A bridge over troubled water: A Structural Political Economy of vertical integration[1]

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In his classic 1973 article, Luigi Pasinetti formalised the algorithm of vertical integration. The algorithm ("logical process") shows the link between representations of industrial interdependencies, originating in Quesnay's *Tableau économique* and systematized by Leontief (1941, 1951), von Neumann (1945-6) and Sraffa (1960) among others, and vertically integrated representations such as those implicit in the classical theory of value, Keynesian macroeconomics and important strands of marginalist economics.[2]

In industrial economies, production is carried out through interdependent processes. For example, agriculture produces corn, which is used in agriculture as seeds and in manufacturing for the subsistence of workers. Manufacture produces steel, which is used in manufacture to make steel and in agriculture in the form of ploughs. The fact that each industry provides inputs for other industries, and acquires the output of other industries as inputs, is what is referred to as industrial (or circular) interdependencies (CI henceforth).

Vertical integration (VI henceforth) is the logical process whereby intermediate commodities are eliminated and attention is concentrated on primary inputs and final commodities. Corn is

[1] The research leading to this article began with the presentation "The political economy of circular interdependencies and vertical integration: Opening the black box of 'national interest'" at the conference *The Economics of Structural Change: A Conference in Honour of Luigi Pasinetti*, 12-13 September 2012, Gonville and Caius College, Cambridge, and the SSRN working paper with the same title (Cardinale, 2012).

[2] The dualism between industrial interdependencies and vertically integrated representations provides a fundamental lens to interpret different traditions in economic analysis (see contributions in Baranzini and Scazzieri, 2012a (1st edn. 1990) and in particular Baranzini and Scazzieri 2012b, 2012c and Landesmann and Scazzieri, 2012; see also Scazzieri 1990, 1996). This paper's focus on vertical integration does not mean to privilege vertically integrated representations over those based on industrial interdependencies, but rather to concentrate on the possibility to switch back and forth between the two representations, which was highlighted by Pasinetti's (1973) formalization.

shown as being produced through an input of labour, which includes agricultural labour as well as the labour used to produce the steel used in agriculture—in other words, all the labour that is used across the economy to eventually produce corn. Something similar holds for means of production: corn is produced through a composite commodity, which includes all the commodities used across all industries to produce corn.

As a result, vertical integration represents the system as a set of final commodities, each produced through an input of (composite) labour and an input of (composite) capital. Industrial interdependencies have disappeared. Or, rather, they have faded to the background, lurking implicit in the vertically integrated coefficients. Pasinetti has argued that this process opens up great possibilities for studying economic dynamics, as it allows preserving a multi-sectoral representation, which is essential for studying non-proportional dynamics, without carrying the analytical burden of inter-industry interdependencies. And, indeed, his work has systematically used vertical integration (Pasinetti, 1981, 1993).

However, here I do not consider the implications of vertical integration for structural dynamics. Rather, I focus on the algorithm of vertical integration in itself—on its being a 'bridge' that allows us to go back and forth between representations of division of labour based on CI and VI. Crossing the bridge, I will argue, one has radically different vistas on production, distribution, and political conflicts. On each side, one sees different forms of conflict (between industries, sectors, classes) and different representations of collective objectives. Taking a further step, it is also worth reflecting on the bridge in itself—the fact that two formally equivalent representations highlight profoundly different views.

This exploration requires revisiting widely held assumptions about economic cleavages and conflicts in society. Recall that in Quesnay's (1972 [1759]) *Tableau*, 'classes' (which we could call industries in modern language) were economic activities as well as socio-political

aggregations. But the socio-political aspect of interdependencies was soon left on the background. Classical Political Economists and then Marx shifted the attention towards conflict between classes defined by income type (wage, profit, rent). The 20th-century 'rediscovery' of industrial interdependencies (Leontief, 1941; von Neumann, 1945-6; Sraffa, 1960), only focused on material and technological aspects; the socio-political dimension remained on the background.

The Structural Political Economy approach (SPE), which informs this article, aims to 'complete' the 20th-century rediscovery of industrial interdependencies. The idea is to use models of structural economic analysis, which provide alternative representations of division of labour, not only to study technological and material relations, but also to investigate possible socio-political aggregations that potentially carry economic interests (e.g. Cardinale 2012, 2015, 2018b; Cardinale and Coffman 2014; Cardinale, Coffman and Scazzieri, 2017; Cardinale and Landesmann, 2017, Cardinale and Scazzieri, 2018). Here it is useful to refer to Truman's (1951) distinction between actual and potential interest groups, where the latter potentially carry interests but do not necessarily organise themselves to influence policy-making. Accordingly, the aggregations suggested by structural representations—be they industries, classes, or VI sectors—can be seen as potential interest groups, which might benefit from specific policies and therefore might (or might not) organise themselves to influence policy.

In the SPE approach, division of labour is seen as potentially guiding the formation of socio-political aggregations within the economy and polity (see Cardinale, Coffman and Scazzieri, 2017). However, in industrial economies division of labour is based on manifold interdependencies; hence, it cannot be seen as univocally determining socio-political aggregations. Rather, models of interdependencies can be seen as providing a set of aggregations that are possible within a given division of labour. For example, the 'capitalists' of a firm might conceive of themselves as belonging to an industry, thus seeing their interest

as aligned with other capitalists (and workers) therein against the interests of other industries. Alternatively, they might see themselves as allied with all capitalists, and in conflict with all workers, across industries. And so forth.

It is well known that the social dimension of division of labour has been explored in sociology at least since Durkheim's (1902) study of whether increasing division of labour is compatible with "social solidarity", and the subsequent work of Ross (1938), Simmel (1955 [1922]) and Coser (1956) on the conditions under which conflicts between groups lead to social cohesion. In political science, similar themes have been addressed by research on political cleavages (Lijphart, 1968; Rae and Taylor, 1970) and on how industrial structure shapes countries' political configuration (e.g. Ferguson, 1995; Ferguson et al., 2018). The SPE approach is compatible with these traditions. However, its explicit use of models of structural economic analysis has important advantages, because it makes it possible to explore the socio-political implications of different representations of division of labour (e.g. CI vs. VI) and of fundamental results in structural economic analysis (such as the VI algorithm and the viability conditions of different models). It thus becomes possible to gain new insights, such as the possibility that 'systemic interest' in the preservation of the system, which derives from productive interdependencies, lead to changes in actors' particular interests and policy stances.

