in table 1

[3] Though this is a standard procedure, it is not entirely unproblematic, because Granger causality refers to the effect of past values, however it is used to infer the presence of the effect of present values. Thus the assumption is, reasonably in a dynamic model, that any effect will be spread over time. Therefore, if there had been no effect of past values, it is unlikely that there be such an effect in present values.

Table 1

Granger Causality Tests (6 Lags)

	UK			USA			France		
Null Hypothesis:	*Obs*	*F-Stat.*	*Prob.*	*Obs*	*F-Stat.*	*Prob.*	*Obs*	*F-Stat.*	*Prob.*
PS does not Granger Cause GAP	54	1.760	*0.132*	62	0.825	*0.556*	50	0.886	*0.515*
GAP does not Granger Cause PS		4.685	*0.001*		3.625	*0.005*		2.515	*0.038*
U does not Granger Cause GAP	54	0.636	*0.701*	62	1.369	*0.246*	50	1.362	*0.256*
GAP does not Granger Cause U		1.215	*0.318*		4.314	*0.001*		2.995	*0.017*
U does not Granger Cause PS	68	1.853	*0.106*	69	1.707	*0.136*	60	1.543	*0.185*
PS does not Granger Cause U		1.814	*0.113*		2.838	*0.017*		0.810	*0.568*

As to the relation between the profit share and the output gap, the results are unambiguous. GAP is Granger causing profit share. In all countries is the F-value higher for the GAP →PS than vice versa, in all three countries it is statistically significant at least at the 5% level, whereas the reverse is nowhere significant. In the following the expression 'statistically significant' will refer to statistical significance at the 5% level. The results are similarly suggestive that the causation goes GAP →U. In all countries is the F value higher and it is statistically significant twice, whereas the reverse is never significant. Only for the question whether U causes PS are the results non-conclusive. Only in the USA do we get significant results for PS→U, and this causation is close to significant in UK. But F statistics are higher for the reverse causation for France and, though by tiny margin, for UK.

Thus the implications for the specification of contemporaneous effects are straightforward for the first three effects. As to the last, the direction of effects between the profit share and unemployment, it was decided to allow the profit share to effect unemployment contemporaneously. However, experimentation with the specification showed that empirical results hardly differ between the specification where U is allowed to affect PS and vice versa. This leaves us with the following specification for contemporaneous interactions:

$$\begin{bmatrix} u_{ACCU} \\ u_{GAP} \\ u_{PS} \\ u_{U} \\ u_{GX} \end{bmatrix} = \begin{bmatrix} b_{11} & 0 & 0 & 0 & 0 \\ b_{21} & b_{22} & 0 & 0 & 0 \\ 0 & b_{32} & b_{33} & 0 & b_{35} \\ b_{41} & b_{42} & 0 & b_{44} & b_{45} \\ b_{51} & b_{52} & 0 & 0 & b_{55} \end{bmatrix} \begin{bmatrix} \varepsilon_{ACCU} \\ \varepsilon_{GAP} \\ \varepsilon_{PS} \\ \varepsilon_{U} \\ \varepsilon_{GX} \end{bmatrix}, \text{ with the expected signs being } \begin{matrix} b_{21} > 0 \\ b_{32} > 0 \\ b_{35} > 0 \\ b_{41} < 0 \\ b_{42} < 0 \\ b_{43} < 0 \\ b_{45} > 0 \\ b_{51} > 0 \\ b_{52} > 0 \end{matrix}.$$

where u is the vector of observed shocks, i.e. the VAR residuals of ACCU, GAP, PS, U and GX, the matrix C is the matrix of contemporaneous interactions and the vector ε is the vector of unobserved innovations.

5. Empirical results

The VAR was estimated with four lags. Lag length tests (see Appendix) indicated that two lags would be sufficient. However, given that some economic variables, in particular investment, may take longer than a year to respond to changes in economic conditions, it was decided to use a lag length of four. Results hardly differ between the two specifications.

Autocorrelation LM tests indicate that autocorrelation is not a major problem (see Appendix). However, the null hypothesis of autocorrelation could not be rejected in the USA for the forth lag and in France for the third lag. The residuals are reasonably close to normally distributed and the null hypothesis of heteroscedasticity was rejected (see Appendix).

