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Macroeconomic and technological dynamics: A structuralist-Keynesian cumulative growth model

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In the Structuralist-Keynesian approach, economic growth is a cumulative causation process driven by a continuous interaction between macroeconomic dynamics and technological dynamics, involving several structural variables (McCombie *et al.*, 2002; León-Ledesma, 2002; Targetti and Foti, 1997). In this context, labour productivity is both an 'input' of the growth process, by influencing macroeconomic dynamics, and an 'output', since technological progress is endogenous and depends on macroeconomic dynamics.

Labour productivity may influence the evolution of the structural variables of the economic growth processes through the unit labour cost, defined as the ratio between wages and labour productivity. The former variable depends on the functional distribution of income and indirectly influences the dynamics of aggregate demand, while the latter depends mainly on technical progress. The study of the role of unit labour costs in the growth process implies the analysis of some relevant relationships:

- between *technical progress and aggregate demand*, whereby the increases of labour productivity are connected with the size of the market, and more specifically with the evolution of consumption and investment;
- between *technical progress and the functional distribution of income*, according to which the improvements of labour productivity could raise wages and profits at the same time; and
- between *technical progress and market structures*, according to which the reductions of price generated by increases in labour

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productivity, which constitute customer gains, grow with the level of competition within the market.

The analysis of unit labour costs involves elements, such as income distribution and technical progress, that are essential for economic growth, and it entails dealing with potentially conflicting factors: efficiency and equity, capital and labour, wage and profits.

Furthermore, the unit labour cost is a crucial factor for international competition. With reference to national competitive strategies, the competitive advantages of peripheral countries lie in low wage levels, while core countries gain from high levels of labour productivity. With reference to firms' competitive strategies, multinational corporations plan activities with low productivity in peripheral countries, while maintaining business activities (with high productivity), such as R&D, in core countries.[1]

In the recent post-Keynesian literature there are important contributions on the growth process in terms of macroeconomic and technological growth paths. In Ocampo and Taylor, 1998, the impact of trade policies is analysed with respect to the peripheral countries, with a focus on liberalisation reforms, productivity growth, prices and income distribution, through the co-movements of a productivity function, representing 'Verdoorn-Kaldor's law' (i.e. the positive effect of the growth rate of output on the growth rate of labour productivity), and a demand function, deriving from a dynamic Keynesian trade multiplier. In Ocampo, 2005, the impact of the dynamics of production structures and public policies on economic growth of peripheral countries is analysed through a baseline model, where technological dynamics is represented by a technical progress function à la Kaldor, 1978, while the macroeconomic dynamic is captured by a simple function, according to which productivity growth boosts economic growth.

In Cimoli *et al.,* 2006, within an analysis of formal and informal sectors in Latin American countries, the dynamics of output, productivity and employment are considered together within a

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[1] See for example Van Liemt, 1992, and Raynauld and Vidal, 1998.

growth model, through the interaction between a "Demand Regime" and a "Productivity Regime". In Naastepad, 2006, with reference to the OECD countries, a general Keynesian model where demand growth can be wage-led or profit-led is built.

This literature can be integrated with two relevant contributions by Sylos Labini about the relationship between investments and labour costs (demand side), and the impact of labour costs on labour productivity (supply side). Indeed, the present paper's main aim is to integrate the model of Ocampo, 2005, Cimoli *et al.*, 2006, and Naastepad, 2006 with Sylos Labini's contributions, 1984; 2001, with an empirical validation of the main structural relationships of such growth model for the European countries.

The paper is structured as follows: section 1 builds a cumulative growth model that illustrates the interactions between macroeconomic dynamics and technological dynamics; section 2 develops an econometric analysis on the basic relationships of the growth process for the European countries; section 3 concludes.

1. A cumulative growth model

Let us illustrate the model of cumulative growth, first by defining the "productivity regime" and the "demand regime", and second by determining the steady state solutions. In what follows, for each variable, capital letters and lower case letters will respectively indicate the level and the rate of growth.

1.1. Productivity regime

In our model the productivity regime encapsulates the technological dynamics identified by a "labour productivity function" à la Sylos Labini (Sylos Labini, 1984, 2010; Guarini, 2009), following the approach of the Italian Sraffian-Keynesian school. The productivity function can be represented by the equation

$$g = \alpha + \beta y + \delta q \qquad (1)$$

where g is the growth rate of productivity, y is the growth rate of income, and q is the growth rate of real unit labour costs. Parameter $\alpha > 0$ stands for innovations not stimulated by production activities, e.g. resulting from R&D activities or human capital formation. Parameter $0 < \beta < 1$ captures the phenomenon of increasing returns, both static and dynamic. It stands for all phenomena linked with the micro- and macro-division of labour, learning by doing and networking, and it describes the so-called Kaldor effect. Real unit labour costs are defined as

$$q = w - g \tag{2}$$

where w and g are the growth rate of real wages and of labour productivity, respectively. Parameter $\delta > 0$ is the absolute labour cost effect, theorised by Sylos Labini (Sylos Labini, 1984-2010): a firm evaluates the cost of a worker with reference to his/her productivity, without taking into account the other inputs; in this optic, it is an absolute evaluation. In accordance with empirical analyses (Sylos Labini, 1992; Guarini, 2009), I assume $0 < \delta < 1$. Wage formation may depend on the unemployment rate, life costs, and labour productivity, but in order to focus the analysis on the comparison between real wage dynamics and labour productivity dynamics,[2] I represent the wage equation in a simple way:

$$w = \theta_1 g \tag{3}$$

The value of parameter $\theta_1 > 0$ can be directly proportional to the trade unions' bargaining power (Sylos Labini, 2002). Hence, the labour productivity function expressed by equation (1) may be expressed[3] in the form

$$g = \frac{\alpha}{1-\delta\theta} + \frac{\beta}{1-\delta\theta} y \tag{4}$$

with $\theta = \theta_1 - 1$.

