The impact of income distribution on consumption: a reassessment

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Abstract: For some Post Keynesian economists, functional income distribution affects economic activity and growth through its effects on investment, consumption and net exports. This study focuses on econometric issues about the consumption function. Post Keynesians generally fail to find a long-run relation between consumption, wages, profits and wealth. However, taking close econometric specifications, Neoclassical get this kind of relation. We lean on this result in order to re-examine the relation between income distribution and consumption. The empirical analysis applies on U.S. quarterly data for the period 1960-2007.

1. Introduction

For some Post Keynesian economists, functional income distribution affects economic activity and growth.[2] The arguments are now well known: everything else being equal, a rise of profit share increases capital profitability and then capital accumulation. But the rise of profit share has an opposite effect on the rate of capacity utilization, via a drop in consumption, because the propensity to consume out of profits is lower than the propensity to consume out of wages. Eventually, capital accumulation decreases if the fall in capacity utilization offsets the increase of profitability, then economy is profit-led. Conversely, capital accumulation increases if the fall in capacity utilization does not offset the increase of profitability, and economy is wage-led.

It is generally assumed that economies are more likely profit-led while taking international trade into account. But it depends on several conditions, notably on the relation between income distribution, labor costs and inflation: a rise of profit share which is based on a reduction of labor costs results in better competitiveness and higher net exports (profit-led regime); on the opposite, a rise of profit share which rests on more inflation results in lower net exports (wage-led regime).[3]

Finally, the impact of income distribution on economic growth is a matter of facts; hence the necessity of econometrics research in this field. The econometric strategy generally consists in specifying and estimating separately three functions (for consumption, accumulation, and net exports) where profit share appears as an independent variable.[4] The coefficients of each equation are then combined in order to compute the global impact of income distribution on economic activity.

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[2] See for instance Badhuri and Marglin [1990], Lavoie [1995], Blecker [2002] and Dutt [2011].
[3] See Blecker [1998] and Hein and Vogel [2008].
[4] Another solution is to jointly estimate the three functions in a VAR (Onaran and Stockhammer [2003]) or in a VECM (Allain and Canry [2007]).

Of course, each step of this methodology raises many questions. We focus here on the consumption function, leaving apart the questions about its theoretical formulation in order to concentrate on econometric issues. We also limit ourselves to macroeconomics approaches (resting on national account datasets) and to multivariate time series analyses for one country (not for panel data).

A special attention is given to cointegration issues. As it is now well known, OLS estimations are biased if the variables are not stationary. The model must then be estimated on the variables in first differences including, if any, error correction terms (which are the residuals of cointegrating relations of the variables in levels). Two cases must be distinguished: in the absence of any cointegrating relation, shocks have a permanent impact on the variables; on the contrary, with cointegrating relations, the impact of shocks may be transitory and vanishing in time. Applied to our topics, it means that a change in income distribution may have permanent or only transitory effects on consumption.

We take Onaran, Stockhammer and Grafl [2011, OSG henceforth] as a benchmark for our study.[5] Their article refers to a Post Keynesian framework in order to analyze the effects of financialization on aggregate demand in the case of USA. In this study, consumption depends on the income distribution between wages, rentier and non-rentier profits. It also depends on housing and financial wealth effects. According to OSG, the marginal propensity to consume is higher for wages than for profits, and higher for non-rentier than for rentier profits. In addition, wealth effects are significant but modest, higher for housing than for financial wealth.

An important aspect of OSG analyses is that they fail to find a long-run (cointegrating) relation between consumption and the other variables of their model. Profit share variations therefore have permanent effects on consumption.

The presence of wealth in OSG is interesting because it allows to compare their results with the recent growing Neoclassical literature on wealth effects. This kind of models is labeled by the acronym "*cay*" (for consumption, assets and labor income which is symbolized by *y*). The theoretical bases are of course radically different, but econometrics shares several common ingredients as it takes consumption, wealth and labor income into account. Yet, it is generally admitted that these three variables are together cointegrated.

The aim of this paper is therefore to lean on the results of the "*cay*" models in order to find a cointegrating relation which takes consumption, wealth as well as income distribution into account. In section 2, we compare Post Keynesian and "*cay*" Neoclassical consumption functions both on their theoretical foundations, econometric specifications and estimation outcomes. Section 3 relates on econometric methodology: different approaches are briefly presented and discussed. Data choice and unit root tests are presented in Section 4. Econometric results are displayed in Section 5 and interpreted in Section 6. Eventually, concluding remarks are formulated in Section 7.

[5] See Nastepaad and Storm [2006], Hein and Vogel [2008, 2009], Stockhammer, Onaran and Ederer [2009], Stockhammer, Hein and Grafl [2011] for other econometric analyses about the effects of income distribution on economic activity.

2. Comparing Post Keynesian and "*cay*" Neoclassical consumption functions

2.1. Theoretical bases and econometric specifications

Post Keynesian and "*cay*" Neoclassical consumption functions relate on two radically different theoretical analyses. Nevertheless the econometric specifications are very close to each other.

The Post Keynesian approach takes its place in a macroeconomic framework where economic activity is demand constrained. In such framework, income distribution being exogenous, the total effect on production as profit share changes is the sum of its partial effects on investment, consumption and net exports. The fundamental assumption about the consumption function (C) is that the marginal propensity to consume is lower for profits (Π) than for wages (W), that is $c_\pi < c_w$. The main reason is that a fraction of capital remuneration is retained in order to maintain and increase the capital stock. In practice, the lower c_π essentially results from the shareholder policy in favor of retained profits.

Because national income (Y) is the sum of wages and profits, the consumption function may be written:

$$C = c_0 + c_w Y + (c_\pi - c_w)\pi Y \tag{1}$$

where $\pi = \Pi / Y$ is the profit share. Because $c_\pi - c_w$ is negative, an increase of π leads to a decrease of C for a given Y. As a consequence, the higher the difference between the two propensities to consume, the greater is the probability for the economy to be wage-led.

