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Accumulation, distribution and employment: a structural VAR approach to a Kaleckian macro model

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Abstract

The paper investigates the relation between effective demand, income distribution and unemployment empirically. A Kaleckian macro model is presented and tested by means of a structural vector autoregression (VAR) model. The hypotheses explored focus on the determination of unemployment. The VAR model consists of capital accumulation, capacity utilization, the profit share, unemployment and the growth of labor productivity and is estimated for the USA, UK and France. We find that employment is demand-led and that income distribution has little effect on either demand or employment. Technological progress effects income distribution as well as employment.
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1. Introduction

This paper investigates the relation between effective demand, income distribution and unemployment empirically. Kaleckians, or if the reader prefers: post-Keynesians, differ

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fundamentally from neoclassical economists in how they perceive of the interaction between the goods market and the labor market. For Kaleckians unemployment is the result of demand deficiencies on the goods markets. Thus goods market variables determine labor market behavior. For neoclassical economics, at least in its textbook version, unemployment is a labor market phenomenon. There exists a real wage which would clear the labor market. Unemployment will arise if the real wage is too high, which will usually be due to frictions caused by governments, labor unions or insiders. Needless to say, present incarnations of the neoclassical theory are more sophisticated and may at times even give different results. The focus of this paper is on the Kaleckian model and neoclassical arguments will only be discussed in passing.

A Kaleckian macroeconomic model 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. In the VAR methodology, each dependent variable is regressed on the lagged values of all other variables in the system. Due to this flexible modeling strategy the VAR allows for Kaleckian as well as non-Kaleckian effects (of the lagged variables). Only in the contemporaneous interactions of the variables is the post-Keynesian model imposed. The model is estimated for the USA, UK and France.[1] The time period under investigation ranges from the early 1960s to the late 1990s.

Hypotheses are derived from the Kaleckian model and explored empirically. Thus the following questions are addressed: Is unemployment driven by goods market variables? What is the effect of changes in the income distribution on accumulation? Does technological progress increase unemployment? In addition to the hypotheses derived from the Kaleckian model, two rather general neoclassical hypotheses are explored. The corresponding questions are: Does an increase in wages cause unemployment? Does an increase in wages lead to substitution effects? Because of the general nature of the VAR methodology, such effects can exist. Since these effects are not derived from an explicit model, but tested ad hoc, no claim is made that a neoclassical model be tested. Rather the empirical relevance of two mechanisms often stressed in the neoclassical literature is evaluated, in addition to the test of the Kaleckian model.

The paper is structured as follows. Section 2 presents the model. Section 3 summarizes the hypotheses to be investigated. Section 4 discusses the econometric method and various data issues. Section 5 presents the econometric results for the tests performed. Section 6 compares the findings with those of earlier research and, finally, Section 7 derives conclusions.

2. The model

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

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

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 profit share, 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. These functions are derived from Kalecki or Kaleckian debates. Where extensions were made, we discuss the relation to standard Kaleckian arguments.

As summarized by Steindl (1981) Kalecki has proposed three versions of his investment function, each centered around the effects of profits, demand and available finance on investment decisions. In his later (1968) work, in addition, he emphasized the role of technological progress in inducing investment. Since the early 1980s the Kaleckian debate routinely uses an investment function depending on profitability and capacity utilization and discussions have focused on it precise formulation. Marglin and Bhaduri (1990) have pointed out that including the profit *rate* along side capacity utilization imposes a stagnationist regime, i.e. an expansionary effect of an increase in the wage share. (We will return to the issue of stagnationist regimes after having introduced the savings function and goods market equilibrium). The investment function proposed by Marglin and Bhaduri has not gone unchallanged (see Lavoie, 1995, 1996), but since it is the more general formulation it will be used.

Marglin and Bhaduri (1990) proposed to decompose the profit rate (r) into the profit share (π), capacity utilization (z) and (technical) capital productivity (k).

$$r = \frac{R}{K} = \frac{R}{Y}\frac{Y}{\bar{Y}}\frac{\bar{Y}}{K} = \pi z k$$

Thus expected profitability, i.e. the expected profit rate, will be composed of expected profit share 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:

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

where all coefficients are positive numbers. Investment is normalized by capital stock, as will be savings. This is for convenience. Compared to the standard empirical literature on investment behavior (e.g. Kopcke, 1985; Ford and Foret, 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 shocks to accumulation.

This investment function is in line with Kalecki's emphasis on demand considerations and available finance, but does not take into account his later work (1968), which emphasized the role of technological progress. This is due to the fact that issue of the recent debate is the question of how distributional changes affect growth. For that purpose technology is

routinely assumed as given. This is not appropriate in our context, thus the Marglin-Bhaduri investment function is augmented by a term for productivity growth.

$$g_t^I \equiv \frac{I_t}{K_t} = a_0 + a_1 z_{t-1} + a_2 \pi_{t-1} + a_5 x_{t-1} \tag{2}$$

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 (Eq. (4)) to get the following expression for capacity utilization (Eq. (5)).

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

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

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, $\partial z/\partial \pi = -b_2/b_1 < 0$, 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, 2002; 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′)

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

Consequently the sign of $\partial z/\partial \pi$ will be indeterminate even contemporaneously. A situation where $\partial z/\partial \pi > 0$ 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 Eqs. (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 Eq. (5′) in (2) we get the following equilibrium growth curve as a function of income distribution.

