Disequilibrium and instability (not equilibrium) as the normal state of the industrial economies*

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"[M]any phenomena which are evolutionary at the microcosmic level are stationary at the macrocosmic level. The individual is born, lives, and dies. And yet it may be that the population is stationary."

(Frisch, 1929, p. 392)

"We start by discarding the idea of equilibrium as a state of rest to which a stable system is expected to return. [...] Our economy never returns. Its equilibrium may be said to exist if its component parts in their process of growth retain some proper relationship to each other, such as output to capital, steel to coal, costs to prices"

(Domar, 1952, pp. 490-1)

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1 Introduction

Equilibrium is an organising principle of economic thinking. However, it would be limiting to argue that there is a consensus as to the interpretation of such a label, especially when Keynesian analyses are considered.

For example, the Neoclassical interpretation of a Keynesian equilibrium as a *position of rest with involuntary unemployment* (e.g. Hahn, 1987), as against Pasinetti's (1981) notion of an equilibrium situation, that is, an *unstable position with full employment*. In the former case, the definition of an equilibrium state cannot be separated from the mechanisms that may (or may not) lead to it, whereas in the latter, the explicit separation between both layers is crucial. In the former case, efficiency is an atomised property, whilst in the latter, efficiency is defined at the structural, rather than individual, level (Pasinetti, 1987).

Such a contrasting use of the equilibrium concept goes beyond the mere distinction between statics or dynamics: as Frisch (1929) early recognised, it is our method of analysis which is static or dynamic, economic phenomena being either stationary or evolutionary.

In fact, evolutionary phenomena are a pervasive feature of industrial economies. Within this context, Pasinetti (2007, pp. 229-231) identifies two types of instability-generating sources: the principle of effective demand and structural dynamics. But he also recalls Keynes's outstanding faults of those same economies: "failure to provide for full employment and its arbitrary and inequitable distribution of wealth and incomes" (Keynes, 1936, p. 372).

These sources of instability and societal faults are not unrelated, quite the contrary: structural dynamics of quantities and prices imply compositional changes that make full employment ever-increasingly harder to achieve (with a resurgent fear of technological unemployment), whilst asymmetries in income distribution amplify the mismatch between the multiplication of abstract purchasing power and actual spending decisions, making the principle of effective demand ever-increasingly important in determining activity levels.

The present chapter explores how Pasinetti's (i) methodological standpoint, (ii) formulation of the principle of effective demand and (iii) conceptualisation of equilibrium, cumulatively build up into a scheme of structural dynamics (Pasinetti, 1965a, 1981, 1993), in which disequilibrium and instability emerge as the pervasive state of *industrial* economies. Within that framework, building blocks (i)-(iii) are used to understand one of those societal faults singled out by Keynes: the increasing difficulty to achieve and maintain full employment.

2 Methodological standpoint: pre-institutional and behavioural relations

A pervasive feature across Pasinetti's analytical frameworks is the careful distinction between pre-institutional and behavioural relations (Pasinetti, 2007, pp. 36-37). This has been rendered explicit early on:

> "The distinction is between those relations which in an economic system are so fundamental as to be independent of the institutional set-up that society has chosen to adopt and those relations which are specific to a particular institutional set-up. For example, Prof. Leontief's input-output inter-industry system is *independent of institutions*; it is a kind of analysis which can be carried out for a socialist as well as for a capitalist country. On the other hand, for example, the *processes through which prices are actually reached* are specific to particular institutional set-ups: they are different according to whether we consider a socialist economy, a capitalist economy, or any mixed type of economy"
> (Pasinetti, 1965b, p. 103-104, italics added)

As evinced and exemplified by the quote above, a pre-institutional concept or relation is *not* one specified in an institutional *vacuum*, but one which "remains *neutral* with respect to the institutional organisation of society" (Pasinetti, 1981, p. 25, italics added). It is meaningful *across* institutional setups, for example, a centrally planned, capitalist or mixed economy, but its realisation occurs *within* a well-specified set of rules, mechanisms and behaviours operating in an *industrial* society.

Instead, institutional concepts are articulated in "*behavioural* relations meant to represent and explain the *effective* working of *actual* economic systems, within a well-defined institutional set-up" (Pasinetti, 2007, p. 37, italics added). Thus, behavioural relations are the characterising element of the institutional layer of analysis.

Crucially, Pasinetti (1981, 1993) is interested in the pre-institutional features of an *industrial* society. Such a society is characterised by "the productive consumption of circulating and fixed capital as the means of production, to be used together with labour, and which should be *necessarily* replaced and accumulated, *if* this circular flow is to be reproduced at an expanding scale" (Garbellini and Wirkierman, 2014, p. 235). That is, Pasinettian pre-institutional concepts or relations do *not* apply to *pre-industrial* societies, they are historically embedded within the 'phase of industry' (Pasinetti, 1981, p. 2), accelerating since the second half of the eighteenth century.

To give an example, while wages and operating surplus (usually labelled 'profits') are pre-institutional categories, workers and capitalists are deeply institutional ones. The former have a *functional* role in relation to the *net* output of the economy: wages financing private consumption and profits financing investment. That is, a truly *functional* distribution of income.

Workers and capitalists are, instead, distinguished by their (lack of) ownership of means of production within the specific institutional setup of a capitalist economy. Given that in stylised descriptions of a capitalist system workers receive wages as their main source of income, whereas capitalists have a command over the use of profits, the distinction between pre-institutional and behavioural categories is unnecessarily blurred.[1] In fact, when comparing in 1970 the System of National Accounts (SNA) — used by capitalist economies at the time — with the Material Product System (MPS) — used by countries in the (former) Soviet Bloc — Richard Stone noted that the 'value added account' in both systems included 'wages' and 'operating surplus' as organising concepts (Stone, 1970, p. 207).

The example of Leontief's 'input-output inter-industry system' — provided by Pasinetti's quote at the beginning of this section — effectively illustrates a scheme of pre-institutional relations. The three different quadrants of an input-output table, (i) intermediate transactions, (ii) value added and (iii) final demand, each closely relates to the (i) production, (ii) income generation and (iii) use of income and capital accounts, respectively, of the (currently used) SNA (UN, 2009, pp. 23-33). However, the income distribution accounts of the SNA — dealing with the *institutional* allocation and (re)distribution of gross value added generated — are *not* part of the input-output scheme. While the input-output table is compiled on the basis of *productive establishments* (irrespective of their

[1]The distinction between the fractions of income saved out of wages and profits with respect the propensities to save of workers and capitalists was an essential feature in Pasinetti's formulation of the 'Cambridge equation' (Pasinetti, 1962).

ownership structure), the sequence of accounts of the SNA is organised around *institutional sectors* of the economy.

