IMK
Institut für Makroökonomie
und Konjunkturforschung
Macroeconomic Policy Institute

November 2012

103

Working Paper

Christian Schoder[1]

Effective demand, exogenous normal utilization and endogenous capacity in the long run. Evidence from a CVAR analysis for the US

November 12, 2012

Abstract

Using the Cointegrated VAR framework, we provide evidence for the US manufacturing sector that the principle of effective demand in a growth context, by which a permanent demand shock has a permanent growth effect, is consistent with a stationary rate of capacity utilization, since production capacities adjust endogenously to current output.

Keywords: Effective demand, stationary utilization rate, endogenous capacity, cointegrated vector autoregression

JEL Classication: E12, E22, C22

[1] Macroeconomic Policy Institute (IMK), Düsseldorf, Germany,
Email: christian-schoder@boeckler.de

Effective demand, exogenous normal utilization and endogenous capacity in the long run. Evidence from a CVAR analysis for the US.*

Christian Schoder†
Macroeconomic Policy Institute (IMK)

November 12, 2012

Abstract

Using the Cointegrated VAR framework, we provide evidence for the US manufacturing sector that the principle of effective demand in a growth context, by which a permanent demand shock has a permanent growth effect, is consistent with the stylized fact of a stationary rate of capacity utilization, since production capacities adjust endogenously to current output.

Keywords: Effective demand, stationary utilization rate, endogenous capacity, cointegrated vector autoregression
JEL Classification: E12, E22, C22

---

*For valuable comments and suggestions, I would like to thank Katarina Juselius. The usual caveats apply.

†Address: Macroeconomic Policy Institute (IMK), Hans-Böckler Str. 39, 40476 Düsseldorf, Germany. Email: christian-schoder@boeckler.de.

1 Introduction

The principle of effective demand is a core pillar of heterodox macroeconomics since all traditions typically perceive economic dynamics as demand constrained in the short-run. Yet, disagreements arise on the form and relevance of effective demand in the long run. In the modern Kaleckian growth theory pioneered by, among others, Rowthorn (1981), Dutt (1984) and Taylor (1985), the steady-state growth rate of the economy and rate of capacity utilization are demand driven. The Kaleckian growth model which features quantity adjustments rather then price adjustments to align savings to investment became the work horse for many applied research questions.[1] On the other hand, growth models in the Classical and Marxian tradition typically maintain that the long-run growth rate of the economy is structurally determined, i.e. independent of aggregate demand and consistent with an exogenous desired rate of capacity utilization.[2]

Naturally, a lively debate has emerged on the relevance of effective demand for long-run analysis, a considerable part of which focused on the role of the rate of capacity utilization as a long-run accommodating variable in Kaleckian growth theory (cf. Lavoie et al. 2004, Schoder 2012b, Skott 2012). The critiques of the Kaleckian growth model typically point towards two shortcomings of the model–one regarding theory, one regarding empirics.[3]

In terms of theory, the canonical Kaleckian growth model has been criticized since it does not require full adjustment, i.e. the consistency of expectations and realizations, in the long run. Hence, critics raised the question why firms should settle on a steady state in which the actual rate of capacity utilization is inconsistent with the desired rate (cf. Committeri 1986, Auerbach and Skott 1988). Kaleckians have responded to this criticism by endogenizing the desired rate of capacity utilization as well as the secular rate of sales growth through hysteresis effects implying the economy to be fully adjusted in the long run (cf. Lavoie 1995b, 1996, Dutt 1997, 2009). Schoder (2012b) found some evidence for such hysteresis effects in the US.

Introducing hysteresis effects, however, does not account for the second criticism put forward: The Kaleckian growth model predicts a non-stationary rate of capacity utilization, i.e. a permanent demand shock implies a permanent change in the utilization rate. Yet, data on the utilization rate such as the one published by the FED typically indicate stationarity despite long swings. Hence, there seems to be some force in the long-run that keep the utilization rate within a rather narrow band which is inconsistent with the Kaleckian benchmark model (Skott 2012).

In light of this latter fundamental weakness of conventional Kaleckian growth theory, Classical/Marxian and Harrodian/Kaldorian authors suggest modifications of and alternatives to the benchmark model, respectively. Motivated by the view that the state of the economy in the long run is determined by the *fundamental laws of capitalism* beyond aggregate demand, the former group typically introduces mechanisms that, in the long run, bring

[1]See Lavoie (1995a), Hein (2007) and Hein and Schoder (2011) on money and financialization. See Blecker (1989) on Kaleckian growth models for open economies.

[2]See, among others, Duménil and Lévy (1999), Shaikh (2009) andTaylor (2012).

[3]See Skott (2012) for a summary of the criticism put forward.

the utilization rate back to an exogenous level through induced changes in investment and saving behavior.[4] While Classical/Marxian contributers tend to accept the Kaleckian model as a valid characterization of the economy in the short run, Harrodian/Kaldorian authors in the tradition of Skott (1989a,b) typically reject this model also for short-run analysis and propose models featuring destabilizing investment dynamics as well as instantaneous price rather than output adjustment. These models also allow for growth effects of demand shocks, yet not within a Kaleckian framework.

Despite some underlying behavioral assumptions which Kaleckians object to, the Harrodian/Kaldorian model is able to reconcile effective demand in the long run with a stationary rate of capacity utilization as observed empirically–an endeavor Kaleckians have not pursued yet.[5]

In a recent contributions, Schoder (2012a,c) has taken up this issue from a Kaleckian perspective. The papers attempt to reconcile the principle of effective demand and the stationarity of the rate of capacity utilization within a Kaleckian framework by introducing an endogenous, pro-cyclical capacity-capital ratio. With destabilizing Harrodian investment dynamics as well as stabilizing distributional and debt dynamics, the proposed model may generate stable (limit) cycles around an endogenous steady state growth rate. A persistent demand shock affects the long-run growth rate permanently through changes in the capacity-capital ratio.