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

Depending on the sign of $(a_2 + a_1(h_2 - b_2/b_1 + h_1))$ the total derivative $\mathrm{d}g_t^I/\mathrm{d}\pi_{t-1}$ 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 $\partial g_t^I/\partial \pi_{t-1} = a_2$), the positive international demand effect $((\partial g_t^I/\partial z_{t-1})(\partial z_{t-1}/\partial nx_{t-1})(\partial nx_{t-1}/\partial \pi_{t-1}) = (a_1 h_2/(b_1 + h_1)))$ and the negative domestic consumption effect $((\partial g_t^I/\partial z_{t-1})(\partial z_{t-1}/\partial \pi_{t-1}) = (-a_1 b_2/(b_1 + h_1)))$. 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 turn to income distribution. In his theoretical work, Kalecki argued that income distribution is crucially determined by price setting of oligopolistic firms. Their prices will depend on degree of competition and on the strength of labor unions, both of which Kalecki (1954) called the 'degree of monopoly power'. In a equally famous piece, Kalecki (1943) argued that sustained full employment would strengthen the working class to a point where it erodes work discipline and thus destablize the capitalist system. While he remarked that much of the resulting wage pressure would result in inflation rather than immediate wage increases, the argument certainly implies that income distribution depends on unemployment. The relevant value of unemployment, following Kalecki's argument, is (a weighted average of) past unemployment rather than its current value. In his empirical work, Kalecki (1954) furthermore emphasized that the profit share will be pro-cyclical due to fixed employment.

The profit share, or distribution, function thus includes capacity utilization and the unemployment rate. Different from Kalecki himself we include a term for productivity growth.

There are two reasons for that. First, Kalecki formulated his argument in the context of a given technology. In a world with growing productivity, the distributional struggle may be more about the division of productivity gains, than about output itself. Second, even if the first point is considered important, *unanticipated* productivity growth will still have short term distributional effects, since wage contracts have long, usually one year, periods. The profit share function thus is:

$$\pi_t = d_0 + d_1 z_t + d_3 u_{t-1} + d_4 x_t \tag{8}$$

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. If wages grow in line with productivity, d_4 will equal zero.

The recent debate has been more on the effects of income distribution than on its determinants. Moreover it usually has taken technology as given. Lavoie (1992) proposes a model where distribution is determined by the change in unemployment. This is hard to reconcile with Kalecki's notion of *sustained* full employment or unemployment. Our profit equation deviates from earlier formulations by Marglin and Bhaduri (1990) and Rowthorn (1980) 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.

Kalecki (1968) emphasized the importance of technological progress for investment, but said little about the determinants of technological progress itself. While calling it 'semi-autonomous', in fact he models it as exogenous. This may be useful for Kalecki's problem of analyzing cycle and trend (though even there one may have doubts), it certainly is not for the purpose of explaining actual economies over the past decades. Thus in modeling the growth of labor productivity we follow Kaldorian lines. Eq. (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.

$$x_t = \tau_0 + \tau_1 g_t + \tau_t z_t \tag{9}$$

Eq. (9) therefore constitutes an extension of the Kaleckian model, however, one that is consistent with his general approach. Kalecki himself had emphasized that putting in use of new machinery increased productivity. The Kaldorian assumption of dynamic returns to scale, however is alien to the Kaleckian argument. But it may be argued that it goes well with Kalecki's insistence on imperfect competition.

Finally there is the unemployment function (Eq. (10)). Kalecki used to assume that unemployment is determined by effective demand, however he rarely included it explicitly in his models, much like other post-Keynesians. More recent Kaleckian literature adopted the habit of assuming that unemployment moves in line with capacity utilization (e.g. Bowles and Boyer, 1995). While this is appealing at first glance, it is incorrect for the purpose of medium run analysis that Kaleckian models are designed for. The fundamental assertion of Kalecki as well as other post-Keynesians is that employment depends on output as determined by effective demand. Assuming that productive capacity is given, as is standard for short run analysis, employment (E) will thus depend of capacity utilization. Once we move beyond the short run however, capacity cannot be treated as exogenous any more. More precisely, it (or at least its rate of change) is endogenously given through the investment function. More formally, if $E = f(Y)$ and $Y = zK$, then the growth of employment will depend on the change of capacity utilization and the growth of capital stock. We thus get the following unemployment function:

$$u_t = e_0 - e_4 g_t - e_1 \Delta z_t + e_3 u_{t-1} + e_5 x_t \tag{10}$$

The unemployment function thus depends on the two goods market variables, accumulation and capacity utilization, then there is past unemployment, and the growth of labor productivity. The first two are standard Keynesian or Kaleckian variables: e_1 and e_4 measure the effect of goods market variables and e_3 unemployment persistence. Finally, if technological progress is not matched by a rise in effective demand, then it will lead to unemployment. This is a natural result in any demand constraint macro model and crystallizes in the effect of e_5. e_0 essentially captures labor supply shocks.

