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30 May 2014

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Abstract

Kaleckian models are widely used for macroeconomic analysis due to their flexibility and simplicity. Sraffians counter that the Kaleckian model fails to capture a central fact of modern economies, the existence and importance of intermediate consumption. The critique is correct, but as the remedy appears to be a detailed analysis with multi-sectoral input-output tables, Sraffian models have not displaced their more tractable Kaleckian counterparts. This paper presents a model with intermediate consumption that is Kaleckian in spirit, although prompted by the Sraffian critique. It is shown that the profit share of GDP can be decomposed into two factors, an average profit share at firm level and a factor capturing intermediate goods consumption. The corresponding firm-level markups for a sample of fourteen OECD countries cluster closely around a common value that remains steady when averaged over business cycles. Taking this as evidence that the factorization is empirically meaningful, the paper then constructs a modified Kaleckian model. Using the modified model it is shown that economies are always profit-led with respect to a change in intermediate consumption, but may be either profit-led or wage-led with respect to a change in the firm-level markup, opening the possibility for diverse trajectories over business cycles. The model is applied to France, which has a particularly long data series, and is shown to perform well in explaining changes in utilization rates.

Keywords: Kaleckian; Sraffian; intermediate consumption; business cycles

1. Introduction

The standard Kaleckian model is the workhorse of Post Keynesian macroeconomic theory. It captures two important features of Post Keynesian thought: different social groups have distinct economic behavior, and economic output is driven by demand. It is also structurally simple and therefore easy to use, which makes it ideal for broad theoretical development, but also vulnerable to the critique that in its simplicity it misses important features of real economies. Much of the critique and response has focused on the use of Kaleckian models for long-run dynamics. This is an important topic, but understanding long-run dynamics in Post Keynesian theory – that is, in complex economies where routines and norms drive behavior under conditions of fundamental uncertainty – is a problem that is far from being solved. Different traditions – Sraffian (Levrero et al. 2013), Harrodian (Skott 2012), Kaldorian (Setterfield 2002), Kaleckian (Setterfield 2003), Schumpeterian (Fagerberg 2003) – each offer valuable insights into long-run behavior, inviting hybrid approaches (e.g., Araujo 2013; Hein et al. 2012). However, not all of the criticism of Kaleckian models refers to the long run. Some has focused on short-term dynamics, where both theory and practice are better established, yet there has been little response.

Steedman's (1992) sweeping critique asked fifteen questions of Kaleckians. The first asked why input-output relationships are excluded from Kaleckian analysis when they are so evident in modern industrial systems; of the remaining questions, many challenged the Kaleckian representation of markups. These questions are relevant to both short and long-term behavior. They were addressed in part by the responses to Steedman from Mainwaring (1992) and Keen (1998), who each constructed a simple multi-sector model to explore adjustment processes linking short-term and long-term dynamics. The present paper addresses the short-run behavior of the Kaleckian model.

In general, Sraffian and Kaleckian approaches appear incompatible on two counts, despite their commonalities (Lavoie 2011): first because they embody different beliefs about long-run dynamics (Hart and Kriesler 2014) and second because they reflect different opinions about the appropriate level of detail in macroeconomic theorizing (Blaug 2009; Kurz and Salvadori 2011; Salanti 2014). This paper is Kaleckian in flavor, in that it explores general features of modern industrial economies using simple models. Concretely, it asks what we can meaningfully say using national aggregates from the system of national accounts. This is not a repudiation of the Sraffian approach – in some cases, perhaps many, it may be necessary to study the entire ramified system of production, including joint production and the production of capital goods. A weakness of the Kaleckian approach is that it is not obvious when its simplifications are inappropriate. Yet a corresponding weakness holds for Sraffian analysis, in that demonstrations that macroeconomic surprises *may* arise from suppressed detailed dynamics do not mean that they *will* arise in any real economy, or that they are pervasive, or relevant. The approach we take in this paper is to introduce a simple representation of intermediate consumption into a Kaleckian model. We show that it can give rise to pervasive and relevant behavior that justify a modification of the standard Kaleckian model, but we also show that model variables are sufficiently regular to justify a Kaleckian approach.

2. Intermediate consumption and the markup

We begin with a standard Post Keynesian assumption that total production is proportional to the capital that is put to use,

$$X = u\kappa K. \quad (1)$$

In this expression, κ is capital productivity, with units of inverse time, and u is the (dimensionless) utilization fraction. We then depart from a standard Post Keynesian development by distinguishing between total production X and GDP Y, the difference being the amount of intermediate production, which is a proportion a of the total,

$$X = Y + aX \quad \Rightarrow \quad Y = (1-a)X. \tag{2}$$

For comparison to presentations of the standard Kaleckian model (e.g., Taylor 2004), we note that the utilization factor is typically defined as the ratio of GDP to capital. This standard utilization factor, u_{stand}, is related to the variables in this paper through

$$u_{\text{stand}} = (1-a)\kappa u. \tag{3}$$

We now proceed as though prices are set by identical firms each applying a uniform firm-level markup on costs. This is clearly false, but it is a useful fiction in that it leads to an empirically relevant factorization of the profit share of GDP. Prices are determined at the level of the firm from unit costs and the markup m_F by

$$P = \left(1 + m_F\right)\left(\frac{wL}{X} + Pa\right). \tag{4}$$

The "firm-level" wage and profit shares can be calculated from this expression, and are found to satisfy

$$\omega_F + \pi_F = 1 - a, \tag{5}$$

$$\pi_F = \frac{m_F}{1 + m_F}. \tag{6}$$

From equation (2) we have the following expressions for the wage and profit shares of GDP,

$$\omega = \frac{wL}{PY} = \frac{wL}{PX}\frac{X}{Y} = \frac{\omega_F}{1-a}, \tag{7}$$

$$\pi = 1 - \omega = \frac{\pi_F}{1-a}. \tag{8}$$

That is, both the wage and profit shares of GDP are equal to the firm-level equivalent divided by one minus the share of firm income going to intermediate consumption.

Equation (10) is important for this paper. It decomposes the profit share of GDP into two factors, one reflecting a characteristic firm-level profit share and the other the share of intermediate consumption. The profit share of GDP has a corresponding markup given by the standard formula

$$m = \frac{\pi}{1-\pi} = \frac{\pi_F}{1 - a - \pi_F} = \frac{1}{1 + (1-a)m_F} m_F, \tag{9}$$

where we have used equation (8) in the final step. If $a = 0$ then the firm and economy-wide markups are the same; otherwise the whole-economy markup is higher than the firm-level markup. This makes sense, because as intermediate goods pass from one firm to another, a markup is applied to the purchase price, thereby amplifying whatever markups had been applied to the intermediate goods that entered earlier in the production chain.

The firm-level markup m_F is a kind of average over diverse sectoral markups, and as noted by Steedman (1992), the influence of markups in different sectors on each other can, in theory, lead to divergent changes in average markups, however calculated. However, we find below that estimates of m_F for a set of OECD countries are considerably more stable than estimates of m, suggesting that the factorization in equation (10) is empirically relevant. In general we expect firms to have similar markups because of competition and emulation, although empirical studies (Hall 1988; Norrbin 1993; Roeger 1995; Nishimura et al. 1999; Klette 1999; Dobbelaere 2004) have shown that markups differ between sectors. This similarity may also hold between countries, either because of competition between global firms or from the transfer of norms from one country to another. In contrast, whole-economy markups will differ between countries because of different levels of intermediate consumption.