1. Vertical integration and circular interdependencies: formally equivalent, substantively different

1.1 Circular interdependencies (CI)

Whilst the idea of interdependencies among aggregations that have both economic and socio-political nature dates back at least to writers in the 'political arithmetik' tradition (e.g.

Davenant, 1698; Petty, 1663; King, 1696; see Coffman 2013; Cardinale and Coffman 2014), François Quesnay's (1759 [1972]) *Tableau économique* arguably provided the first formalization of circular interdependencies, describing the circulation of commodities and money between industries that were seen as economic activities as well as socio-political aggregations. 20th-century models of industrial interdependencies (von Neumann, 1945; Sraffa, 1960; Leontief, 1941, 1951) can be seen as being directly inspired by Quesnay.

But not all CI models are created equal. Take, for example, the representations adopted by Leontief and Sraffa.[3] Equation (1) shows the price system of a Leontief open system.

$$[p_1 \quad \dots \quad p_{n-1}] \begin{bmatrix} (1-a_{11}) & \cdots & -a_{1,n-1} \\ \vdots & \ddots & \vdots \\ -a_{n-1,1} & \cdots & (1-a_{n-1,n-1}) \end{bmatrix} = [\bar{V}_1 \quad \dots \quad \bar{V}_{n-1}]$$

(Adapted from Pasinetti, 1977: 61)

Where p_i are prices, a_{ij} are inter-industry coefficients, and V_i indicate the value added in each industry. For example, the value added of industry 1 equals the price of good 1 minus the prices of all the inputs (from 1 to n-1), weighed according to the proportion by which they are used in the production of good 1. Crucially, there is no determination of (*no assumption about*) how value added is distributed between types of income (Leontief, 1951; Pasinetti, 1977: 55, 61). Value added is basically an "all inclusive income" that will have to be divided between "wages, salaries, profit, and rents" (Pasinetti, 1977: 55).

The price system of the Leontief open system is often thought to have no important practical application (see Pasinetti 1977: 73). But from a SPE perspective, there could be a crucial one. In fact, equation (1) induces us to see that each industry receives a value added V_i, which is

[3] To make notation uniform across the two models, I will follow the formulation provided by Pasinetti (1977).

then distributed among income types *within the industry*. Moreover, the equation shows the labour and capital employed in each industry. Since there are no conditions imposing that they be remunerated uniformly across industries, this model leaves open the possibility that remuneration differs.[4] Hence, we are made aware of the possibility of conflict *between industries (and, potentially, between classes within each industry).* This is fully compatible with the analysis of Steenge and Van den Berg (2001). In fact, starting from Isnard's (1781) reading and generalization of Quesnay's *Tableau*, they show that, within a range compatible with the viability of the system, each combination of prices corresponds to a different distribution of surplus across industries. This has crucial implications from an SPE perspective, which will be discussed in the next section.

Sraffa follows a different route. So long as the economy is stationary, there is no net product to be distributed and hence no need for assumptions about distribution. In fact, no such assumptions are made in Chapter 1 of *Production of Commodities by Means of Commodities* (Sraffa, 1960). However, when turning to consider an economy with surplus, in Chapter 2, Sraffa immediately makes the assumption that the unitary wage and the rate of profit are uniform.

$$\begin{cases} (a_{11}p_1 + \cdots + a_{n-1,1}p_{n-1})(1+\pi) + a_{n1}w = p_1 \\ \vdots \\ (a_{1,n-1}p_1 + \cdots + a_{n-1,n-1}p_{n-1})(1+\pi) + a_{n,n-1}w = p_{n-1} \end{cases}$$

(From Pasinetti, 1977: 73)

In equation (2), we can see that the price of good 1 is made of the costs of inputs, remunerated at the rate of profit π, and the cost of labour, remunerated at wage *w*. In other words, surplus is

[4] Steedman (2000) argues that Leontief ends up assuming homogenous labour, or at least exogenously given relative wage rates. What matters for our purposes is that the Leontief open system does not impose conditions whereby labour should be remunerated equally across industries (even if it was homogenous).

divided between homogenous labour and capital. Crucially, we can *see* the labour employed in the corn industry and that employed in the steel industry. But since by assumption they are remunerated at the same rate (w), we are forced to see those inputs of labour as part of the same homogenous 'pool'. The same holds for capital: we can see the capital used in each industry, but since it is remunerated at homogenous rate π, we are led to see it as a homogenous pool across industries. And this leads to conceive of labour and capital as socio-political aggregations. So the cleavage in society is inevitably between labour and capital, irrespective of the industries in which they are deployed. We see the industries, but we cannot see them as socio-political aggregations.

Therefore, whilst the Leontief model leaves considerable freedom as to how value added is distributed across industries and types of income within them, in the Sraffa system we lose the possibility that value added is shifted across industries: conflict can only be between classes.[5]

1.2 Vertically integrated sectors (VI)

I have explained the intuitive meaning of vertical integration at the beginning of the article. In more formal terms, vertical integration can be expressed through a linear transformation of coefficients of use of intermediate commodities and labour into (i) a vertically integrated labour coefficient, which "expresses in a consolidated way the quantity of labour directly and indirectly required in the whole economic system to obtain one physical unit of [a given] commodity […] as a final good" (Pasinetti, 1973: 6); and (ii) a unit of vertically integrated

[5] The intellectual and socio-political context in which Leontief and Sraffa developed their models might help explain some of the differences discussed above. In fact, whilst both authors share a grounding in the theory of the circular flow (Leontief, 1991 [1928]; Sraffa, 1960), Leontief developed that approach for empirical purposes, whereas Sraffa was concerned with production prices in the Ricardian and Marxian traditions. However, this article aims to rationally reconstruct the representations' implications for socio-political analysis, rather than analyse their origin. The latter would nonetheless be an interesting direction for further research. See also footnote 8.

productive capacity, which "expresses in a consolidated way the series of heterogeneous physical quantities of commodities […], which are directly and indirectly required as stocks, in the whole economic system, in order to obtain one physical unit of [a given] commodity as a final good" (ibid.). As a result, each final commodity can be represented as the result of an input of a (consolidated) quantity of labour and a (consolidated) quantity of capital goods. For example, corn is produced by a consolidated input of labour across industries and a consolidated input of commodities (both corn and steel) across industries.