In their econometric specification, OSG add two other hypotheses. They firstly make a distinction between rentier profits (Π_r; interests and dividend paid to households) and non-rentier profits (Π_{nr}) including "retained earnings as well as proprietors' income, depreciation and taxes. Thus it is expected that there is consumption out of proprietor's income" (OSG, fn. 5, p. 641) such that $c_{\pi nr}$ is supposed to be positive despite the retained earnings. Hence the assumption that $c_{\pi nr} < c_{\pi r} < c_w$. Secondly, OSG assume the presence of wealth effects via housing assets (HA) and financial assets (FA). Dividing by Y, the consumption function becomes:

$$\frac{C}{Y} = c_w + \frac{c_0}{Y} + (c_{\pi r} - c_w)\pi_r + (c_{\pi nr} - c_w)\pi_{nr} + c_{ha}\frac{HA}{Y} + c_{fa}\frac{FA}{Y} \tag{2}$$

where π_r and π_{nr} are rentier and non-rentier profit shares in national income.

Turning to the Neoclassical theory, the high increase of wealth during the 1990s in the USA as well as the collapses of financial wealth (2000 to 2002) and housing wealth (since 2006) have fueled numerous researches about the wealth-consumption ratio.[6] The main references are probably two articles from Lettau and Ludvigson [2001, 2004]. The theoretical basis is the intertemporal budget constraint in the permanent income hypothesis. Because of this constraint, household consumption depends on their wealth. But this wealth combines observable (financial and tangible assets) and an unobservable component: the human capital. A solution is given by the assumption that the observable labor income (W) can describe the unobservable human capital. Hence the consumption function is:

$$C = c_0 + c_a A + c_w W \tag{3}$$

[6] See Paiella [2009] for a survey.

where *A*, which represents observable wealth, may be disaggregated in several components (housing *vs*. financial, stock market *vs*. non stock market, etc.). It is important to put the stress on the differences between (2) and (3): in (2), consumption depends on income and a wealth effect is added; in (3) consumption depends on wealth and labor income appears as a proxy for human capital.

Of course, despite the huge differences in theoretical foundations, the estimation of (3) ought to produce results which may be reinterpreted in a Post Keynesian framework. Note that profits do not enter in (3) because assets are already included. But from the Post Keynesian point of view, equation (3) is a particular case of the more general equation (2) with $c_{\pi r} = c_{\pi nr} = 0$. In addition, data availability frequently constrains Neoclassical economists to use the disposable income instead of the labor income, which may be reinterpreted as the assumption that $c_{\pi r} = c_w$. Eventually, equation (3) may easily be enriched in order to take account of Π_r and Π_{nr}. This will be done further in this paper.

2.2. Looking for a long-run relationship

In spite of the proximity of the specifications, the econometric outcomes differ in many ways. The most obvious is perhaps that Neoclassicals generally find a cointegrating relation between the variables in levels while Post Keynesians fail to find it. To understand what is at stake here, it is necessary to briefly remind some basic properties of time series. Let us assume that a time series may be written:

$$y_t = (\phi + 1) y_{t-1} + \varepsilon_t$$

in levels, or equivalently:

$$\Delta y_t = \phi y_{t-1} + \varepsilon_t$$

in first differences. The time series is said to be a random walks (difference stationary, integrated I(1), or having a unit root) if ϕ is not significant. In this case, y_t depends on its past level (y_{t-1}) and on a white noise (ε_t). But, as y_{t-1} also depends on its past level (y_{t-2}) and on a white noise (ε_{t-2}), and the same for y_{t-2}, y_{t-2}… the whole process may be rewritten:

$$y_t = \sum_{i=0}^{\infty} \varepsilon_{t-i}$$

The present value of *y* results from a succession of random shocks, the oldest shocks having the same importance as the most recent ones. Whatever its origin, a shock has a permanent effect on y_t and the series never comes back at its previous level; y_t is a long (infinite) memory time series. On the opposite, y_t is stationary, I(0), if ϕ is significantly negative. Then the series has a short memory and a random shock has no permanent impact on its level.

If times series are random walks, applying OLS in a multivariate analysis leads to spurious, biased results. The solution is to calculate the first differences of the series (which are stationary: if $\phi = 0$, $\Delta y_t = \varepsilon_t$). The estimation is then implemented on the dynamical model. But the properties of the multivariate analysis are identical than that of the univariate analysis: the models have long run memory; shocks on explanatory variables have permanent effects on the level of the dependent variable.

However, a linear combination of several I(1) series may result in stationary residuals (μ_t). In this case, the series are cointegrated and the linear combination gives the long-run relationship between the variables in levels. The series of residuals μ_t is then included (with one time lag) as an error correction term in the OLS estimation of the equation in first differences to obtain

a short-run relationship. The corresponding coefficient α, which is negative (as ϕ was in the univariate analysis), gives the magnitude of the adjustment around the long-run relationship. In brief, a shock affects the level of some dependant variables; as a result, the long-run relationship is temporary broken ($\mu_t \neq 0$); then the error correction (via α) tend to restore this relationship (but at another level); eventually, a part of the initial shock remains permanent whereas the other part is only transitory.

An essential outcome of "*cay*" models is that they generally succeed in finding a cointegrating relation between the three variables. That enables the authors to compute the long-run elasticities of consumption and the corresponding mpc. As examples, Table 1 lists a few results for U.S. economy.

Table 1. Wealth and labor income effects on consumption in "*cay*" models for USA.

		Wealth		Labor income	
		elasticity	mpc	elasticity	mpc
Lettau and Ludvigson [2001]	1952-1998	0.31		0.59	
Lettau and Ludvigson [2004]	1951-2003	0.30	0.046	0.60	
Sousa [2008]	1953-2004	0.42	0.062	0.65 0.41	0.66 0.53
Xu [2005]	1952-1998	0.24		0.65	
Barrell and Davis [2007]	1980-2001	0.20		0.80	

For their part, Post Keynesians don't find any cointegrating relation. Adding distributional effects is not at stake here. There is no reason for the cointegrating relation to disappear whether these effects are included in it or not. The econometric models are consequently estimated on the variables in first differences, as it is the case for OSG whose results for equation (2) above are summarized in Table 2.[7]

Table 2. Onaran, Stockhammer and Grafl [2011]
U.S. quarterly data (1960:1 - 2007:4)

$c_w - c_\pi$	$c_w - c_{\pi r}$	$c_w - c_{\pi nr}$	c_{ha}	c_{fa}
0.14	0.10	0.16	0.02	0.007

As OSG underline, marginal propensities to consume out of wealth are lower than in conventional estimations, particularly for financial assets. But $c_w - c_\pi$ is qualitatively similar to the results of Naastepad and Storm [2007] and Hein and Vogel [2008], knowing that these two studies do not include wealth effects nor they make the distinction between rentiers and non-rentiers. However, $c_w - c_{\pi nr}$ seems to be abnormally high because proprietors' income only represents about fifty percent of Π_{nr} and most of the remaining part is not distributed to households.