[2] Sylos Labini, 1992.
[3] The intermediate step is: $g = \alpha + \beta y + \delta(\theta_1 - 1)g$.

Only with $1 - \delta\theta > 0$ can there be a positive relationship between the growth rate of income and that of labour productivity.

In accordance with this condition, for a positive technological dynamics there are two alternatives. On the one hand, wages may grow less than labour productivity ($\theta < 0$); this dynamic reduces the growth of labour productivity, because there is no room for cost-saving investments. On the other hand, wages may grow more than $\theta > 0$; in this case there is room for cost-saving investments, but there is a sort of knife-edge. With $0 < \theta < 1$, there is a virtuous circle between labour productivity and wage dynamics, but with $\theta > 1$, the dynamics can explode and the increase in wages can negatively affect technological dynamics (Sylos Labini, 1984, 2010; Corsi and Guarini, 2010).

In case that $0 < \theta < 1$, market conditions may influence equation (4). In fact, competition stimulates firms to react strongly to increases in labour costs by enacting cost-saving investments. In other words, competition raises the parameter δ.

1.2 Demand regime

The term 'demand regime' refers to the macroeconomic dynamics. The starting point is the dynamic version of effective demand (see appendix A), represented by the following equations:

$$y = \lambda_W^C q + \psi_x x + \psi_i i \tag{5}$$

In equation (5), the variables q, x, i are the growth rates of real unit labour costs, exports and investments, respectively; parameter $\lambda_W^C > 0$ is the propensity (private plus public: Nastepad, 2006) to consume, and parameters $\psi_x, \psi_i > 0$ are respectively related to the export share of effective demand and the investments share of effective demand.

According to the Naastepad, 2006, the level of exports positively depends on world income (Z) and on the real labour costs "associated with one unit of world exports" (Q^*), while they depend negatively upon Q; thus the exports function is $X = Z^{\epsilon_0} \left(\frac{Q}{Q^*}\right)^{-\lambda_{\Pi}^{X}}$, where $\epsilon_0 > 0$ is the elasticity of exports with respect to world demand and $\lambda_{\Pi}^{X} > 0$ is the propensity to export. Assuming $Q^* = 1$, the growth rate of exports is represented by the following equation:

$$x = \epsilon_0 z - \lambda_{\Pi}^{X} q \quad (6)$$

Equation (6) contains some elements that characterise the exports sector in different economies. Simplifying, we may compare core countries with peripheral countries aiming to reduce labour costs for competitive strategies. Core countries, thanks to an effective organisation of the exports sector, focus on technical progress that increases labour productivity and generates high economies of scale, while peripheral countries mostly maintain low wages because they have traditional sectors devoted to exports with no significant increasing returns. Furthermore, peripheral countries have a comparative disadvantage in terms of a lower level of ϵ_0, because their exports consist mainly of primary goods.

According to Sylos Labini, 1984; 1992, the investments finalised to increase productive capacity depend on three main components: the "total supply of bank loans, which represents the basis for external financing" and that for simplicity may be ignored here; the degree of utilization of capacity "that can be expressed as the ratio between actual and potential output"; and the profit share (H). The degree of utilization of productive capacity depends positively on the components of the effective demand, while profit share depends negatively on real labour costs, Q. Indeed, real unit labor costs are equivalent to the wage share. In dynamic terms, we obtain $h = -\rho q$, where h is the growth rate of the profit share and parameter $\rho = \frac{Q}{1-Q} > 0$ depends on functional income distribution. [4]

Following Sylos Labini, 1984, p. 215, we assume that the investment function is the product of two independent components:

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[4] $1 = H + Q \rightarrow 0 = h\frac{H}{H+Q} + q\frac{Q}{H+Q} \rightarrow h = -q\frac{Q}{H+Q}\frac{H+Q}{H} = -\frac{Q}{1-Q}q = -\rho q$

one expresses the 'profit effect', while the other one represents the impact of wages on investments. Thus, we obtain:

$$I = \bar{I} I_W I_\Pi = \bar{I} Q^{(\lambda_W^I - \lambda_\Pi^I)} \quad (7)$$

with $\bar{I}, \lambda_W^I, \lambda_\Pi^I > 0$. According to equation (7), the investment function is the product of the wage-led investment I_W, that are investments positively influenced by real labour costs (with propensity λ_W^I), and the profit-led investments I_Π, that are investments negatively influenced by real labour costs (with propensity λ_Π^I). $\bar{I}$ refers to other exogenous elements, such as the "animal spirits".