The model was estimated for the periods 1970:1-1997:2, 1966:1-1997:2, and 1972:1-1997:1 for UK, USA and France respectively. The different periods are due to data availability. All VARs satisfy the stability condition. The specification is over-identified, however the LR test for over-identification verifies the validity of our restrictions. The results of the structural estimation, i.e. the contemporaneous effects, are summarized in Table 2

Table 2. Estimated contemporaneous effects

	UK		USA		France	
Sample(adj.):	1970:1 1997:2		1966:1 1997:2		1972:1 1997:2	
Included observations:	56		64		52	
	Coefficient	*Prob.*	Coefficient	*Prob.*	Coefficient	*Prob.*
b(21)	565.339	*0.000*	442.858	*0.000*	743.181	*0.000*
b(32)	0.317	*0.013*	-0.060	*0.318*	0.057	*0.700*
b(35)	-10.055	*0.532*	60.646	*0.000*	60.868	*0.001*
b(41)	-45.591	*0.186*	-33.648	*0.168*	-144.288	*0.000*
b(42)	-0.401	*0.000*	-0.435	*0.000*	-0.089	*0.066*
b(43)	-0.012	*0.800*	-0.004	*0.955*	0.009	*0.822*
b(45)	30.486	*0.000*	32.659	*0.000*	8.950	*0.115*
b(51)	-0.632	*0.435*	-1.769	*0.000*	0.178	*0.834*
b(52)	0.007	*0.000*	0.007	*0.000*	0.007	*0.000*
Log likelihood	393.976		512.817		458.115	
LR test for over-identification:						
Chi-square(1)	0.595	*0.440*	0.000	*0.997*	1.835	*0.176*

Overall, the results support the validity of the model proposed. 15 out of 24 estimated coefficients are statistically significant at the 5% level, with all but one of their signs as expected by theory. All of the following effects refer to contemporaneous effects. The effect of the accumulation on capacity utilization is statistically significant in all three countries. Capacity utilization affects the profit shareonly in the UK at the 5% level. A shock to productivity growth increases the profit share in the USA and France. A shock to accumulation leads to lower unemployment at the 5% level only in France, but signs are negative in all countries. An innovation to capacity utilization lowers unemployment in the UK and USA at the 5% level and in France at the 10% level. An innovation to productivity growth increases unemployment at the 5% level in the UK and USA, and at the 10% level in France. Only the effect of accumulation on productivity growth is not statistically significant in two countries and has the 'wrong' sign in the USA, where it is statistically significant.

Table 3. Summary of impulse responses

	UK	USA	France
H1 Keynesian labor market $\frac{\partial u}{\partial a} < 0$ and $\frac{\partial u}{\partial z} < 0$	yes ACCU and Z, both sig or close to sig	yes ACCU and Z	yes ACCU and Z
H2 neoclassical labor market $\frac{\partial u}{\partial \pi} < 0$	no no effect	yes but sig only after 7 periods	no (insig)
H3 substitution $\frac{\partial x}{\partial \pi} < 0$	no insig / no effect	no insig	no insig
H4 Kaleckian distribution-led regimes	no effect insig	insig (ACCU profit-led) (Z exhilarationist)	insig (ACCU profit-led) (Z stagnationist)
H5 reserve army effect $\frac{\partial \pi}{\partial u} > 0$	yes insig	no no effect	no no effect
H6 imperfect wage indexation $\frac{\partial \pi}{\partial gx} > 0$	no	yes sig for 3 periods contemp. coeff. sig.	yes contemp. coeff. sig
H7 technological unemployment $\frac{\partial u}{\partial gx} > 0$	yes long contemp. coeff. sig.	yes sig to 6 lags contemp. coeff. sig.	yes sig to 4 lags

Note. sig = statistically significant

The results of the impulse response analysis can be found in Figures 1 to 3 and are summarized in Table 3. Strong support is found for the Keynesian labor market hypothesis. Goods market variables play a strong role in determining unemployment. Shocks to accumulation as well as capacity utilization have the statistically significant negative effects on the rate of unemployment. How long these effects last differs across countries.