As in "*cay*" models, consumption results from shocks on the other variables. But in "*cay*" models, an adjustment of the dynamics restores the relation between variables in level while there is no stable relation between the levels in Post Keynesian estimations.

Many reasons can explain why Post Keynesians don't get a long-run relationship. Some may relate to the data choice, despite the fact that the studies we have mentioned use datasets from the U.S. National Income and Product Accounts (NIPA) and Federal Reserve (see below the section about data). Another important difference rests on the precise specification of the

[7] Of course, c_w which is the constant of equation (2) disappears because of first differentiation and the remaining intercept in the dynamic model corresponds to a drift.

equation to be estimated: "*cay*" models refer to (logs) levels while OSG refer to ratios relative to GDP. Assuming there is a cointegrating relation between the variables, it may disappear when levels are transformed into ratios. It is the reason why we will make our own estimations on levels rather than on ratios.

But in this paper, we would like to focus more fundamentally on a third difference relating on econometric methodology.

3. Econometric methodology

Several methods have been proposed in order to test and implement cointegration in multivariate time series models. Some are based on the Engle and Granger [1987] single equation approach. Others attempt to include error correction terms in VAR models. That is the case for Johansen's vector error correction model (VECM). In this section, we briefly present the VECM approach which we will use further. We then consecutively present the methodology used by Lettau and Ludvigson [2001, 2004] which is a combination of dynamic ordinary least squares (DOLS) and VAR models, and the autoregressive distributed lag (ARDL) approach which is applied by OSG. We finish by a brief comparison about the "*cay*" and Post Keynesians estimations results whose conclusion is that ARDL might not be appropriate for estimating the consumption function.

3.1. The vector error correction model (VECM) approach

Following Johansen [1988, 1991], we assume a vector Z_t of k non-stationary I(1) variables that can be represented by a VAR of order p:

$$Z_t = \sum_{i=1}^{p} A_i \, Z_{t-i} + \Psi \, D_t + \varepsilon_t$$

where D_t is a vector of non-stochastic variables (intercept, trends, etc.) and ε_t a white noise of dimension $(k \times 1)$. Because the variables forming Z_t are I(1), the system may be reformulated in its error correction form (VECM):

$$\Delta Z_t = \sum_{i=1}^{p-1} \Gamma_i \Delta Z_{t-i} + \Pi Z_{t-1} + \Psi D_t + \varepsilon_t \qquad (4)$$

Each stochastic component of this new system is I(0), except Z_{t-1} which is I(1). The aim of the Johansen procedure is to find a decomposition of the Π matrix, i.e. $\Pi = \alpha\beta'$ such as $\beta' Z_{t-1}$ is stationary. The number of cointegration relations is given by the Π matrix rank. The coefficients of β' are associated to the long-run relationship while those of α give the adjustment parameters toward the long-run relationship.

The model being a VAR, every variable is endogenous and its dynamics results from exogenous shocks. But the adjustment parameters affect this dynamics and restore the cointegration relation between the variables in levels.

3.2. The dynamic ordinary least squares (DOLS)

Johansen's methodology is applied in several "*cay*" models.[8] But Lettau and Ludvigson [2001, 2004][9] prefer to estimate their VECM with a two step approach. The first step consists

[8] See for instance Slacalek [2004], Chen [2006], Koop et al. [2008], de Veirman and Dunstan [2010].
[9] See also Sousa [2008].

in estimating the cointegration relation via a dynamic ordinary least squares (DOLS) equation (see Stock and Watson [1993]). Let us break Z_t down in y_t and the vector of the k–1 other X_t series. According to the DOLS methodology, the equation is estimated on the levels but augmented with q leads and p lags of ΔX_t, that is:

$$y_t = X_t\beta + \Psi D_t + c_0 + \sum_{i=-p}^{q} \Psi_i' \Delta X_{t+i} + u_t \tag{5}$$

The role of these leads and lags is to eliminate the effects of the regressor endogeneity. In the second step, the lagged residuals (u_{t-1}) are simply put in the VAR of the first differences in order to describe the dynamics of the model and to estimate the parameter adjustments.

3.3. The autoregressive distributed lag (ARDL) approach

The VECM being a system, each variable is both explanatory and predicted. But estimating the whole system ought to be useless when the attention is focused on one only equation. Several single equation approaches have been proposed since Engle and Granger [1987]. We present here Pesaran, Shin and Smith [2001] ARDL approach which is often used in the empirical literature. We take again the partition of Z_t in y_t (which is now the dependent series) and the vector X_t (the explanatory series). Under one restrictive condition (on which we return soon), the VECM (4) may be simplified by the single equation:

$$\Delta y_t = c_0 + c_1 t + \pi_{yy} y_{t-1} + \pi_{yX.X} X_{t-1} + \sum_{i=1}^{p-1} \Psi_i' \Delta Z_{t-i} + u_t \tag{6}$$

Cointegration is tested via a t-statistic test on π_{yy} and a F-statistic test for the jointly significance of π_{yy} with the $\pi_{yX.X}$ coefficients. However, the asymptotic distributions of these tests are not standard under the null hypothesis of no cointegrating relation. Pesaran et al. [2001] then propose two sets of critical values: a lower bound assuming that all the variables are I(0); an upper bound assuming that all the variables are I(1). The null hypothesis is rejected if calculated t and F are higher than the upper bound.[10] In that case, π_{yy} represents the adjustment parameter and the coefficients of the cointegrating equation are obtained by dividing the elements of $\pi_{yX.X}$ by $-\pi_{yy}$.