Equation (3) shows how VI labour coefficients depend on CI coefficients. Something analogous holds for vertically integrated units of productive capacity.

$$\begin{bmatrix} v_1 \\ \vdots \\ v_{n-1} \end{bmatrix} = \left\{ \begin{bmatrix} (1-a_{11}) & \cdots & -a_{1,n-1} \\ \vdots & \ddots & \vdots \\ -a_{n-1,1} & \cdots & (1-a_{n-1,n-1}) \end{bmatrix}^{-1} \right\}' \begin{bmatrix} a_{n1} \\ \vdots \\ a_{n,n-1} \end{bmatrix}$$

(Adapted from Pasinetti, 1981: 112)

Equation (3) shows that the labour required to produce good 1 is a weighted average of labour in (potentially) all industries. Whilst interdependencies between industries are presupposed, they are not visible. So we can see an input of labour entering the production of a series of commodities and a set of capital goods, variously owned and used across the economy, entering production of the same commodities. Vertically integrated sectors thus appear as 'artificial' constructions that do not point to any (prima-facie) obvious socio-political aggregation. For example, an industry such as agriculture is recognisable as a socio-political aggregation: it is obvious which workers are employed and which commodities are used within the industry, as well to what is produced (corn) and who buys it (other industries and final consumers). The vertically integrated sector that produces corn, in contrast, is an artificial construction of all the

labour and commodities used across the economy to produce the corn used by consumers. It will include a fraction of agricultural workers' labour (the fraction that goes to final demand), a fraction of steel workers' labour (the fraction that produces the steel that is then used in agriculture), etc. Something similar holds of capital inputs. Of course, it is difficult to assign a socio-political correlate to such construction. For example, which steel workers precisely work for the VI sector producing agricultural products?

2. Vertical integration and circular interdependencies: a Structural Political Economy reading

The algorithm of vertical integration allows us to cross the bridge between two representations of the economy that are formally equivalent, yet highlight different features of the economy. Let us now see what socio-political aggregations are suggested by each representation.

2.1 *CI representations: an SPE reading*

CI representations make it possible to visualise the multiplicity of industries as well as their interdependencies. Industries have been shown to often be relevant socio-political aggregations. For example, the relevance of industrial cleavages has been documented for political outcomes at the national level (Ferguson, 1995; Ferguson et al., 2018) as well as supranational policy-making (e.g. Coen 2007, Coen and Richards 2009) and especially for economic development (e.g. Furtado, 1967; Hirschman, 1968; Mamalakis, 1969; O'Donnell, 1977). From an SPE perspective the explicit use of CI models for the purpose of understanding industrial interests has a further advantage: by showing the multiplicity of industries and their interdependencies, these models provide a heuristic to understand conflict as well as the limits within which it must be contained.

Let us start from the Leontief open system. Two interpretations are possible. One, referring to the price system, is about conflicts on prices, which lead to changes in value added across industries. Following Steenge and Van den Berg's (2001) reading of Isnard's generalization of the *Tableau*, one can envision that, within a range of prices compatible with viability of the economy, there could be a conflict over policies leading to changes in prices, corresponding to different distributions of value added across industries. Crucially, prices must remain within a certain range, outside which the distribution of value added would make some industries unable to continue production, thus making the whole system unviable.

The other interpretation, referring to the quantity system, is suggested by the "Hawkins-Simon conditions" for viability (Hawkins and Simon 1949; see also Nikaido 2014; Duchin and Steenge 2007; Steenge 2011). The conditions concern the technology matrix; if they are met, the system can reproduce itself (i.e. reintegrate the means of production utilised at the beginning of the production process) and produce a surplus under a variety of sectoral proportions.

Whilst the two interpretations above might highlight different forms of conflicts and constraints, for example on prices or quantities, they both point to the possibility of conflict between industries: within a range of proportions given by technology, an industry can expand relative to others without making the system unviable. The existence of a range is crucial: if only one proportion were compatible with viability, any deviation would jeopardize the system and hence conflict would not be possible.

The model thus highlights the multiplicity of industries and the possibility of conflict between them. In addition, it makes it possible to see labour and capital not as homogenous pools, but as differentiated across industries. In other words, labour and capital in each industry can be seen as separate socio-political aggregations. In fact, Leontief's lack of assumptions about

distribution of value added leaves room to conceive that workers and capitalists within a sector be allied, if we allow for different remuneration in each sector (i.e. if we do not assume uniformity of wage and profit across industries). Alternatively, workers and capitalists within an industry might be allied against other industries, but also in conflict within the industry. In sum, this models suggests a *conflict between industries (and, potentially, between classes within each industry).*

This analysis suggests that *value added can be taken as an indication of industrial interests, just in the same way as wage or profit are often taken as indications of class interests.* And if a sector is able to retain a higher value added, then all categories of income within that sector might benefit from it, at least in principle. Therefore, the problem here is the *formation* of value added in an industry instead of another—as opposed to distribution of a *given* social product between (homogenous) classes. Industrial proportions are thus not just a technical matter, but can themselves be the object of political conflict.

However, there is a key constraint to the pursuit of an industry's particular interest. Whilst industrial interdependencies allow for conflict between industries, they also require that the system be kept within proportions compatible with viability, thus imposing limits on conflict. We can interpret this as a *systemic interest* in the viability of the system, which balances or limits particular interests (Cardinale 2015, 2017, 2018a). Keeping the system viable is a necessary condition for each industry's pursuit of its own interest—it does not (necessarily) reflect a "normative" commitment to some definition of collective interest (see Cardinale and Coffman, 2014, on the importance of this approach to understand the sustainability of taxation in eighteenth-century Britain). In other words, the political strategy of each industry must reconcile its particular interest with systemic interest. Models of industrial interdependencies thus *allow for conflict but also impose limits on it*.

The concept of systemic interest can help shed new light on trade-offs between collective interests and particular interests. Take, for example, List's (1996 [1827], p. 87) remark that "[canals] and railroads may do great good to a nation, but all waggoners will complain of this improvement. Every new invention has some inconvenience for a number of individuals, and is nevertheless a public blessing". Or take Kuznets' (1971) idea that economic development requires the state to resolve conflicts among interest groups, but it also needs a 'feeling of community' that leads interest groups to sacrifice their particular interests. In both cases, there is a trade-off between particular interests and collective interest, but little indication about how it can be studied.