There is a specific instance of the pre-institutional configuration of the economy which Pasinetti labels 'natural':

> "The 'natural' magnitudes possess a series of remarkable normative properties, but are singled out in a way that is independent of *how* they may actually be achieved"
> (Pasinetti, 2002, p. 337)

For example, in Pasinetti's *natural* economic system, total wages equal total consumption and total profits equal total new investments (Pasinetti, 1981, pp. 146-147). This is a desirable normative property as it renders possible the smooth reproduction of the expanding circular flow representing the economy. However, the specification of the natural configuration will not describe *how* profits adjust to match investment or *viceversa*, which instead depends on the set of behavioural relations assumed.

Moreover, it is possible analyse the structural features of an economy within a logically consistent set of pre-institutional relations, *even if* there is a mismatch between total profits and investment. Thus, while a natural configuration presupposes a pre-institutional layer of analysis, the reverse is not true. This is relevant, inasmuch as several pre-institutional categories in Pasinetti's frameworks — such as the 'standard' rate of productivity growth (Pasinetti, 1981, pp. 101-104) — are useful for representing and *measuring* aspects of *actual* economies, irrespective of whether the underlying magnitudes satisfy the desirable normative properties of their natural configuration.

Pasinetti's quote opening this section is also interesting as it postulates that 'the processes through which prices are actually reached' pertains to the institutional layer of analysis, whereas the conditions required for the economy to be in a *natural* configuration remain pre-institutional. This methodological standpoint bears striking resemblance, albeit with a different terminology, to that adopted by Sraffa in the path leading to the formulation of his system of production (Sraffa, 1960). In fact, a set of *computable* prices could be conceived as the answer to the following problem, posed by Sraffa:

> "The problem is that of *ascertaining the conditions of equilibrium of a system of prices and the rate of profits, independently of the study of the forces which may bring about such a state of equilibrium.* Since a solution

of the second problem carries with it a solution of the first, that is the course usually adopted in modern theory. The first problem however is susceptible of a more general treatment, independent of the particular forces assumed for the second; and in view of the unsatisfactory character of the latter, there is advantage in maintaining its independence. (D3/12/15: 2; emphasis added)"
(Kurz and Salvadori, 2005, p. 433)

Ascertaining the 'conditions of equilibrium' is at the basis of the specification of the natural configuration of a set of pre-institutional relations in Pasinetti (1981, 1993). But to better understand such conceptualisation of (dis)equilibrium, it is necessary to explore the role of *effective demand* in an *industrial* society.

3 The (pre-institutional) principle of effective demand

The *principle* of effective demand plays a foundational role in Keynesian analyses (Keynes, 1936, ch. 3). But its definition, characterisation and interpretation are far from unique. Pasinetti (1974, 1997) suggests to distinguish between "the basic process of income generation *by* effective demand" (Pasinetti, 1974, p. 36, italics added) and finding the *determinants* of effective demand. The former can be dealt with at a pre-institutional level, whereas the latter usually leads to specifying a multiplier mechanism through the *propensity to consume*, which is a *behavioural* relation based on a 'fundamental psychological law' (Keynes, 1936, p. 96).

At the *pre-institutional* level, the principle of effective demand can be rendered clear by contrasting an *industrial* society with a primitive, *pre*-industrial one:

> "In primitive (agricultural) societies, each farmer tries to produce as much as he can. He will then take whatever amount of his produce is in excess of his needs to the market. And there this produce will fetch the price the market makes. In an industrial society it is not so. At any given point in time, productive capacity is indeed what it is — it cannot be changed. But productive capacity does not mean production — it only means *potential* production. In order that there may be *actual* production, there must be *effective* demand"
> (Pasinetti, 1974, pp. 31-32)

The depth of this statement lies in distinguishing an *inverted causal link* between output and its uses as a characterising feature of industrial societies, with respect to pre-industrial ones. This can be illustrated by specifying and discussing two simple models which emphasise this distinction.

The pre-industrial economy may be characterised by the following relations amongst aggregate magnitudes:

$$\Pi \equiv Y - C \qquad \text{(Surplus)} \qquad (1)$$
$$C = a_c N \qquad \text{(Consumption)} \qquad (2)$$
$$Y = \frac{1}{a_l} N \qquad \text{(Output)} \qquad (3)$$
$$N = \bar{N} \qquad \text{(Labour Force)} \qquad (4)$$

The surplus (Π) in (1) is the residual after consumption (C) has been deducted from output (Y). Necessary consumption in (2) is determined by the (per-capita) consumption needs (a_c) to reproduce the labour force (N). Output (Y) in (3) is obtained by employing the labour force (N) at the current level of productivity ($1/a_l$). Finally, in (4), it is assumed that the labour force employed in the system is given ($\bar{N}$).

By replacing (4) in (3), note that output is determined independently of demand conditions:

$$\bar{Y} = \frac{1}{a_l} \bar{N} \qquad (5)$$

that is, *every* unit of labour produces as much as possible, bounded by the available technique ($1/a_l$).

From (2) and (3), the consumption requirements to reproduce the labour force depend on the level of output:

$$C = a_c a_l Y \qquad (6)$$

Note that $a_c a_l$ represents the consumption requirement of the labour content of a unit of output. It allows to express each unit of labour into its consumption content. Therefore, $a_c a_l Y$ summarises the consumption needs allowing for the reproduction of the labour force.

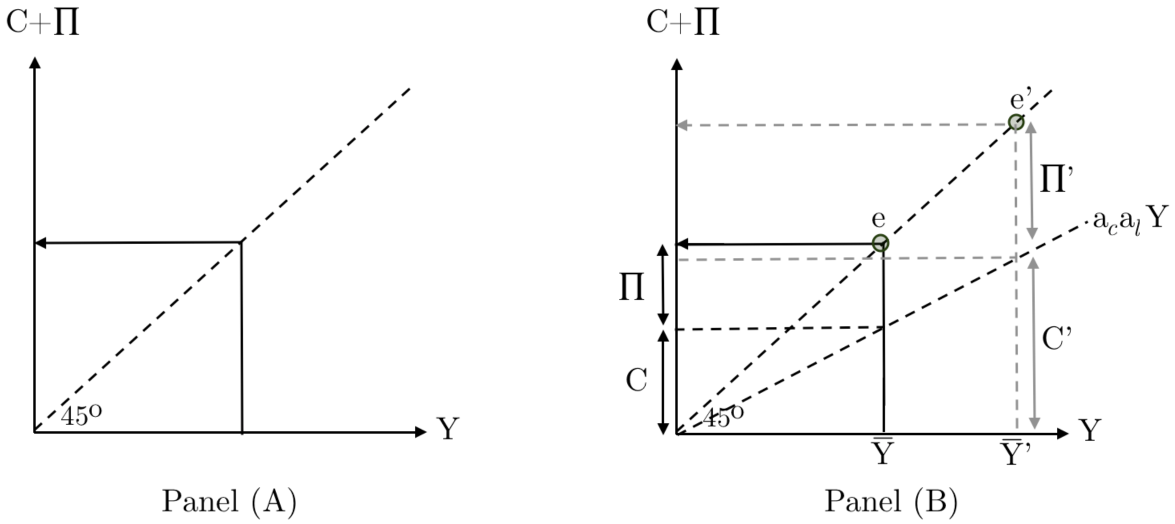
Introducing (6) into (1), for output $\bar{Y}$ determined in (5), we *residually* obtain the surplus of the system:

$$\Pi = (1 - a_c a_l)\bar{Y} \qquad (7)$$

The causal link goes *from* output *to* the surplus (taken to the market to fetch a price). The direction goes from resources to its possible uses. Consumption may be seen as a *cost*, that is, the productive consumption of labour, rather than as an activating source of demand.