But, according to assumption 3 of Pesaran et al. [2001, p. 293], their methodology applies only if the X_t are the "long-run forcing" variables for y_t. The cointegrating relation must only explain Δy_t; it must not explain the dynamic of some series of the X_t vector.[11] In other words, the X_t variables must be weakly exogenous, that is not affected by any error correction term. If this condition is not respected, the model is biased and another methodology must be applied.

3.4. A brief discussion about the estimations results

It must be underlined that Lettau and Ludvigson [2001, 2004] plead for the use of a VECM approach. The reason is obvious while looking at the results of their VAR estimations (Table 3). Indeed, the authors show that consumption and labor income are weakly exogenous: the adjustment parameters are non significant and may be restricted to zero in the two equation explaining Δc_t and Δy_t.

[10] The null hypothesis is accepted if the calculated values are under the lower bound. The test is inconclusive if the values are between the two bounds; it depends on the order of integration of each variable.

[11] Practically, the null hypothesis of no cointegration must be accepted when equation (5) is separately estimated with each variable of the X_t vector as dependent.

Table 3. Lettau and Ludvigson [2004] U.S. quarterly data (1951:4 - 2003:1)			
	c	*a*	*y*
Cointegrating vector	1	– 0.30	– 0.60
Adjustment parameters	n.s	0.387	n.s.

It means that the restoration of the long-run relationship only occurs through wealth adjustments: wealth increases if consumption is higher than its long-run level, and conversely.[12]

This result should be surprising, but it is not in the Neoclassical framework: because of the intertemporal budget constraint, forward-looking households foresee changes in the return of their wealth; as a consequence, they smooth their consumption by hastening some expenses. What appears as the ex post adjustment following a shock is interpreted as the ex post confirmation that households were right when they expected a rise of their wealth.

From the methodological point of view, a crucial point is that most (if not all) VECM "*cay*" models conclude that consumption is weakly endogenous. This conclusion could explain why OSG and other Post Keynesians fail to find any long-run relationship in their studies: it is probably not because there is no cointegrating relation; but because this relation plays no role in the consumption dynamics. The single equation analysis may be not appropriate here.[13]

Eventually, the analysis of Lettau and Ludvigson [2001, 2004] raises the question about why don't they use Johansen's methodology. One possible answer is that Johansen's tests could invalidate the presence of any cointegration relation. That is part of Rudd and Whelan [2002] criticisms,[14] a result we will confirm later (but on data which do not cover the same period).

4. Data choice and unit root tests

As they estimate the consumption function, Neoclassical economists directly use data about households (and non-profit organizations) accounts. The issue is more difficult for Post Keynesians who need to introduce one or many variables about the whole income distribution between wages and profits.

As a consequence, and because they want to estimate investment and net exports functions too, Post Keynesians generally refer to firms accounts. But this choice is particularly questionable if the aim is to estimate the propensities to consume. There are indeed some discrepancies between the incomes paid by firms and those received by households. The main differences are about firms' net interest payments which sensibly differ from households' interest income.[15] Other differences appear for the other time series. For instance, in 2005, thanks to a one-year window of favorable tax treatment, firms repatriated unusually large dividends from their foreign affiliates. As a result, they paid unusually low net dividends, but the households' dividend income was only slightly affected by this operation.

[12] For Sousa [2008] who makes a distinction between stock-market and non stock-market wealth, the adjustment mostly operates through the former. On the contrary, adjustment seems to operate via housing wealth in Sweden (Chen [2006]). See also De Veirmans and Duncan [2010], Carroll et al. [2006] on this topic.

[13] We ought to precise that a cointegrating relation may be obtained while using single equation models such as ARDL. See for instance Barrell and Davis [2007]. But their results are probably biased because wealth is not weakly exogenous (contrary to labor income; see Barrell and Davis [2007, fn. 8, p. 259]).

[14] See also Slacalek [2004].

[15] In fact, personal interest income is the difference between the interests paid by all the institutional sectors and the interests received by sectors other than households.

For these reasons, we refer directly to the households accounts. As in "*cay*" models, we deduct taxes from households account. We then calculate after-tax labor income (W) and after-tax personal income receipts on assets (i.e. interests and dividends; Π_r). We also disaggregate the portmanteau variable which, in OSG, includes proprietors' income as well as retained earnings, depreciation and taxes on corporate income: Π_{nr} now represents the after-tax proprietors' income while the "non-distributed" profits (Π_{nd}) results from the difference between GDP and what households receive ($W + \Pi_r + \Pi_{nr}$) . Of course, the marginal propensity to consume out of Π_{nd} is expected to be low. We also compute an "aggregate profits" time series (Π) as the sum of Π_r, Π_{nr} and Π_{nd}.

Net wealth (A) is the net worth of households and non-profit organizations. In order to focus on the distributional effects, we do not make any distinction in this paper between housing and financial wealth. Finally, durable goods are excluded from consumption (C).[16]

Our study focuses on USA and we adopt the same sample period than OSG: 1960:1 - 2007:4. The quarterly series are extracted from the NIPAs' tables, except net wealth which was taken in the Fed's flow of funds accounts. Data are calculated per capita, deflated by the personal consumption expenditures price level, and expressed in logarithmic form for econometric reasons.[17] As it has been underlined before, the model is estimated on the levels rather than on the ratios relative to GDP.

According to the Augmented Dickey-Fuller and the Phillips-Perron unit roots tests, all first differences between the variables are I(0) or I(0)+C. Variables in levels are generally I(1) or I(1)+C. There are however two exceptions. For the level of aggregate profits (Π), the tests don't reject the hypothesis that the series is trend stationary (i.e. I(0)+T+C). For the level of non-distributed profits (Π_{nd}), the results are not quite clear: the Phillips-Perron test concludes for a trend stationary series; the Augmented Dickey-Fuller test concludes in favor of an integrated series with a trend (i.e. I(1)+T+C) at the 5% level, but in favor of a trend stationary series at the 10% level.