The dynamic version of equation (7) is

$$i = \bar{\iota} + (\lambda_W^I - \lambda_\Pi^I) q. \quad (8)$$

The twofold effect of real unit labour costs on investments is empirically explained by Sylos Labini, 1984; 1992, considering the relationship between capital accumulation and the growth rate of wages, given the growth rate of labour productivity, and by excluding the influence of g on w. According to this perspective, the difference $(\lambda_W^I - \lambda_\Pi^I)$ is positive for low growth rates of wages (the wage effect is higher than the profit effect) and negative for high growth rates of wages (the profit effect is higher than the wage effect). Hence, there is a sort of a parabolic relation between capital accumulation and wages increases. In this optic,

> "given the increase in productivity – there is an 'optimum' rate of wage increase that maximizes the positive effects and minimizes the negative effects on investment of the dynamics of the cost of labour. It is 'optimum' in the sense that it maximizes the rate of accumulation" (Sylos Labini, 1984, p. 218).[5]

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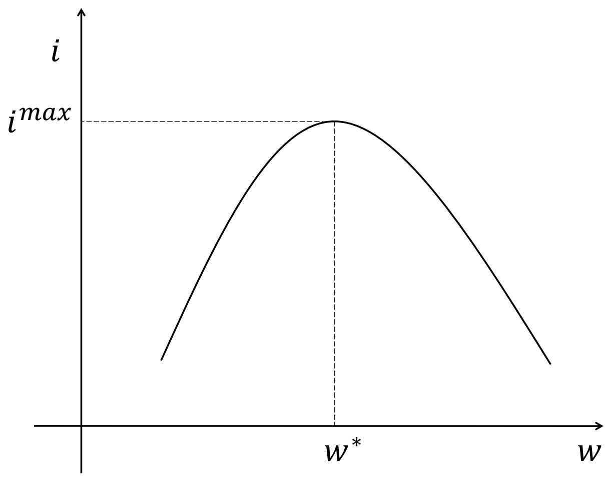
[5] The "optimum rate of wage increase implies an 'optimum' rate of profit [...]. The optimum rate of wage increase [...] will be equal to the rate of productivity increase in a close economy in which the prices of raw materials are assumed constant. In an open economy the income effect can be supplemented by foreign demand, so that the rate of wage increase can be smaller than the rate of increase of productivity without negatively affecting the rate of increase of total effective demand. Indeed, in such a situation the cost of labor tends to decrease with a consequent increase in the international competitiveness and in the growth of exports. On the other hand, a wage

Growth rates of wages that are too low can correspond to a phase of crisis when, due to a depression of consumption, real investments are substituted by financial investments. This is relevant to the study of this function because the dynamic of capital accumulation influences the business cycle by changing its features between countries and in the course of time.[6]

Figure 1 – Dynamic relationship between investments and wages



In light of the previous analysis and given that $q = \theta g$, the growth rate of income is equal to the following equation:

increase more rapid than productivity depresses both profits and exports, and their growth, but does not affect negatively the rate of profit and international competitiveness if the raw materials prices fall sufficiently" (Sylos Labini, 1984, pp. 218).

6 "The process of accumulation, which is a cyclical process, does not proceed in all capitalist countries and in all periods at the same pace. It is my contention that one of the determinant of the trend of output of that process is given by the behaviour of the cost of labor" (Sylos Labini, 1984, p. 220).

$$y = \lambda_W^C \theta g + \psi_x \epsilon_0 z - \psi_x \lambda_\Pi^X \theta g + \psi_i \bar{\iota} + \psi_i \left(\lambda_W^I - \lambda_\Pi^I \right) \theta g \qquad (9)$$

From this equation, exogenous macroeconomic factors are gathered in a new parameter

$$\mu = \psi_x \epsilon_0 z + \psi_i \, \bar{\iota}$$

and it is assumed, following Naastepad (2006), $\mu > 0$. Let us focus on the endogenous macroeconomic factors by describing the labour productivity effect on income through two channels, the wage channel and the profit channel. The wage channel can be synthetised by the parameter

$$\lambda_W = \lambda_W^C + \psi_i \lambda_W^I > 0$$

defined as wage-led-demand propensity, according to which labour productivity boosts wages, raising both consumption and, through effective demand, investments.

The profit channel can be indicated by the parameter

$$\lambda_\Pi = \psi_x \lambda_\Pi^X + \psi_i \lambda_\Pi^I > 0,$$

defined as profit-led-demand propensity. Since this channel depends inversely on labour costs, the following parameter

$$\lambda = (\lambda_W - \lambda_\Pi)$$

is a combination of the two opposite effects. Finally, in order to formulate the demand regime, equation (9) can be rewritten in the following way:

$$y = \mu + vg \qquad (10)$$

with $v = \lambda\theta$.

According to equation (10), the effect of labour productivity on income can be analysed in two complementary ways: (*i*) as the result of a difference between the wage channel and the profit channel $(\lambda_W - \lambda_\Pi)$; and (*ii*) as the result both of the difference between the propensity to consume and the propensity to export $\left(\lambda_W^C - \psi_x \lambda_\Pi^X\right)$, and of the difference between the two investment propensities: wage-led and profit-led ($\lambda_W^I - \lambda_\Pi^I$). In this latter case, we see that investments play a central role in the process.

1.3. The steady state solutions

In our model, the macroeconomic dynamic (MD), represented by the demand regime interacts with the technological dynamic (TD) formulated by the productivity regime, and within this interaction the dynamic of labour costs plays an important role. The model is composed of the following equations system:

$$y = \mu + \nu g \text{ [MD]} \tag{11}$$

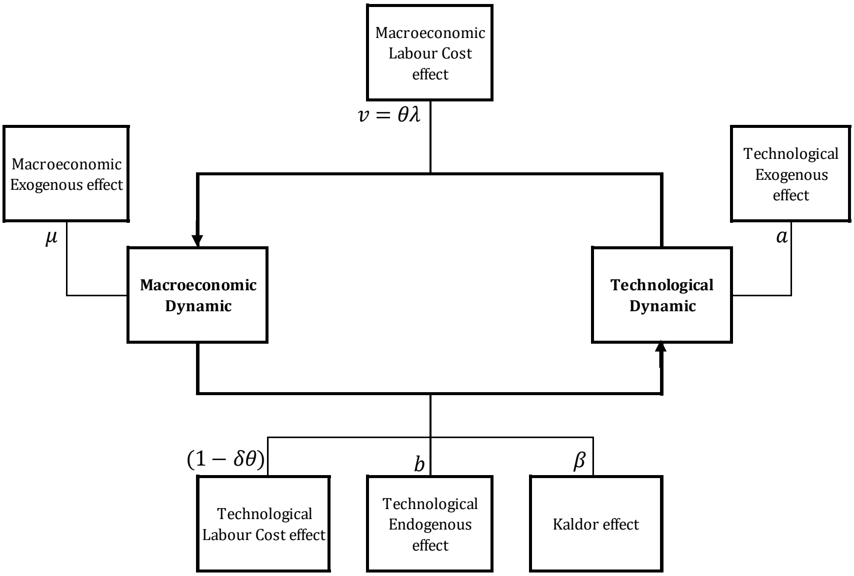
$$g = a + by \text{ [TD} \tag{12}$$

with $a = \frac{\alpha}{1-\delta\theta}$ and $b = \frac{\beta}{1-\delta\theta}$, where α represents innovations not stimulated by economic factors, and β is the Kaldor effect.

In detail, in equation (11), μ represents the *macroeconomic exogenous* (ME) *effect*; ν stands for the *macroeconomic technological* (*MT*) *effect*, composed of a *macroeconomic labour costs* (MLC) *effect*, indentified by $\theta\lambda$. In equation (12), a stands for a *technological exogenous* (TEx) *effect*, b indicates the *technological endogenous* (TEn) *effect*, consisting of the Kaldor effect (β), and $(1-\delta\theta)$ is the *technological labour costs* (TLC) *effect*.

Equation (12) is a new version of equation (11), where q has been endogenised, namely $q = \theta g$.

Figure 2 – Macroeconomic and technological effects in the model



Solving the equations system, we obtain the following equilibrium growth rates of income, labour productivity and employment:

$$y^* = \frac{\mu + va}{1 - vb}$$

$$g^* = \frac{a + \mu b}{1 - vb}$$

$$n^* = \frac{\mu(1-b) + a(v-1)}{1 - vb}$$

with $a = \frac{\alpha}{1-\delta\theta}$, $b = \frac{\beta}{1-\delta\theta}$, and $n^* = y^* - g^*$.[7]

[7] Starting from $y = \mu + vg$ and $g = a + by$, we obtain $y = \mu + v(a + by) = \mu + va + vby \rightarrow y^* = \frac{\mu+va}{(1-vb)}$ and $g^* = a + b\left(\frac{\mu b+va}{1-vb}\right) = \frac{a+\mu b+bva-bva}{(1-vb)} = \frac{a+\mu b}{(1-vb)}$. Consequently, since $n = y - g$, we have $n^* = \left[\frac{\mu+va}{(1-vb)}\right] - \left[\frac{a+\mu b}{(1-vb)}\right] = \frac{\mu(1-b)+a(v-1)}{1-vb}$.

The condition for positive and stable equilibrium solutions is $0 < \nu b < 1$, according to which the TD line is flatter than the MD line.

In this model, the *ME effect* (μ) is positively correlated with all variables. The *MLC effect* ($\theta\lambda$) positively affects the growth rate of all variables if the two parameters θ and λ have the same sign, or in other words if the functional distribution of income is wage-oriented (profit-oriented) and the wage-led-demand propensity (profit-led-demand propensity) is dominant. For all variables, the *TLC effect*, $(1 - \delta\theta)$, positively influences the growth rate of labour productivity when θ is positive, i.e. when the functional distribution of income is wage-oriented, while the effect is ambiguous with respect to the other variables. The *Kaldor effect* positively affects the growth rate of income and labour productivity and it has an ambiguous impact on the growth rate of employment. Finally, the *TEx effect* (a) positively affects the growth rate of labour productivity and the growth rate of income if the *MLC effect* is positive, while the impact of a on the growth rate of employment is ambiguous.

With regard to the equilibrium growth rate of employment, $n^* > 0$ when

$\mu(1 - b) + a(\nu - 1) > 0.$

Hence, employment policy should focus on the *ME effect* and/or on fostering a positive sign of the *MLC effect.* In order to represent both functions in a graph (where vertical axis and horizontal axis correspond to growth rate of income and the growth rate of labour productivity, respectively), equation (12) is transformed into the following equation:

$$y = -\frac{\alpha}{\beta} + \frac{(1-\theta\delta)}{\beta} g \qquad (16)$$

Let us draft both functions by taking into account the employment dynamic. In figure 3[a], similar to the figure in Corsi and Roncaglia, 2002, different economic growth scenarios can be identified, dividing the graph into the following six areas: *Area I,* in which income and productivity increase but employment decreases; *Area II*, in which all structural variables increase, determining economic development; *Area III,* in which income and employment grow, while labour productivity decreases; *Area IV,* in which all structural variables diminish, determining an economic crisis; *Area V*, in which employment increases while income and labour productivity diminish; *Area VI*, in which labour productivity increases, while employment and income decline.

Furthermore, figure $3[b]$ represents the functions of demand regime and productivity regime in the case of $v > 0$ and it shows that an increase of the macroeconomic exogenous effect (from μ to μ') can move and economy from Area I (with $y *> 0, g *> 0, n *< 0$) to Area II (exhibiting $y' *> 0, g' *> 0, n' *> 0$).