Since the assumption of a pro-cyclical capacity-capital ratio is crucial for the principle of effective demand in a Kaleckian model, Schoder (2012a) provides theoretical and empirical arguments. For various US industrial sectors since the late 1940s, the capacity-capital ratio is estimated as a function of the business cycle. The result is a positive response of the growth rate of the capacity-capital ratio to a change in the difference between utilization and trend utilization.

Empirical analyses of heterodox growth models, however, suffer from low quality of capital stock data. Hence, the normalization through the capital stock which facilitates theoretical reasoning comes at a high cost once the model is brought to the data. The present paper seeks to complement the previous contributions by approaching the principle of effective demand, the endogeneity of relative capacity growth and the stationarity of the utilization rate from a statistical perspective. We derive an econometric model without normalization through the capital stock from a simple Kaleckian growth model as well as testable hypothesis implied by the principle of effective demand and the stationarity of the utilization rate. In particular, we

[4]See, among others, Duménil and Lévy (1999), Shaikh (2007) and Shaikh (2009). For a survey, see Hein et al. (2012, 2011).

[5]Kaleckians may put forward three objections to the Harrodian/Kaldorian models: First, the assumption of an instantaneous price adjustment may be questioned due to evidence of considerable price rigidities (cf. Blinder et al. 1998, Klenow and Kryvtsov 2008, Nakamura and Steinsson 2008). Second, the notion of a predetermined output may be seen as too strong an assumption in light of widespread *just-in-time* production, delivery lags instead of production lags as well as the existence of considerable inventories. Third, the crucial assumption that the adjustment costs for a given output expansion or investment increase with the level of employment is not fully convincing (cf. Hein et al. 2012). Even if such a relationship exists, the models neglect the impact of labor market conditions on distribution, which is purely an accommodating variable, despite the emphasis on conflict.

study the interaction of output, full capacity output and and a composite leading indicator for the US manufacturing sector from 1955Q1 to 2012Q2 employing a Cointegrated VAR model in the I(1) and I(2) analytical framework as developed by Johansen and Juselius (1990), Johansen (1995) and Juselius (2006). We find some evidence that the principle of effective demand by which a permanent demand shock has a permanent growth effect is consistent with a stationary rate of capacity utilization, since production capacities adjust slowly to output.

The remainder of the paper proceeds as follows. Section 2 motivates the econometric model consistent with the predictions of a Harrod-Kalecki growth model with an endogenous capacity-capital ratio. In section 3, the data used are discussed. Section 4 formalizes the econometric model, discusses potential misspecification and parameter stability and presents our main findings applying I(1) and I(2) analyses. Section 5 concludes the paper.

2 Some theoretical considerations

The Kaleckian interpretation of the principle of effective demand as a feature of a growth theory is that the growth rate of output is demand-driven in the long run. In statistical terms, therefore, logarithmized output has to be integrated of order two, i.e. follow an I(2) process.[6] If it was I(1), the growth path of output would be stochastic but the growth rate would be deterministic in the long run. Let y_t denote the log of real output which is determined by demand which, in turn, we assume to be driven by expected demand (y_t^e).[7] Hence, the output relation is

$$y_t = \beta_{32} y_t^e + \beta_{02} + \mu_{2,t}, \tag{1}$$

where $\mu_{2,t}$ is a stationary disturbance term and y_t^e is forward looking and, hence, predetermined in t. Since we take the principle of effective demand as a theoretical postulate whose consistency with a stationary utilization rate we want to evaluate empirically, it is sufficient to assume y^e to be an I(2) process without modeling it explicitly.ling it explicitly.

Further, logarithmized capacity utilization is defined as $u_t = y_t - y_t^c$ with y_t^c denoting full-capacity output. The FED provides data on the rate of capacity utilization which is consistent with the definition of u_t. Despite long swings, it can be taken as a stylized fact for long-run analysis that capacity utilization, structurally determined by the firms optimization problems, is stationary (Skott 2012). Hence, we assume u_t to be an I(0) process around a constant mean, $\bar{u}$. Hence, we have the utilization relation as

$$y_t = -y_t^c + \beta_{01} + \mu_{1,t}, \tag{2}$$

where $\beta_{01} \equiv \bar{u}$ is a constant and $\mu_{1,t}$ is a possibly highly persistent but stationary disturbance term.

[6]Loosely speaking, a stochastic process is integrated of order k, i.e. I(k), if and only if it is stationary, i.e. I(0), after first-differencing k-times.

[7]For instance, investment and consumption can be assumed to be functions of expected income which is consistent with Kaleckian and Harrodian growth models.

Since y_t is I(2) and u_t is I(0), (2) implies that full-capacity output, y_t^c, is also I(2). Hence, we have established the condition for the principle of effective demand and the exogeneity of the normal rate of capacity utilization to hold at the same time: y_t^c has to be I(2) and adjust endogenously to the stochastic trend in y_t which, in turn, follows y_t^e which, in turn, is independent of y_t^c.