5. Econometric results

The model to be estimated is:

$$C = c_0 + c_w W + c_{\pi r}\Pi_r + c_{\pi nr}\Pi_{nr} + c_{\pi nd}\Pi_{nd} + c_a A \qquad (7)$$

We first attempt to estimate two reduced specifications of (6): the "*cay*" model (i.e. we a priori assume that $c_{\pi r} = c_{\pi nr} = c_{\pi nd} = 0$); a model including profits as an aggregate (Π) which rests on the a priori assumption that $c_{\pi r} = c_{\pi nr} = c_{\pi nd}$.

We then estimate the full equation (7). As expected, we will see that Π_{nd} can be excluded from the long-run relationship (i.e. that $c_{\pi nd}$ can be restricted to zero). We will also see that the assumption of weak exogeneity cannot be rejected for Π_{nd} (i.e. that the cointegrating relation has no impact on the dynamics of Π_{nd}). In addition, the variations of Π_{nd} have no effect on the other variables of the model. As a consequence, we repeat the estimation of equation (7) without including Π_{nd}, neither in the long-run relationship nor as an exogenous in the short-run dynamics.

[16] There is a debate here. The "*cay*" models limit themselves to non-durable goods because of a better adequacy to theoretical models. But an argument for taking durable goods into account is that, wealth sudden changes are more likely to affect durable than non-durable consumption. See Ludwig and Sløk [2004] for a discussion.
[17] See appendix for details about the data construction.

Generally, the lag length criteria[18] (FPE, AIC, SC and HQ) conclude in favor of $p = 2$ which results in only one lag of first differences in the short-run model. Adding more lags may seem to be a good idea for improving the predictive properties of the model but it must be avoided for three reasons: more lags quickly reduces the degrees of freedom on sample with a few points; as lags reduces the residuals autocorrelation, too much lags generate some autocorrelation; eventually, too much lags induce some bias in the Johansen's cointegration tests.

As it is well known, the cointegration tests depend on the choice of the deterministic components D_t in equation (4). We gave priority to models with a constant in the short-run dynamics because several variables in first differences are I(0)+C. The presence of a trend in the cointegrating relation raises questions. On the first hand, it is not appropriate in equation (7) where a trend would raise some interpretation difficulties (the trend suggests that a variable has been forgotten in the analysis). In addition, the presence of a trend captures a lot of the explanatory power of the other variables: it reduces the elasticities and the corresponding marginal propensity to consume. But on the other hand, the trend must be added when Π or Π_{nd} are included in the model if we want to be consistent with the unit root tests.

5.1. The "cay" model

The following table displays the results of cointegration tests depending on the deterministic components for the basic "*cay*" model including consumption (*C*), net wealth (*A*) and labor income (*W*). The null hypothesis is not rejected in configurations (a) and (b) but these specifications are leaved aside (here and henceforth) because of their inconstancy with the results of unit root tests. In particular, the constant is highly significant while computing the unit root test for ΔC.[19]

Selected (0.05 level*) Number of Cointegrating Relations by Model

Data Trend:	None (a)	None (b)	Linear (c)	Linear (d)	Quadratic (e)
Test Type	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Trace	2	2	0	0	0
Max-Eig	2	1	0	0	0

*Critical values based on MacKinnon-Haug-Michelis (1999)

As before mentioned, the null hypothesis of no cointegration cannot be rejected in configuration (c): the probabilities for the trace and for the maximum eigenvalue tests are respectively 11,2% and 14,2%. This result may explain why Lettau and Ludvigson adopted a two step approach in their articles.[20]

[18] FPE, AIC, SC and HQ respectively refer to Final Prediction Error, Aikake, Schwartz, and Hannan-Quinn information criteria. The results of SC and/or HQ sometimes indicate $p = 1$, but we ruled out this possibility which would exclude any short-run dynamics.

[19] We also leave aside the configuration (e) which assumes a trend in the short-run dynamics which corresponds to the presence of a quadratic trend in the variables in levels.

[20] Interestingly, implementing the VECM in spite of the acceptance of the null hypothesis leads to results which are very close to those of Lettau and Ludvigson.

5.2. The "aggregate profits" model

We just add aggregate profits (Π) in the "*cay*" model remembering that this series is supposed to be trend stationary (I(0)+T+C). The results of the cointegration tests are:

Selected (0.05 level*) Number of Cointegrating Relations by Model

Data Trend:	Linear (c)	Linear (d)
Test Type	Intercept	Intercept
	No Trend	Trend
Trace	1	1
Max-Eig	0	0

*Critical values based on MacKinnon-Haug-Michelis (1999)

Because of a trend in Π, we focus on configuration (d) for which the null hypothesis of no cointegrating vector is not rejected by the maximum eigenvalue test at the 5% level (the associate probability is 12.55%).

However, if we suppose the presence of a cointegrating relation, it is important to check whether it is due to the presence of a stationary variable in the model or not. The test consists in restricting the coefficients of *C*, *A* and *W* to be jointly equal to zero in the cointegrating vector. The value of the $\chi^2(3)$ is 6.51 and the corresponding probability 8.91%. We therefore leave aside this specification in order to focus on the full model.

5.3. The full model

The following table displays the cointegration tests for equation (6).

Selected (0.05 level*) Number of Cointegrating Relations by Model

Data Trend:	Linear (c)	Linear (d)
Test Type	Intercept	Intercept
	No Trend	Trend
Trace	1	1
Max-Eig	0	1

*Critical values based on MacKinnon-Haug-Michelis (1999)

Let us remind that unit root tests showed that Π_{nd} should be either I(0)+T+C or I(1)+T+C. We therefore focus on configuration (d) and jointly test the restriction to zero for all the coefficient of the cointegrating relation but that of Π_{nd}. The null hypothesis is now strongly rejected ($\chi^2(5) = 21.50$; Pr = 0,07%).

Because the coefficient of this non-distributed profits Π_{nd} is expected to be close to zero, we test if it could be excluded from the cointegration space. This hypothesis is confirmed because the value of the $\chi^2(1)$ is 1.41 and the corresponding probability 23.59%.[21] In addition, the adjustment parameter for $\Delta\Pi_{nd}$ is not significant and the weak exogeneity is not rejected $\chi^2(2) = 1.82$ and Pr = 40,30% when Π_{nd} exclusion and weak exogeneity are jointly tested).[22]

[21] The same exclusion test is strongly rejected when it is performed on the other five variables.