In a variant of the system, we want to consider non-Keynesian effects. A standard labor demand schedule would be negatively sloped in wages. Here our proxy for wages is the profit share. If labor demand primarily depends on wages, as neoclassical economics assumes, e_2 should be the important coefficient, which captures the effect of real wage per worker after controlling for labor productivity.

$$u_t = e_0 - e_4 g_t - e_1 \Delta z_t + e_3 u_{t-1} + e_5 x_t - e_2 \pi_t \tag{10'}$$

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′)).

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. All hypotheses except the last two, which deal with neoclassical theory, follow directly from the model presented above.

H1 (The demand-led labor market hypothesis). Kaleckians as well as other 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 $\partial u/\partial z < 0$ and $\partial u/\partial g^I < 0$.

H2 (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; Rowthorn, 1981). 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 if accumulation is wage-led (profit-led), an innovation to the profit share has a negative (positive) effect on accumulation.

H3 (The reserve army effect). Kalecki's (1943) paper implies the existence of a positive effect of unemployment on the profit share. Various theories derive such a 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). 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 $\partial\pi/\partial u > 0$.

H4 (Imperfect wage indexation to labor productivity). If wages are imperfectly indexed to labor productivity growth, then we expect an innovation to labor productivity growth to effect the profit share positively, i.e. that $\partial\pi/\partial x > 0$. Such an effect is consistent with the Kaleckian framework, indeed with all models that assume money wage contracts at least in the short run and have been at the center of the Kaldorian models by Boyer (1988, 1993).

H5 (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 $\partial u/\partial x > 0$. This, again, is a proposition that most Keynesian would share.

Two neoclassical hypotheses, the downward sloping labor demand curve and substitution, will also be considered. A full discussion of a neoclassical model of accumulation, distribution and employment is beyond the scope of this paper. However these two neoclassical effects will still be discussed because, first, they refer to the most frequent criticisms that post-Keynesian economists face and, second, these are crucial for many mainstream (e.g. OECD) policy recommendations. The flexible VAR methodology used allows to draw some empirical conclusions on them.

H6 (The neoclassical labor market hypothesis). Neoclassical labor market analysis holds that employment will be a negative function of real wages. This proposition is derived from profit maximizing behavior of competitive firms. In our model, the proxy for real wages is one minus the profit share. Thus H2 posits that an innovation to the profit share will decrease unemployment, i.e. that $\partial u/\partial \pi < 0$.

A qualification is in place. Not all neoclassical theories support the above hypothesis. In particular, recent debates on the market power and labor demand have proposed and successfully tested empirically cases where increases in minimum wages can increase employment (Card and Krueger, 1994). Nonetheless the standard assumption is that the labor demand curve is downward sloping in wages.

H7 (Substitution). The second effect refers to the issue of substitution. While Kaleckians usually content themselves with assuming a Leontief technology, neoclassical economists insist on the importance of substitution. Thus they claim that if there is an increase in wages (in the present context a decrease in the profit share) labor will be substituted for capital. As a consequence of the higher capital labor ration labor productivity will increase. Thus H7 states that $\partial x/\partial \pi < 0$.[2]

As a qualification it has to be noted that there is nothing intrinsic to neoclassical theory that requires substitution to work strongly and fast. Thus a rejection of H7 is consistent with neoclassical theory as a special case. However the importance that neoclassical growth theorists have attributed to substitution (e.g. Solow, 1970) justifies associating this hypothesis with neoclassical theory.

All the effects discussed above (except H2) are partial effects. The VAR framework used does not distinguish between partial and total effects, but gives the effects at different points in time. Only the estimated contemporaneous effects are clearly partial effects. We will interpret the effects in the impulse responses as being dominated by partial effects in the short run, i.e. the first two or three semesters.

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

[2] If H7 holds this need not necessarily be due to substitution. H7 can also be derived from efficiency wage models. We are grateful to an anonymous referee for pointing this out.

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 et al., 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 (Eq. (11)). No contemporaneous effects are treated explicitly.

$$\text{Standard VAR}: \quad y_t = d_t + Cy_{t-1} + \upsilon_t \tag{11}$$

where: y is the vector of variables, d is deterministic variables (constant, trend), υ is the 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 υ_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).

$$\text{Primitive VAR}: \quad By_t = d_t + Ay_{t-1} + \varepsilon_t \tag{12}$$

In this system of equations contemporaneous interactions are represented explicitly in the matrix B. Contrary to υ_t in (11), ε_t in (12) will not be cross-correlated. Note that $C = B^{-1}A$ and $\upsilon_t = B^{-1}\varepsilon_t$, the latter explains the nature of cross-correlation among the errors in υ.

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 thus proceeds in three steps. First the standard VAR (Eq. (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) as percentage of potential output, 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. Identical specifications were applied to all three countries.