Figure 1 graphically depicts this causal link. Panel (A) shows the *basic* principle at work: resources (output) generate uses (consumption and surplus). A point of output on the x-axis is mapped through the 45° diagonal to a point of consumption and surplus on the y-axis: once $Y = \bar{Y}$, $C + \Pi$ are determined.

Figure 1: A pre-industrial society: from output (Y) to consumption and surplus ($C + \Pi$)



Panel (B), instead, depicts how the *distribution* of output between consumption and surplus is determined. Besides the 45° diagonal, the consumption ray representing (6) specifies the consumption requirements of the labour force at a given output level. Once output $\bar{Y}$ has been fixed using (5), consumption (C) is given by the vertical intersection with the consumption ray, whereas the vertical distance between the consumption ray and the 45° diagonal, at output level $\bar{Y}$, residually determines the size of the surplus (Π), exhausting total output at point e.

In this society, for a given level of productivity ($1/a_l$) and (per-capita) consumption needs (a_c), a higher size of the surplus can only be obtained by increasing the (given) labour force ($\bar{N}$), leading to an increase in output (from $\bar{Y}$ to $\bar{Y}'$ in Figure 1), which will then be distributed into consumption and surplus (C' and Π' in Figure 1, respectively), exhausting total output at point e'.

In contrast to this logic, the *principle* of effective demand operating in an *industrial* economy emerges from the following relations amongst aggregate magnitudes:

$$Y \equiv C + I \qquad \text{(National Income)} \qquad (8)$$
$$C = a_c L \qquad \text{(Consumption)} \qquad (9)$$
$$I = \bar{I} \qquad \text{(Investment)} \qquad (10)$$
$$L = a_l Y \qquad \text{(Employment)} \qquad (11)$$
$$L \leq \bar{N} \qquad \text{(Resource constraint)} \qquad (12)$$

The components of national income (8) consist of consumption (C) and investment (I). In (9), aggregate consumption is determined by the (per-capita) demand (a_c) exerted by those employed (L). In (10), investment (I) is autonomous. Finally, expressions (11) and (12) imply that employment is determined by the labour requirements per unit of output (a_l) applied to the output scale (Y) of the system, and that this level of labour demand is constrained by the (given) size of the labour force ($\bar{N}$).

By introducing (11) in (9), consumption is related to the level of income *through* employment:

$$C = a_l a_c Y \qquad (13)$$

Note that $a_l a_c$ represents the labour content of per-capita consumption demand, and it *numerically* coincides with $a_c a_l$ in (6), that is, the consumption content of a unit of output. Within the specific institutional set-up of a capitalist economy, the former may be interpreted as the 'value of labour power', whereas the latter as a 'propensity to consume' (Trigg, 2006, p. 19).

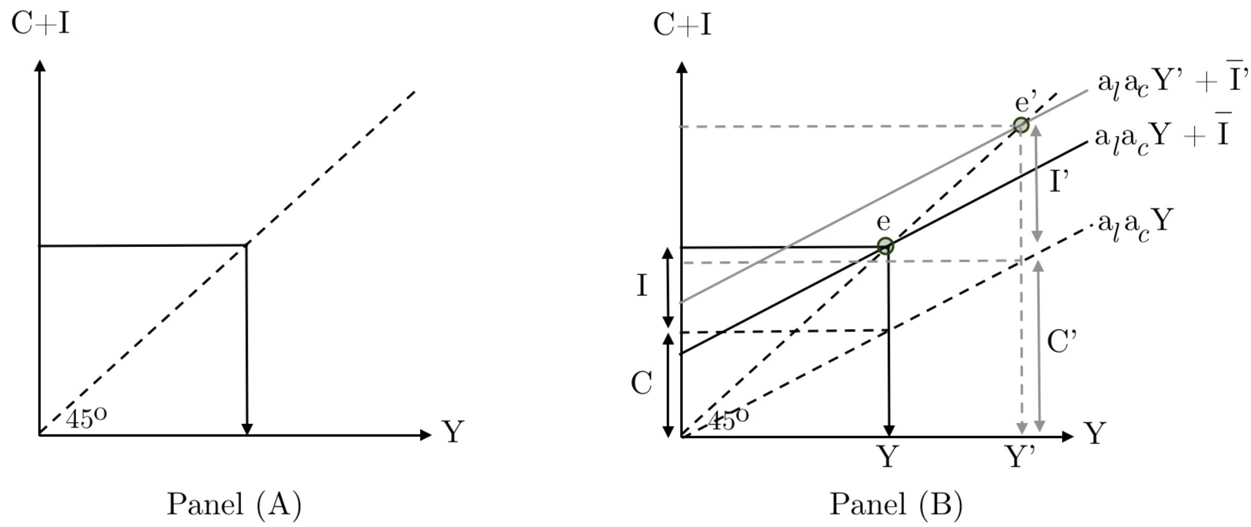
Substituting (13) for C as well as (10) for I in (8), and solving for output Y we obtain:

$$Y = \frac{1}{1 - a_l a_c} \cdot \bar{I} \qquad (14)$$

Comparing (14) with (7) renders apparent the contrast between an industrial and pre-industrial society, respectively. From (14), the causal link goes *from* investment demand *to* income. Consumption may be seen as an *activating* source of demand. But productive capacity, in this context given by the available labour force $\bar{N}$, does not necessarily translate into employment and output (as in the pre-industrial society). *Actual* production is only activated by *effective* demand, at least when $L < \bar{N}$.

Figure 2 graphically depicts this causal link. Panel (A) shows the *pre-institutional* principle of effective demand: uses $(C+I)$ generate resources (Y).[2] A point of aggregate consumption and investment on the y-axis is mapped through the 45° diagonal to a point of output on the x-axis: this clock-wise direction contrasts with the anti clock-wise direction found in Panel (A) of Figure 1. This is the deep asymmetry — highlighted by Pasinetti (1974) — between industrial and pre-industrial societies, as regards the role of demand in the determination of output (and employment).