Systemic interest can help analyse such trade-offs—and it has interesting properties. First, unlike 'national interest', it is not tied to the national level; it can express an interest in the preservation of any system of interdependencies, including for example regional or supranational ones (Cardinale, 2017). Second, systemic interest does not (typically) dictate a specific policy. On the contrary, it specifies a range of proportions: it is a *constraint* on possible outcomes, and is therefore (in principle) compatible with a plurality of policies.

Because systemic interest derives from interdependencies, models that do not take them into account (see Rogowski 1987; Persson and Tabellini 2002) are typically unable to specify potential limits to each industry's pursuit of its own interest. Yet systemic interest can be of great relevance for understanding industries' interest formation and policy stances, as shown for example by Cardinale and Landesmann (2017) with reference to tradable and non-tradable industries in the Eurozone and their conflict around policies affecting the real exchange rate. More broadly, the interplay of particular and systemic interests could help analyse a range of empirical problems characterized by the need to understand the formation of interests as well

as potential changes in policy stances that result from threats to the viability of the system.[6] The interplay of particular and systemic interests could also be explored through models that have extended Leontief's CI approach to new theoretical and empirical problems. For example, CI approaches can be enhanced to take into account scarcity (e.g. Quadrio Curzio, 2009; Steenge, 2015; see also Duchin, 2015).[7] Moreover, new databases have been developed on CI foundations to address emerging economic problems. For example, the World Input-Output Database (WIOD) was developed to account for the increasing fragmentation of production across countries and its effects on productivity and trade (Timmer et al., 2015), whilst the Exiobase database was created to study the environmental impact of production and consumption (Tukker et al., 2013; Wood et al., 2015).[8]

The foregoing argument was developed with reference to the Leontief open system (and extensions thereof). However, not all CI representations are equally conducive to the visualization of industrial conflicts (and systemic interests). For example, in the Sraffa system industries are visible, so that inter-industry conflicts could be visible too, at least in principle. However, the assumptions of uniformity of wage and profit shift attention from conflict between industries to conflict between classes: whilst the contributions of labour to each

[6] This approach may be especially relevant in the case of fragile ecosystems whose preservation is likely to be an important element of systemic interest. For example, the literature on sustainable fisheries that combines input-output and ecological models (e.g. Jin, Hoagland and Dalton, 2003; Bhat and Bhatta, 2006) has estimated effects of different types of regulation (e.g. open-access harvesting vs. access restrictions) on different segments of the industry and on other industries (Bhat and Bhatta 2006). An SPE analysis of such results might explore particular interests towards different forms of regulation (e.g. cleavages depending on the techniques adopted by different firms within the industry) as well as the systemic interests in keeping the ecosystem viable, on the part of different segments of the industry and other industries (see e.g. Jin et al.'s (2013) estimated costs of habitat destruction for the economy as a whole). These considerations about balancing particular and systemic interests can also be important for analyzing the EU Common Fisheries Policy (see Carpi et al., 2017) and informing further developments thereof.

[7] The interplay of scarcities and rents in structural dynamics has been studied extensively by Quadrio Curzio (1967, 1986, 2009; see also Quadrio Curzio and Pellizzari, 1999, 2018) by combining CI and VI features. That line of research might therefore prove particularly suitable for an SPE analysis along the lines pursued in this paper (see also Cardinale, 2015; Scazzieri, Baranzini and Rotondi, 2015).

[8] A different perspective, not taken in this paper but worthy of further investigation, would be to consider how the development of the initial CI models was influenced by the perception of specific economic problems, and similarly how more recent models might reflect new perceived problems. See also footnote 5.

industry is visible, it is remunerated at the same rate across industries, so that it appears as a uniform block in the economy. This is reinforced by the well-known result that, in the standard system, distribution can be seen as independent of prices and displays a trade-off between profit and wage, which leads to taking division of labour (the system of interdependencies) as a simply technical (not political) factor. In other words, the *formation* of surplus is a technical matter; the political aspect only lies in the distribution of a *given* surplus between classes.

2.2 VI representations: an SPE reading

Whilst industries, as highlighted by CI models, have been shown to often correspond to significant socio-political aggregations, it is not obvious whether the same holds for VI sectors. In fact, VI sectors are combinations of industries that are broken down and recomposed according to a logical criterion that hardly corresponds, at least prima facie, to any socio-political aggregation. In Truman's (1951) terms, one can conjecture that it would be difficult for such 'potential' interest groups to organise themselves into 'actual' interest groups. What kind of socio-political aggregations does VI suggest? This is of course open to interpretation, but three possibilities seem particularly relevant.[9]

The first is the economic system as a whole. In fact, because VI coefficients are linear combinations of inter-industry coefficients, every final commodity is obtained going through stages of production that involve many industries. This amounts to the view that the economy as a whole produces a set of final commodities. In fact, the contribution of individual industries is not visible: *the whole system* produces final commodities. In other words, whilst a VI

[9] The analysis below follows Pasinetti's (1981) vertically integrated model; the resulting socio-political aggregations and conflicts obviously depend on this choice. It is likely that an SPE analysis of other vertically integrated models, or of models combining CI and VI features, would suggest different aggregations and potential conflicts (e.g. Quadrio Curzio, 1967, 1986; Lowe, 1976; Amendola and Gaffard, 1988; Hagemann, 1990; Cardinale and Scazzieri, 2016; Bianchi and Labory, 2018; Landesmann, 2018).

representation is a disaggregated one, in the sense that output is broken down into different commodities, it is a highly artificial (i.e., abstract) disaggregation. The emphasis is thus on the *cooperative, systemic aspect of production*. For example, the Pasinetti version emphasizes the macroeconomic dimension. In fact, in the absence of (explicit) industrial interdependencies, what makes the system more than a collection of vertically integrated sectors is the macroeconomic condition. It is therefore not surprising that, in this approach, a crucial collective objective is full employment. For example, for Pasinetti (1981, p. 91), an 'Agency' might be entrusted with targeting full employment, which is likely to be a moving target because of changes in technology and demand. Of course, adopting the whole economy as a socio-political aggregation raises the problem of how the systemic objective is formed. Full employment is only one possible objective; an economy could rather pursue maximum growth, or yet another objective. Hence, in this case political conflict could be conceived of in terms of how the systemic objective is determined.