The contemporaneous interactions are given by Eqs. (2), (5), (8), (9) and (10′). In order to keep the model simple and manageable, the number of contemporaneous interactions has to be kept small. Thus an additional restriction was applied. Since, with mark ups constant and fixed labor costs, the profit share changes endogenously by definition, whereas consumption expenditures take time to adjust to changes in income, it was decided to allow only a contemporaneous effect from capacity utilization to profit share and not vice versa. This leaves us with the following specification for contemporaneous interactions:

$$\begin{bmatrix} \upsilon_{\mathrm{ACCU}} \\ \upsilon_{\mathrm{GAP}} \\ \upsilon_{\mathrm{PS}} \\ \upsilon_{\mathrm{U}} \\ \upsilon_{\mathrm{GX}} \end{bmatrix} = \begin{bmatrix} b_{11} & 0 & 0 & 0 & 0 \\ b_{21} & b_{22} & 0 & 0 & 0 \\ 0 & b_{32} & b_{33} & 0 & b_{35} \\ b_{41} & b_{42} & 0 & b_{44} & b_{45} \\ b_{51} & b_{52} & 0 & 0 & b_{55} \end{bmatrix} \begin{bmatrix} \varepsilon_{\mathrm{ACCU}} \\ \varepsilon_{\mathrm{GAP}} \\ \varepsilon_{\mathrm{PS}} \\ \varepsilon_{\mathrm{U}} \\ \varepsilon_{\mathrm{GX}} \end{bmatrix},$$

$$\text{with the expected signs being : } \begin{matrix} b_{21} > 0 \\ b_{32} > 0 \\ b_{35} > 0 \\ b_{41} < 0 \\ b_{42} < 0 \\ b_{45} > 0 \\ b_{51} > 0 \\ b_{52} > 0 \end{matrix}.$$

Table 1
Estimated contemporaneous effects

	UK		USA		France	
	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
Sample (adj.):	1970:1 to 1997:2		1966:1 to 1997:2		1972:1 to 1997:2	
Included observations	56		64		52	
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

where υ is the vector of observed shocks, i.e. the VAR residuals of ACCU, GAP, PS, U and GX, the matrix B 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 A) 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 A). 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 A).

The model was estimated for the periods 1970:1 to 1997:2, 1966:1 to 1997:2, and 1972:1 to 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 1.

Overall, the results support the validity of the model proposed. 15 out of 24 estimated Kaleckian coefficients[3] are statistically significant at the 5% level, with all but one of their

[3] 24 out of the 27 coefficients are Kaleckian since b(43) is a neoclassical effect. Strictly speaking, the Kaleckian

Table 2
Summary of impulse responses

	UK	USA	France
H1 demand-led market $\partial u/\partial a < 0$ and $\partial u/\partial z < 0$	Yes ACCU and Z, both sig or close to sig	Yes ACCU and Z	Yes ACCU and Z
H2 distribution-led regimes	No effect Insig.	Insig. (ACCU profit-led) (Z exhilarationist)	Insig. (ACCU profit-led) (Z stagnationist)
H3 reserve army effect $\partial\pi/\partial u > 0$	Yes Insig.	No No effect	No No effect
H4 imperfect wage indexation $\partial\pi/\partial gx > 0$	No	Yes Sig for three periods Contemp. coeff. sig.	Yes Contemp. coeff. sig
H5 technological unemployment $\partial u/\partial gx > 0$	Yes Long Contemp. coeff. sig.	Yes Sig. to six lags Contemp. coeff. sig.	Yes Sig. to four lags
H6 neoclassical labor market $\partial u/\partial\pi < 0$	No No effect	Yes But sig only after seven periods	No (insig.)
H7 substitution $\partial x/\partial\pi < 0$	No Insig./no effect	No Insig.	No Insig.

Note. sig = statistically significant.

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 share only 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.

The results of the impulse response analysis can be found in Figs. 1–3 and are summarized in Table 2. Strong support is found for the demand-led labor market hypothesis. Goods market variables play a strong role in determining unemployment. Shocks to accumulation as well as capacity utilization have statistically significant negative effects on the rate of unemployment. How long these effects last differs across countries.

model ought to be estimated without b(43). However, since the estimate of b(43) is so close to zero and statistically insignificant, the two specifications are not reported separately.