Figure 2: An industrial society: from consumption and investment $(C+I)$ to output (Y)



Panel (B) of Figure 2 depicts how aggregate consumption and investment determine output, and corresponds to the traditional textbook presentation of the '*Keynesian* model of income determination' (Dornbusch and Fischer, 1993, p. 55). Besides the 45° diagonal, the consumption ray representing (13) specifies consumption demand per unit of output at *each* income level. A parallel upward shift of the consumption ray by the amount of autonomous investment gives the aggregate expenditure function $(a_l a_c Y + \bar{I})$. The point where aggregate expenditure crosses the 45° diagonal defines the output *actually* produced (point e in Figure 2). Consumption (C) is given by the vertical intersection with the consumption

[2]The idea of graphically representing the principle of effect demand as in Panel (A) of Figure 2 may be found in Pasinetti (1974, p. 32).

ray at that level of income, whereas autonomous investment is visualised as the vertical distance between point e and the point of consumption.

In this society, as long as $L < \bar{N}$, for a given level of productivity ($1/a_l$) and (per-capita) consumption demand (a_c), a higher level of output can only be obtained by increasing autonomous investment, as evinced by (14). The parallel upward shift of the aggregate expenditure function when $\bar{I}$ increases to $\bar{I}'$ makes current output (Y at point e) insufficient to satisfy aggregate demand ($C + I'$). Output will increase to reach point e' in Figure 2. In the *process of adapting* actual production to effective demand, higher levels of income induce higher aggregate consumption — along consumption ray (13) — until output reaches Y' and consumption becomes C'. But this adjustment process depends on behavioural relations about how the economy actually operates.[3] Therefore, the distinction between Panel (A) and Panel (B) in Figure 2 illustrates the difference between the pre-institutional and behavioural layers of analysis.

Within the context of the simple model specified by relations (8)-(12), it has been so far (implicitly) assumed that $L < \bar{N}$, that is, the labour force is not fully employed. Instead, when $L = \bar{N}$, the system (8)-(12) may be inconsistent if the level of investment is autonomous.

Indeed, from (11) when $L = \bar{N}$, output is constrained by the available productive capacity: $\bar{Y} = (1/a_l)\bar{N}$, so that consumption in (9) becomes $a_l a_c \bar{Y}$. Substituting this latter term for C in (8), and solving for I gives:

$$I = (1 - a_l a_c)\bar{Y} \tag{15}$$

that is, investment is determined by full-employment output $\bar{Y}$.[4] Hence, if the autonomous level of investment in (10) is different from that implied by (15), the system becomes inconsistent.

Therefore, while the pre-institutional principle of effective demand remains a basic feature of an industrial economy, it becomes necessary to explore how it is related to the *growth* of productive capacity. Within that context, full utilisation of productive capacity and full employment need not coincide. The combination of the principle of effective demand with the "*derived demand* aspect of investment goods, due to their being used

[3]For example, the 'multiplier' process which may be *derived* from expression (14) can be assumed to operate within the same accounting period ('instantaneously') or with a time lag (Pasinetti, 1974, p. 40).

[4]Note the formal equivalence between investment in the industrial system and the surplus of the pre-industrial system determined in (7).

as means of production" (Pasinetti, 1981, p. 176) allows to single out the conditions for equilibrium growth, from a *pre-institutional* perspective.

4 Equilibrium, full employment and stability

The conceptualisation of (dis)equilibrium and (in)stability in Pasinetti (1981, 1993) may be traced to the problem of determining the condition(s) which *must* be satisfied for the economy to expand at full employment and full capacity utilisation. Pasinetti's point of departure could be thought to be the contributions by Roy Harrod (1939) and Evsey Domar (1946).

However, it is not necessarily apparent how the notions of *warranted* and *natural* growth relate to Pasinetti's own framework. Setting up such a bridge, as well as discussing the dichotomy that Pasinetti identifies between pre-institutional and behavioural relations emerging from the Harrod-Domar model are the aims of this section. This conceptual discussion shall pave the way for the analysis of structural economic dynamics in *industrial* economies.

4.1 The conditions for equilibrium growth

To keep things as simple as possible, reconsider aggregates at constant prices for a closed economy characterised by the same relations (8), (9), (11), (12) as above, but where investment I is no longer autonomous and the labour force N is allowed to vary:

$$Y \equiv C + I \qquad \text{(National Income)} \qquad (16)$$
$$C = a_c L \qquad \text{(Consumption)} \qquad (17)$$
$$I = \kappa \Delta P \qquad \text{(Investment)} \qquad (18)$$
$$L = a_l Y \qquad \text{(Employment)} \qquad (19)$$
$$L \leq N \qquad \text{(Resource constraint)} \qquad (20)$$

Out of the two components of national income in (16), consumption (C) is defined as in (9). Instead, in (18), investment (I) is determined by the *acceleration principle*: κ represents the "value of the capital goods *required for* the production of a unit increment of output" (Harrod, 1939, p. 16, italics added),[5] multiplying the *increase* in productive capacity (ΔP). Finally, employment is determined by the *given* labour input coefficient (a_l) applied to output (Y), that is, by labour demand requirements, and constrained by the size of the labour force N (which is now allowed to grow/decay).

In order to operate with relations (16)-(20), the starting point is to understand the task we are supposed to solve. Following Domar (1946):

> "The economy will be said to be in equilibrium when its productive capacity P equals its national income Y. Our first task is to discover the *conditions under which this equilibrium can be maintained*, or more precisely, the *rate of growth* at which the economy *must* expand in order to remain in a continuous state of full employment"
> (Domar, 1946, p. 146, italics added)

Assume, first, that the economy is currently in an equilibrium. That is, income equals productive capacity ($Y = P$) and the labour force is fully employed ($L = N$). Therefore, (17) and (19) become, respectively:

$$C = a_c N \qquad \text{(Consumption)} \tag{21}$$

$$N = a_l Y \qquad \text{(Labour force)} \tag{22}$$

To find the growth rate at which the economy *must* expand to *maintain* this initial equilibrium, introduce (22) into (21) (obtaining $C = a_l a_c Y$), replace this expression for C in (16), and solve for Y:[6]

$$Y = \frac{1}{1 - a_l a_c} \cdot I \tag{23}$$

Moreover, if coefficients a_c and a_l are fixed, then:

$$\Delta Y = \frac{1}{1 - a_l a_c} \cdot \Delta I \tag{24}$$

Dividing each side of (24) by the corresponding side of (18), gives:

$$\frac{\Delta Y}{\Delta P} \cdot \frac{1}{\kappa} = \frac{1}{1 - a_l a_c} \cdot \frac{\Delta I}{I}$$

[5] Assuming infinitely durable fixed capital, it represents a ratio between new investment and the increase in *capacity* output (Domar, 1946, p. 140). Moreover, it is implicitly assumed that "all new capital goods are required for the sake of the increment of output of consumers' goods" (Harrod, 1939, p. 17).