One could object that a y_t^c being affected by y_t is not inconsistent with an economy featuring endogenous utilization in the short run but exogenous utilization in the long run such as Duménil and Lévy (1999) and Shaikh (2009) due to the capacity building effect of investment. Yet, in heterodox macro models the capacity effect is typically super-fast. A rise in investment simultaneously leads to a higher capital stock and, therefore, a higher capacity. In reality, a rise in the flow (investment) leads to a change in the stock (capital) with some delay. In our CVAR analysis, this effect will be captured by the short-run dynamics of the econometric model. The cointegrating relation will capture the long-run effect of output on capacity through changes in capital productivity which is on a different time scale than the relatively fast effect of output on capacity through a higher level of capital.[8]

How can an endogenous I(2) long-run capacity output which is equivalent to an endogenous capacity-capital ratio be justified? In heterodox growth models, the capacity-capital ratio is typically assumed to be constant (cf. Taylor 2004, Skott 2012, Hein et al. 2012). Regarding the trend of the variable, a large body of literature analyzes if technical change is labor saving or augmenting in the long run, i.e. if the capacity-capital ratio tends to decrease or increase. In industrialized countries technical change has been found to be slightly labor saving in the long run (cf. Foley and Michl 1999, pp. 37-41 and Duménil and Lévy 2004).

Regarding the cyclical pattern, there are good reasons for a pro-cyclical capacity-capital ratio as pointed out in detail by Schoder (2012a). First, as argued by Nikiforos (2011) full-capacity output as reported by the Fed does not measure the technically feasible capacity but the highest level of output that can be produced under *normal* conditions and maintained sustainably. Indivisibilities in the production process such as shift work may then cause capacity output to change endogenously. Any number of shifts is associated with a certain full-capacity output beyond which profits may become negative and production cannot be sustained unless another shift is introduced. Running another shift is associated with additional fixed costs but reduces unit variable costs since over-time labor can be saved. In a boom with high demand expectations some firms may introduce additional shifts and, hence, raise their full-capacity output even though no capital investment need to have taken place. Capacity and, therefore, the capacity-capital ratio will be endogenous.

Second, investment induced technical change may affect the capacity-capital ratio procyclically (cf. Schoder 2012a). If a deviation of the utilization rate from the desired rate implies some form of costs arising from an inefficient use of resources, on the one hand, and a lack of flexibility in accommodating demand required to deter market entry of potential competitors, on the other, then a firm will seek to invest in capital which helps realigning

[8]DeLong and Summers (2012) have analyzed the short-run capacity effect of utilization (triggered by changes in the level of capital rather than its productivity) by regressing the growth rate of capacity output on the two years lagged utilization rate (both in percent) and find a slope coefficient of 1.88.

the utilization rate to the desired rate. For instance, if utilization is too high, a firm will choose structures and equipment which raise the productivity of capital, since this increases capacity output and, therefore, reduces utilization for a given demand to be accommodated. Hence, the capacity output-capital ratio will move pro-cyclically.

It is easy to see that, given the structure of our simple model, the principle of effective demand in a growth context combined with the stationarity of the utilization rate implies the following predictions which can be tested:

Hypothesis 1. *There are two cointegrating relationships between the three variables of the form CI(2,2), i.e. from I(2) variables to I(0): The first one is between y_t, y_t^c and a constant and is characterized by the vector* $(1, -1, \beta_{01})$. *The second one is between y_t and y_t^e and is characterized by* $(1, 0, \beta_{02})$.

Hypothesis 2. *Since y_t is fully characterized by y_t^e, y_t is error-correcting to the output relation but not to the utilization relation.*

Hypothesis 3. *If y_t^c is exogenous then it should not be error-correcting to the utilization relation.*

Hypothesis 4. *If y_t^e is predetermined it should be weakly exogenous.*

3 Data

We employ quarterly data from 1955Q1 to 2012Q2. For y_t and y_t^c, we use the logs of the production index and the full-capacity index, respectively, for the US manufacturing sector provided by the FED. y_t^e is approximated by the trending Composite Leading Indicator provided by the OECD which is an average of business and consumer confidence indicators. All variables are seasonally adjusted.[9]

The three time series used are plotted in levels and first differences in Figures 1 and 2, respectively. Graphical inspection yields the following noteworthy insights:

First, all variables follow the same stochastic trend. Even though the plot in first differences indicates that, apart from y_t^c which is rather smooth, y_t and y_t^e may well be I(1), we take the stochastic trend as an I(2) process for the following reasons: First, the volatility of these series may blur the picture and make their first differences appear more stationary than they are. Second and more importantly, we seek to analyze whether or not an endogenously changing y_t^c can be observed making the principle of effective demand consistent with a constant rate of capacity utilization. Hence, even though output being I(2) and the utilization rate being I(0) can be contested, they are not the issues at hand and shall be taken as theoretical priors.

Second, as confirmed by the plot in differences, y_t^e is leading and closely correlated with y_t.

[9] All three series are also available in monthly frequency. Yet we chose to use quarterly data since the quality of the Composite Leading Indicator is not satisfactory in the first part of the sample with constant values for several months followed by sudden changes.

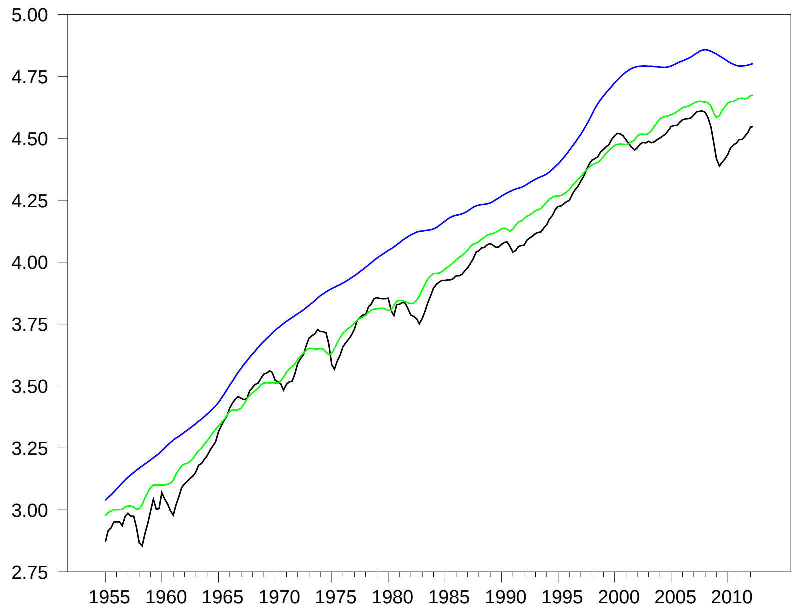

Figure 1: The logs of the production index (black), capacity index (blue) and the composite leading indicator (green) for the US in levels.