The second socio-political aggregation might be VI sectors themselves. It was noted above that sectors do not seem to correspond, at least prima facie, to obvious socio-political aggregations. However, imagine a case of significant within-industry heterogeneity, such as when some parts of an industry belong to the VI sector of tradable goods whereas other parts contribute to the VI sector of non-tradable goods (see Cardinale and Landesmann, 2017). In such a case, the relevant cleavage might be between VI sectors rather than industries, and the formation of economic interests and policy stances might be shaped accordingly. The possibility of conflicts between VI sectors seems compatible with Pasinetti's model under the assumption of the possibility of different sectoral profit rates.

The third possibility for aggregation is along the lines of wage and profit (which in Pasinetti's model do not necessarily correspond to workers and capitalists, given the assumption that workers can save). In this case, we need to distinguish between the hypothesis of differentiated

profit rates and the 'competitive' situation, in which the profit rate is relatively uniform across sectors. In the former case, the model can suggest the coexistence of cleavages between wages and profit and between different VI sectors. In the latter, 'competitive' case, the only conflict is between wage and profit. It is interesting to note the similarities and differences vis-à-vis CI analysis. As in the passage from Leontief to Sraffa, the conflict becomes between wage and profit as soon as the assumption of uniform rates is made. But whereas Sraffa constructs a wage-profit frontier, Pasinetti's analysis finds that only a specific rate of profit leads to full employment and full capacity utilization: other rates are suboptimal.

2.3 Comparing the political economy of VI and CI

Let us bring the argument together. In CI representations, conflict can be between industries (Leontief approach)—which leaves open the possibility of conflict between classes within each industry—or classes (Sraffa approach). Moreover, in the former case (Leontief) viability can be seen as an explicitly 'political' problem, in that it requires specific constraints on the choices concerning proportions between industries. Viability thus constitutes a form of systemic interest, to be understood as a constraint imposed on the pursuit of particular (industrial) interests. In the latter case (Sraffa), viability is a purely 'technical' problem—and one that is assumed at the outset—so that the political dimension boils down to distribution of surplus between classes.

In VI representations, conflict can be between VI sectors or classes, or both, depending on the 'institutional' features of the economy and polity in question. Systemic interest takes a different form. Recall that, in CI models, viability is a criterion that can be satisfied by a plurality of proportions, leaving open the possibility of conflicts between industries; as such, it is a constraint on the pursuit of particular interests, not an objective in itself. The full employment

criterion of VI models—at least under 'competitive' conditions—is only compatible with one equilibrium profit rate: other rates are suboptimal, in that they lead to unemployment. Hence, whilst in CI models the political strategy of each industry has to make sure that proportions do not violate viability conditions, in VI models unemployment (in and of itself) does not jeopardize the system. Hence, whilst it can be seen as a collective objective, it is not necessarily a constraint on the pursuit of particular interests on the part of sectors or classes.

3. LOOKING AHEAD: STRUCTURES, REPRESENTATIONS, AND INTERESTS

So far we have discussed, so to speak, the vistas from each side of the bridge. We can now turn to the bridge itself—the formal equivalence between CI and VI representations.

The foregoing analysis has investigated the socio-political aggregations suggested by different representations of division of labour. However, it leaves open the problem of which representations, out of the many that are possible in a given situation, will be adopted by economic actors—industries, sectors, segments of labour and capital within each industry, etc.—as a guide to the formation of their interests, which in turn informs their political action, and hence economic policies and systemic outcomes. This is an important problem in political science (Blyth, 2003), and it may be argued to be relevant for structural economic analysis as well (Cardinale, 2018b; Cardinale and Scazzieri, 2018; Scazzieri, 2018).

According to Blyth, the extreme positions concerning how political actors form their own interests are structural determination and 'ideational' construction. According to the former, actors' positions within economic structure univocally determine their interests. According to the latter, formation of interests depends on 'ideas' that are largely independent of economic structures. It can be shown that many routes to reconcile economic structures with 'ideas' have

significant shortcomings (Cardinale, 2018b). However, for the current purposes it is important to focus on how the VI algorithm, as interpreted in this article, shows crucial limitations of both of the aforementioned extreme positions—structural determination and ideational construction. In fact, the VI algorithm shows that the same economy can be represented through models that highlight different socio-political aggregations and economic interests. Hence, interests cannot be conceived of as being univocally determined by economic structure. But this does not amount to claiming that interests can simply be formed in a way that is independent of economic structures. In fact, some constructions of interests might not be compatible with existing structures; they might therefore lead to ignoring viability conditions and prove unsustainable.[10]

At this stage of the argument, it seems necessary to prevent a possible objection. In fact, one might argue that the foregoing analysis suggests that a variety of representations of interests is possible even remaining *within* a CI or VI representation; in other words, the VI algorithm might not seem to be necessary for us to obtain the result of lack of univocal determination. In this regard, we must note that the VI algorithm makes it possible to move between alternative representations of the same productive system. In other words, it shows that the same productive system cannot be represented univocally; hence, it cannot univocally determine economic interests. This is different from the shift between different cleavages within the same representation of division of labour (e.g. from Leontief to Sraffa), deriving from different assumptions about homogeneity of remuneration of labour or capital. In fact, the VI algorithm entails a shift *between* representations of division of labour, whilst the shift (so to speak) from

[10] This argument can also have implications for the political science literature on cleavages, since it might lead to formation of conflicts along different lines at the same time. In fact, the same industry might be allied with some industries for a given policy issue and with others for different issues. Similarly, different segments of labour and capital might be allied in some situations but be in conflict in others. The fact that the same structure could be represented in different ways further complicates the picture, because actors might adopt different representations of particular and systemic interests. In further research, it would be interesting to study under what conditions such cleavages would foster or hinder the recognition and pursuit of systemic interests.

Leontief to Sraffa takes place *within* a given representation of division of labour. And whilst it is true that both shifts can give rise to different socio-political aggregations and economic interests, they do so 'at different levels', so to speak. We might say that the former is at a fundamental level—that of division of labour: it concerns the representation of the technical and material aspect of production. The latter is more 'institutional', having to do with assumptions about remuneration of factors of production *within* a given structure of division of labour.