INSERT Figure 1 – 3 about here

Only weak evidence was found, however, for the neoclassical labor market hypothesis. No evidence was found that an innovation to the profit share would affect unemployment in the

UK. In France it did seem to affect unemployment, but not at a standard level of statistical significance and only in the USA did a shock to the profit share cause the effect expected at standard significance levels, but only after 7 periods. Moreover, no evidence to support the substitution hypothesis was found. In no country did an innovation to the profit share have a clear negative effect on productivity.

Distribution also seems to play little role in determining goods market outcomes. None of the effects in the impulse responses were statistically significant. Thus our estimations merely suggest income distribution has little effect. While this is an unspectacular finding, it confirms the theoretical work by Blecker (1989, 1999), Bhaduri and Marglin (1990) and the empirical one by Bowles and Boyer (1995). The result may be due to offsetting effects of profitability and demand.

We found no evidence for the reserve army effect, as it is measured by the rate of unemployment. An innovation to unemployment has little or no effect on the profit share. Only in the UK was there a positive effect, but not statistically significant. This is a surprising finding that is not consistent with the literature. However, the results seem to be robust and may be due to the generous lags of the dependent variable.[4] An innovation to productivity growth, on the other hand, does (statistically significantly) increase the profit share in the USA and France. There the contemporaneous effects are also statistically significant. So productivity changes are not neutral in terms of distribution.

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[4] Results are the same if employment as share of the working age population is used instead of the rate of unemployment, thus it does not seem to depend on the measure of labor market slack. Single equation estimations were ambiguous, but did indicate that including lagged dependent variables did decrease the likelihood of getting a statistically significant effect of unemployment on income distribution.

Finally, an innovation to labor productivity growth does have a positive impact on unemployment in all countries, and, in fact, rather persistently so. This suggests that a (positive) supply side shock does not by itself generate the demand to keep the economy at full employment. Neither accumulation nor capacity utilization shows strong or statistically significant reaction to an innovation to labor productivity growth.

How reliable are these findings? A series of tests were performed to ensure the robustness of the results. First, it was checked whether the results were sensitive to variable specification. The profit share of the total economy was used instead of the profit share of the business sector. The employment share (employment divided by working age population) was used instead of the unemployment rate. Instead of the output gap, detrended capital productivity and GDP growth were used. In neither case were there major changes in the results. Second, to check whether missing variables are distorting the results we experimented with specification including, alternatively, the real interest rate, inflation and the change in inflation. Again, no major changes in the impulse responses occurred, though, unsurprisingly, confidence intervals increased. Third, unfortunately there is no standard test for structural breaks in a VAR. Instead the model was estimated for sub-periods. The sample was split in half and estimated for 82-97. None of these did indicate any dramatic change in either the coefficients or the impulse responses. However, diagnostic statistics for the sub-periods deteriorated notably.

Given the dismal performance of the profit share in explaining other variables, the question arises whether profit share is an appropriate measure for income distribution. At the conceptual level we consider the profit share appropriate, because it puts real wages in relation to output. However, there may be measurement problems. First there is the issue of taxes. The savings differential through which profit share is expected to effect consumption, works from net income, i.e. post-tax income, whereas profit share measures pre-tax income distribution. The same is true for the profit share in labor demand. If there is a significant tax wedge between post-tax wages and gross compensation, the profit share may be a bad proxy. However, since tax structures change slowly, it would be surprising, if this problem dominates the VAR estimations. Second, the profit share is value added minus labor compensation. Thus it includes the income of self-employed as profits, whereas wage payments to management are counted as wages. This may explain why the USA report a roughly stable profit share of the period 1980-95, whereas, in fact, the bottom 80% of wage earners experienced declines in their real wages (Gordon 1996). These issues certainly deserve further research, however addressing them is beyond the scope of the present paper.

Thus we conclude that, while the discussion and development of indicators of income distribution is warranted, the results are robust. In particular they do not seem to be due to missing variables or specific proxies chosen.

6. Conclusion

A structural VAR system consisting of accumulation, capacity utilization, the profit share (as a proxy for income distribution), unemployment and the growth of labor productivity was estimated, based on a general Post-Keynesian macro model. The results suggest that accumulation impacts strongly upon capacity utilization and both, accumulation and capacity utilization, have significant effects on unemployment. Thus the basic Keynesian story is confirmed: goods market variables have a strong impact on unemployment and the economy is driven by investment expenditures. Contrary to neo-classical expectations, little or no evidence was found for the hypothesis that changes in real wages, and thus income distribution, effect unemployment. Moreover, the substitution of labor for capital in response to higher wage share is not verified empirically.