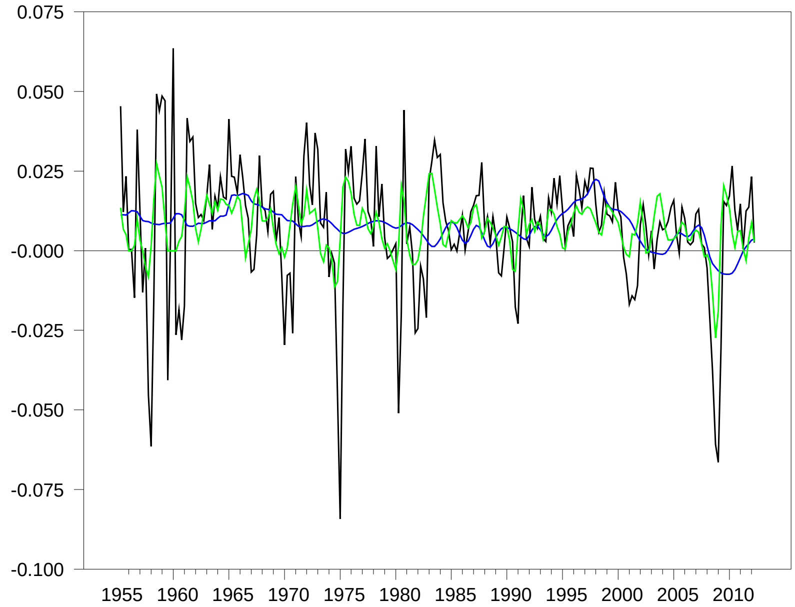

Figure 2: The logs of the production index (black), capacity index (blue) and the composite leading indicator (green) for the US in first differences.

Third, the level plot provides some indication of y_t^c adjusting slowly to changes in y_t. Note, further, that capacity output seems to have been smoothed by the FED. This will

Table 1: Tests for autocorrelation, residual normality and homoskedasticity

Trace Correlation:		=	0.793	
Tests for Autocorrelation				
Ljung-Box(56):	ChiSqr(468)	=	444.421	{0.777}
LM(1):	ChiSqr(9)	=	18.861	{0.026}
LM(2):	ChiSqr(9)	=	5.938	{0.746}
Test for Normality:	ChiSqr(6)	=	46.630	{0.000}
Test for ARCH				
LM(1):	ChiSqr(36)	=	112.304	{0.000}
LM(2):	ChiSqr(72)	=	184.097	{0.000}

Notes: p-values in curly brackets.

affect the short-run dynamics of the model but not the cointegrating relations.

4 Econometric analysis

To test the hypotheses 1 to 4 posed above, we apply a cointegration analysis developed by Johansen and Juselius (1990), Johansen (1995) and Juselius (2006) and estimate the following VAR model in VECM representation:

$$\Delta \mathbf{x}_t = \boldsymbol{\alpha} \begin{bmatrix} \boldsymbol{\beta}' & \boldsymbol{\beta_0}' \end{bmatrix} \begin{bmatrix} \mathbf{x}_{t-1} \\ c \end{bmatrix} + \sum_{i=1}^{k-1} \boldsymbol{\Gamma}_i \Delta \mathbf{x}_{t-1} + \boldsymbol{\Phi} \mathbf{D}_t + \boldsymbol{\varepsilon}_t, \tag{3}$$

where $\mathbf{x}_t = \begin{bmatrix} y_t & y_t^c & y_t^e \end{bmatrix}'$, $\mathbf{D}_t$ is a matrix of deterministic variables and $\boldsymbol{\varepsilon}_t \sim \mathbf{I}\mathcal{N}_p(\mathbf{0}, \boldsymbol{\Omega})$ is a vector of disturbances. We include a constant term restricted to the cointegrating space since utilization fluctuates around a constant mean. We include dummies for the following quarters since they feature large outliers: transitory dummies for 1959Q3 to 1959Q4 and for 1965Q1 to 1965Q2 as well as a permanent dummy from 1975:1. We chose $k = 4$ as the optimal lag length following the suggestion of the SBC information criteria. Moreover, including fewer lags in the model would lead to severe serial correlation problems.

4.1 Misspecification tests

Table 1 reports the tests for residual normality, independency and homoscedasticity. While there is still some evidence for first-order autocorrelation the Ljung-Box test as well as the LM test for second-order autocorrelation reject the null. Normality of the residuals as well as homoscedasticity are rejected.

The recursive and backwards recursive tests of $\boldsymbol{\beta}(t)$="known beta", of beta constancy and of eigenvalue fluctuation indicate parameter stability for the unrestricted model as well

Table 2: Rank test

p-r	r	Eig.Value	Trace	Trace*	Frac95	P-Value	P-Value*
3	0	0.166	65.080	40.505	35.070	0.000	0.011
2	1	0.069	24.111	9.934	20.164	0.012	0.651
1	2	0.035	7.967	1.941	9.142	0.085	0.785

as for all restrictions considered below.

4.2 I(1) analysis

Even though we assume our variables to follow an I(2) stochastic trend, we first apply an I(1) analysis to our system. This is because an I(1) model is much simpler to interpret while the estimates of the $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}'$ matrices are still consistent. Below, we will check the robustness of our result by pursuing an I(2) analysis.