Therefore, one might say that univocal determination of interests is impossible even within a given representation of division of labour (say, within the CI scheme). But the VI algorithm leads to a more radical result: even the structure of division of labour cannot be taken as given: not even the 'objective' structure of interdependencies can be represented univocally. And this is coherent with the fundamental idea of SPE: the socio-political analysis of the economy does not only concern distribution of a given surplus, but also lies in the very technical and material arrangements expressed by division of labour.

The foregoing argument may appear to provide a ‘negative’ result—that economic structure cannot univocally determine actors’ representation of the structures within which they act, and hence of the socio-political aggregation to which they belong and their economic interests. However, this result may prove to be a highly generative one for structural economic analysis. Two fundamental directions can be singled out.

One can be seen as a contribution to the empirical analysis of the formation of interests that are made possible by economic structures in a given situation. Structural analysis can help appreciate that *observed* interests, such as those reconstructed by political science analyses (e.g. Ferguson, 1995; Ferguson et al., 2018), are not the only possible ones. For example, in a given situation one might observe alliances formed along industry lines, but SPE suggests that

alliances could also be informed by VI sectors. Moreover, workers might make coalitions with other workers across industries or with 'capitalists' in the same industry. The systemic objective could be full employment, maximum growth, or yet another—or a combination thereof. Each representation will highlight different particular interests as well as constraints (systemic interest). Visualizing a variety of possibilities can help political actors (i.e. socio-political aggregations) become aware of alternatives and potentially identify forms of systemic interest that would not otherwise be apparent. For example, if actors adopt a VI representation, which assumes viability at the outset, they might overlook the need to keep the system within proportions compatible with viability.

The other direction involves understanding why, in a given context, actors settle on certain representations of interests out of the many that are possible. This direction requires that the theoretical scope of structural economic analysis be expanded. In fact, it can be argued that structural analysis studies the complex constraints that division of labour imposes on the pursuit of a variety of objectives (individual, industrial or sectoral, systemic, …) within the economy and polity (Cardinale and Scazzieri, 2018). However, moving from possibilities (what division of labour makes possible) to propensities (what possibilities are more likely in a given context) requires understanding how actors make decisions *within structures*. Structural analysis lacks such a theory; hence, it is typically not equipped to move from possible outcomes to actual outcomes—except by assuming simple behavioural rules. This article exposes this problem: because economic structures cannot univocally determine representations adopted by actors, understanding the formation of interests requires understanding what representations are adopted in any given context. This is a necessary direction if structural analysis aspires to understand the socio-political aspect of economic structure. This direction could be pursued by developing a theory of action within economic structures, perhaps also drawing on building blocks from work that has addressed the problem in different theoretical contexts (Bourdieu,

1990; Sewell, 1992; Emirbayer and Mische, 1997, Cardinale 2018a; see also Cardinale 2018b), as well as opening up to historical and empirical studies that can help understand the contextual conditions that make some visualisations, decisions and outcomes more likely than others.

4. CONCLUSION

This article's argument was organised around the metaphor of the algorithm of vertical integration as a bridge between two vistas. The aim was to provide an SPE reading of CI and VI, showing the different views on cleavages and economic interests associated with them. The structure of division of labour (industrial interdependencies and VI sectors) was used as a blueprint for socio-political aggregations, showing that conflicts must not necessarily (or exclusively) be conceived of in terms of "class" analysis; division of labour is therefore not just a technical issue, but is itself a "political" one, in that it is invested with interests and is the object of conflicts.

But the two vistas aren't all that matters. The "bridge" is significant in itself, for the algorithm of vertical integration shows the formal equivalence between two representations leading to different socio-political aggregations, cleavages and visualisations of systemic interests. This formal equivalence suggests the impossibility of univocal structural determination of economic interests. It thus calls for opening up the range of conflicts and systemic interests that are possible in a given situation, over and above those actually perceived by actors. Symmetrically, the article calls for structural analysis to address how to move from possible representations to those that are more likely in a given situation—and this requires extending the theoretical corpus of structural analysis to study action within structures (Cardinale 2018b; Cardinale and Scazzieri, 2018).

Seen in this light, the algorithm of vertical integration seems to go much beyond what Pasinetti (1973) originally envisioned. Appreciating these ramifications requires paying renewed attention to the socio-political dimension of the structure of division of labour—a layer that is connected, but not reducible, to the material dimension emphasized by the 20th-century revival of structural analysis.

REFERENCES

Amendola, M. and Gaffard, J.L. (1988) *The Innovative Choice*, Oxford: Blackwell.

Baranzini, M., and Scazzieri, R. (2012a, 1st edn 1990) (eds.) *The Economic Theory of Structure and Change*, Cambridge: Cambridge University Press.

Baranzini, M., and Scazzieri, R. (2012b, 1st edn 1990) 'Introduction', in M. Baranzini and R. Scazzieri (eds.) *The Economic Theory of Structure and Change*, Cambridge: Cambridge University Press, pp. 1-20.

Baranzini, M., and Scazzieri, R. (2012c, 1st edn 1990) 'Economic Structure: Analytical Perspectives', in M. Baranzini and R. Scazzieri (eds.) *The Economic Theory of Structure and Change*, Cambridge: Cambridge University Press, pp. 227-333.

Bhat, M.G. and Bhatta, R. (2006) 'Regional economic impacts of limited entry fishery management: an application of dynamic input–output model', *Environment and Development Economics*, 11, pp. 709–72.

Bianchi, P. and Labory, S. (2018) 'The Political Economy of Industry', in I. Cardinale and R. Scazzieri (eds.), *The Palgrave Handbook of Political Economy*, London: Palgrave Macmillan, pp. 463-488.

Blyth, M. 2003. 'Structures Do Not Come with an Instruction Sheet: Interests, Ideas, and Progress in Political Science.' *Perspectives on Politics* 1 (4): 695–706.

Bourdieu, P. 1990. *The logic of practice*. Cambridge: Polity Press.

Cardinale, I. (2012). "The Political Economy of Circular Interdependencies and Vertical Integration: Opening the Black Box of 'National Interest'". SSRN Scholarly Paper ID 2357981. Rochester, NY: Social Science Research Network. http://papers.ssrn.com/abstract=2357981.