The findings suggest that productivity growth, does play an important role. It is not distributionally neutral and causes unemployment. Thus the findings highlight the empirical relevance of neo-Kaldorian models, which emphasize that a positive technology shock will not automatically increase output, but rather its effect interact with demand formation.

The econometric results do not lend themselves to straightforward policy conclusions, since no policy variables, such as government investment, were included. However, they support Keynesian theorizing of how the economy works strongly. Thus with all due qualifications, the most important policy conclusion is negative and simple. It will be no surprise to Keynesians, but is stubbornly ignored by mainstream economists and organizations: wage reductions are ineffective in combating unemployment.

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Figure 1. Impulse responses UK

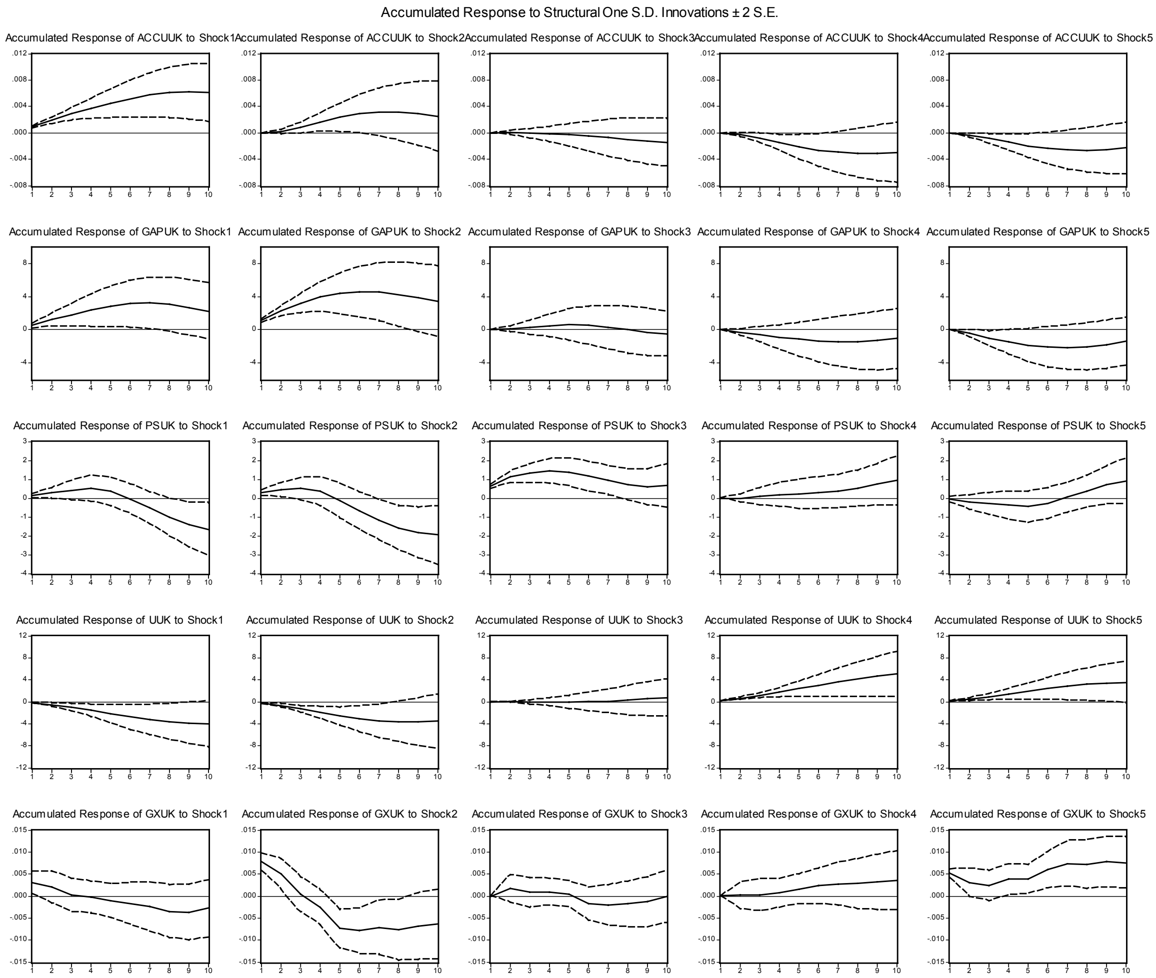


Figure 2. Impulse responses USA

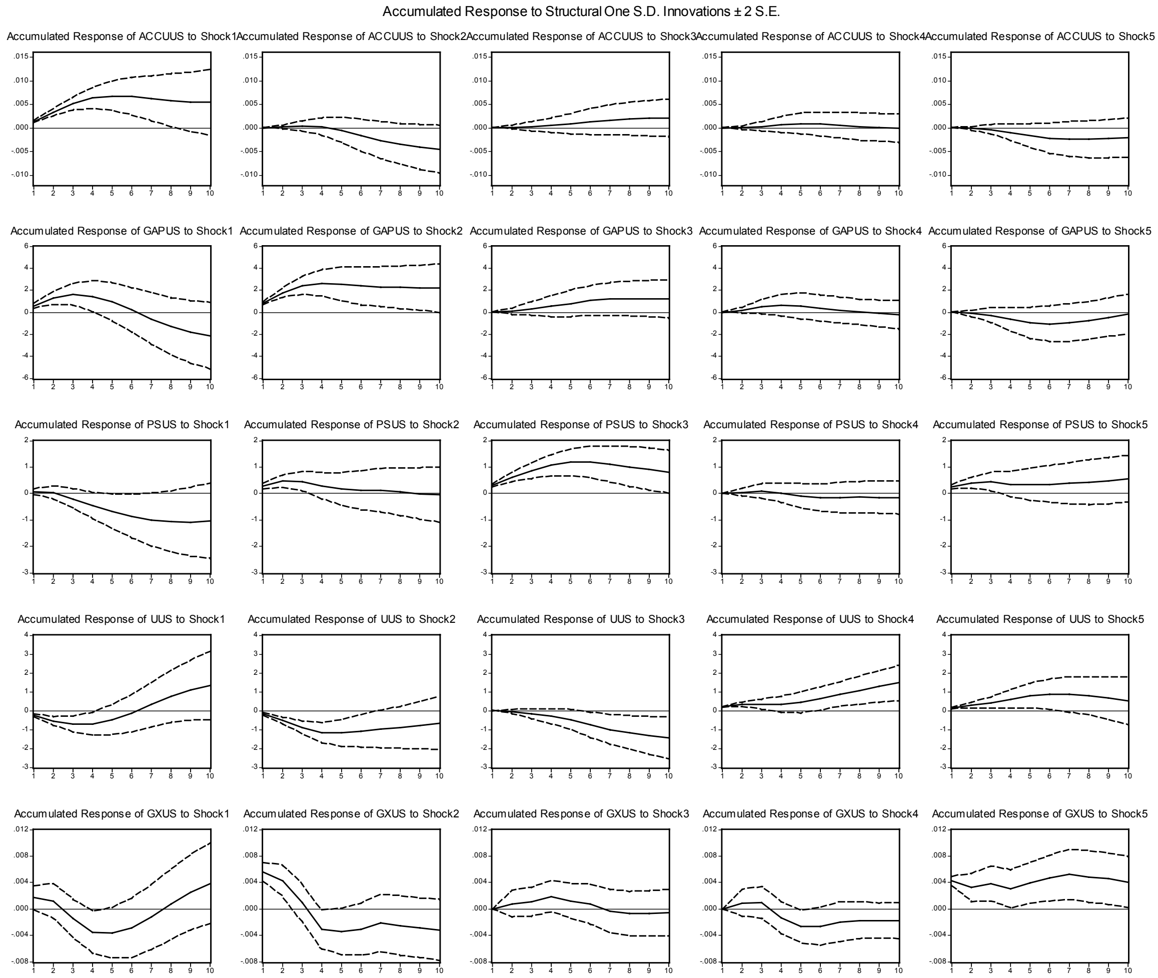
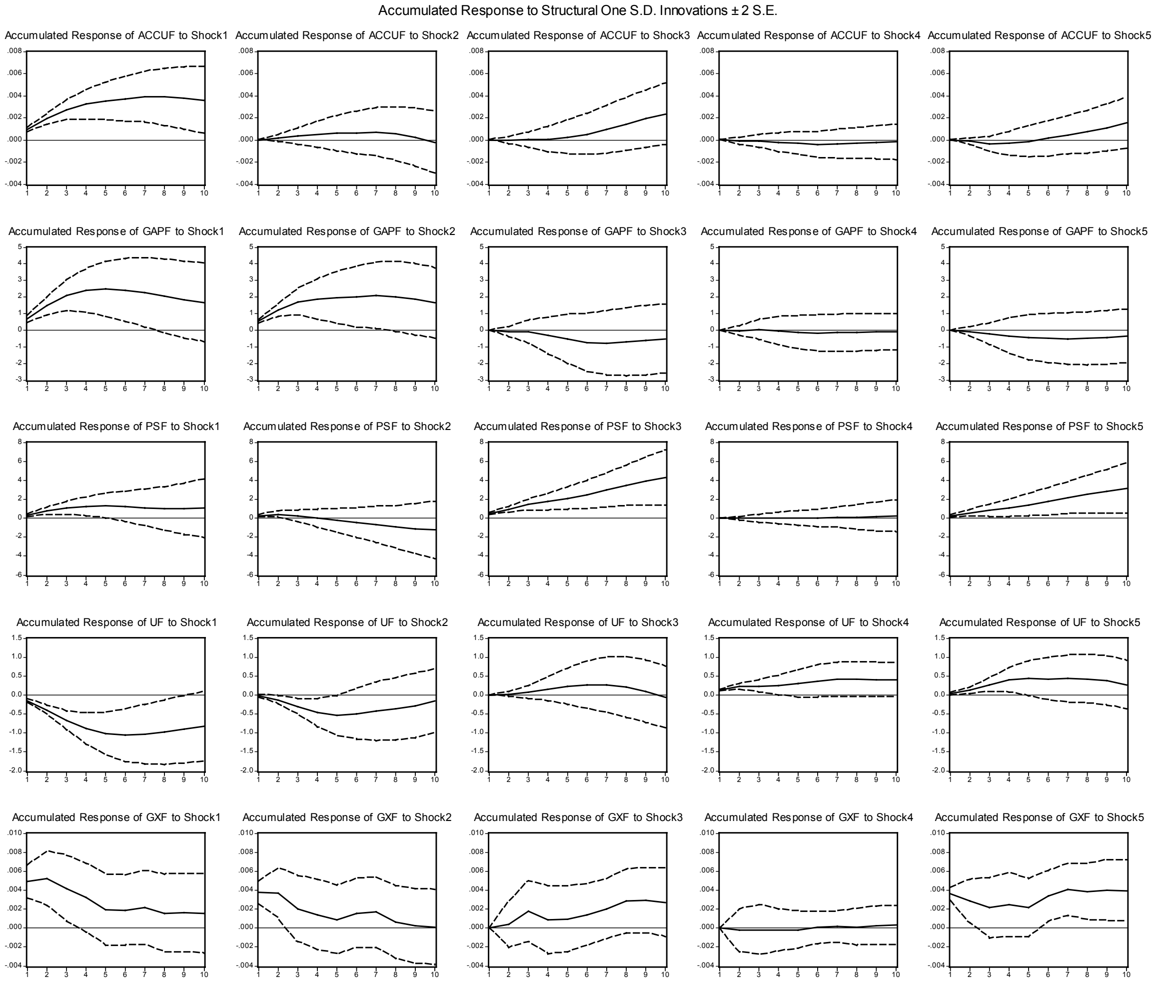