These expectations are borne out by international data, as shown in Figure 1.[1] As seen in the figure for the 14 OECD countries with a complete record between 1995 and 2010, the whole-economy markups as calculated using equation (10) are higher, more dispersed, and more variable than the derived firm-level markups. With the exception of Norway, which has a mean firm-level markup of 0.26, the estimated firm-level markups cluster closely around 0.16, which is a plausible average markup for OECD countries (Wu 2009).[2] This observation suggests that the Kaleckian markup m compounds two effects, the firm-level markup and the amplification of the markup through the network of interconnected firms. Only the first of these properly reflects monopoly power, and between 1995 and 2010 it was comparatively steady for 13 of the 14 OECD countries in the data set (Norway excluded). To the extent that the firm-level markup is steady, the firm level profit share is also steady, so to a first approximation there is a trade-off within the firm between paying for wages and paying for intermediate goods.

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[1] Data are from the UNdata online database (UNSD 2013) for the 14 OECD countries for which data were available for all years between 1995 and 2010: Austria, Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Norway, Portugal, Sweden, Switzerland, United Kingdom, and United States. Economy-level profit is calculated as gross operating surplus divided by GDP, while the share of intermediate consumption is calculated as intermediate consumption at purchaser's prices divided by total output at basic prices.

[2] A larger set of countries shows more variation. This is to be expected, because firm markups are driven by a combination of competitive pressure and norms, which are likely to be similar across OECD countries, but not in the rest of the world. For the 79 countries in the UNdata database (UNSD 2013) that report the necessary data in 2010, the median value of the estimated firm-level markup is 0.22. The 5% quantile is 0.12 and the 95% quantile is 0.78. The estimated markups for two countries (Azerbaijan and Timor-Leste) exceed 1.00.

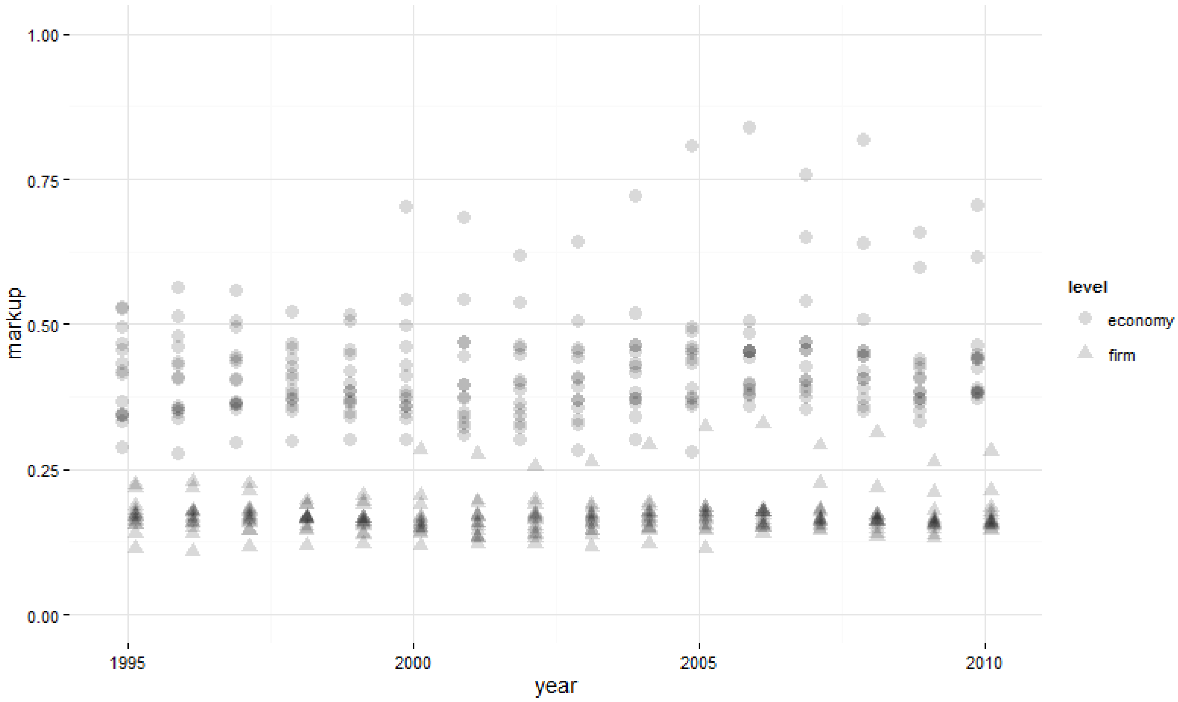

Figure 1: Markup of at the level of the whole economy (circles) and the firm (triangles) for 14 OECD countries. To distinguish the series more easily they have been shifted slightly to left and right, and they are partly transparent to account for overlapping points. (Author's calculations)

The return to capital can be calculated from either firm-level or national output. At firm level,

$$r = \pi_F \frac{X}{K} = \pi_F \kappa u = \frac{m_F}{1+m_F} \kappa u. \tag{10}$$

At national level,

$$r = \pi \frac{Y}{K} = \pi(1-a)\kappa u = \frac{m_F}{1+m_F} \kappa u. \tag{11}$$

The two calculations give the same result because the intermediate goods term enters in both GDP and the profit share of GDP, and cancels in the final expression.

Figure 1 illustrates the first of two essential results from this paper, that the decomposition of the profit share in equation (10) into two factors is empirically meaningful. We have constructed a simple model incorporating intermediate consumption that leads to a representation of the profit share of GDP as the ratio of two factors, one representing the firm-level profit share and one reflecting arising from markups on intermediate goods. The decomposition appears to be empirically meaningful because, from Figure 1, the implicit firm-level profit rates are quite steady and, for a selection of countries, they cluster around a common value. This result emboldens us to introduce the factorization into the standard Kaleckian model, which we take up in the next section.

3. A Kaleckian model with intermediate consumption

The standard Kaleckian model (Blecker 2002; Taylor 2004) proposes separate behavioral equations for savings and investment. Part of both wages and profits are saved, but at different rates. The rate of gross capital formation due to savings is given by

$$g^s = \left[s_w(1-\pi) + s_\pi \pi\right]\frac{Y}{K}. \tag{12}$$

Substituting from earlier expressions and rearranging then gives

$$g^s = \left[s_w(1-a) + (s_\pi - s_w)\pi_F\right]\kappa u. \tag{13}$$

Investment is driven by the level of utilization and the profit rate,

$$g^i = \gamma + \alpha r + \beta u. \tag{14}$$

From equation (12) or (13) we can write this as

$$g^i = \gamma + \left(\alpha\kappa\pi_F + \beta\right)u. \tag{15}$$

Equations (15) and (17) represent the second essential result from this paper, a reformulation of the Kaleckian model. We argue that this formulation, which incorporates the factorization of the profit share in equation (10) better reflects economic reality. We now explore this model using a conventional Kaleckian approach.

First, we impose the Keynesian stability condition, which states that savings respond more readily to a change in utilization than does investment. That is,

$$\Delta \equiv \frac{\partial}{\partial u}\left(g^s - g^i\right) = s_w(1-a)\kappa + (s_\pi - s_w - \alpha)\kappa\pi_F - \beta > 0. \tag{16}$$

At equilibrium, investment and saving are equal, in which case

$$u = \frac{\gamma}{\Delta}. \tag{17}$$

In the Kaleckian model developed in this section, changes to intermediate consumption expenditure and firm-level markups can affect utilization rates in the short run. From Equation (19) the response of utilization rates to a is found to be

$$\frac{\partial u}{\partial a} = -\frac{u}{\Delta}\frac{\partial \Delta}{\partial a} = \frac{u s_w}{\Delta}. \tag{18}$$

This expression is unambiguously positive (unless there is marginal dissaving out of wages). It suggests that if π_F and κ remain steady then economies will be profit-led. The channel through which this happens is that an increase in intermediate consumption at the expense of wages reduces a leakage – saving from wages – which therefore increases current demand.