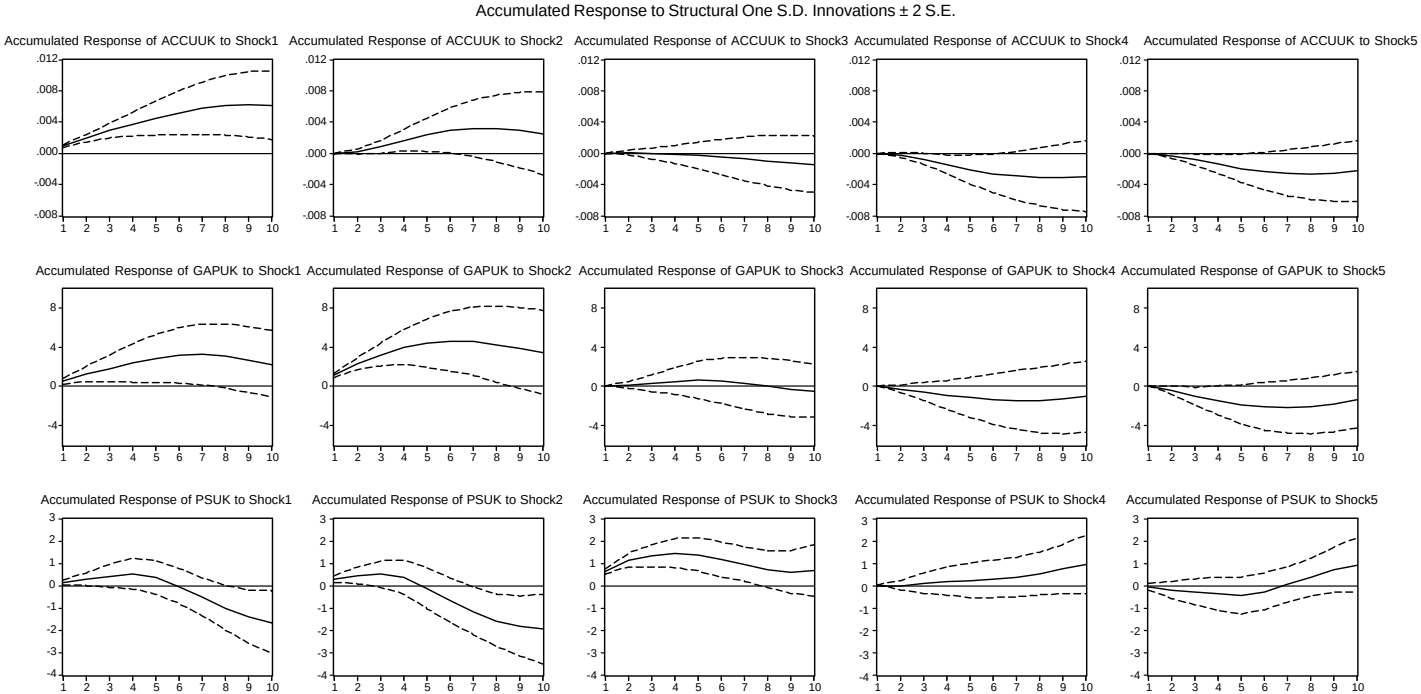

Fig. 1. Impulse responses UK.

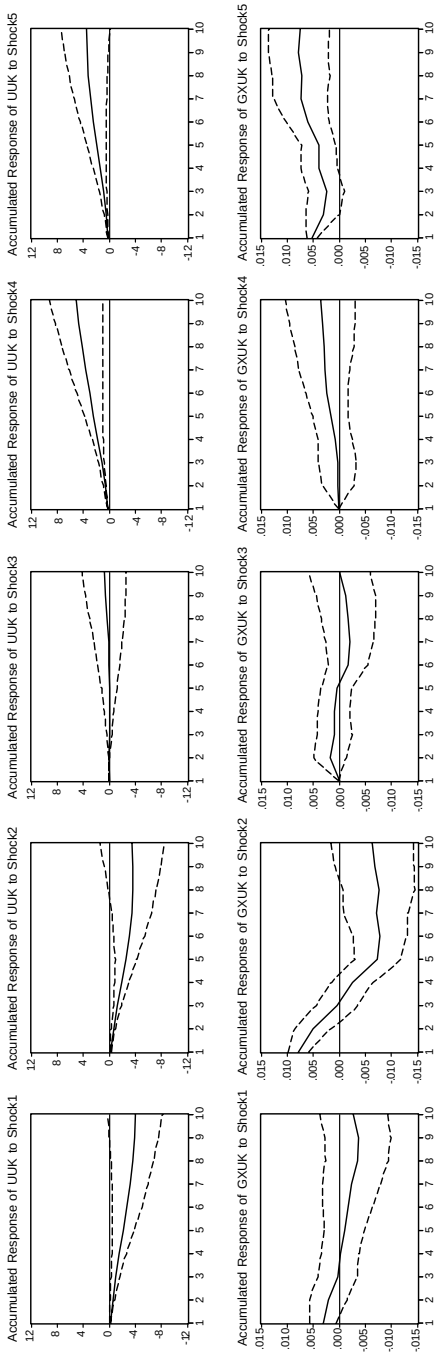

Fig. 1. (*Continued*).