Figure 3. Impulse responses France



APPENDIX

Lag length tests

VAR Lag Order Selection Criteria

UK
Endogenous variables: ACCUUK GAPUK PSUK UUK GXUK
Exogenous variables: C @TREND
Sample: 1960:1 1997:2
Included observations: 54

Lag	LogL	LR	FPE	AIC	SC	HQ
0	95.27659	NA	2.92E-08	-3.158392	-2.790062	-3.016342
1	383.2542	501.2943	1.73E-12	-12.8983	-11.60915*	-12.40113
2	419.1622	55.85686*	1.19E-12*	-13.3023	-11.09232	-12.45000*
3	434.2099	20.62092	1.86E-12	-12.9337	-9.802891	-11.72627
4	458.5591	28.8583	2.19E-12	-12.90959	-8.85796	-11.34704
5	494.6222	36.0631	1.85E-12	-13.31934	-8.346879	-11.40166
6	534.45	32.45233	1.59E-12	-13.86852*	-7.975233	-11.59571

USA
Endogenous variables: ACCUUS GAPUS PSUS UUS GXUS
Exogenous variables: C @TREND
Sample: 1960:1 1997:2
Included observations: 62

Lag	LogL	LR	FPE	AIC	SC	HQ
0	215.0668	NA	9.22E-10	-6.615059	-6.271973	-6.480355
1	490.2865	488.2929	2.89E-13	-14.68666	-13.48586*	-14.2152
2	527.0096	59.23093*	2.02E-13*	-15.06483*	-13.00631	-14.25660*
3	542.6546	22.71049	2.87E-13	-14.76305	-11.84682	-13.61807
4	562.7616	25.94446	3.67E-13	-14.60521	-10.83126	-13.12347
5	583.6487	23.58219	4.87E-13	-14.47254	-9.840875	-12.65403
6	606.3344	21.95394	6.66E-13	-14.39788	-8.908505	-12.24262

France
Endogenous variables: ACCUF GAPF PSF UF GXF
Exogenous variables: C @TREND
Sample: 1960:1 1997:2
Included observations: 50

Lag	LogL	LR	FPE	AIC	SC	HQ
0	225.8042	NA	1.23E-10	-8.632169	-8.249765	-8.486548
1	423.7577	340.4799	1.23E-13	-15.55031	-14.21189*	-15.04063*
2	457.2371	50.88870*	9.07E-14*	-15.88948	-13.59506	-15.01575
3	478.9534	28.66559	1.14E-13	-15.75814	-12.5077	-14.52035
4	511.0261	35.92141	1.03E-13	-16.04105	-11.83459	-14.43921
5	545.0063	31.26175	9.86E-14	-16.40025	-11.23779	-14.43436
6	583.8859	27.99333	9.71E-14	-16.95544*	-10.83696	-14.62549

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Autocorrelation test

VAR Residual Serial Correlation LM Tests
H0: no serial correlation at lag order h

	UK		USA		France	
Sample:	1960:1 1997:2		1960:1 1997:2		1960:1 1997:2	
Incl. Obs.:	54		64		52	
Lags	*LM-Stat*	*Prob*	*LM-Stat*	*Prob*	*LM-Stat*	*Prob*
1	36.870	*0.059*	21.519	*0.663*	28.211	*0.298*
2	24.911	*0.467*	18.390	*0.825*	16.263	*0.907*
3	35.756	*0.075*	26.476	*0.383*	41.016	*0.023*
4	34.264	*0.102*	38.359	*0.043*	21.251	*0.679*
5	22.110	*0.629*	22.676	*0.597*	16.135	*0.911*
6	18.425	*0.824*	37.501	*0.052*	27.697	*0.322*
7	33.129	*0.128*	23.188	*0.567*	16.231	*0.908*
8	18.016	*0.842*	15.091	*0.939*	29.078	*0.261*
9	20.411	*0.725*	16.864	*0.887*	33.467	*0.120*
10	24.097	*0.514*	14.870	*0.944*	16.135	*0.911*
11	19.697	*0.763*	31.120	*0.185*	18.912	*0.801*
12	13.344	*0.972*	32.341	*0.148*	29.383	*0.248*

Probs from chi-square with 25 df.

Normality Test of VAR residuals

	VAR residual of ACCU	GAP	PS	U	GX
UK					
Jarque-Bera	1.545	19.685	2.048	0.469	1.153
Probability	*0.462*	*0.000*	*0.359*	*0.791*	*0.562*
USA					
Jarque-Bera	1.479	1.806	0.555	6.968	1.351
Probability	*0.477*	*0.405*	*0.758*	*0.031*	*0.509*
France					
Jarque-Bera	4.788	1.289	2.598	0.587	2.995
Probability	*0.091*	*0.525*	*0.273*	*0.746*	*0.224*

White Heteroscedasticity Test (joint test)

	Chi-sq	df	Prob.
UK	631.2502	630	*0.479*
USA	672.0241	630	*0.120*
France	629.8514	630	*0.494*