The response to a change in the firm-level profit share is

$$\frac{\partial u}{\partial \pi_F} = -\frac{u}{\Delta}\frac{\partial \Delta}{\partial \pi_F} = -\kappa u \frac{s_\pi - s_w - \alpha}{\Delta}. \quad (19)$$

This is similar to the conventional Kaleckian result, and this expression can be positive or negative, giving rise to profit-led or wage-led behavior respectively. In contrast to the standard Kaleckian model, for the present model this terminology applies to the firm-level profit share, rather than the profit share of GDP.

When the degree of intermediate consumption and the firm-level profit rate are changing, the wage share of GDP also changes, according to

$$\omega = 1 - \frac{\pi_F}{1-a}. \quad (20)$$

The trajectories of a and π_F over the trade cycle give rise to different trajectories in the u-ω plane. Broadly, two combinations are possible: either the economy is profit-led with respect to both a and π_F, which we call "profit-led" or it is profit-led with respect to a and wage-led with respect to π_F, which we call "partially wage-led". From Equation (21), the second combination can occur in the plausible situation in which either the response of investment to a change in the profit rate, α, is not strong or savings out of profits are substantially higher than out of wages.

Possible trajectories for a partially wage-led economy are shown in Figure 2. At the start of the recovery the profit rate increases as prices rise in a strengthening market. As a result, the wage share of GDP falls and, because this is a partially wage-led economy, utilization also falls. However, the fall in utilization halts as firms place orders for intermediate goods that they need to fulfill their own orders, and a begins to rise. The wage share continues to fall, but eventually the rise in profits slows through a combination of inter-firm competition and an increase in the wage bill. Eventually, the share of intermediate goods begins to stabilize, but continued pressure to raise wages leads to a falling profit share and eventually a falling share of intermediate goods in firms' costs. The result from this particular sequence is a U-shaped trajectory in the u-ω plane. Such U-shaped trajectories are observed in the data (Nikiforos and Foley 2012), so the model is at least not inconsistent with observation. In the next section we discuss the case of France, for which we have constructed a data set covering 1963-2011.

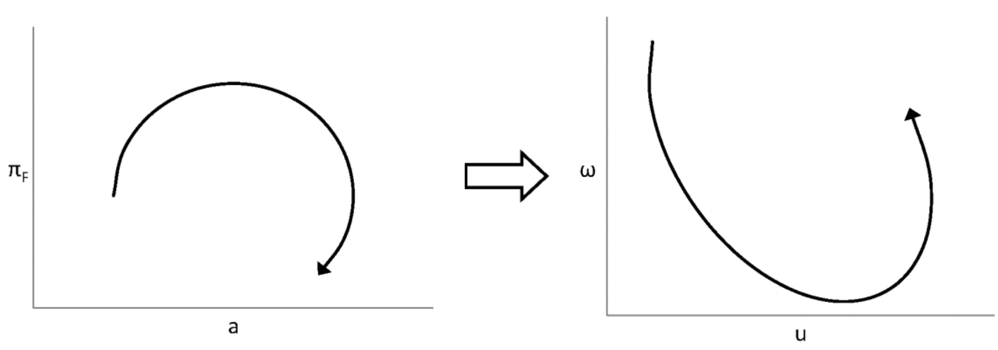

Figure 2: Schematic trajectories for a partially wage-led economy

4. Case study: France 1963-2011

Of the countries in the UNdata database (UNSD 2013), France has the longest historical record with a single series, so we use it to illustrate long-term changes in model variables. We take the income of the self-employed into account, which we did not do in the construction of Figure 1 because the data are available for France but not for all of the fourteen countries represented in the figure. We do this by computing the profit share of GDP as gross operating surplus divided by GDP less mixed income, and the wage share of GDP as employee compensation divided by GDP less mixed income, which is equivalent to assigning mixed income to profits and wages in proportion to their share outside the self-employed sector. To compute capital we first apply the GDP deflator recorded in the World Development Indicators database (World Bank 2014) to put all values in real terms. Depreciation data are only available for France from 1978 onward, so we use estimates of capital productivity from Kamps (2006) to calculate capital stock from 1963 to 1977. From 1978 onward we calculate the capital stock by taking the previous year's stock, adding gross fixed capital formation, and subtracting depreciation. Finally, to separate capital productivity from utilization, we apply a Hodrick-Prescott filter with a frequency cutoff determined by the depreciation rate (details are provided in the Appendix).

Selected model variables are shown in Figure 3. The firm-level markup m_F has been close to 0.16 since 1990, although it has been gradually falling over that time. Before the mid-1980s it was closer to 0.13, but underwent a transition over a period coinciding with the wave of privatization in France that began in 1986 (Schmidt 1999). Both firm-level markups and the firm-level wage share were rising between 1963 and the early 1970s at the expense of intermediate consumption. This period coincides with the end of the *Trente Glorieuse* (a term coined by Fourastié 1979), the thirty years of rapid growth between the end of the second world war and the early 1970s. The global commodity bubble of the 1970s may account for the peak after 1973. The global recessions of 1975 and 1991 are evident in the utilization trend, while the 1982 recession is manifested as the start of a gradual decline that extended into the 1980s (Tuppen 1988). The general slowdown in the early 2000s and the Great Recession in the late 2000s are each apparent. Capital productivity has generally fallen since the early 1970s, although the decline slowed in the 1990s, a trend commented on in detail by Piketty (2014). Trends from the mid-1990s suggest an increase in intermediate consumption, mainly but not exclusively at the expense of wages.