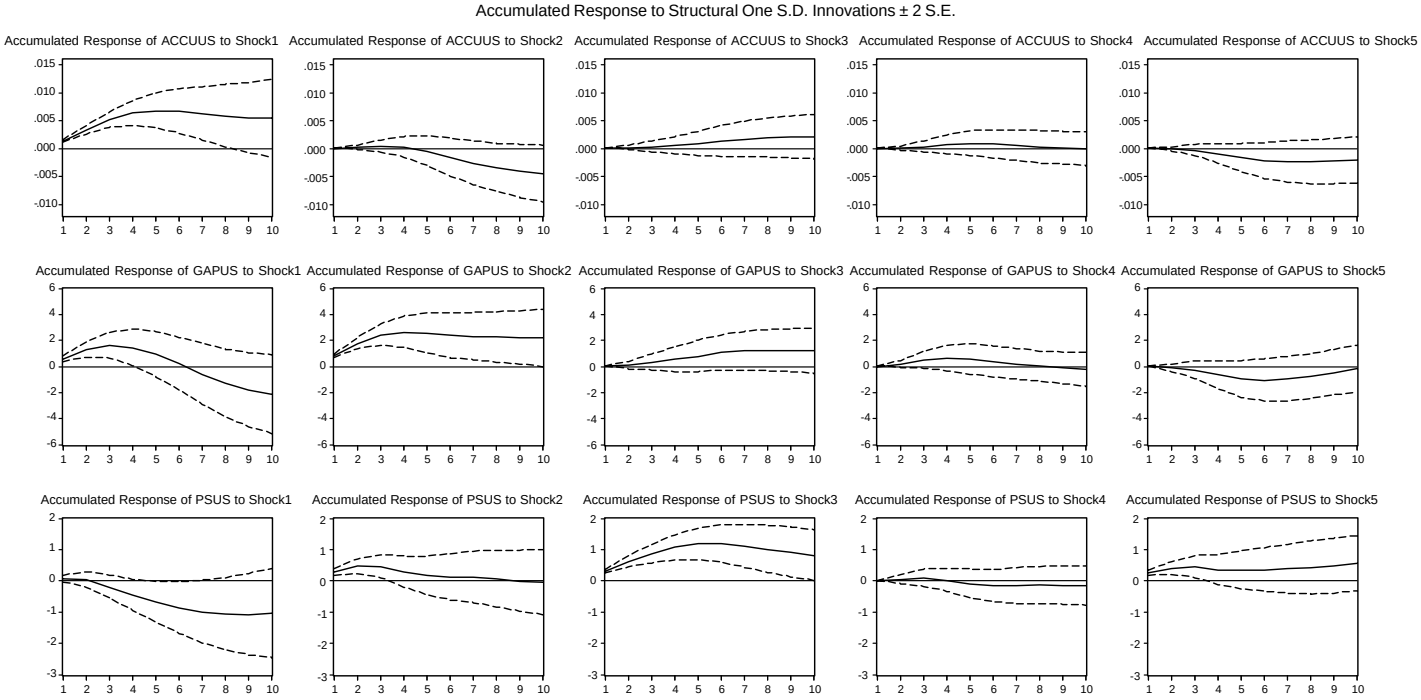

Fig. 2. Impulse responses USA.

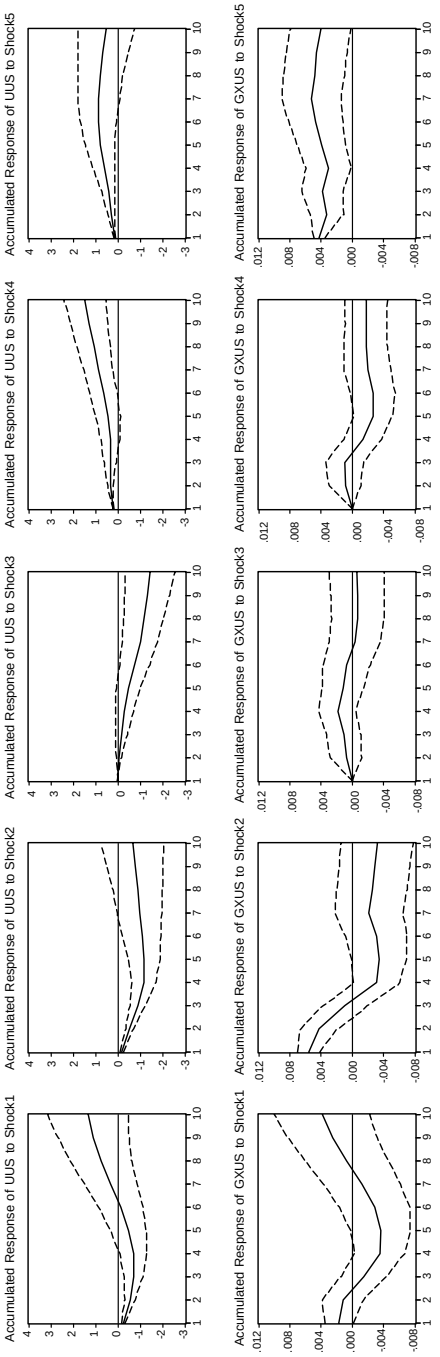

Fig. 2. (*Continued*).