[6] We assume that $a_l a_c < 1$, that is, the labour requirement to reproduce per-capita consumption is lower than 1, which means that the available labour in the economy is not entirely used up to reproduce aggregate consumption.

from where we see that the growth rate of new investment is given by:

$$\frac{\Delta I}{I} = \frac{\Delta Y}{\Delta P} \cdot \frac{1 - a_l a_c}{\kappa} \tag{25}$$

Investment will grow in *equilibrium* when the *change* in productive capacity coincides with that of income, that is, when $\Delta Y = \Delta P$. Therefore, from (25), the equilibrium growth rate of investment will be g_w:

$$g_w = \frac{1 - a_l a_c}{\kappa} \tag{26}$$

which corresponds to the *warranted* growth rate in Harrod (1939, p. 17). Note that, from (23) and given that coefficients a_c and a_l are fixed, income and investment are tied by a constant proportionality relationship. Therefore, for equilibrium to be maintained, g_w is also the equilibrium growth rate of Y.

However, from (22) — as a_l is not changing — the expansion in income should coincide with that of the labour force:[7]

$$\frac{\Delta Y}{Y} = \frac{\Delta N}{N} = g_n \tag{27}$$

which corresponds to the *natural* growth rate in Harrod (1939), when labour productivity $(1/a_l)$ is constant. It represents an upper bound, the "maximum sustainable rate of growth that technical conditions make viable to the economic system as a whole" (Pasinetti, 1974, p. 96).

Therefore, if equilibrium is characterised by an expansion of productive capacity *pari passu* that of effective demand $(\Delta P = \Delta Y)$ — given by g_w — which also allows for a 'continuous state of full employment' — given by g_n — the consistency relation to be satisfied is:

$$g_n = \frac{1 - a_l a_c}{\kappa} \tag{28}$$

which solves the task we had set, and corresponds to *a* 'Golden Age' dynamics (Cozzi, 1969, p. 12). It is important to emphasise that (28) is conceived as a relation between (given) magnitudes, rather than as a rule for determining *any* of the variables involved in the expression.

[7]For a given a_l, we have: $\Delta N = a_l \Delta Y$, so that $\Delta N/N = a_l \Delta Y/N = \Delta Y/Y$.

Interestingly, from (23) and (28), equilibrium investment must satisfy:

$$I = \kappa g_n Y \tag{29}$$

which can be inserted into (16) for I, together with (21) in the place of C, and solving for Y, we have:

$$Y = (1 - \kappa g_n)^{-1} a_c N \tag{30}$$

Pre-multiplying both sides of (30) by the labour input coefficient a_l and considering (22):

$$N = a_l Y = a_l (1 - \kappa g_n)^{-1} a_c N \tag{31}$$

The labour force N vanishes from both sides of (31), obtaining:

$$a_l (1 - \kappa g_n)^{-1} a_c = 1 \tag{32}$$

as a *necessary* condition for equilibrium growth. In (32), the coefficient:

$$\eta(g_n) = a_l (1 - \kappa g_n)^{-1} \tag{33}$$

represents the total — direct and (hyper-)indirect — labour requirements to reproduce a unit of output *when* the economy is expanding at the natural growth rate g_n (Pasinetti, 1977, p. 196).[8] Therefore, condition (32) may be compactly expressed as:

$$\eta(g_n) \cdot a_c = 1 \tag{35}$$

A condition analogous to (35), within the context of a multisectoral economy, represents a cornerstone of Pasinetti's approach to the concept of equilibrium (see, e.g. Pasinetti, 1981, pp. 46-8). When (35) holds, the economy is in an *equilibrium situation*: the expansion of productive capacity is matched by the growth of effective demand ($\Delta P = \Delta Y$) and the

[8]This may be seen by developing the terms in the left-hand side of (33):

$$a_l \cdot (1 - \kappa g_n)^{-1} = a_l \cdot [1 + \kappa g_n + (\kappa g_n)^2 + \ldots] = a_l + a_l \cdot \kappa g_n + a_l(\kappa g_n) \cdot (\kappa g_n) + \ldots \tag{34}$$

The first term of this infinite series, a_l, measures the direct labour required to produce a unit of output, the second term, $a_l \cdot \kappa g_n$ measures the labour required to produce the new investment goods that support the expansion of output, the third term measures the labour required to produce the new investment goods supporting the additional requirements of new investment, and so on for terms of higher order. From (28), $\kappa g_n = 1 - a_l a_c$, thus, given the assumption that $a_l a_c < 1$, the infinite series is convergent.

labour force is fully employed.

It is important to note the equivalence between conditions (28) and (35), especially when considering a *disequilibrium* situation. For example, if the actual growth rate of income is $\bar{g}$ such that $\eta(\bar{g}) \cdot a_c < 1$, then:

$$\eta(\bar{g}) \cdot a_c < 1 \qquad \text{if and only if} \qquad \bar{g} < \frac{1 - a_l a_c}{\kappa} = g_n \tag{36}$$

that is, the economy is growing *below* the full-employment growth rate, while also $\Delta Y < \Delta P$, so that the increase in effective demand falls short of the *required* increase in productive capacity.[9] A similar analysis could be done for the case where $\eta(\bar{g}) \cdot a_c > 1$.[10]

4.2 Pre-institutional and behavioural relations in Harrod and Domar

The derivation of the warranted growth rate — g_w in (26) — *formally* differs with respect to the routes taken by Harrod and Domar.

Consider Harrod first. His 'fundamental equation' (Harrod, 1939, p. 17), $G_w = s/C$ determines G_w based on the ratio between s, "the fraction of income which individuals and corporate bodies *choose to save*" (Harrod, 1939, p. 16, italics added), and C, "the amount of capital per unit increment of output required by technological *and other conditions* (including the state of confidence, the rate of interest, etc.)" (Harrod, 1939, p. 18, italics added).

For Harrod, "the *sum of decisions* to produce [...] are on balance justified [when κ in (18) equals the] increment in the stock of capital divided by the increment in total output which *actually occurs*" (Harrod, 1939, p. 18, italics added). That is, warranted growth obtains when κ coincides with its *ex-post*, realised counterpart $I/\Delta Y$.