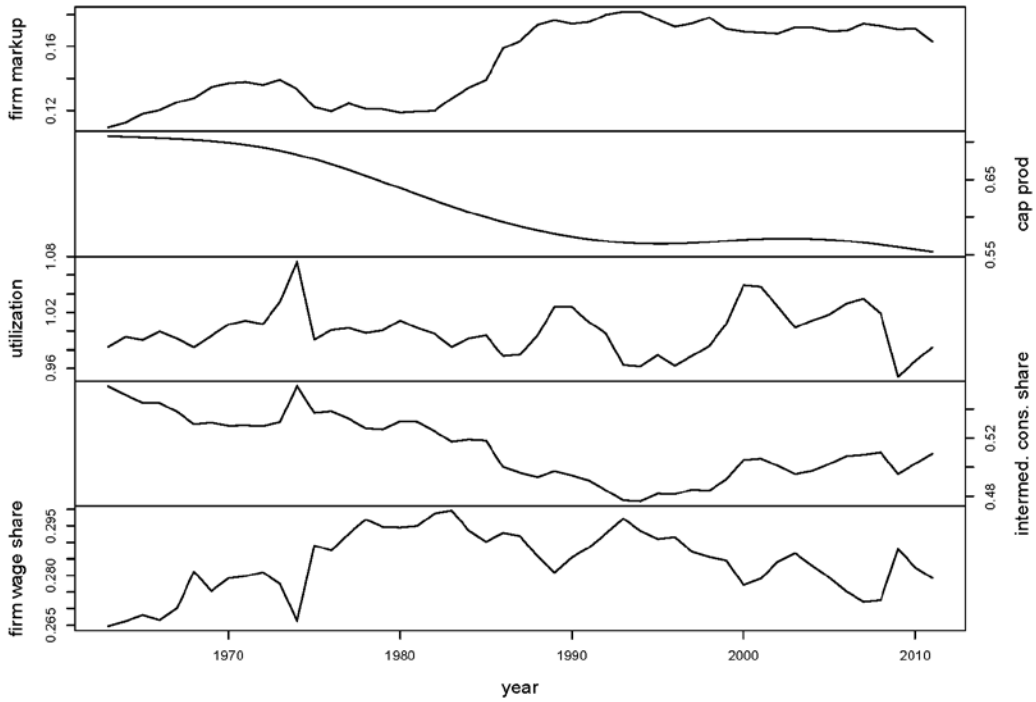

Figure 3: Trends of selected model variables for France, 1963-2011

To gain some understanding of how the model variables vary over business cycles we examine the data between 1990 and 2007. This period follows the wave of privatization and ends before the Great Recession. It includes two recessionary periods, after 1991 and after 2001. The trajectory in the a-π_F plane is shown in Figure 4, and the trajectory in the u-ω plane is shown in Figure 5. As seen in Figure 4, intermediate consumption fell during both recessions, while the firm-level profit share generally rose. Between recessions an opposite trend led to a general increase in intermediate consumption and a fall in the profit share. As we show later using the model developed in this paper, France was profit-led during this period, so these changes have counteracting impacts on utilization, but, as expected, utilization falls during recessions (Figure 5). In the 1991 recession the wage share was relatively flat, and then fell during the recovery. In the 2001 recession the wage share first rose significantly before falling as the recovery took hold.

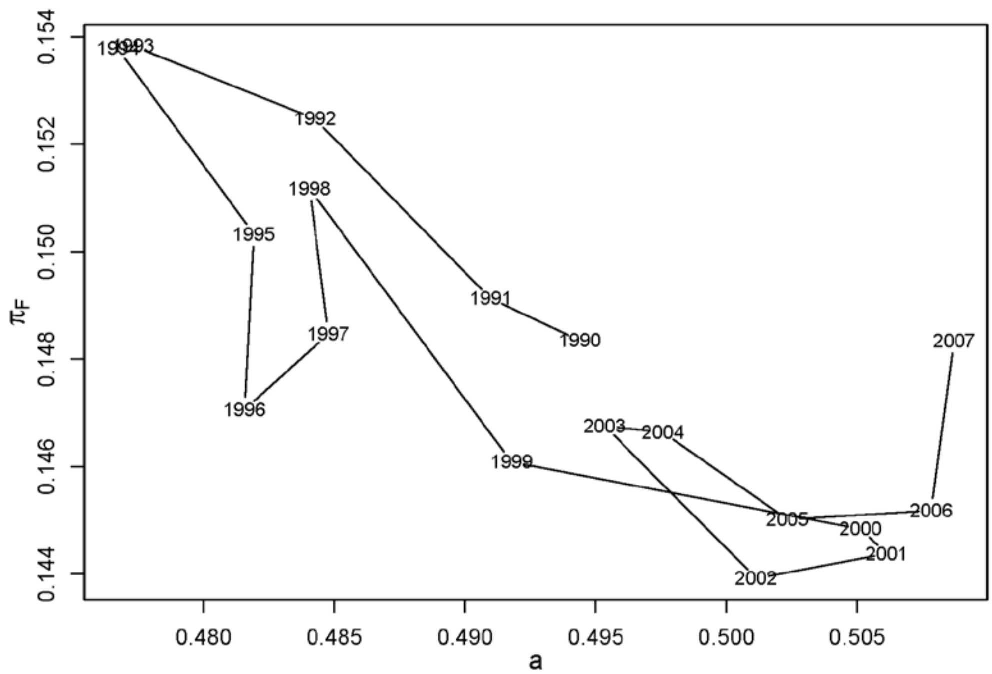

Figure 4: Trajectory in the a-π_F plane for France from 1990-2007

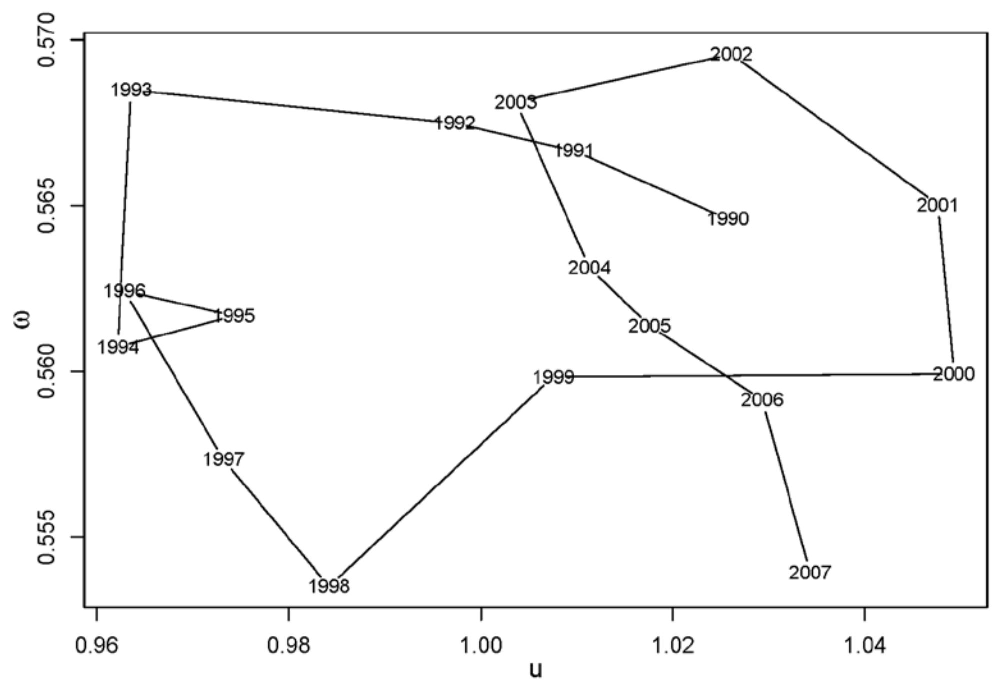

Figure 5: Trajectory in the u-ω plane for France from 1990-2007

We next ask how well the model developed in this paper explains changes in utilization and whether the fitted parameters are consistent with a profit-led or partially wage-led economy. We expect to find

$$\Delta u \cong \frac{\partial u}{\partial a}\Delta a + \frac{\partial u}{\partial \pi_F}\Delta \pi_F, \quad \frac{\partial u}{\partial a} > 0. \tag{21}$$

We contrast this with the standard model in which the profit share of GDP drives changes in utilization,

$$\Delta u \cong \frac{\partial u}{\partial \pi}\Delta \pi. \tag{22}$$

We test these expectations by fitting the following model:

$$\text{Model 1:} \quad \Delta u_t = c_0 + c_1 t + c_2 \Delta a_t + c_3 \Delta \pi_{F,t} + \varepsilon_{1,t}, \tag{23}$$

where the $\varepsilon_{1,t}$ are independent and normally distributed, t is the number of years since 1990, and c_1 corrects for a small drift in the residuals. We contrast this with a standard Kaleckian formulation,

$$\text{Model 2:} \quad \Delta u_t = c_4 + c_5 t + c_6 \Delta \pi_t + \varepsilon_{2,t}. \tag{24}$$

We fit the models to data for the period 1990-2011 using the dynlm package version 0.3-3 with R version 3.0.2. This period follows the wave of privatization and the stabilization of the firm-level profit share and extends to the end of the available data series.