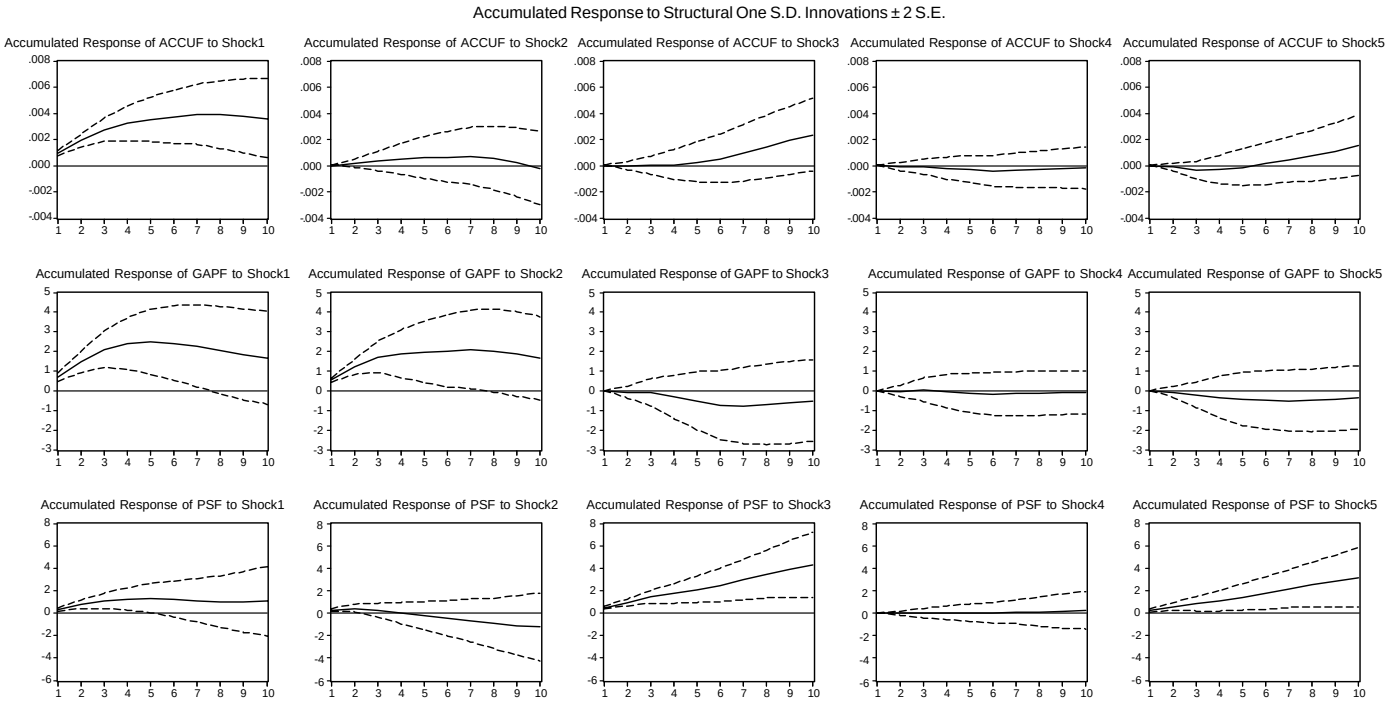

Fig. 3. Impulse responses France.

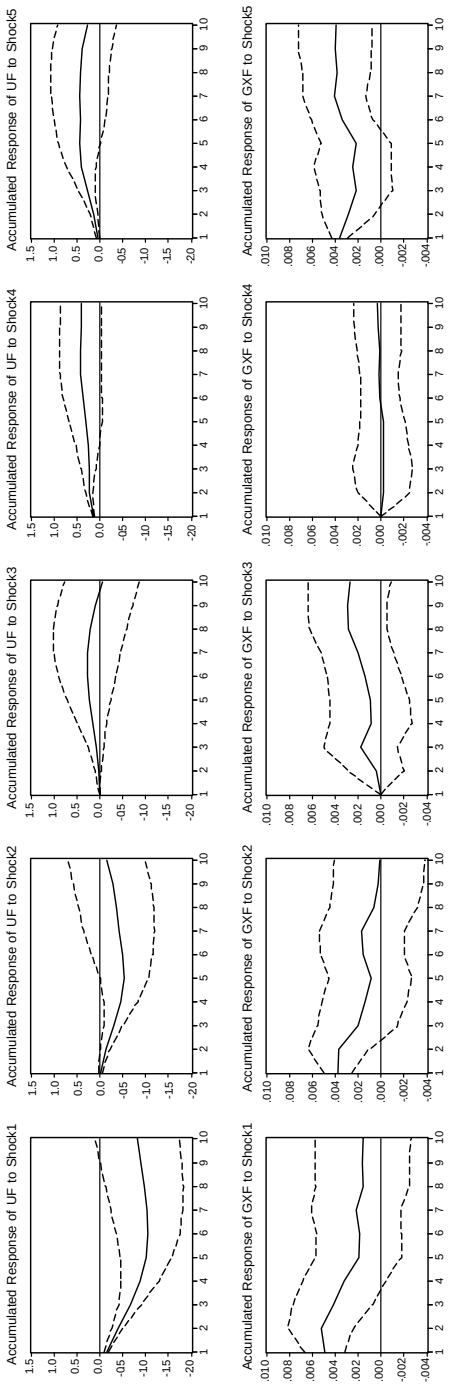

Fig. 3. (*Continued*).

Distribution seems to play little role in determining goods market outcomes. None of the effects in the impulse responses were statistically significant. While this is an unspectacular finding, it is consistent with the theoretical work by Blecker (1989) and Bhaduri and Marglin (1990). 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.

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.

Weak or no evidence was found 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 seven 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.

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 the 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.

[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.

Given the disappointing 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 are significant changes in the 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 1980–1995, 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. While neither of these conceptual problems seems strong enough to explain the results, there is a simple empirical evidence that the profit share is a meaningful variable: it is (negatively) correlated with real wage, in France and the UK statistically significant at the 5% level. Thus the profit share variable is certainly not dominated by noise due to measurement errors.

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. Comparison with existing empirical literature

The existing empirical macroeconomic literature on Kaleckian model has focused on the goods market. In particular, the model by Marglin and Bhaduri (1990) has inspired empirical research since profit-led as well as wage-led regimes are allowed for by theory.