Cardinale, I. (2015) 'Towards a structural political economy of resources', in M. Baranzini, C. Rotondi and R. Scazzieri (eds), *Resources, Production and Structural Dynamics*, Cambridge: Cambridge University Press, pp. 198-210.

Cardinale, I. (2017) ‘Sectoral Interests and ‘Systemic’ Interest: Towards a Structural Political Economy of the Eurozone’, in I. Cardinale, D. Coffman and R. Scazzieri (eds.), *The Political Economy of the Eurozone*, Cambridge: Cambridge University Press, pp. 216-37.

Cardinale, I. (2018a) ‘Beyond Constraining and Enabling: Toward New Microfoundations for Institutional Theory’, *Academy of Management Review*, no. 43, vol. 1, pp.1-24.

Cardinale, I. (2018b) ‘Structural Political Economy’, in I. Cardinale and R. Scazzieri (eds.), *The Palgrave Handbook of Political Economy*, London: Palgrave Macmillan, pp. 769-784.

Cardinale, I. and Coffman, D. (2014) ‘Economic Interdependencies and Political Conflict: The Political Economy of Taxation in Eighteenth-Century Britain’, *Economia Politica: Journal of Analytical and Institutional Economics*, 31 (3): 277–300.

Cardinale, I., Coffman, D. and Scazzieri, R. (2017) ‘Framing the Political Economy of the Eurozone: Structural Heuristics for Analysis and Policy’, in I. Cardinale, D. Coffman and R. Scazzieri (eds.), *The Political Economy of the Eurozone*, Cambridge: Cambridge University Press, pp. 483-551.

Cardinale, I. and Landesmann, M.A. (2017) 'Exploring sectoral conflicts of interest in the Eurozone: A Structural Political Economy approach', in I. Cardinale, D. Coffman and R. Scazzieri (eds.), *The Political Economy of the Eurozone*, Cambridge: Cambridge University Press, pp. 284-336.

Cardinale, I. and Scazzieri, R. (2016) 'Structural Liquidity: The Money- Industry Nexus', *Structural Change and Economic Dynamics*, 39, pp. 46–53.

Cardinale, I. and Scazzieri, R. (2018) 'Political Economy as Theory of Society', in I. Cardinale and R. Scazzieri (eds.), *The Palgrave Handbook of Political Economy*, London: Palgrave Macmillan, pp. 787-815.

Carpi, P., Scarcella, G., and Cardinale, M. (2017) 'The Saga of the Management of Fisheries in the Adriatic Sea: History, Flaws, Difficulties, and Successes toward the Application of the Common Fisheries Policy in the Mediterranean', *Frontiers in Marine Science*, 4, article 423.

Coen, D. 2007. 'Empirical and Theoretical Studies in EU Lobbying', *Journal of European Public Policy*, 14(3): 333–45.

Coen, D. and Richards, J. 2009. *Lobbying the European Union: Institutions, Actors and Policy*. Oxford: Oxford University Press.

Coffman D. (2013), *Excise Taxation and the Origins of Public Debt*, Basingstoke: Palgrave Macmillan.

Coser, L. (1956) *The Functions of Social Conflict*, London: Routledge and Kegan Paul.

Davenant C. (1698), *Discourses on the Public Revenues and on the Trade of England in Two Parts.*

Duchin, F. (2015) 'The Transformative Potential of Input-Output Economics for Addressing Critical Resource Challenges of the Twenty-First Century', in M. Baranzini, C. Rotondi and R. Scazzieri (eds), *Resources, Production and Structural Dynamics*, Cambridge: Cambridge University Press, pp. 136-154.

Duchin, F. and Steenge, A. E. 2007. 'Mathematical Models in Input-Output Economics', Rensselaer Working Papers in Economics, n. 0703.

Durkheim, E. (1902) *De la division du travail social,* 2nd ed. augmentée d'une preface sur les groupements professionels, Paris, Alcan.

Emirbayer, M., & Mische, A. 1998. What is agency? *American Journal of Sociology*, 103, pp. 962–1023.

Ferguson, T. 1995. *Golden Rule: The Investment Theory of Party Competition and the Logic of Money-Driven Political Systems.* Chicago: University of Chicago Press.

Ferguson, T., Jorgensen, P., and Chen, J. (2018) 'Industrial Structure and Political Outcomes: The Case of the 2016 US Presidential Election', in I. Cardinale and R. Scazzieri (eds.), *The Palgrave Handbook of Political Economy*, London: Palgrave Macmillan, pp. 333-440.

Furtado, C. (1967) 'Industrialization and Inflation', *International Economic Papers*, 12, pp. 101–19.

Hagemann, H. (1990) 'The Structural Theory of Economic Growth', in M. Baranzini and R. Scazzieri (eds.), *The Economic Theory of Structure and Change*, Cambridge: Cambridge University Press, pp. 144-171.

Hawkins, D. and Simon, H. A. 1949. 'Note: Some Conditions of Macroeconomic Stability', *Econometrica*, 17: 245–48.

Hirschman, A. (1968) ‘The Political Economy of Import-Substituting Industrialization in Latin America’, *The Quarterly Journal of Economics*, 82 (1, February), pp. 1–32.

Jin, D., Hoagland, P., Morin Dalton, T. (2003) ‘Linking economic and ecological models for a marine ecosystem’, *Ecological Economics*, 46, pp. 367-385.

Landesmann, M. (2018) ‘Political Economy of Structural Change’, in I. Cardinale and R. Scazzieri (eds.), *The Palgrave Handbook of Political Economy*, London: Palgrave Macmillan, pp. 705-748.

Landesmann, M. and Scazzieri, R. (2012, 1st edn 1990) ‘Specification of Structure and Economic Dynamics’, in M. Baranzini and R. Scazzieri (eds.), *The Economic Theory of Structure and Change*, Cambridge: Cambridge University Press, pp. 95–121.

Leontief, W.W. (1991 [1928]) ‘The Economy as a Circular Flow’, *Structural Change and Economic Dynamics*, 2 (1), pp. 181–212.

Leontief, W. W. 1941. *The Structure of the American Economy, 1919–1929*. Cambridge, MA: Harvard University Press.

Leontief, W. W. 1951. *The Structure of the American Economy, 1919–1929* (2nd edn). New York: Oxford University Press.