The mechanism advanced by Harrod is deeply embedded in *behavioural* relations. The propensity to save s has been *chosen*, coefficient C reflects the technique in use, but also the *state of confidence*. The matching between *ex-post* investment and planned capacity expansion occurs for "that addition to capital goods in any period, which *producers regard as ideally*

[9] The result in (36) can be obtained by noting that $\eta(\bar{g}) \cdot a_c = a_l(1 - \kappa\bar{g})^{-1} a_c < 1$ and, solving for $\bar{g}$ throughout the series of inequalities: $(1 - \kappa\bar{g})^{-1} < (a_l a_c)^{-1}$ so that $\kappa\bar{g} < 1 - a_l a_c$, obtaining $\bar{g} < (1 - a_l a_c)/\kappa = g_n$. Moreover, from (25), note that $\bar{g}/g_n = (\Delta I/I)/[(1 - a_l a_c)/\kappa] = \Delta Y/\Delta P < 1$.

[10] Such a case would lead to inflationary pressures, as described in Pasinetti (1981, p. 48).

suited to the output which they are undertaking in that period" (Harrod, 1939, p. 19, italics added). Thus, rather than *full* capacity utilisation, it is an expansion rate that fulfils effective demand *expectations*.

The case of Domar is different. While he relies on the 'multiplier theory' to determine changes in income, his methodological standpoint is closer to a pre-institutional layer of analysis. To begin with, Domar acknowledges "the difficulties of determining productive capacity, both conceptually and statistically" (Domar, 1947, p. 37), that is, his framework was conceived in terms of magnitudes that should be *measurable*. Moreover, his interpretation of g_w in (26) is that it represents the (constant) compound rate at which investment is *required* to grow *to maintain* equilibrium (Domar, 1946, p. 141). In fact, Domar's analysis is carried out "at a pure level of logical consistency" (Pasinetti, 1974, p. 95).

In contrast, Harrod aims to use the divergence between g_w in (26) and g_n in (27) to understand where the *actual* (average) growth rate $\bar{g}$ of a *capitalist* economy might be. This implies studying which *forces* or *adjustment mechanisms* are operating in the economy, capable of closing the divergence between g_w and g_n, and making $\bar{g}$ approach this growth *norm*. The analysis of such adjustment mechanisms allows to define the *stability* properties of an equilibrium configuration, and it is inherently based on behavioural relations. For example, it depends on "particular assumptions on how entrepreneurs react to divergence of reality from expectations" (Pasinetti, 1974, p. 97). Indeed, Harrod (1939) concluded on the 'inherent instability' of his warranted growth path.

While the Harrodian *warranted* growth rate is based on behavioural relations, his *natural* growth rate is pre-institutional: it is a *constraint* on the system, given by technological possibilities. In his framework of structural dynamics, Pasinetti (1981, 1993) followed Domar's approach, but incorporated the Harrodian concept of *natural* growth to carry out a *pre-institutional* analysis of the (changing) compositional structure of industrial economies.

Based on this depiction, it might seem that the pre-institutional layer of analysis has little to say about (in)stability. However, while the study of actual adjustment mechanisms may provide a guidance to explain where the capitalist economy is going, a pre-institutional analysis may conclude on the practical impossibility of an equilibrium position being reached, making disequilibrium the *normal* state of industrial economies. Thus, rather than finding explanations as to why the economy is *not* returning to an equilibrium path, the focus might be defining a *normative* configuration towards which the system could be taken.

5 Structural dynamics and effective demand in industrial economies

Pasinetti's framework of structural economic dynamics has been specified and discussed at length in Pasinetti (1965a, 1981, 1993), and further developed and generalised by Garbellini (2010). Thus, the aim of this section is to highlight some logical implications of Pasinetti's analytical scheme as regards the increasing difficulty to achieve and maintain full employment. These observations will be based on the building-blocks developed so far: the pre-institutional analysis of industrial economies, the principle of effective demand, and the conceptualisation of (dis)equilibrium.

Pasinetti's framework provides a *multisectoral foundation* for the principle of effective demand, so the economy considered is characterised by $n-1$ commodities for final uses (each indexed by i), produced by means of capital goods and labour. The aim is to single out the conditions that *ought to* be satisfied *if* full capacity utilisation and full employment are to be maintained.

To keep the presentation as simple as possible, but at the same time be able to relate this scheme to relations (16)-(20) defined above, we assume an infinite lifespan for fixed capital goods, so that gross investment consists entirely of (capacity-generating) *new* investments. The *quantity side* of the system may be described by the following relations:

$$Y(t) \equiv \sum_{i=1}^{n-1} p_i(t)C_i(t) + p_{k_i}(t)J_i(t) \qquad \text{(National Income)} \qquad (37)$$

$$C_i(t) = a_{in}(t)N(t), \qquad \text{for } i = 1, \ldots, n-1 \qquad \text{(Consumption)} \qquad (38)$$

$$J_i(t) = \dot{C}_i(t), \qquad \text{for } i = 1, \ldots, n-1 \qquad \text{(Investment)} \qquad (39)$$

$$N(t) = \sum_{i=1}^{n-1} a_{ni}(t)C_i(t) + a_{nk_i}(t)J_i(t) \qquad \text{(Labour Force)} \qquad (40)$$

The components of (nominal) national income $Y(t)$ in (37) are the sum across sectors of nominal final consumption and nominal gross investment. As in (21), output for consumption of commodity i ($C_i(t)$) in (38) is given by the (per-capita) demand coefficient ($a_{in}(t)$) multiplying the size of the labour force ($N(t)$).

In (39), $J_i(t)$ represents the current output of capital goods used to produce final consumption good i, *measured* in units of productive capacity for that sector.[11] As in (18), equation (39) is based on an acceleration principle, but in this case the current output of capital goods is required to match the change in levels of *final consumption*.[12] It is crucial to note that the change in $C_i(t)$ also represents the *required* change in the *number* of units of productive capacity to support its production. Therefore, equation (39) represents a necessary condition for full-capacity utilisation in sector i.

Finally, (40) states that the (aggregate) labour force $N(t)$ should match the sum across sectors of the labour content of output for consumption and investment: $a_{ni}(t)$ is the coefficient of labour requirements per unit of output for consumption in sector i, whereas $a_{nk_i}(t)$ is the coefficient of labour requirements per unit of output for investment in sector i.

To understand the relevance and implications of a *multisectoral* scheme with respect to an *aggregate* one, we first consider the case of uniform growth at natural rate g_n, already discussed in section 4.

When the labour force — given at time $t = 0$ by $\bar{N}(0)$ — expands at steady rate g_n:[13]

$$N(t) = \bar{N}(0)e^{g_n t} \tag{41}$$

$$\dot{N}(t) = g_n N(t) \tag{42}$$

relations (38)-(40) become:

[11] See Pasinetti (1981, p. 36) for a discussion of the meaning of measuring capital goods in terms of (vertically integrated) productive capacity.