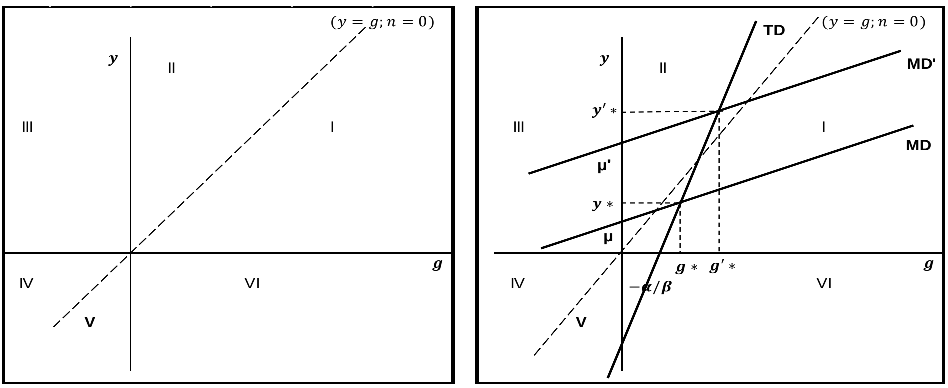
Some considerations can be drawn from figure 3. This analytical context allows to take into account the structural changes and the complexity of economic development, while the mainstream growth literature tends to undervalue these elements by disregarding the interaction among variables and their potential conflicting dynamics.

However, this framework also differs from the standard Keynesian approach, which assumes that growth in employment is directly proportional to the income growth rate, under the hypothesis $g = 0$ (Sylos Labini, 1992). Indeed, according to the Keynesian view, innovations are not relevant and the technology is given in the short-term. While in the Schumpeterian view à la Sylos Labini, labour productivity can rise in the short term thanks to the innovations generated from increases in labour costs (and from past investments – even if this aspect to simplicity is not analysed in this paper). Moreover, income growth is not a sufficient condition for employment growth, because the dynamic of labour productivity can work adversely.

In the growth process, growth is not necessarily both "inclusive" (increasing employment) and "smart" (increasing labour productivity). This aspect has important implications for European economic policy, given that one of the main goals of the "Europe 2020 Strategy" of the European Union for the period 2014-2020 is "smart and inclusive growth" (European Commission, 2010). Indeed, the realisation of smart and inclusive growth depends on the combination between technological and macroeconomic factors. In other terms, focusing on income growth only is not sufficient to understand the structural nature of a growth process.

Figure 3 – Relationships among the structural variables of economic growth

a) ***b)***



Finally, this model may explain some structural causes of economic crises in light of Post-Keynesian interpretations (Corsi and Guarini, 2010; Blankenburg and Palma, 2009). The first cause is the increase in inequality in terms of a redistribution of income favouring profits: in the model, this implies $\theta < 0$ (Fitoussi and Saraceno, 2011). The second cause is an excessive use of profits for financial investments at the expense of investments in the productive process: in the model this case implies a very low λ_{Π}^{I} (Crotty, 2009). Another relevant case is the reinforcement of an oligopolistic market regime: in the model, this case implies very low value of the parameter δ (Palma, 2009). According to the model, all these conditions entail a significant slowdown in growth, or recession.

2. Empirical analysis

In this section, the basic relationships of the demand regime and productivity regime and the capital accumulation function are estimated for the European countries[8] in the period 1992-2012. An application to Europe of the abovementioned framework can be interesting because firstly, in the empirical Structuralist-Keynesian literature, contributions mainly refer to peripheral countries or selected OECD countries; secondly, the abovementioned European Europe 2020 Strategy develops a policy framework worth of empirical examination.

The equations estimated are the following:

$$y_{j,t} = \omega_0 + \omega_1 y_{j,t-1} + \omega_2 g_{j,t} + \sum_{t=1}^{m} \varrho_t \tau_{j,t} + \varepsilon_{j,t}. \quad (17)$$

$$g_{j,t} = \vartheta_0 + \vartheta_1 g_{j,t-1} + \vartheta_2 y_{j,t} + \vartheta_3 GAP_{j,t-1} + \sum_{t=1}^{m} \varrho_t \tau_{j,t} + \varepsilon_{j,t}. \quad (18)$$

$$i_{j,t} = \zeta_0 + \zeta_1 i_{j,t-1} + \zeta_2 w_{j,t} - \zeta_3 {w^2}_{j,t} + + \sum_{t=1}^{m} \varrho_t \tau_{j,t} + \varepsilon_{j,t} \quad (19)$$

Equations (17), (18) and (19) respectively represent the demand regime, the productivity regime and the capital accumulation functions. The variables y, g, i, w are the growth rates of the gross domestic product, labour productivity, fixed capital formation and of wages at constant prices, respectively. The variable GAP represents the ratio between the maximum observed value of labour productivity and the value of the country considered, while subscripts j and t refer to country and time, respectively. As in Hein and Tarassow, 2010, GAP is a control variable capturing technological catching-up. Finally, τ_{it} is a set of time dummies, from year 1 (1992) to year m (2012), and ε_{jt} is the error term.

[8] The European countries included in the analysis are: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxemburg, Macedonia, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom.

With respect to the theoretical section, parameters $\omega_0, \omega_2, \vartheta_0, \vartheta_2, \zeta_2, \zeta_3$ respectively indicate the macroeconomic exogenous effect, the macroeconomic labour costs effect, the technological exogenous effect and the technological endogenous effect, the wage effect and the profit effect of wages on investments,. Parameters $\omega_1, \vartheta_1, \zeta_1$ capture the path dependence of the income growth rate, labour productivity growth rate and fixed capital formation growth rate, respectively. Finally, parameter ζ_0 represents the exogenous component of investments.