The results are shown in Table 1. As seen in the table, Model 1 performs very well, explaining over 90% of the variation in the utilization rate. There is a slight negative trend, as reflected in the small value for c_1. With this term included, the autocorrelation function of the residuals is insignificantly different from zero for all positive lags. Also, a normal quantile-quantile plot of the residuals reveals no significant deviations from normality. The coefficient for the change in a is of the expected sign. The coefficient for the change in π_F is positive, indicating that France was profit-led during this period. This result differs from other assessments (Hein and Vogel 2008), but appears to be robust, as different specifications gave the same result. We also ran the model with lagged differences of all model variables, but the coefficients on the lagged variables were not significantly different from zero.

In contrast, Model 2 does not explain the data well. Although the coefficient on the profit share of GDP is significant, the model explains only 23% of the variation in the utilization rate. The sign of the coefficient is positive, again indicating that France was profit-led during this period.

Table 1: Parameter estimates for change in utilization in France, 1990-2011

	Model 1: Factored profit share			Model 2: Profit share		
Parameter	Value	t-Statistic	Sig.	Value	t-Statistic	Sig.
Δa	3.73	14.69	***			
$\Delta \pi_F$	1.47	2.32	*			
$\Delta \pi$				2.23	2.38	*
t	-6.30×10^{-4}	-2.75	*	0.00	0.14	
const.	0.00	1.17		0.31	0.21	
R^2	0.93			0.23		
adj. R^2	0.91			0.15		

5. Discussion

Kalecki (1969, chap.1) argued that industry markups reflect the degree of monopoly, a position that continues to be taken in presentations of the standard Kaleckian model (e.g., Blecker 2002, p.132). Some Post Keynesian approaches to markups are more nuanced (Lavoie 2001, pp.25–27), but still focus on the decisions taken by individual firms. Monopoly, norms, and similar considerations do, indeed, affect firm-level markups, but the markup applied by a firm cannot be taken to equal to the markup estimated at the level of the whole economy from the profit share, as is routinely done. This is a central critique of Kaleckian models from a Sraffian perspective as presented by Steedman (1992).

Steedman's alternative to the Kaleckian approach appears to be to always work within a disaggregated input-output framework, because industry markups are interrelated. While we accept the critique, we challenge this solution to the problem based on the results summarized in Figure 1. In this paper we built a model that requires only national aggregates as reported under the system of national accounts (SNA93). It is a single-sector model with an aggregate input-output coefficient, a. We then derived a relationship between the economy-wide markup calculated from the profit share of GDP and an imputed firm-level markup, as in equation (11). When estimated from national accounts for a selection of 14 OECD countries we found that with few exceptions the firm-level markups were stable and similar across countries. Although they do appear to vary slightly, they are clustered closely around a value of 0.16 over the period 1995-2010. While it is tempting to report this as a "stylized fact", it is more likely to reflect a transatlantic consensus on business norms that arose in the 1980s and 1990s. Firm-level markups are determined by competitive pressures and norms, and when these change over time or between countries, the markup is also expected to change. This is shown in the data for France, where the estimated firm-level markup jumped from a low to a high value during a period of privatization. It is also shown in the data for non-OECD countries, which, although more sparse, exhibits a much wider range of estimated markups.

The factorization of the profit share of GDP into a relatively stable factor reflecting firm-level markups and a factor reflecting the degree of intermediate consumption leads to a modified Kaleckian model as captured in equations (15) and (17). Investment decisions depend on the firm-level markup and utilization, but not on the degree of intermediate consumption. Intermediate consumption does affect the savings rate because at a fixed firm-level markup there is a trade-off between the share of firm income going to wages and to intermediate consumption. When income is shifted away from wages then savings from wages – a leakage – is diverted toward buying intermediate goods, which stimulates the economy. We note in passing the contrast between this demand-side mechanism and the supply-side argument that shifting from wages to profits stimulates the economy through increased saving.

The economy is always profit-led with respect to an increase in intermediate goods consumption, but can be either profit-led or wage-led with respect to the firm-level profit share. Over a business cycle, firm-level markups and intermediate goods consumption can be expected to increase and decrease at different times. If the economy is wage-led with respect to the firm-level profit share – that is, it is partially wage-led – then the wage share can alternately fall and rise even as utilization expands. In the profit-led case, as for France after 1990, the wage share always falls as utilization increases. The model performed well when applied to data for the period between 1990 and 2011 in France, explaining over 90% of the change in utilization rates.

The essence of the model is captured in equations (15) and (17). For applied work, most of the variables are reported in national accounts. Which variables are actually available, and over what time, varies from country to country, but coverage has expanded in recent years. In addition to the national accounts data it is necessary to calculate the capital stock, but, because gross capital formation and depreciation are reported in national statistics, only an initial estimate for the capital stock is required. Historical estimates are available for the OECD (Kamps 2006) and the world (Nehru and Dhareshwar 1993).

Extensions to this study could include testing the model with a larger set of countries. However, further tests should take account of trade (Stockhammer et al. 2009), the government sector (Jong-Il and Dutt 1996), and finance (Hein 2013), as these will help to explain variation between countries. Both the literature on extensions to the basic Kaleckian model and the literature on industry markups (e.g., Wu 2009) can inform such studies.

6. Conclusion

We have constructed a modified Kaleckian model that takes into account both firm-level markups and the degree of intermediate goods consumption in the economy. Both factors influence the profit share of GDP and the aggregate markup, because, as markups are applied by firms that have purchased goods from other firms that applied their own markups, the markups accumulate across the economy. When there is substantial intermediate goods consumption the aggregate markup can be substantially higher than the firm-level markup. Also, intermediate consumption and firm-level markups can change independently of one another. Firm-level markups are constrained by competition and norms, while the degree of intermediate goods consumption is less constrained and is susceptible to a wider array of influences.

In the model constructed in this paper, the firm-level markup and the degree of intermediate goods consumption have different effects on utilization rates. Economies are always profit-led with respect to a change in intermediate goods consumption, but can be either wage-led or profit-led with respect to a change in the firm-level profit share. In combination with different trajectories for intermediate goods consumption and the firm-level markup, this can lead to different trajectories for utilization and the wage share over business cycles. In an application to France, which did experience different patterns of change over different business cycles, the model performed well, explaining over 90% of the observed variation in the utilization rate.

This paper accepts the Sraffian critique of the standard Kaleckian model (Steedman 1992) that it does not include intermediate consumption and does not take into account interactions between markups in different firms. However, we challenge the idea that only a detailed analysis can give meaningful results. We show that introducing intermediate consumption in a minimal way into a Kaleckian model gives rise to pervasive and relevant behavior that justify a modification of the standard model. However, we also show that this minimal modification may be sufficient for the sort of analyses to which Kaleckian models are put. In particular, estimates of the firm-level markup, a kind of average markup for the economy, are found to cluster around a common and stable value for a selection of OECD countries between 1995 and 2010. This stability and regularity suggests that, although simple, the model captures relevant features of the real world.

7. References

Araujo, R. A. (2013) 'Cumulative causation in a structural economic dynamic approach to economic growth and uneven development'. *Structural Change and Economic Dynamics*, 24. 130–40. doi:10.1016/j.strueco.2012.09.001.

Blaug, M. (2009) 'The Trade-Off between Rigor and Relevance: Sraffian Economics as a Case in Point'. *History of Political Economy*, 41(2). 219–47. doi:10.1215/00182702-2009-001.

Blecker, R. A. (2002) 'Distribution, Demand, and Growth in Neo-Kaleckian Macro Models'. *The Economics Of Demand-Led Growth: Challenging the Supply-side Vision of the Long Run*, M. Setterfield (ed.). Edwar Elgar, Cheltenham, UK.

Cochrane, J. H. (1988) 'How Big Is the Random Walk in GNP?' *Journal of Political Economy*, 96(5). 893–920.