[22] The results are similar when these tests are performed on the configuration (c), i.e. without a trend. In addition, null hypothesis of no cointegration is not rejected for the maximum eigenvalue test (Pr = 10.93%).

As a consequence, Π_{nd} is excluded from the VECM. We only keep its lagged first differences as exogenous in the VAR.

5.4. The models with no consumption out of non-distributed profits: cointegration analysis

Eventually, a reduced version of equation (6) is estimated where Π_{nd} is dropped from the cointegrating vector and $\Delta\Pi_{nd,t-1}$ appears as exogenous in the VAR. Four quarter dummies (1975:2, 1980:4, 2004:4 and 2005:1) are also introduced in order to redress small problems of heteroskedasticity and skewness. According to the cointegration tests (see the following table), we accept the presence of a cointegrating relation in either configuration (c) or (d). Configuration (c) is now preferred because none of the variables is trended.

Selected (0.05 level*) Number of Cointegrating Relations by Model

Data Trend:	Linear (c)	Linear (d)
Test Type	Intercept No Trend	Intercept Trend
Trace	1	1
Max-Eig	1	1

*Critical values based on MacKinnon-Haug-Michelis (1999)

Performing the unit root tests on the cointegrating relation confirms that every time series is a random walk. The unrestricted estimation is displayed on the column (A) of Table 4.

Table 4. Cointegration analysis				
	(A)	(B)	(C)	(D)
	β matrix (long-run relationship)			
C	1.000	1.000	1.000	1.000
A	-0.252 [-4.61]	-0.229 [-3.90]	-0.366 [-11.24]	-0.365 [-9.24]
W	-0.490 [-9.06]	-0.503 [-8.65]	-0.570 [-9.77]	-0.632 [-12.92]
Π_r	-0.126 [-3.54]	-0.126 [-3.30]	-0.043 [-1.89]	0.000
Π_{nr}	-0.115 [-2.34]	-0.132 [-2.51]	0.000	0.000
constant	-0.197	-0.204	0.358	0.614
	α matrix (adjustment parameters)			
ΔC	-0.038 [-2.07]	0.000	0.000	0.000
ΔA	0.313 [3.32]	0.351 [3.94]	0.363 [4.61]	0.286 [4.20]
ΔW	-0.033 [-0.94]	0.000	0.000	0.000
$\Delta\Pi_r$	0.015 [0.22]	0.000	0.000	0.000
$\Delta\Pi_{nr}$	0.322 [2.59]	0.436 [4.06]	0.274 [2.78]	0.244 [2.89]
χ^2		$\chi^2(3) = 4.32$ Pr = 22.9%	$\chi^2(4) = 7.78$ Pr = 10.0%	$\chi^2(5) = 10.41$ Pr = 6.5%
t-statistics are in square brackets				

Note that Π_{nr} could be dropped ($\chi^2(1) = 3.35$; Pr = 6,73%) but we keep this variable for a while because we don't expect that there is no consumption out of proprietors' income. However, adjustment parameters are not significant for ΔW and $\Delta\Pi_r$, and restricting them to zero results in a loss of significance for ΔC. Eventually, the hypothesis of joint weak exogeneity for the three variables is not rejected (column B).

We could stop here, but exclusion tests show again that it is possible to drop Π_{nr} (column C), and then Π_r (column D).

The (opposite of the) coefficients of the β matrix represent to the long-run elasticities of consumption (i.e. the long-run elasticity of consumption with respect to wages is 0.503 in column B).

5.5. The model with no consumption out of non-distributed profits: dynamic analysis

Table 5 displays the results of the VAR analysis with the error correction term (ect_{t-1}) corresponding to the cointegrating vector residuals of column (B).

Table 5. Estimates from cointegrated VAR (based on model B)					
	ΔC_t	ΔA_t	ΔW_t	$\Delta \Pi_{r,t}$	$\Delta \Pi_{nr,t}$
ect_{t-1}	0,000	0,351 ***	0,000	0,000	0,436 ***
ΔC_{t-1}	0,157 *	0,925 **	0,405 ***	0,504	1,101 **
ΔA_{t-1}	-0,012	-0,005	-0,053 *	0,008	0,069
ΔW_{t-1}	0,148 ***	0,334	-0,061	-0,161	0,483
$\Delta \Pi_{r,t-1}$	-0,024	0,069	0,005	0,462 ***	-0,189
$\Delta \Pi_{nr,t-1}$	0,018	0,007	0,002	-0,112 **	0,029
$\Delta \Pi_{nd,t-1}$	0,033 ***	0,040	0,070 ***	0,161 ***	0,071
constant	0,004 ***	-0,002	0,003 ***	0,002	-0,005
*D*1 (1975:2)	0,011 ***	0,036 *	0,043 ***	0,022	0,041
*D*2 (1980:4)	0,003	0,013	0,005	0,062 ***	0,025
*D*3 (2004:4)	0,003	-0,009	-0,005	0,063 ***	0,005
*D*4 (2005:1)	0,002	0,033	-0,010	-0,093 ***	-0,026
R^2_{adj}	0,228	0,078	0,199	0,357	0,098
Symbols *, ** and *** represent respectively significance level of 10%, 5% and 1%.					

The post-estimation diagnostics indicate that there is no evidence of autocorrelation (portmanteau and LM tests) or heteroskedasticity (VEC residual heteroskedasticity test). The VEC residual normality tests (Cholesky orthogonalization) show that there is no skewness but excess kurtosis for some variables. However, this problem is not too worrying, according to Hamilton [1994], because VECM estimations are sensitive to autocorrelation and skewness, but remain quite robust in case of excess kurtosis.

6. Results interpretation

Thanks to the long-run elasticities of consumption (matrix β in Table 4), it is possible to compute the marginal propensities to consume which are displayed in Table 6.