[12] For any variable X, we write $\dot{X} = \frac{d}{dt}(X)$ to indicate the time derivative of X.

[13] Note that (42) is obtained by taking the time derivative of expression (41):

$$\dot{N}(t) = \frac{d}{dt}(\bar{N}(0)e^{g_n t}) = g_n\bar{N}(0)e^{g_n t} = g_n N(t)$$

And this procedure may be applied to all variables changing at steady growth rates.

$$C_i(t) = a_{in}(t)\bar{N}(0)e^{g_n t}, \qquad \text{for } i = 1, \ldots, n-1 \tag{43}$$

$$J_i(t) = \dot{C}_i(t), \qquad \text{for } i = 1, \ldots, n-1 \tag{44}$$

$$\sum_{i=1}^{n-1} a_{ni}(t)C_i(t) + a_{nk_i}(t)J_i(t) = \bar{N}(0)e^{g_n t} \tag{45}$$

As recognised by Cozzi (1969, p. 28), for given technical ($a_{ni}(t)$, $a_{nk_i}(t)$) and (per-capita) consumption demand ($a_{in}(t)$) coefficients, equation system (43)-(45) is *overdetermined*: there are $2 \times (n-1)$ unknowns — $C_i(t), J_i(t)$ for $i = 1, \ldots, n-1$ — and $2 \times (n-1) + 1$ equations. Therefore, full utilisation of *sectoral* productive capacities (given by necessary conditions (44)) and full employment (implied by (45)) may only be mutually compatible by a *fluke*.

There are (at least) two equally valid ways out of this *impasse*.

On the one hand, *if* full capacity utilisation and full employment are to be verified, then one of the *determinants* in (43)-(45) has to be *endogenously* determined, in order to make all equations mutually compatible. Amongst these determinants, it is plausible to think that *one* of the (per-capita) consumption coefficients, $a_{in}(t)$, may adjust so that (45) holds. For example, by choosing $a_{jn}(t)$, we would have:

$$a^*_{jn}(t) = \frac{1 - \sum_{i=1, i \neq j}^{n-1} [a_{ni}(t) + g_n a_{nk_i}(t)] \cdot a_{in}(t)}{a_{nj}(t) + g_n a_{nk_j}(t)} \tag{46}$$

that is, (per-capita) consumption coefficient $a^*_{jn}(t)$ is determined by all other *given* coefficients and ensures that all equations in (43)-(45) hold.

The intuition behind this solution may be seen clearly if — as in Pasinetti (1981, p. 38) — equation system (43)-(45) was articulated into a closed Input-Output model (Leontief, 1937). Even when one degree of freedom has been granted (by taking the labour force at any time t as given), the structural matrix of the system cannot be of full rank (n), so one of the columns (or rows) needs to be linearly dependent. This implies that (at least) one of the technical or consumption coefficients becomes endogenous, in order to obtain a non-trivial solution that complies with the full employment condition (45). As sharply observed by Leontief:

> "Unless it is assumed that the values of all the coefficients are subject

> to some unknown law of prestabilized harmony, this requirement [equivalent to equation (45)] indicates that at least one of them is not a genuine independent datum but rather a variable which adjusts itself to the values of all the other parameters so as to satisfy the aforementioned consistency condition. [...] No economic system could possibly exist in which all the technical and consumption coefficients were independent of one another" (Leontief, 1951, p. 47)

Thus, from an economic perspective, when the technical conditions (represented by labour input coefficients $a_{ni}(t)$, $a_{nk_i}(t)$) are given, it must be the *structure* (and level) of (per-capita) consumption demand that adjusts to reach full employment.

On the other hand, *if* all technical and (per-capita) consumption coefficients *are* taken as *given*, due to the mathematical form of equation system (43)-(45), it is possible to obtain *meaningful* solutions for consumption in (38) and investment in (39), which do *not* comply with full employment condition (45) (Pasinetti, 1993, pp. 22-23).

Therefore, if an *equilibrium* situation is characterised by the simultaneous fulfilment of (43)-(45), whilst meaningful solutions may be obtained even when (45) does not hold, *disequilibrium* will be the normal state of *actual* industrial economies *when* all structural coefficients are taken as given.

However, the case of balanced growth considered so far conveys a notion of growth *without* development (Pasinetti, 1987, p. 993). In order to understand the deeper implications of the process of structural dynamics unfolding in an industrial economy, technical and (per-capita) consumption coefficients in each sector i are allowed to change at given, steady but *uneven* rates:[14]

$$a_{in}(t) = a_{in}(0)e^{r_i t} \qquad \text{(Consumption coefficient)} \tag{47}$$

$$a_{ni}(t) = a_{ni}(0)e^{-\rho_i t} \qquad \text{(Technical coefficient for consumption)} \tag{48}$$

$$a_{nk_i}(t) = a_{nk_i}(0)e^{-\rho_{k_i} t} \qquad \text{(Technical coefficient for investment)} \tag{49}$$

[14]The assumption of steady rates of change is introduced to simplify the presentation. See the detailed discussion in Pasinetti (1981, pp. 81-83).

with time derivatives given by:

$$\dot{a}_{in}(t) = r_i a_{in}(t) \tag{50}$$

$$\dot{a}_{ni}(t) = -\rho_i a_{ni}(t) \tag{51}$$

$$\dot{a}_{nk_i}(t) = -\rho_{k_i} a_{nk_i}(t) \tag{52}$$

that is, r_i is the rate of change of (per-capita) consumption coefficient for commodity i, ρ_i is the rate of change of productivity in the production of final commodity i, and ρ_{k_i} is the rate of change of productivity in the production of productive capacity for consumption commodity i.

Assume we start from an equilibrium situation under uniform growth at rate g_n. How will equation system (43)-(45) change as we incorporate dynamic movements (47)-(49)?