Dobbelaere, S. (2004) 'Estimation of price-cost margins and union bargaining power for Belgian manufacturing'. *International Journal of Industrial Organization*, 22(10). 1381–98. doi:10.1016/j.ijindorg.2004.10.003.

Fagerberg, J. (2003) 'Schumpeter and the revival of evolutionary economics: an appraisal of the literature'. *Journal of Evolutionary Economics*, 13(2). 125–59. doi:10.1007/s00191-003-0144-1.

Fourastié, J. (1979) Les Trente glorieuses ou la Révolution invisible de 1946 à 1975. Fayard, Paris.

Gómez, V. (2001) 'The Use of Butterworth Filters for Trend and Cycle Estimation in Economic Time Series'. *Journal of Business & Economic Statistics*, 19(3). 365–73. doi:10.1198/073500101681019909.

Hall, R. E. (1988) 'The Relation between Price and Marginal Cost in U.S. Industry'. *Journal of Political Economy*, 96(5). 921–47. doi:10.2307/1837241.

Hart, N. and Kriesler, P. (2014) *Keynes, Kalecki, Sraffa: Coherence?* 2014-06. School of Economics, The University of New South Wales. http://ideas.repec.org/p/swe/wpaper/2014-06.html.

Harvey, A. C. and Jaeger, A. (1993) 'Detrending, stylized facts and the business cycle'. *Journal of applied econometrics*, 8(3). 231–47.

Hein, E. (2013) 'Finance-dominated capitalism and re-distribution of income: a Kaleckian perspective'. *Cambridge Journal of Economics*, . bet038. doi:10.1093/cje/bet038.

Hein, E., Lavoie, M. and van Treeck, T. (2012) 'Harrodian Instability and the "normal Rate" of Capacity Utilization in Kaleckian Models of Distribution and Growth—a Survey'. *Metroeconomica*, 63(1). 139–69. doi:10.1111/j.1467-999X.2010.04106.x.

Hein, E. and Vogel, L. (2008) 'Distribution and growth reconsidered: empirical results for six OECD countries'. *Cambridge Journal of Economics*, 32(3). 479–511. doi:10.1093/cje/bem047.

Hodrick, R. J. and Prescott, E. C. (1997) 'Postwar U.S. Business Cycles: An Empirical Investigation'. *Journal of Money, Credit and Banking*, 29(1). 1–16. doi:10.2307/2953682.

Hoque, H. A. A. B., Kim, J. H. and Pyun, C. S. (2007) 'A comparison of variance ratio tests of random walk: A case of Asian emerging stock markets'. *International Review of Economics & Finance*, 16(4). 488–502. doi:10.1016/j.iref.2006.01.001.

Jong-Il, Y. and Dutt, A. K. (1996) 'Government debt, income distribution and growth'. *Cambridge Journal of Economics*, 20(3). 335–51.

Kalecki, M. (1969) Theory of Economic Dynamics: An Essay on Cyclical and Lon-Run Changes in Capitalist Economy. Augustus M. Kelly, New York, NY, US.

Kamps, C. (2006) 'New Estimates of Government Net Capital Stocks for 22 OECD Countries, 1960-2001'. *IMF Staff Papers*, 53(1). 120–50.

Keen, S. (1998) 'Answers (and Questions) for Sraffians (and Kaleckians)'. *Review of Political Economy*, 10(1). 73–87. doi:10.1080/09538259800000048.

Klette, T. J. (1999) 'Market Power, Scale Economies and Productivity: Estimates from a Panel of Establishment Data'. *The Journal of Industrial Economics*, 47(4). 451–76.

Kurz, H. D. and Salvadori, N. (2011) 'In Favor of Rigor and Relevance: A Reply to Mark Blaug'. *History of Political Economy*, 43(3). 607–16. doi:10.1215/00182702-1346851.

Lavoie, M. (2011) 'Should Sraffian economics be dropped out of the post-Keynesian school?' *Economies et sociétés*, 45(7). 1027–59.

Lavoie, M. (2001) 'Pricing'. *A new guide to post Keynesian economics*, R. P. F. Holt and S. Pressman (eds.). Contemporary political economy series. Routledge, London ; New York.

Lecocq, F. and Shalizi, Z. (2014) 'The economics of targeted mitigation in infrastructure'. *Climate Policy*, 14(2). 187–208. doi:10.1080/14693062.2014.861657.

Levrero, E. S., Palumbo, A. and Stirati, A. eds. (2013) Sraffa and the Reconstruction of Economic Theory: Volume Two: Aggregate Demand, Policy Analysis and Growth. Palgrave Macmillan.

Lo, A. W. and MacKinlay, A. C. (1988) 'Stock market prices do not follow random walks: evidence from a simple specification test'. *Review of Financial Studies*, 1(1). 41–66. doi:10.1093/rfs/1.1.41.

Maddison, A. (1994) *Standardised Estimates of Fixed Capital Stock: A Six Country Comparison*. 199409. Groningen Growth and Development Centre, University of Groningen. http://ideas.repec.org/p/dgr/rugggd/199409.html.

Mainwaring, L. (1992) 'Steedman's critique: a tentative response from a tentative Kaleckian'. *Review of Political Economy*, 4(2). 171–77. doi:10.1080/09538259200000014.

Nehru, V. and Dhareshwar, A. (1993) 'A New Database on Physical Capital Stock: Sources, Methodology and Results'. *Revista de Analisis Economica*, 8(1). 37–59.

Nelson, C. R. and Plosser, C. R. (1982) 'Trends and random walks in macroeconmic time series: Some evidence and implications'. *Journal of Monetary Economics*, 10(2). 139–62. doi:10.1016/0304-3932(82)90012-5.

Nikiforos, M. and Foley, D. K. (2012) ‘Distribution and Capacity Utilization: Conceptual Issues and Empirical Evidence’. *Metroeconomica*, 63(1). 200–229. doi:10.1111/j.1467-999X.2011.04145.x.

Nishimura, K. G., Ohkusa, Y. and Ariga, K. (1999) ‘Estimating the mark-up over marginal cost: a panel analysis of Japanese firms 1971–1994’. *International Journal of Industrial Organization*, 17(8). 1077–1111. doi:10.1016/S0167-7187(98)00011-3.

Norrbin, S. C. (1993) ‘The Relation between Price and Marginal Cost in U.S. Industry: A Contradiction’. *Journal of Political Economy*, 101(6). 1149–64. doi:10.2307/2138575.

Pedersen, T. M. (2001) ‘The Hodrick–Prescott filter, the Slutzky effect, and the distortionary effect of filters’. *Journal of Economic Dynamics and Control*, 25(8). 1081–1101. doi:10.1016/S0165-1889(99)00059-7.

Piketty, T. (2014) *Capital in the Twenty-First Century*. The Belknap Press of Harvard University Press, Cambridge Massachusetts.

R Development Core Team (2011) *R: A Language and Environment for Statistical Computing*. R Foundation for Statistical Computing, Vienna, Austria. http://www.R-project.org.

Roeger, W. (1995) ‘Can Imperfect Competition Explain the Difference between Primal and Dual Productivity Measures? Estimates for U.S. Manufacturing’. *Journal of Political Economy*, 103(2). 316–30.

Salanti, A. (2014) ‘Rigor versus Relevance in Economic Theory: A Plea for a Different Methodological Perspective’. *History of Political Economy*, 46(1). 149–66. doi:10.1215/00182702-2398957.

Schmidt, V. A. (1999) ‘Privatization in France: the transformation of French capitalism’. *Environment and Planning C: Government and Policy*, 17(4). 445–61. doi:10.1068/c170445.