Table 6. Long-run marginal propensities to consume (computed at sample mean)				
	(A)	(B)	(C)	(D)
c_a	0.04	0.04	0.06	0.06
c_w	0.51	0.53	0.60	0.66
$c_{\pi r}$	0.67	0.67	0.23	0.00
$c_{\pi nr}$	1.02	1.17	0.00	0.00
c_{π} [(a)]	0.29	0.32	0.05	0.00
$c_{\pi nr,osg}$ [(b)]	0.18	0.21	0.00	0.00
$c_w - c_{\pi}$	0.22	0.21	0.55	0.66
$c_w - c_{\pi r}$	-0.16	-0.14	0.37	0.66
$c_w - c_{\pi nr}$ (osg)	0.33	0.32	0.60	0.66
[(a)] c_{π} is the weighted average of $c_{\pi r}$, $c_{\pi nr}$ and $c_{\pi nd}$ (where $c_{\pi nd} = 0$). [(b)] $c_{\pi nr,osg}$ is the weighted average of $c_{\pi nr}$ and $c_{\pi nd}$. It corresponds to the non-rentier definition in OSG.				

The magnitude of c_a is close to the conventional estimations. However, c_w is lower than expected in models (A) and (B). There could be two reasons. Firstly, consumption relates here only on non-durable goods and services. As durable goods represent about 13% of total consumption expenses, c_w would have been higher if it had been estimated on the whole consumption. The second reason is that, by construction, the elasticities of consumption must sum to unity. As a consequence, the inclusion of new variables (which are positively correlated to consumption) tend to reduce the previous coefficients. It is particularly the case in models (A) and (B) where $c_{\pi nr}$ is abnormally high. Finally, it is difficult to say if $c_{\pi r}$ is too high or not: shareholders decision to save could relate to retained earnings. It is then not so inconceivable to expect a high propensity to consume out of dividends.[23]

The comparison with OSG results shows that, in spite of a really divergent estimation of $c_w - c_{\pi r}$ (–0.14 vs. 0.10), the resulting difference $c_w - c_\pi$ is higher in our model (0.21 vs. 0.14).

Models (C) and (D) are of course not satisfactory. But they are interesting because they tend to confirm that the previous values for $c_{\pi nr}$ and $c_{\pi r}$ are probably overestimated. However, the possibility to restrict the two marginal propensities to zero reveals the fragility of the methodology. We will come back on this issue further.

We now turn to the short-run dynamics and to the comprehension of the whole model (we still relate on model B). The VAR estimation shows (Table 5) that a rise of ΔC_{t-1} has positive and significant effects on all the variables (but $\Delta\Pi_{r,t}$): on ΔC_t, it could denote persistence or habits formation; on ΔW_t or $\Delta\Pi_{nr}$, it could be an expression of the multiplier effect (an rise of consumption results in more employment and more income for sole proprietors). The variations of Π_r and Π_{nr} have little effects, apart on $\Delta\Pi_{r,t}$: it is worth noting that an rise of rentier profits results in a new rise in the next period. The positive (but moderate) impact of $\Delta\Pi_{nd,t-1}$ on ΔC_t and on ΔW_t raises questions; but the high impact on $\Delta\Pi_{r,t}$ may indicate that retained profits for one period leads to distributed profits in the next one.

Focusing on the explanations of consumption dynamics, ΔC_t depends on ΔW_{t-1}, ΔC_{t-1}, $\Delta\Pi_{nd,t-1}$ (moderate but not yet explained), and on a drift. The large positive effect of ΔW_{t-1} is particularly consistent with the Post Keynesian theory. However, variations of wealth, rentier, or non-rentier profits have no significant impact on ΔC_t.

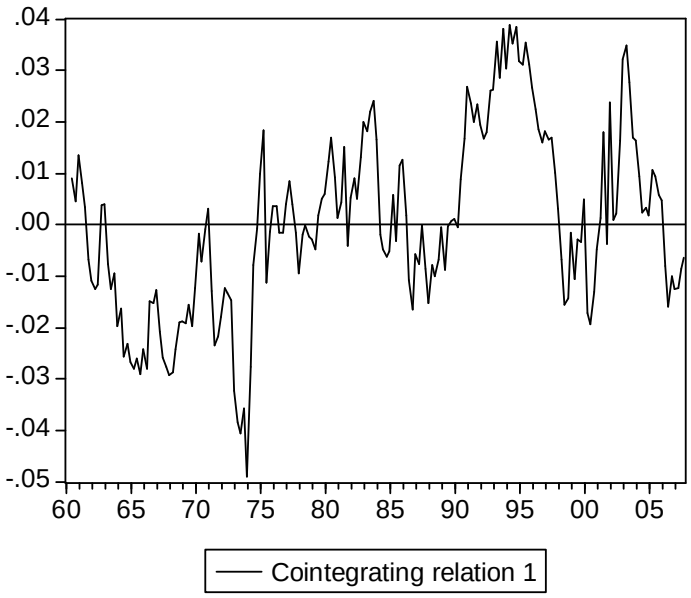
What are the consequences on the long-run relationship between the variables in levels? A rise of one of the above significant variables results in an increase of C in the next period; or simply, C increases of 0.4% because of the drift. As a consequence, C goes over its long-run level. Because the adjustment parameter is not significant in the equation of ΔC_t, the return towards the cointegrating vector go through the two significant adjustment parameters of the VAR. The adjustment via $\Delta\Pi_{nr,t}$ could easily be explained: a rise of consumption may induce a rise of proprietors' income. But the adjustment parameter via ΔA_t has no clear explanation in the Post Keynesian framework. This lack of explanation ought to generate further analysis in order to understand the causes of wealth dynamics.

However, it seems that the convergence through the long-run relationship could take other channels if the gap with the cointegrating relation results from an increase of C_t. Firstly, W_t increases with almost the same drift (0.3%) than C_t. Secondly, as before mentioned, a rise in C leads to rises in A, W, and Π_{nr} in the next period. All these effects may contribute to the restoration of the long-run relationship. Of course, the story is different if the departure from the equilibrium has other origins. For instance, a positive shock on Π_r results in a C which is

[23] See Baker et al. [2007] on this issue.

lower than its long-run level and the restoration of equilibrium essentially goes through the two significant adjustment parameters.