Noting that $J_i(t) = \dot{C}_i(t) = \dot{a}_{in}(t)N(t) + a_{in}(t)\dot{N}(t)$, using (42) and (50), new investment in (44) becomes:

$$J_i(t) = \dot{C}_i(t) = (g_n + r_i)a_{in}(t)N(t) \tag{53}$$

Therefore, introducing (53) into (45), recalling (38) and (41), and rearranging terms, condition (45) becomes:

$$\sum_{i=1}^{n-1}[a_{ni}(t) + (g_n + r_i)a_{nk_i}(t)] \cdot a_{in}(t) = 1 \tag{54}$$

where the term in square brackets in (54):

$$\eta_i(t, g_n + r_i) = a_{ni}(t) + (g_n + r_i)a_{nk_i}(t) \tag{55}$$

captures the total — direct and (hyper-)indirect — labour required to reproduce a unit of commodity i and produce "those means of production that are strictly necessary to expand such a circular process at a rate of growth $[(g_n + r_i)]$" (Pasinetti, 1988, p. 127). It is labelled 'vertically hyper-integrated labour coefficient' for commodity i (Pasinetti, 1981, p. 102), and is a (simplified) multisectoral counterpart to expression (33) in section 4 above.[15]

Note that, even though $\eta_i(t, g_n + r_i)$ is a *technical* coefficient, it depends on the rate of change of final consumption commodity i $(g_n + r_i)$ — via

[15]The full generalisation of the concept of hyper-integrated labour requirements may be found in Pasinetti (1988, 1989).

the investment relation (53). Thus, in an economy undergoing structural dynamics, $\eta_i(t, g_n + r_i)$ logically implies the impossibility to fully separate growth from (hyper-integrated) productivity (and its rate of change).[16]

Introducing (55) into (54) gives:

$$\sum_{i=1}^{n-1} \eta_i(t, g_n + r_i) \cdot a_{in}(t) = 1 \tag{56}$$

that is, a multisectoral counterpart to condition (35) in section 4 above. Also in this case, (56) represents a *necessary* condition for the system to be in an *equilibrium situation*: a configuration of full capacity utilisation *and* full employment.

Condition (56) has been labelled the *effective demand* macroeconomic condition for equilibrium growth (Pasinetti, 1981, p. 86). It captures two key features of Pasinetti's framework.

First, it specifies the level *and* sectoral composition of (per-capita) consumption demand which should be achieved to maintain full employment. As such, it represents an application of the (pre-institutional) principle of effective demand discussed in section 3 above: in order to activate the full-employment level of outputs, there must be adequate *effective* final demand. In this sense, unless we *assume* an adjustment similar to (46), condition (56) will, most probably, *not* hold in actual industrial economies. Note also how the dependence of each sectoral (hyper-integrated) productivity coefficient (55) on the corresponding (commodity-specific) growth rate of *consumption* demand $(g_n + r_i)$ reinforces this conclusion.

Second, condition (56) states that the sum across sectors of the *shares* of labour force employed in each sector must add up to one. Each term $\eta_i(t)a_{in}(t)$ represents the comprehensive labour content of the units of (per-capita) consumption effectively produced in the system. As such, it allows to study the *structural* dynamics of employment, *even when* full employment is maintained at the aggregate level:

$$\frac{d}{dt}\left(\sum_{i=1}^{n-1} \eta_i(t)a_{in}(t)\right) = \frac{d}{dt}(1)$$

[16] See Garbellini (2010, pp. 105-8) for a detailed discussion.

which amounts to obtaining:

$$\sum_{i=1}^{n-1} \dot{\eta}_i(t) a_{in}(t) + \eta_i(t) \dot{a}_{in}(t) = 0 \tag{57}$$

From (55), we have:

$$\dot{\eta}_i(t) = \dot{a}_{ni}(t) + (g_n + r_i)\dot{a}_{nk_i}(t) \tag{58}$$

Therefore, using (51) and (52), and dividing by $\eta_i(t)$, we obtain:

$$\frac{\dot{\eta}_i(t)}{\eta_i(t)} = -\rho_i \cdot \frac{a_{ni}(t)}{\eta_i(t)} + (-\rho_{k_i}) \cdot \frac{(g_n + r_i)a_{nk_i}(t)}{\eta_i(t)} = -\rho_i^{'} \tag{59}$$

that is, the rate of hyper-integrated productivity change $\rho_i^{'}$ in (59) is a weighted average of the rates of productivity change for final consumption commodity i (ρ_i) and for supporting its capacity expansion (ρ_{k_i}).

Introducing (50) and $\dot{\eta}_i(t) = -\rho_i^{'}\eta_i(t)$ — from (59) — into (57), we may rearrange terms to finally obtain:

$$\sum_{i=1}^{n-1} (r_i - \rho_i^{'}) \cdot \eta_i(t) a_{in}(t) = 0 \tag{60}$$

that is, the share of employment in (hyper-integrated) sector i, $\eta_i(t)a_{in}(t)$, will increase (decrease) when per-capita consumption demand is expanding faster (slower) than productivity, so that $r_i - \rho_i^{'} > 0$ ($r_i - \rho_i^{'} < 0$). Thus:

> "even if we start from the hypothesis that total full employment is in some way maintained over time [...] the maintenance of full employment at a global level requires a continuous process of re-proportioning of employment at the sectoral level"
> (Pasinetti, 1993, p. 51)

Therefore, the interplay between the structure of demand and productivity has far-reaching implications for *technological unemployment* in actual industrial economies: the fast pace of technological progress reflected in high values of $\rho_i^{'}$ needs to be counteracted by corresponding increases in r_i, if (56) is to be maintained.

But *can* (56) be maintained through time? In *exact* terms, it simply *cannot*. In fact, introducing (48) and (49) into (55), recalling (47), and using these expressions in (56), it is possible to obtain:

$$\sum_{i=1}^{n-1} a_{ni}(0)a_{in}(0)e^{(r_i-\rho_i)t} + (g_n + r_i)a_{nk_i}(0)a_{in}(0)e^{(r_i-\rho_{k_i})t} = 1 \qquad (61)$$

Formulation (61) for effective demand condition (56) implies that a sum of exponential functions (on the left-hand side) must be equal to a constant (on the right-hand side). As shown by Cozzi (1969, p. 45), this may only occur if (and only if) *all* exponents in *each* function are equal to zero. That is, when $r_i = \rho_i = \rho_{k_i}$ for $i = 1, \ldots, n-1$. In economic terms, when there are *no* structural dynamics of employment. Thus, an *equilibrium* situation is impossible to be maintained over time in *exact* terms. And if achieved at some point, it will be highly *unstable*, given the pervasive structural dynamics of consumption and technology.

Thus, disequilibrium and instability, rather than equilibrium, is the *normal* state of *actual* industrial economies. However, this does not preclude the possibility of condition (56) being *approximately* satisfied in a dynamic context:

> "As a starting point, it is necessary to define what might be called a 'satisfactory' state of economic growth. It seems reasonable to consider as 'satisfactory' a state of economic growth in which the evolution of the economic system is taking place by maintaining both an *approximately* full employment of the labour force and an *approximately* full utilization of the productive capacities in the various branches of the economy. If this definition is accepted, then some *constraints* are immediately imposed on the growth of the economic system"
> (Pasinetti and Scazzieri, 1987, p. 527, italics added)

Therefore, rather than seeking explanations as to why the economy does not return to its equilibrium path, it may be more fruitful to empirically implement computable *norms* — such as (56) and (60) — in order to quantify how far (or close) actual economies are from them, providing a *compass* for policy.

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