Setterfield, M. (2003) ‘Neo-Kaleckian growth dynamics and the state of long-run expectations: wage-versus profit-led growth reconsidered’. *Old and New Growth Theories: An Assessment*, N. Salvadori (ed.). Edward Elgar Publishing.

Setterfield, M. (2002) ‘A model of Kaldorian traverse: cumulative causation, structural change and evolutionary hysteresis’. *The economics of demand-led growth: challenging the supply-side vision of the long run*, M. Setterfield (ed.). Edward Elgar, Cheltenham, UK ; Northampton, MA. 215–33.

Skott, P. (2012) ‘Theoretical and Empirical Shortcomings of the Kaleckian Investment Function’. *Metroeconomica*, 63(1). 109–38. doi:10.1111/j.1467-999X.2010.04111.x.

Steedman, I. (1992) ‘Questions for Kaleckians’. *Review of Political Economy*, 4(2). 125–51. doi:10.1080/09538259200000011.

Stockhammer, E., Onaran, Ö. and Ederer, S. (2009) ‘Functional income distribution and aggregate demand in the Euro area’. *Cambridge Journal of Economics*, 33(1). 139–59. doi:10.1093/cje/ben026.

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

Tuppen, J. (1988) *France Under Recession: 1981-1986: 1981 - 1986*. SUNY Press, New York, NY, US.

UNSD (2013) ‘National Accounts Official Country Data Table 4.1 Total Economy’. http://data.un.org/Explorer.aspx?d=SNA.

World Bank (2014) ‘World Development Indicators’. http://data.worldbank.org/data-catalog/world-development-indicators.

Wu, H. (2009) ‘Entry barriers and markup ratios: evidence from OECD countries’. *Applied Economics Letters*, 16(2). 125–30. doi:10.1080/13504850601018122.

Appendix 1Appendix: Decomposing capital productivity

In the body of the paper we decompose the ratio of total output to capital as the product of a utilization factor and an underlying capital productivity. Calling the ratio of total output to capital the "apparent" capital productivity, κ_{app}, we have

$$\kappa_{\text{app}} \equiv \frac{X}{K} = u\kappa. \tag{1}$$

We separate this product into a trend component and a cyclical component using the well-known Hodrick-Presscott (HP) filter (Hodrick and Prescott 1997).

The utilization factor is expected to change over a business cycle (that is, between 6 quarters and 8 years), while the capital productivity is expected to change on the time scale over which the capital stock turns over, between 15 and 40 years (Lecocq and Shalizi 2014). We work in logs,

$$\ln \kappa_{\text{app},t} = \ln \kappa_t + \ln u_t. \tag{2}$$

This has the form considered by Hodrick and Prescott (1997),

$$y_t = g_t + c_t, \tag{3}$$

where g_t is a smoothly-varying "growth" component and c_t is the "cycle". The variable y_t is the observation. We note that the c_t in our model, represented by $\ln u_t$, might not be independent of one another, because the contribution of "animal spirits" to capacity utilization leads to persistent episodes of high or low utilization – booms and slumps.

The Hodrick-Prescott (HP) filter separates the growth and cycle components by minimizing a weighted sum of squares,

$$\min_{\{g_t\}} \left\{ \sum_{t=1}^{T} c_t^2 + \lambda \sum_{t=1}^{T} \left[\left(g_t - g_{t-1} \right) - \left(g_{t-1} - g_{t-2} \right) \right]^2 \right\}, \tag{4}$$

where λ is chosen based on the underlying economic process. Hodrick and Prescott were careful to say that they assumed very little about their series, except that they expect a slowly-moving fundamental component and a more rapidly varying cyclical component. Thus, use of the filter requires minimal theoretical assumptions. Harvey and Jaeger (1993), among others, have argued that the filter can introduce a spurious signal, but as argued by Pederson (2001), this is true even for an ideal filter, and is not particular to the HP filter. Below, we address this concern by considering different values for λ. Another question is whether the series exhibits a random walk. In that case any secular trend is an accident of history generated by a sequence of random fluctuations. However, as argued by Piketty (2014), there are good reasons to think that the trend in capital productivity in France is due to a deterministic process unfolding over time at a rate determined by the rate of capital turnover. Also, although capital productivity can exhibit large variability, its long-run behavior appears to be bounded (Maddison 1994), which is not consistent with a random walk. Despite these theoretical and empirical reasons to expect a deterministic trend, we nevertheless test whether the series has the characteristics of a random walk.

As shown by Gómez (2001), the HP filter is a low-pass filter, in that it separates slowly-varying from rapidly-varying components. The gain function in the frequency domain goes from unity at very low frequencies to zero at infinitely high frequencies. It has the shape of a steep cliff that reaches a value of one-half at a cut-off frequency ω_c satisfying

$$\lambda = \left(2\sin\frac{\omega_c}{2} \right)^{-4}. \tag{5}$$

The frequency of an oscillation is equal to 2π divided by the period. The period, in turn, is given by the relevant time scale for the economic process. For capital productivity, the relevant time scale is the turnover time of capital, between 15 and 40 years, and is equal on average to the inverse of the depreciation rate. In this paper we use the inverse depreciation rate, so we have

$$\omega_c = 2\pi\delta. \tag{6}$$

The corresponding value for λ is then

$$\lambda = \left[2\sin\left(\pi\delta\right) \right]^{-4}. \tag{7}$$

For France, with an average depreciation rate of 3.83% per year, corresponding to a time scale of T = 26 years, λ is 302.

Alternative decompositions using T = 15, 26, and 40 years (corresponding to λ=33, 302, 1649) are shown in Figure A1. For each, we used the mFilter package version 0.1-3 in R version 3.0.2 (R Development Core Team 2011). As seen in the figure, the estimated utilization rates are qualitatively similar, although their detailed trends are different. As the first difference in u is used in the model developed in the paper, a reasonable check on the robustness of the choice of time scale is the correlation of the first difference of u between the different series. The results are

$$\text{corr}(\Delta u_{T=26}, \Delta u_{T=15}) = 0.99, \quad \text{corr}(\Delta u_{T=26}, \Delta u_{T=40}) = 0.99. \tag{8}$$

It therefore makes very little difference to the analysis which time scale, and therefore which value of λ, we use.