The dataset used is obtained from the Eurostat website, category "Economy and Finance", "GDP and main components".[9] The econometric techniques used are the one-step System GMM (developed by Arellano and Bover, 1995; Blundell and Bon, 1998) and the one-step Difference GMM Dynamic Panel (developed by Arellano and Bond, 1991) models. Thanks to the two versions of the GMM method, it is possible to take into account both the potential autocorrelation due to the introduction in the regression of the lagged dependent variable, and the potential endogeneity caused by endogenous covariates.

Specifically, we expect there to be endogeneity between income and labour productivity, due to their interactions explained in the above model. To solve these problems, in the one step difference GMM the instruments used are in lagged levels, while in the one step system GMM the instruments are both in lagged levels and in lagged first differences (Roodman, 2009). Hence, in all equations, the error term ε_{it} consists of both unobserved country-specific effects u_i, with $iid\ (0, \sigma_u^2)$, and observation-specific errors v_{it} , with $iid\ (0, \sigma_v^2)$.

[9] Available at http://ec.europa.eu/eurostat/data/database.

Table 1 – *Econometric estimates of the cumulative growth model*

	DEMAND REGIME		PRODUCTIVITY REGIME		CAPITAL ACCUMULATION FUNCTION	
	eq. (2.1)		**eq. (2.2)**		**eq. (2.3)**	
Dependent variable	y_{jt}		g_{jt}		i_{jt}	
	System GMM	Difference GMM	System GMM	Difference GMM	System GMM	Difference GMM
y_{jt-1}	0.367***	0.392***				
	(0.0565)	(0.0696)				
g_{jt}	0.698***	0.722***				
	(0.1022)	(0.1268)				
ω_0	-0.00929					
	(0.0059)					
g_{jt-1}			-0,00637	-0.0848*		
			(0.0542)	(0.0488)		
y_{jt}			0.447***	0.404***		
			(0.1024)	(0.1087)		
GAP_{jt-1}			0.0114**	0.0201**		
			(0.0053)	(0.0080)		
ϑ_0			-0.0134			
			(0.0330)			
i_{jt-1}					0.232***	0.227***
					(0.0744)	(0.0731)
w_{jt}					0.730***	0.682***
					(0.2213)	(0.2004)
w^2_{jt}					-1.987***	-1.935***
					(0.4440)	(0.4493)
ζ_0					-0.0488***	
					(0.0092)	
Observations	424	398	416	390	427	401
AR(1): p-value	0.009	0.004	0.037	0.03	0.001	0.001
	(-2.62)	(-2.89)	(-2.09)	(-2.16)	(-3.25)	(-3.31)
AR(2): p-value	0.526	0.606	0.722	0.466	0.335	0,291
	(-0.63)	(-0.52)	(0.36)	(-0.73)	(-0.96)	(-1.06)
Hansen test: p-value	1	1	1	1	1	1
	(6.18)	(6.20)	(3.55)	(4.51)	(0.97)	(7.50)
Test for Temporal Dummies: p-value	0	0	0	0	0	0
	(626.41)	(625.71)	(261.25)	(549.61)	(1390.00)	(487.21)

Notes: * denotes p-value < 0.10, ** p-value < 0.05, and *** p-value < 0.01. Robust standard errors and values of test statistics are reported in parentheses.

As table 1 shows, according to the econometric estimates the growth rate of income is positively and significantly influenced by the lagged growth rate of income and the current growth rate of labour productivity (demand regime), while the growth rate of labour productivity inversely depends (in the case of difference GMM) on the lagged growth rate of labour productivity and positively on the current growth rate of income and the gap of labour productivity (productivity regime). Finally, we find that the growth rate of fixed capital formation is positively and significantly affected by the lagged growth rate of fixed capital formation and the current growth rate of wages, while it is negatively and significantly influenced by the square of the current growth rate of wages.

It is found too that the relationship between capital accumulation and the growth rate of wages is a downward parabola, as theorised by Sylos Labini, 1984. Thus, there appears to exist a wage growth rate that maximizes capital accumulation (that is the "optimum growth rate of wages"). In the period considered, given the values of the other variables, it is about 1.8%.[10] This results from the post-estimation maximisation of the investment function, given the estimated values of the parameters, and it represents the value at which the linear and the quadratic terms are extreme.

We find that the macroeconomic exogenous effect is not statistically significant. This result can suggest that in the European economy exports are not very attractive for the rest of the world demand (they have low income elasticity) and the propensity to invest is weak (low exogenous components of the investment function). In addition, the technological exogenous effect too appears as not

[10] In eq. (2.3), for the GMM system the range of w is [-0.23972829, 0.23568161], the sum $w+w^2$ has its maximum in argext = 0.1836098, standard error of argext (delta method) is equal to 0.0441269, and 95% confidence interval for argext = (0.0971227, 0.2700969); while for the GMM difference the range of w is [-0.23972829, 0.23568161], the sum $w + w^2$ has its maximum in argext = 0.1760975, standard error of argext (delta method) is equal to 0.0446057, and 95% confidence interval for argext (0.088672, 0.2635229).

statistically significant, perhaps due to insufficient investments on R&D and human capital. Furthermore, parameters of the lagged terms of the income growth rate and fixed capital growth rate are positive and statistically significant; this can indicate that income and investments dynamics are characterised by path dependence. While the parameter of the lagged growth rate of labour productivity is negative, its significance is ambiguous: it is significant only in GMM difference model. Finally, it is found that labour productivity dynamics is characterised by technological catching-up.