4.2.1 Rank test

Our theoretical considerations suggest two cointegrating relationships between our three variables since they all follow the same stochastic trend which seems to be confirmed by the level plot in Figure 1. Table 2 reports the rank test statistics.

Note the large difference between the p-values of the trace test and the Bartlett corrected trace test for 1 and 2 ranks. This suggests that our variables are I(2) which is also confirmed by the estimated roots of the companion matrix. Regardless which rank is selected, the first unrestricted root is always larger than 0.98, indicating an I(2) stochastic trend. In this case, the trace tests become unreliable. Nevertheless, according to the uncorrected trace test, we can accept the hypothesis of $r = 2$ which is consistent to the theoretical prior.

4.2.2 Testing restrictions on $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}'$

Using the I(1) analysis, Table 3 reports the estimates of $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}'$ for different set of restrictions. The model including the restrictions derived from theory is reported in model (a). Note there is one overidentifying restriction which the LR test cannot reject. Note further that we leave the constant in the relation between y_t and y_t^e unrestricted. This constant is restricted in model (b). The two overidentifying restrictions are rejected. For some reason, however, the estimate of the constant, 0.389, in the relation between y_t and y_t^c in model (a) is inconsistent with the data. It implies a long-run equilibrium of $y_t - y_t^c = -0.389$ which is equivalent to $u_t = 0.677$ in equilibrium. Yet, the mean around which u_t fluctuates with some persistence is 0.802. To correct for this inconsistency (which has to be clarified), we additionally restrict the constant in the first cointegrating relation to $0.096 = -\log(0.802)$. The estimates are reported in model (c). Note that the LR test rejects the overidentifying restrictions in this case. Model (d) reports the estimate of the model restricting the

Table 3: Estimation results for restricted I(1) models

	Model (a) $\chi^2(1) = 0.060$ {0.807}				Model (b) $\chi^2(2) = 8.007$ {0.018}			
	y	y^c	y^e	*const.*	y	y^c	y^e	*const.*
The cointegrating relations $\boldsymbol{\beta}$								
$\boldsymbol{\beta_1}'$	1.000	−1.000	0.000	0.389 [13.130]	1.000	−1.000	0.000	0.015 [0.392]
$\boldsymbol{\beta_2}'$	1.000	0.000	−1.093 [−34.698]	0.864 [5.680]	1.000	0.000	−1.089 [−58.116]	0.000
The adjustment coefficients $\boldsymbol{\alpha}$								
$\boldsymbol{\alpha_1}'$	0.020 [0.829]	0.003 [3.406]	−0.014 [−1.852]		0.039 [1.685]	0.003 [3.445]	−0.012 [−1.599]	
$\boldsymbol{\alpha_2}'$	−0.029 [−3.480]	−0.001 [−3.163]	0.006 [2.254]		−0.005 [−0.398]	−0.002 [−3.295]	0.005 [1.138]	

	Model (c) $\chi^2(2) = 8.187$ {0.017}				Model (d) $\chi^2(3) = 8.951$ {0.030}			
	y	y^c	y^e	*const.*	y	y^c	y^e	*const.*
The cointegrating relations $\boldsymbol{\beta}$								
$\boldsymbol{\beta_1}'$	1.000	−1.000	0.000	0.096	1.000	−1.000	0.000	0.096
$\boldsymbol{\beta_2}'$	1.000	0.000	−1.066 [−16.245]	−0.389 [−1.331]	1.000	0.000	−1.086 [−123.343]	0.000
The adjustment coefficients $\boldsymbol{\alpha}$								
$\boldsymbol{\alpha_1}'$	0.004 [0.157]	0.003 [3.319]	−0.012 [−1.635]		0.022 [0.905]	0.003 [3.506]	−0.013 [−1.693]	
$\boldsymbol{\alpha_2}'$	0.010 [1.678]	−0.001 [−3.051]	0.002 [0.951]		0.008 [0.788]	−0.001 [−3.253]	0.003 [1.042]	

Notes: t-statistics are in brackets, p-values in curly brackets.

constant of the first relation to 0.096 and the constant of the second relation to 0. This is the specification consistent with the theory but the LM test rejects the overidentifying restrictions.

If not indicated otherwise, the following results hold for all specifications: First, in equilibrium a one-percent increase in y_t^e is associated with a statistically significant more-than-one-percent increase in y_t with coefficients ranging from 1.066 to 1.093. This might indicate a long-run multiplier effect.

Second, y_t is not error-correcting to the utilization rate, i.e. the first cointegrating relation, since the corresponding loadings are all insignificant and have the wrong sign. In the first specification, y_t error-corrects the second relation. That means, excess output implies a reduction of output in the succeeding period.

Third, in all specifications, y_t^c is error-correction to the utilization rate with a small but significant coefficient of 0.003. A positive deviation of utilization from its long-run mean leads to a slow acceleration of full-capacity output. The change in y_t^c is also affected by the output relation. A y_t exceeding its equilibrium level causes y_t^c to decrease slightly. This

Table 4: Tests of weak exogeneity

	Model (a) $\chi^2(1) = 0.060$ {0.807}	Model (b) $\chi^2(2) = 8.007$ {0.018}
$H_0 : \alpha_{11} = \alpha_{12} = 0$	$\chi^2(3) = 32.290$ {0.000}	$\chi^2(4) = 30.913$ {0.000}
$H_0 : \alpha_{21} = \alpha_{22} = 0$	$\chi^2(3) = 9.693$ {0.021}	$\chi^2(4) = 13.929$ {0.008}
$H_0 : \alpha_{31} = \alpha_{32} = 0$	$\chi^2(3) = 3.949$ {0.267}	$\chi^2(4) = 17.056$ {0.002}
	Model (c) $\chi^2(2) = 8.187$ {0.017}	**Model (d)** $\chi^2(3) = 8.951$ {0.030}
$H_0 : \alpha_{11} = \alpha_{12} = 0$	$\chi^2(4) = 32.030$ {0.000}	$\chi^2(5) = 32.081$ {0.000}
$H_0 : \alpha_{21} = \alpha_{22} = 0$	$\chi^2(4) = 13.442$ {0.009}	$\chi^2(5) = 15.151$ {0.010}
$H_0 : \alpha_{31} = \alpha_{32} = 0$	$\chi^2(4) = 13.131$ {0.011}	$\chi^2(5) = 13.952$ {0.016}