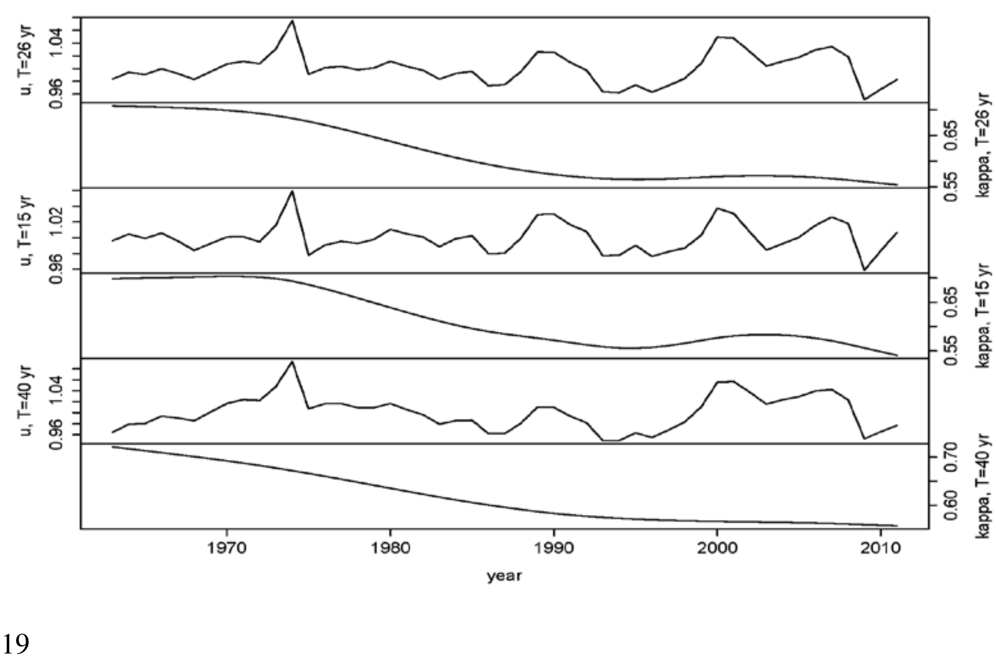

Figure A1: Alternative decompositions using different time scales

Properties of the empirical time series for κ_{app} for France between 1963 and 2011 are shown in Figure A2. As shown, the autocorrelation function for the levels of log κ_{app} decreases more or less linearly with the lag, while the autocorrelation function for first differences (corrected for the mean) is insignificantly different from zero at all positive lags. However, the differences are not normally distributed, as shown in the bottom-left panel; there is a higher than normal probability of large negative movements.

The final panel in the figure shows the ratio of the variances of "long differences" divided by the lag, as recommended by Cochrane (1988). Both Cochrane, who analyzed macroeconomic trends, and Lo and MacKinley (1988), who analyzed financial trends, prompted further work on what are now called "variance ratio tests". The literature offers a considerable variety of variance ratio tests to choose from (e.g., Hoque et al. 2007), but Cochrane's "plot and look" method is straightforward and provides insights that are obscured by summary statistics. The calculations, including corrections for small samples (Cochrane 1988, p.907), were implemented by the author in R code, which is provided below. In Cochrane's plot, a series generated by a random walk will result in a horizontal line, while a stationary series will tend asymptotically toward zero. As shown in the figure, up to a lag of about 15 years the series looks like a random walk. After that time is begins to fall, and drops sharply at about 25 years. This is consistent with the expected lifetimes of long-lived capital stocks, which range from 15 to 40 years, and with the average depreciation rate in France between 1963 and 2011 of 26 years.

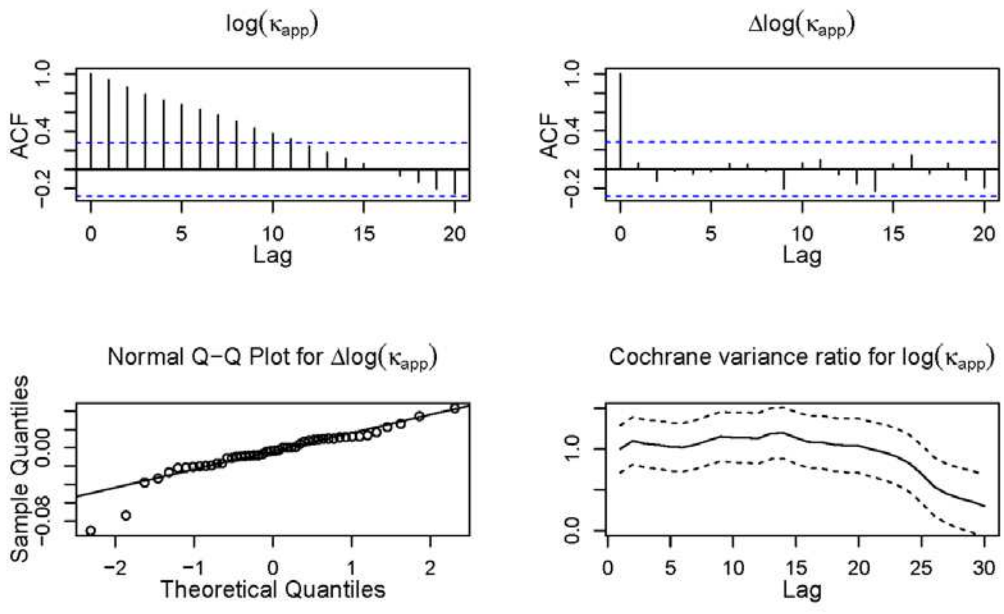

Figure A2: Properties of the κ_{app} time series for France, 1963-2011

The corresponding graphs for the log of the derived series for u are shown in Figure A1. As seen in the figure, there is persistence in the utilization rate at lag one, as expected – until there is a correction, rising utilization feeds a further rise, while slumps tend to persist. However, first differences are uncorrelated. As for the κ_{app} series, there is a higher-than normal probability of a large negative change – when utilization falls, it is more likely to fall sharply than a normal distribution would suggest. The Cochrane plot shows that the series for *u* is stationary at short lags, as expected for the cyclical component of a decomposed series (Nelson and Plosser 1982).

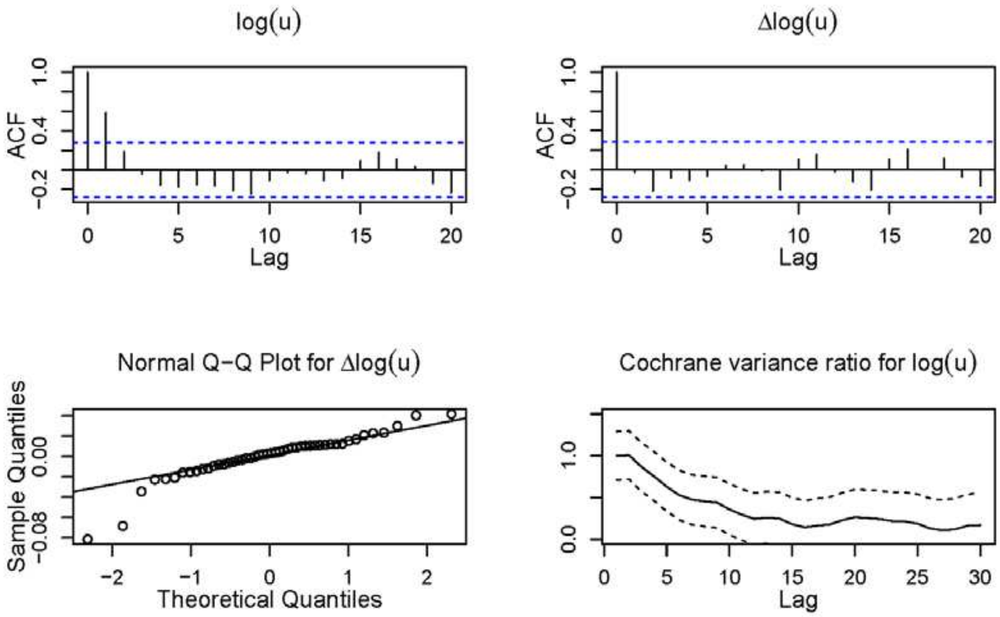

Figure A3: Properties of the *u* time series for France, 1963-2011

R code for Cochrane variance ratio test

```
cochrane.var.ratio <- function(x, max.lag=30) {
  y <- matrix(ncol=2,nrow=max.lag)
  colnames(y) <- c("vr","error")
  N <- length(x)
  mu <- mean(diff(x))
  for (k in 1:max.lag) {
    variance <- var(diff(x, lag=k) - mu)
    dof.corr <- N/(N - k + 1)
    # This will become a ratio below
    y[k,"vr"] <- dof.corr * variance/k
    y[k,"error"] <- sqrt(2/(N - k))
  }
  y[,"vr"] <- y[,"vr"]/y[1,"vr"]
  y[,"error"] <- sqrt(y[,"error"]^2 + y[1,"error"]^2)
  return(y)
}
```