Bowles and Boyer (1995) focus on the question of how distributional changes affect output. They estimated four equations, investment, profit share, savings and net exports by means of a single equation approach. They find that France, Germany and Italy are weakly profit-led, whereas UK and USA are wage-led. The domestic sector of the economies is wage-led in all countries. Similarly, the world economy as a whole would be wage-led. Their work differs theoretically as well as econometrically from ours. In terms of modeling, the key differences are that they focus exclusively on the goods market, bypassing the labor market as well as technological progress. The key difference in the econometric approach is that Bowles and Boyer use a single equation approach, while the present paper uses a systems approach.

Gordon (1995a,b) estimates a model that is also inspired by Marglin and Bhaduri (1990). He takes different approaches to the estimation of profit function and the demand function. He discusses the profit function (what we have called the distribution function) in depth and argues based on his earlier work in collaboration with Bowles and Weisskopf that the

profit function is non-linear in capacity utilization. The profit function is estimated by a single equation approach, with numerous control variables. He also includes an index of capitalist power as an explanatory variable. Empirically he concludes finds that the profit function is indeed non-linear and that the US has been in the downward sloping range in the postwar era. For the demand function he estimates a two stage least square model, i.e. a systems approach, of savings, investment and net exports. The lagged interest rate and the lagged profit rate are used as shift variables and capacity utilization as endogenous variable. Gordon finds that demand is profit-led in the USA.

Taylor (1996) summarizes this evidence as suggesting that "aggregate demand tends to be profit-led in industrialized economies and wage-led in developing countries." (156). However he adds no econometric work, thus in particular his claim that developing countries would be wage-led is not substantiated. Hein and Krämer (1997) on the other hand claim that advanced capitalist countries have been wage-led. They do so by discussing the average values of the profit share and accumulation over business cycles, but do not offer econometric evidence. Unlike the other literature discussed above, no effort is made to identify (the respective slopes of the) distribution and demand functions.

Thus methodically the contribution of the present paper is that a VAR approach is applied to Kaleckian model. Theoretically the contribution consists of the explicit modeling of the labor market. The key question that has motivated earlier work was the effect of distribution on demand. With respect to this question our findings are neutral. While they fail to support the profit-led results of Gordon (1995a,b), they also render no further evidence to Hein and Krämer's (1997) claim that economies are wage-led. So our results are close to the mixed finding of Bowles and Boyer (1995), but only superficially so. France, for example, is profit-led in Bowles and Boyer (1995), but the closest to a wage-led regime in our findings. The inverse is true for USA and UK. However, due to the large confidence intervals, we abstain from further comparisons of the country results.

It may thus appear that our results are less precise than those of Bowles and Boyer (1995) and Gordon (1995a,b). However, this need not be the case. Bowles and Boyer (1995) as well as Gordon (1995a,b) report point estimates without the corresponding confidence intervals. This is probably due to the fact that they derive their point estimates from non-linear combinations of regression coefficients. It is indeed non-trivial to calculate the corresponding standard errors.[5] In one case, the UK, it possible to calculate a rather straight forward approximation of the standard error for the estimate of Bowles and Boyer, which gave a t-value of well below one. This indicates that their results may not be statistically significant at conventional levels.

Thus it is likely that our results are in fact consistent with those of Bowles and Boyer (1995) and Gordon (1995a,b). Their aim was to evaluate the relative economic significance of the counteracting effects of changes in the income distribution. They derived seemingly clear, if at times mixed results, for different countries, because no confidence intervals were

[5] The point estimate is a linear combination of the partial effects of profits on savings, investment and net exports. However, in most cases these partial effects are themselves long-run or steady state estimates which consist of non-linear interactions of estimated coefficients. Thus there are difficulties in calculating the confidence intervals.

calculated. Our econometric results indicate that the resulting net effect of change in income distribution is close to and statistically not distinguishable from zero.

7. 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 Kaleckian 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 neoclassical 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 also suggest that productivity growth, does play an important role. It is not distributionally neutral and causes unemployment.

Including the labor market to the basic Kaleckian model has proven an interesting empirical exercise. There are several ways in which the work could be extended. On the one hand there is room for elaboration within the Kaleckian approach. Here the lack of financial variables is the probably most obvious shortcoming. While there is significant theoretical work on, for example, conflict inflation, little empirical research exists as of yet. On the other hand a systematic comparison and test of Kaleckian and various kinds of neoclassical approaches is still needed and would clarify theoretical differences as well as the empirical relevance of the respective arguments. Our empirical results, while vindicating the Kaleckian approach, will to a large extent be consistent with a New Keynesian approach.

The econometric results do not lend themselves to specific 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, whereas demand matters.

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Appendix A. Lag length tests

A.1. VAR Lag Order Selection Criteria

UK
Endogenous variables: ACCUUK GAPUK PSUK UUK GXUK
Exogenous variables: C @TREND
Sample: 1960:1 to 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 to 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 to 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

Symbol (*) 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.

Appendix B. Autocorrelation, normality and heteroscedesticity tests

B.1. VAR residual serial correlation LM tests

H0: no serial correlation at lag order H

	UK		USA		France	
Sample	1960:1 to 1997:2		1960:1 to 1997:2		1960:1 to 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 d.f.

B.2. 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

B.3. White Heteroscedasticity Test (joint test)

	χ^2	d.f.	Probability
UK	631.2502	630	0.479
USA	672.0241	630	0.120
France	629.8514	630	0.494

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