Notes: p-values in curly brackets.

finding is not easy to interpret since one would expect an output disequilibrium at a given utilization rate not to affect capacity. Note that a disequilibrium in the first relation is highly correlated with a disequilibrium in the second relation. Hence, one can ask the question in what direction an increase in y_t causes y_t^c to change, in equilibrium. Since the loading of the utilization relation is larger than the loading of the output relation, y_t^c will increase and, hence, stabilize the system.

Fourth, the loadings to y_t^e are insignificant in almost all specifications which may suggest weak exogeneity of the Composite Leading Indicator. In fact, the LR test of weak exogeneity of y_t^e in the unrestricted model (not reported in Table 3) cannot be rejected, whereas weak exogeneity can be rejected for all other variables. Table 4 reports the test results of the LR test of overidentifying restrictions for the models considered if weak exogeneity of y_t, y_t^c and y_t^e, respectively, is additionally imposed. Compared to the benchmark test statistics of the models without restrictions on $\boldsymbol{\alpha}$, restrictions on the loadings to y_t^e cause the smallest increases in the test statistics. Hence, there seems to be some evidence for y_t^e to be exogenous.

Overall, we have found evidence in support of the hypotheses 1 to 4 postulated above using the I(1) analytical framework. In the following, we will apply the I(2) framework to analyze these hypothesis.

4.3 I(2) analysis

Equivalently to the I(1) analysis, we estimate the following model:

$$\Delta^2 \mathbf{x}_t = \boldsymbol{\alpha}\{\begin{bmatrix}\boldsymbol{\beta}' & \boldsymbol{\rho_0}'\end{bmatrix}\} \begin{bmatrix}\mathbf{x}_{t-1} \\ t\end{bmatrix} + \begin{bmatrix}\boldsymbol{\delta}' & \boldsymbol{\gamma_0}'\end{bmatrix} \begin{bmatrix}\Delta\mathbf{x}_{t-1} \\ c\end{bmatrix} + \boldsymbol{\zeta} \begin{bmatrix}\boldsymbol{\beta}' & \boldsymbol{\rho_0}' \\ \boldsymbol{\beta}'_{\perp 1} & \tilde{\boldsymbol{\gamma}}_{\mathbf{0}}'\end{bmatrix} \begin{bmatrix}\Delta\mathbf{x}_{t-1} \\ c\end{bmatrix} \tag{4}$$
$$+ \sum_{i=1}^{k-2} \boldsymbol{\Gamma}_i \Delta \mathbf{x}_{t-1}^2 + \boldsymbol{\Phi}\mathbf{D}_t + \boldsymbol{\varepsilon}_t,$$

Table 5: Rank test

Approximate 95% fractiles					
$p-r$	r	$s_2=3$	$s_2=2$	$s_2=1$	$s_2=0$
3	0	89.020	69.376	53.921	42.770
2	1		48.520	34.984	25.731
1	2			20.018	12.448

where, as above, $\mathbf{x}_t = \begin{bmatrix} y_t & y_t^c & y_t^e \end{bmatrix}'$, $\mathbf{D}_t$ is a matrix of deterministic variables and $\boldsymbol{\varepsilon}_t \sim \mathbf{I}\mathcal{N}_p(\mathbf{0}, \boldsymbol{\Omega})$ is a vector of disturbances. To include a constant term but no linear trend in the cointegration space, we restrict $\boldsymbol{\rho_0}' = 0$ and leave $\boldsymbol{\gamma_0}'$ unrestricted. If we followed the advice of the I(2) rank test reported in Table 5, there would be no cointegrating relationship and one stochastic I(2) trend. This may be because both the util

The estimation results for the model with restrictions on the trend in the cointegration space as well as the restrictions derived from theory are reported in Table 6. Even though, we have to reject these restrictions according to the LR test, the results are very similar to the I(1) analysis.[10] Again, there is an accelerator effect of y_t^e on y_t in the long run.

The analysis of the error correction mechanism is more complicated in the I(2) framework. If $\alpha_{ij}\delta_{ij} < 0$ than $\Delta^2 x_{i,t}$ is error correcting to $\Delta x_{i,t}$ and if $\delta_{ij}\beta_{ij} > 0$ than $\Delta x_{i,t}$ is error-correcting to $x_{i,t-1}$. Hence, comparing the estimates for $\boldsymbol{\beta_1}$ and $\boldsymbol{\delta_1}$ reveals that a change in y_t equal to a change in y_t^c leaving the utilization rate constant has no effect on the acceleration of the variables. Yet, Δy_t is not error-correcting to capacity utilization, whereas Δy_t^c is. Comparing $\boldsymbol{\delta_1}$ and $\boldsymbol{\alpha_1}$ reveals that only $\Delta^2 y_t^c$ is significantly error-correcting to the utilization relation. For the output relation the estimates imply that Δy_t is not error-correcting to output, whereas Δy_t^e is. Moreover, as in the I(1) analysis, both $\Delta^2 y_t$ and $\Delta^2 y_t^c$ are error-correcting to output.