Lijphart, A. (1968) *The Politics of Accommodation*, Berkeley and Los Angeles: University of California Press.

List, F. 1996 [1827] *Outlines of American Political Economy in Twelve Letters to Charles J. Ingersoll*., Wiesbaden, Böttiger.

Lowe, A. (1976) *The Path of Economic Growth*. Cambridge; New York: Cambridge University Press.

Mamalakis, M. (1969) 'The Theory of the Sectoral Clashes', *Latin American Research Review*, 4 (Fall), pp. 9–46.

von Neumann, J. (1945-46) 'A Model of General Economic Equilibrium', *The Review of Economic Studies*, Vol. 13, No. 1, pp. 1–9.

Nikaido, H. 2014. 'Hawkins-Simon Conditions', in S. N. Durlauf and L. E. Blume (eds), *The New Palgrave Dictionary of Economics. Second Edition*. Basingstoke, Palgrave Macmillan, 2008. The New Palgrave Dictionary of Economics Online. Palgrave Macmillan.

O'Donnell, G. (1977) 'Estado y Alianzas en la Argentina 1956–1976', *Desarollo Económico*, 16 (January–March), pp. 523–54.

Pasinetti, L. L. (1973) 'The Notion of Vertical Integration in Economic Analysis', *Metroeconomica*, Vol. 25, No. 1, pp. 1–29.

Pasinetti, L. L. 1977. *Lectures on the Theory of Production*. London: Macmillan.

Pasinetti, L. L. (1981) *Structural Change and Economic Growth: A Theoretical Essay on the Dynamics of the Wealth of Nations*. Cambridge; New York: Cambridge University Press.

Pasinetti, L. L. 1993. *Structural economic dynamics: a theory of the economic consequences of human learning*. Cambridge; New York: Cambridge University Press.

Quadrio Curzio, A. (1967) *Rendita e distribuzione in un modello economico plurisettoriale*, Milan, Giuffrè.

Quadrio Curzio, A. (1986) 'Technological Scarcity: An Essay on Production and Structural Change', in M. Baranzini e R. Scazzieri (eds.), *Foundations of Economics. Structures of Inquiry and Economic Theory*, Oxford and New York: Basil Blackwell, pp. 311-38.

Quadrio Curzio, A. (2009, 1st edn 1996] 'Production and Efficiency with Global Technologies', in M. Landesmann and R. Scazzieri (eds.), *Production and Economic Dynamics*, Cambridge: Cambridge University Press, pp. 105–39.

Quadrio Curzio and Pellizzari 2018 in I. Cardinale and R. Scazzieri (eds.), *The Palgrave Handbook of Political Economy*, London: Palgrave Macmillan, pp. 657-704.

Quesnay, F. 1972 [1759]. *Quesnay's Tableau Économique*. Eds. M. Kuczynski and R. L. Meek. London; New York: Macmillan; A.M. Kelley for the Royal Economic Society and the American Economic Association.

Rae, D.W., and Taylor, M. (1970) *The Analysis of Political Cleavages*, New Haven and London: Yale University Press.

Rogowski, R. (1987) 'Political Cleavages and Changing Exposure to Trade', *The American Political Science Review*, 81(4): 1121-1137.

Ross, E. A. (1920) *The Principles of Sociology*, New York: The Century Company.

Scazzieri, R. (1990) 'Vertical Integration in Economic Theory', *Journal of Post-Keynesian Economics*, 13.1, pp. pp. 20-46.

Scazzieri, R. (1996) 'Introduction to Pasinetti's Structural Economic Dynamics: A Symposium', *Structural Change and Economic Dynamics*, 7.2, pp. 123-5.

Scazzieri, R. (2018), 'Political Economy of Economic Theory' in I. Cardinale and R. Scazzieri (eds.), *The Palgrave Handbook of Political Economy*, London: Palgrave Macmillan, pp. 193-233.

Scazzieri, R., Baranzini, M., and Rotondi, C. (2015) 'Resources, Scarcities and Rents: Technological Interdependence and the Dynamics of Socio-Economic Structures', in M. Baranzini, C. Rotondi and R. Scazzieri (eds), *Resources, Production and Structural Dynamics*, Cambridge: Cambridge University Press, pp. 427-484.

Sewell, W. H., Jr. 1992. A theory of structure: Duality, agency, and transformation. *American Journal of Sociology*, 98: 1-29.

Simmel, G. (1955 [1922]) '*Conflict' and 'The Web of Group Affiliations'*, New York: The Free Press.

Sraffa, P. (1960) *Production of Commodities by Means of Commodities: Prelude to a Critique of Economic Theory.* Cambridge: University Press.

Steedman, I. (2000) 'Income Distribution, Foreign Trade and the Value-Added Vector', *Economic Systems Research,* 12(2): 221-230.

Steenge, A.E.(2011) 'On the Evolution of Multi-Sectoral Models; Optimality and Beyond', in M. Ciaschini and G.C. Romagnoli (eds), *L'economia italiana: metodi di analisi, misurazione e nodi strutturali; Saggi per Guido M. Rey*, Milan, Franco Angeli, 92-114

Steenge, A.E. (2015) 'Limits, Resources and Distributional Trade-offs: Structural Constraints and Opportunities' in M. Baranzini, C. Rotondi and R. Scazzieri (eds), *Resources, Production and Structural Dynamics*, Cambridge: Cambridge University Press, pp. 107-125.

Steenge, A. E. and Van den Berg, R. (2001) 'Generalising the Tableau Economique: Isnard's Systeme des Richesses', *International Journal of Applied Economics & Econometrics*, 9(2): 121-146.

Timmer, M.P., Dietzenbacher, E., Los, B., Stehrer, R., and de Vries, G.J., (2015) 'An Illustrated User Guide to the World Input–Output Database: the Case of Global Automotive Production', *Review of International Economics*, 23(3), pp. 575–605.

Tukker, A., et al. (2013) 'EXIOPOL – Development and Illustrative Analyses of a Detailed Global MR EE SUT/IOT', *Economic Systems Research*, 25(1), pp. 50–70.

Truman, D.B. (1951) *The Governmental Process*, New York, Knopf.

Wood, R. et al. (2015) 'Global sustainability accounting-developing EXIOBASE for multi-regional footprint analysis', *Sustainability (Switzerland)*, 7, pp. 138-163.