The following graph represents the cointegrating relation. It shows that consumption was generally lower than its long-run level until 1975. As a consequence, error correction terms induce a decrease of both wealth and non-rentier profits during this subperiod. On the contrary, consumption was greater than its long-run level between 1990 and 1998, and later between 2001 and 2006. Then, wealth and non-rentier profits tend to increase during these subperiods.



7. Concluding remarks

In this paper, we use a VECM approach in order to study the effects of income distribution on consumption. We are able to show the presence of a cointegrating relation between consumption, wealth, labor income, rentier and non-rentier profits. The resulting long-run elasticities of consumption are used in order to calculate the marginal propensities to consume. According to our results, the difference between the propensities to consume out of wages and out of aggregate profits is about 21% (model B). This is higher than the Onaran et al. [2011] results who obtain a difference of about 14%. Included in a complete macroeconomic model, our results might play in favor of a wage-led regime: an increase of the profit share induces a decline of consumption which might offset the positive effect on capital accumulation (and perhaps on net exports).

The study may be improved in many ways. In particular, variance decomposition and impulse response functions may help to understand whether the effects of some shocks on the model are permanent or transitory. But, before implementing these developments, it seems essential to give answers to three important issues which have been raised in the paper.

Firstly, the specification of the consumption function remains problematic, particularly because the use of long-run elasticities introduces an internal restriction (the sum of the coefficients must equal unity) which may bias the outcome. Indeed, in the Keynesian theory

there is no restriction about the marginal propensities to consume. But here restrictions are induced by the model specification.

Secondly, our estimations show some instability in the coefficient estimations. This relative lack of robustness of the VECM analysis is well known. Authors as Slacalek [2004] or Koop et al. [2007] have pointed out this problem in the "*cay*" model framework. As a result, some attempts have been made in order to implement other econometric methodologies.[24] Another strategy consists in checking the estimation robustness by comparing the results of alternative methodologies (VECM, ARDL, DOLS, but also FM-OLS, CCR, etc.).[25]

A difficulty here is that the error correct term simultaneously appears in two short-run equations. In such case, according to Pesaran et al. [2001], the ARDL approach may result in a biased estimation of the cointegrating relation.

Thirdly, the adjustments mechanisms are highly questionable. We have already underlined that Post Keynesian theory does not have clear explanations about why a gap with the long-run relationship leads to a wealth adjustment. But the difficulties are more important. It is the signification of the cointegration relation itself which is at stake. Indeed, the logical interpretation of this relation would be to say that, everything else being equal, a 1% rise of rentier profits (for instance) induces a 0.12% rise of consumption. But it is not the way by which adjustments occurs: everything else being equal, the 1% rise of rentier profits results in a consumption level which is lower than its log-run level, i.e. ect is negative. The negative *ect* leads to a decrease of both wealth and non-rentier profits levels, and these are these reductions which induce the restoration of the long-run relationship. Of course, this story is only part of the whole explanation but it would show that the initial rise of rentier profits does not lead to a rise of consumption.

In other words, the cointegrating relation might have no economic meaning. It might say nothing about causalities. It may just reflect some regularity between the variables in levels. Whether this regularity is broken down, some adjustments take place in order to restore it. But the history of the variables might fundamentally be given by their short-run dynamics.

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[24] See for instance Carroll et al. [2006].

[25] FM-OLS and CCR are respectively the acronyms for full modified ordinary least squares and canonical cointegration regression.

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9. Appendix: data description

The sources are the National Income and Production Accounts (NIPAs) edited by the U.S. Department of Commerce (Bureau of Economic Analysis), except for wealth which is drawn from the Flow of Funds Accounts (Board of Governors of the Federal Reserve System). Data are quarterly and seasonally adjusted at an annual rate. The sample period is 1960:1 - 2007:4. Every time series used in the estimations is per capita (see Population below) and in real terms (see Price deflator).

POPULATION

Population is the midperiod population. NIPA Table 2.1.

PRICE DEFLATOR

Consumption, labor income, profits and wealth are deflated by the personal consumption expenditure chain-type price deflator (2005=100). NIPA Table 2.3.4.

CONSUMPTION (C)

Consumption is defined as the expenditure in non-durable consumption goods and services. NIPA Table 2.3.5.

LABOR INCOME (W)

As in Lettau and Ludvigson [2001, 2004] and Sousa [2008], labor income is calculated after taxes. After-tax labor income is the sum of wage and salary disbursements (line 3), personal current transfer receipts (line 16) and employer contributions for employee pension and insurance funds (line 7) minus personal contributions for government social insurance (line 24), employer contributions for government social insurance (line 8) and taxes. The formula for taxes is given below with NUMERATOR = wage and salary disbursements (line 3). NIPA Table 2.1.

TAXES

Taxes are defined as: (personal current taxes (line 25)) * [NUMERATOR / (wage and salary disbursements (line 3) + proprietor' income with inventory valuation and capital consumption adjustments (line 9) + rental income of persons with capital consumption adjustment (line 12) + personal income receipts on assets (line 13))]. NIPA Table 2.1.

PROFITS

Rentier profits (Π_r) is calculated as the After-tax personal income receipts on assets. It is the difference between personal income receipts on assets (line 13) and taxes (whose formula is given above with NUMERATOR = personal income receipts on assets (line 13)). Note that personal income receipts on assets are the sum of personal interest income (line 14) and personal dividend income (line 15). NIPA Table 2.1.

Non-rentier profits (Π_{nr}) is calculated as the After-tax proprietor' income with inventory valuation and capital consumption adjustments. It is the difference between proprietor' income with inventory valuation and capital consumption adjustments (line 9) and taxes whose formula is given above with NUMERATOR = proprietor' income with inventory valuation and capital consumption adjustments (line 9)). NIPA Table 2.1.

Non-distributed profits (Π_{nd}) is calculated as GDP – ($W + \Pi_r + \Pi_{nr}$). See NIPA Table 1.1.5 for GDP.

WEALTH (A)

Wealth is defined as the net worth of households and non-profit organizations. As for Lettau and Ludvigson [2004], current wealth is measured at the end of the previous quarter. Flow of Funds Accounts: Table B.100 (series FL152090005.Q).