Hence, the I(2) analysis confirms the result that y_t is error-correcting to the output relation but not to the utilization relation, that there is some endogenous error-correcting adjustment of y_t^c from the utilization relation and that there is no significant feedback of the utilization relation on y_t^e.

The I(2) analysis, however, reveals some additional insights. First, the estimates of $\beta'_{\perp 1}$ suggest that there is almost a perfectly proportional relationship between all variables in the medium run which is not surprising given the similarity of the time series used. Second, the estimates of $\tilde{\boldsymbol{\beta}}'_{\perp 2}$ indicate that the I(2) trend affected all variables equally. Third, the estimates of $\boldsymbol{\alpha}'_{\perp 1}$ suggest that the common I(2) trend has primarily been generated by the twice cumulated shocks to capacity output and to a lesser extent to the composite leading indicator. Fourth, the last row in the table confirms that the disturbances to y_t and y_t^e have a higher standard deviation than the ones to y_t^c.

[10] Note that the restrictions cannot be rejected, if we allow for a linear trend in the cointegration space which only changes the results of the output relation. Since, however, the restrictions imposed are not the subject of debate, we report the results of the model which is most consistent with our theoretical priors.

Table 6: Estimation results for restricted I(2) model

$\chi^2(3) = 8.567$ {0.036}					
	y	y^c	y^e	*const.*	*trend*
The cointegrating relations β					
β_1'	1.000	−1.000	0.000	—	0.000
β_2'	1.000	0.000	−1.083 [−8.596]	—	0.000
The cointegrating relations δ					
δ_1'	−7.484	−7.484	−6.909	0.395	—
δ_2'	−18.586	−18.586	−17.158	0.810	—
The adjustment coefficients α					
α_1'	0.020 [0.857]	0.003 [3.489]	−0.013 [−1.728]		
α_2'	−0.030 [−3.386]	−0.001 [−3.214]	0.007 [2.285]		
The adjustment coefficients $\beta_\perp$					
$\beta_{\perp 1}'$	1.000	1.000	0.923		
$\tilde{\beta}_{\perp 2}'$	0.006	0.006	0.006		
The common trends $\alpha_\perp$					
$\alpha_{\perp 1}'$	1.000	42.809 [35.023]	11.352 [56.559]		
σ_ε	0.010	0.000	0.003		

Notes: t-statistics are in brackets, p-values in curly brackets.

5 Concluding remarks

Schoder (2012c) attempts to reconcile the principle of effective demand and the stationarity of the rate of capacity utilization within a Kaleckian framework by introducing an endogenous capacity-capital ratio. Some theoretical arguments and empirical evidence for a pro-cyclical behavior of this ratio have been put forward by Schoder (2012a). The present paper has sought to complement these other contributions by analyzing the long-run behavior of capacity without normalizing the variables by the capital stock which facilitates theoretical reasoning but aggravate empirical analysis due to the low quality of capital stock data.

Using the Cointegrated VAR framework of Johansen and Juselius (1990), Johansen (1995) and Juselius (2006), we provide evidence that the principle of effective demand by which a permanent demand shock has a permanent growth effect is consistent with a stationary rate of capacity utilization, since production capacities adjust slowly to output.

We take the principle of effective demand in a growth context which implies output to follow an I(2) process as well as the stationarity of the rate of capacity utilization relating output and full-capacity output as theoretical priors. Using the composite leading indicator as a proxy for demand expectations exogenous from output and capacity output, we derive two steady state relations between the three variables. The principle of effective demand and the stationarity of the utilization rate can then be shown to be consistent with each other if capacity output adjusts endogenously.

We apply to the cointegrating VAR framework to study this question for the US manufacturing sector from 1955Q1 to 2012Q2. We find evidence that there are two cointegrating relationships between the three variables of the form CI(2,2), i.e. from I(2) variables to I(0): The first one is between output, full-capacity output and a constant. The second one is between output and the composite leading indicator. Moreover, we find that output is fully characterized by the composite leading indicator, since output is error-correcting to the output relation while it is not error-correcting to the utilization relation. We also find evidence for capacity utilization to be error-correcting to the utilization relation, i.e. to be endogenously adjusting. Finally, we find evidence for the composite leading indicator to be weakly exogenous.

The core implication of this analysis for the debate between advocates and critiques of the principle of effective demand in Kaleckian growth models is that it should not focus on the question of stationarity of the utilization rate. We provide some evidence that capacity output adjusts endogenously which makes the principle of effective demand and the stationarity of the utilization rate consistent with each other. Hence, future research should focus on the dynamic properties of output. Effective demand implies output to follow an I(2) process which has been taken as an theoretical prior in this study. Yet, this may well be contested.

References

Auerbach, P., Skott, P. (1988): Concentration, competition and distribution, *International Review of Applied Economics*, 2(1), pp. 42–61.

Blecker, R. A. (1989): International competition, income distribution and economic growth, *Cambridge Journal of Economics*, 13, pp. 395–412.

Blinder, A. S., Canetti, E. R. D., Lebow, D. E., Rudd, J. B. (1998): *Asking About Prices*, Russell Sage Foundation, New York.

Committeri, M. (1986): Some comments on recent contributions on capital accumulation, income distribution and capacity utilization, *Political Economy*, 2(2), pp. 161–86.

DeLong, J. B., Summers, L. H. (2012): Fiscal Policy in a Depressed Economy.

Duménil, G., Lévy, D. (1999): Being Keynesian in the short term and classical in the long term: The traverse to classical long-term equilibrium, *The Manchester School*, 67(6), pp. 684–716.

Duménil, G., Lévy, D. (2004): *Capital Resurgent: Roots of the Neoliberal Revolution.*, Harvard University Press, Cambridge, MA.

Dutt, A. K. (1984): Stagnation, income distribution and monopoly power, *Cambridge Journal of Economics*, 8(1), pp. 25–40.