The empirical evidence provides interesting theoretical and political elements to discuss. Our results confirm the Kaldorian idea of the market: it is primarily a valid instrument to generate resources and not, as in mainstream economics, essentially an instrument to allocate resources (Kaldor, 1979).

As it emerges, the austerity policies implemented in the European Union are a serious obstacle to technological progress. Empirical evidence shows that in the EU, economic growth is a necessary condition to develop economies of scale and innovation. Hence, austerity policies generate a vicious circle: a reduction of aggregate demand reduces labour productivity, which in turn depresses the macroeconomic dynamic. Data confirms that in Europe there exists a serious contradiction between the fiscal and monetary policies driven by the principles of austerity and the Europe 2020 Strategy aiming at innovation and growth; there is a trade-off between the two groups of targets. In other terms, effective industrial policies are incompatible with austerity (Botta, 2014).

Finally, an excessive reduction of real unit labour costs can negatively influence investments and weaken economic growth. In that regard, the following reflection by Sylos Labini becomes relevant:

> "[i]n certain periods the rate of wage increase tends to be systematically 'too low' […] thus determining an excessive increase in profits: the revers tends to happen in other periods. In periods of the former type the increase in investment, during the ascending phases of the cycle, tends to be higher than in the latter periods, but the crises tend to be more serve. It might be strange that an expansion of profits can be such

as to prepare the ground for particularly severe crises. But it is so" (Sylos Labini, 1984, pp. 220).

Therefore, labour policies repressing the wage dynamic are not the viaticum of employment growth, as argued by mainstream economics, but they strengthen a recessionary trap that Europe can only exit through a radical change of theoretical references and political initiatives (Roncaglia, 2014).

3. Concluding remarks

The aim of this paper has been to build a cumulative growth model by focusing on the role of labour productivity and of unit labour costs. To this end, I have integrated the model by Ocampo, 2005, Cimoli et al., 2006, and Naastepad, 2006, with the contributions by Sylos Labini, 1984;2001. The model outlines a cumulative growth process by interacting the demand regime, which represents the macroeconomic dynamic, and the productivity regime concerning the technological dynamic.

As the model shows, labour productivity is both the product and engine of the cumulative growth circle. In fact, in the productivity regime, technological progress is endogenous thanks to the Kaldor effect and the labour costs effect. In the demand regime, labour productivity affects income through wage and profit channels. This interactive dynamics may depend on functional income distribution and market forms.

Finally, I estimated the statistical significance of the demand regime and productivity regime, and of the twofold influence of labour costs on investments, for the European countries in the period 1992-2012.

The model provides elements that may be starting points for future research. In fact, it may be considered as a framework within which to study the structural nature of the current crisis. More in general, it may be useful to build studies on growth based on both the Keynesian perspective on demand-side mechanisms and a

Schumpeterian analysis of technological progress from the supply side. Moreover, the model, unlike mainstream models, predicts that social and policy choices in terms of income distribution influence the growth process.

From the policy point of view, the model suggests the coordination between supply-side policies – industrial policy and anti-trust policy – and demand-side policies, such as fiscal policy and monetary policy, in order to promote growth and to sustain the cumulativeness of this process. This last consideration represents the current challenge for the current European Union policies, founded on austerity and neoliberalism inspired by mainstream economics.

Appendix

Starting from the standard national account system, the following equation represents the income Y that depends upon the effective demand:

$$Y = C + I + X - M \qquad \text{(a.1)}$$

where C, I, X, M, are the levels respectively of private plus public consumption (according to Nastepad, 2006), aggregate investment, exports and imports. Consumption and imports may be identified by the following equations

$$C = (1 - \sigma_w)QY + (1 - \sigma_\pi)(1 - Q)Y$$

$$M = mY$$

Consumption depends positively upon the real unit labour cost Q, since it is equivalent to the wage share of income.[11] Parameter $\sigma_w > 0$ is the propensity to save out of profits, while $\sigma_w > 0$ is the propensity to save out of wages. Finally, parameter $m > 0$ is the propensity to

[11] Note that $Q = \frac{W}{Y} = \frac{real\ wage\ rate}{labour\ productivity} or \frac{Unit\ Labour\ Cost}{price\ level}$ and that $QY = W$ and $(1 - Q)Y = \Pi$.

import, thus imports are positively influenced by the national income. Equation (a.1) may be rewritten in the following way

$$Y = \Phi^{-1}(I + X) \quad \text{(a.2)}$$

with $\Phi = [1 - (1 - \sigma_w)Q - (1 - \sigma_\pi)(1 - Q) + m]$.

Thus, Φ^{-1} is the Keynesian multiplier that is endogenised, since it depends on income distribution, labour productivity and on real wages. The dynamic version of (a.2) is

$$y = \lambda_W^C q + \psi_x x + \psi_i i$$

where $\lambda_W^C = -\xi(\sigma_\pi - \sigma_w)$, with $\xi = -\frac{Q}{\Phi}$, is the propensity to consume,[12] and $\psi_i = \frac{\Phi^{-1} I}{Y}$, $\psi_x = \frac{\Phi^{-1} X}{Y}$. It is assumed $\lambda_W^C > 0$, that is $(\sigma_\pi - \sigma_w) > 0$ as in the standard Keynesian model.