Dutt, A. K. (1997): Equilibrium, path dependence and hysteresis in post-Keynesian models, in: Arestis, P., Palma, G., Sawyer, M., eds., *Markets, Unemployment and Economic Policy: Essays in Honour of Geoff Harcourt*, Routledge, London, vol. 2, pp. 238–53.

Dutt, A. K. (2009): Path dependence, equilibrium and economic growth, in: Arestis, P., Sawyer, M., eds., *Path Dependency in Macroeconomics. International Papers in Political Economy*, Macmillan Palgrave, Houndmills, New York, pp. 119–61.

Foley, D. K., Michl, T. R. (1999): *Growth and Distribution*, Harvard University Press, Cambridge, London.

Hein, E. (2007): Interest rate, debt, distribution and capital accumulation in a post-Kaleckian model, *Metroeconomica*, 58(2), pp. 310–39.

Hein, E., Lavoie, M., van Treeck, T. (2011): Some instability puzzles in Kaleckian models of growth and distribution: A critical survey, *Cambridge Journal of Economics*, 35(3), pp. 587–612.

Hein, E., Lavoie, M., van Treeck, T. (2012): Harrodian instability and the 'normal rate' of capacity utilisation in Kaleckian models of distribution and growth - a survey, *Metroeconomica*, 63(1), pp. 139–169.

Hein, E., Schoder, C. (2011): Interest rates, distribution and capital accumulation – A post-Kaleckian perspective on the US and Germany, *International Review of Applied Economics*, 25(6), pp. 693–723.

Johansen, S. (1995): *Likelihood-Based Inference in Cointegrated Vector Autoregressive Models*, Oxford University Press.

Johansen, S., Juselius, K. (1990): Maximum likelihood estimation and inference on cointegration - with applications to the demand for money, *Oxford Bulletin of Economics and Statistics*, 52(2), pp. 169–210.

Juselius, K. (2006): *The Cointegrated VAR Model: Methodology and Applications*, Oxford University Press.

Klenow, P. J., Kryvtsov, O. (2008): State-Dependent or Time-Dependent Pricing: Does It Matter for Recent U.S. Inflation?, *The Quarterly Journal of Economics*, 123(3), pp. 863–904.

Lavoie, M. (1995a): Interest rates in post-Keynesian models of growth and distribution, *Metroeconomica*, 46, pp. 146–77.

Lavoie, M. (1995b): The Kaleckian Model of Growth and Distribution and Its Neo-Ricardian and Neo-Marxian Critiques, *Cambridge Journal of Economics*, 19(6), pp. 789–818.

Lavoie, M. (1996): Traverse, hysteresis, and normal rates of capacity utilization in Kaleckian models of grwoth and distribution, *Review of Radical Political Economics*, 28(4), pp. 113–47.

Lavoie, M., Rodríguez, G., Seccareccia, M. (2004): Similitudes and Discrepancies in Post-Keynesian and Marxist Theories of Investment: A Theoretical and Empirical Investigation, *International Review of Applied Economics*, 18(2), pp. 127–49.

Nakamura, E., Steinsson, J. (2008): Five Facts about Prices: A Reevaluation of Menu Cost Models, *The Quarterly Journal of Economics*, 123(4), pp. 1415–1464.

Nikiforos, M. (2011): On the Desired Rate of Capacity Utilization, Working Paper 16-2011, The New School, New York.

Rowthorn, R. E. (1981): Demand, real wages and economic growth, *Thames Papers in Political Economy*, Autumn, pp. 1–39.

Schoder, C. (2012a): Endogenous capital productivity in the Kaleckian growth model. Theory and Evidence, Working Paper 102, Macroeconomic Policy Institute (IMK), Düsseldorf, Germany.

Schoder, C. (2012b): Hysteresis in the Kaleckian growth model: A Bayesian Analysis for the US manufacturing sector from 1984 to 2007, *Metroeconomica*, 63(3), pp. 542–568.

Schoder, C. (2012c): Instability, stationary utilization and effective demand: A synthesis of Harrodian and Kaleckian growth theory, Working Paper 104, Macroeconomic Policy Institute (IMK), Düsseldorf, Germany.

Shaikh, A. (2007): A proposed synthesis of Classical and Keynesian growth, SCEPA Working Papers 2007-1, Schwartz Center for Economic Policy Analysis (SCEPA), The New School.

Shaikh, A. (2009): Economic policy in a growth context: A Classical synthesis of Keynes and Harrod, *Metroeconomica*, 60(3), pp. 455–94.

Skott, P. (1989a): *Conflict and Effective Demand in Economic Growth*, Cambridge University Press, Cambridge.

Skott, P. (1989b): Effective Demand, Class Struggle and Cyclical Growth, *International Economic Review*, 30(1), pp. 231–47.

Skott, P. (2012): Theoretical and empirical shortcomings of the Kaleckian investment function, *Metroeconomica*, 63(1), pp. 109–138.

Taylor, L. (1985): A stagnationist model of economic growth, *Cambridge Journal of Economics*, 9(4), pp. 381–403.

Taylor, L. (2004): *Reconstructing Macroeconomics: Structuralist Proposals and Critiques of the Mainstream*, Harvard University Press, Cambridge.

Taylor, L. (2012): Growth, cycles, asset prices and finance, *Metroeconomica*, 63(1), pp. 40–63.

Publisher: Hans-Böckler-Stiftung, Hans-Böckler-Str. 39, 40476 Düsseldorf, Germany
Phone: +49-211-7778-331, IMK@boeckler.de, http://www.imk-boeckler.de

IMK Working Paper is an online publication series available at:
http://www.boeckler.de/imk_5016.htm

ISSN: 1861-2199

Hans Böckler Stiftung

Fakten für eine faire Arbeitswelt.