Table B.1 – *Descriptive statistics of the system GMM models*

DEMAND REGIME

Variable		Mean	Std. Dev.	Min	Max	Observations
y_{jt}	overall	0.0250	0.0360	-0.1562	0.2176	N = 424
	between		0.0115	0.0088	0.0484	n = 26
	within		0.0343	-0.1752	0.2082	T = 16.31
y_{jt-1}	overall	0.0263	0.0359	-0.1562	0.2176	N = 424
	between		0.0113	0.0098	0.0495	n = 26
	within		0.0342	-0.1746	0.2076	T = 16.31
g_{jt}	overall	0.0194	0.0317	-0.0863	0.2042	N = 424
	between		0.0155	-0.0007	0.0541	n = 26
	within		0.0282	-0.1207	0.1974	T = 16.31

12 Indeed, Φ can be rewritten in this way, $\Phi = (1 - Q + \sigma_w Q - 1 + Q + \sigma_\pi Q + m) = \sigma_\pi - Q(\sigma_\pi - \sigma_w) + m$. Hence the growth rate of Φ becomes $\phi = -\frac{Q}{\Phi}(\sigma_\pi - \sigma_w)q$.

PRODUCTIVITY REGIME

Variable		Mean	Std. Dev.	Min	Max	Observations
g_{jt}	overall	0.0186	0.0302	-0.0863	0.1687	N = 416
	between		0.0150	-0.0007	0.0491	n = 26
	within		0.0268	-0.1165	0.1554	T = 16
g_{jt-1}	overall	0.0204	0.0321	-0.1192	0.2042	N = 416
	between		0.0158	0.0006	0.0573	n = 26
	within		0.0287	-0.1235	0.1972	T = 16
y_{jt}	overall	0.0242	0.0349	-0.1562	0.1074	N = 416
	between		0.0111	0.0088	0.0484	n = 26
	within		0.0333	-0.1731	0.0906	T = 16
GAP_{jt-1}	overall	1.8465	1.8469	0.4491	9.3507	N = 416
	between		1.8837	0.4892	7.1886	n = 26
	within		0.4277	-0.4853	4.2691	T = 16

CAPITAL ACCUMULATION FUNCTION

Variable		Mean	Std. Dev.	Min	Max	Observations
i_{jt}	overall	0.0287	0.0957	-0.3953	0.3759	N = 427
	between		0.0240	0.0030	0.0892	n = 26
	within		0.0931	-0.4369	0.3289	T = 16.42
i_{jt-1}	overall	0.0342	0.0952	-0.3953	0.3759	N = 427
	between		0.0260	0.0056	0.1100	n = 26
	within		0.0921	-0.4465	0.3323	T = 16.4231
w_{jt}	overall	0.0264	0.0499	-0.2397	0.2357	N = 427
	between		0.0142	0.0093	0.0587	n = 26
	within		0.0481	-0.2662	0.2234	T = 16.42
w^2_{jt}	overall	0.0032	0.0074	0.0000	0.0575	N = 427
	between		0.0052	0.0004	0.0201	n = 26
	within		0.0057	-0.0169	0.0411	T = 16.42

Table B.2 – *Descriptive statistics of difference GMM models*

DEMAND REGIME

Variable		Mean	Std. Dev.	Min	Max	Observations
y_{jt}	overall	0.0242	0.0347	-0.1562	0.1064	N = 398
	between		0.0110	0.0081	0.0448	n = 26
	within		0.0331	-0.1731	0.0877	T = 15.31
y_{jt-1}	overall	0.0266	0.0357	-0.1562	0.2176	N = 398
	between		0.0112	0.0106	0.0490	n = 26
	within		0.0341	-0.1733	0.2084	T = 15.31
g_{jt}	overall	0.0181	0.0301	-0.0863	0.1687	N = 398
	between		0.0151	-0.0021	0.0491	n = 26
	within		0.0266	-0.1170	0.1507	T = 15.31

PRODUCTIVITY REGIME

Variable		Mean	Std. Dev.	Min	Max	Observations
g_{jt}	overall	0.0180	0.0303	-0.0863	0.1687	N = 390
	between		0.0152	-0.0021	0.0509	n = 26
	within		0.0268	-0.1189	0.1506	T = 15
g_{jt-1}	overall	0.0198	0.0302	-0.0861	0.1687	N = 390
	between		0.0153	0.0013	0.0521	n = 26
	within		0.0267	-0.1184	0.1563	T = 15
y_{jt}	overall	0.0238	0.0348	-0.1562	0.1064	N = 390
	between		0.0108	0.0077	0.0445	n = 26
	within		0.0333	-0.1703	0.0897	T = 15
GAP_{jt-1}	overall	1.8115	1.8110	0.4491	9.3507	N = 390
	between		1.8531	0.4878	7.1140	n = 26
	within		0.4080	-0.4327	4.3217	T = 15

CAPITAL ACCUMULATION FUNCTION

Variable		Mean	Std. Dev.	Min	Max	Observations
i_{jt}	overall	0.0260	0.0943	-0.3953	0.3759	N = 401
	between		0.0215	-0.0069	0.0821	n = 26
	within		0.0922	-0.4269	0.3428	T = 15.42
i_{jt-1}	overall	0.0323	0.0956	-0.3953	0.3759	N = 401
	between		0.0238	0.0094	0.1033	n = 26
	within		0.0931	-0.4401	0.3358	T = 15.42
w_{jt}	overall	0.0260	0.0505	-0.2397	0.2357	N = 401
	between		0.0145	0.0105	0.0611	n = 26
	within		0.0488	-0.2689	0.2233	T = 15.42
w^2_{jt}	overall	0.0032	0.0076	0.0000	0.0575	N = 401
	between		0.0056	0.0004	0.0220	n = 26
	within		0.0057	-0.0187	0.0400	T = 15.42

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