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## Explorations in the theory of the firm: Understanding the production function

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# explorations in the theory of the firm: understanding the production function

by  
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«The Rochdale co-operative experiments...showed that associations of workmen could manage shops, mills, and almost all forms of industry with success, and they immediately improved the conditions of the men, but then they did not leave a clear place for masters. *Quelle horreur!*»  
(from the *Spectator*, as quoted in Karl Marx, *Das Kapital*, V. I, p. 331 fn.)

## I. introduction

This essay is motivated by what appears to be an increasing social awareness of worker dissatisfaction in modern industrial societies [7; 8; 11; 15; 23; 49; 59] and by current discussions of worker dissatisfaction and of workers' control in the radical economic literature [7; 8; 9; 10; 11; 13; 19; 21; 22; 23; 27; 52]. Such discussions quite often focus on the central role of the hierarchical division of labor in the contemporary work environment. A broad range of alternatives has been proposed in many countries. Although it might be argued that political considerations would weigh heavily (if not solely) on the decision, practically, social scientists are asked to assist in the evaluation of alternatives. The methodological tools employed in such evaluation tasks are of decisive importance. It is this «practical» problem with which the paper is concerned. In doing so it essentially comprises a critical reconsideration of the neo-classical theory of the firm. At the same time, this work reveals a virtual lack of any influence on neo-classical economic orthodoxy by the movement for workers' control. This movement has demonstrated the strength of the relationship between the quality of the work environment and the social relations of the work place on the one hand, and worker dissatisfaction, on the other.

This essay is neither comprehensive in its review of the literature, nor original. It can be described best as a review paper aiming at a synthesis. It draws substantially from Gintis [20] and Bowles and Gintis [10] to argue the critical importance of the «explicit power» which is left in the hands of employers. The hierarchical division of labor as an organizational form is seen as the institutional framework for such power. The question of the «optimal» organizational form is addressed

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in terms of both the notion of economic efficiency and concepts in the technical literature of organization and information economics [3; 12; 28; 29; 30; 35; 36; 41; 45].

A summary of the remainder of the paper would go as follows. First, we trace the origin of the neoclassical theory of the firm in the writings of Coase and Simon. Second, we discuss how the hierarchical division of labor fits into the logic of the theory of the firm. Third, we contest a specific implication of the neoclassical position, namely that contemporary work organization conforms to worker preferences. Fourth, we review selectively some relevant classical writings by Adam Smith, Charles Babbage, and Karl Marx. Fifth, after reviewing some refinements of the neoclassical position we identify the element of power as central to the organization of the workplace. Sixth, we probe the relevance of the methodological tools employed by recent literature on mechanisms of resource allocation. This literature regards the institutional framework as an unknown rather than a datum. Seventh, we offer a link between critical views about the theory of the firm (such as the ones which are maintained in this essay), and concrete aspects of economic reality. That is, the relationship between work organization and income distribution.

We hope that such a synthetic review of the literature would be of interest even outside the discipline of economics. For the issues go much beyond such narrow boundaries. As we mentioned right at the outset, the question of how to enhance the quality of the work environment and to democratize the work place is ultimately political. The nature of the relationship between efficiency, income distribution, and control at the level of the productive enterprise seems to be a fundamental factor in the resolution of pertinent political questions. We have not, however, included overtly political considerations within the scope of this essay—albeit, they underlie most of our arguments.

## II. origins and interpretations of the neoclassical theory of the firm

R. Coase in his influential paper on the theory of the firm [14] gives a rigorous explanation of why authoritarian forms of economic organization—«islands of conscious power,» [14, p. 388] where «the direction of resources is dependent on an entrepreneur,» [14, p. 292]—supersede market exchange. The explanation rests on the existence of costs of operating in a market system (collecting information about prices, arranging contracts, etc.) upon which savings can be made by

setting up a firm. But from the point of view of what particular jobs involve, contracts are admittedly vague, «...the exact details being left until a later date. All that is stated in the contract is the limits to what the persons supplying the commodity or service is expected to do. The details... (are) decided later by the purchaser.» [14, p. 392] Coase seems to believe that this is due to excessive costs of continuous short-term contracting.

H. Simon in [46] gives a formal description of the employment relationship: Let B be the employer, W the employee, and A the set of all specific actions W would perform if employed by B; B is seen to exercise *authority* over W if W permits B to select  $x, x \in A$ , and an *employment relationship* obtains if W accepts the authority of B and B is willing to pay W an agreed-upon wage. Simon also gives an elegant, but somewhat primitive, model for the choice between an employment contract and a sales contract.<sup>1</sup>

Once the employment relationship has been specified then the neoclassical theory of the firm assumes that labor inputs may be treated symmetrically with other inputs. Clearly, the organization of the labor input has to comply with the profit maximization objective. More specifically, according to the theory, profit maximization<sup>2</sup> implies that organizational forms which are chosen are efficient. In particular, job design chosen is efficient and although this theorem is usually construed in a narrow technical sense, as Gintis points out [20; p. 3], a *bona fide* interpretation of the neoclassical view is that worker preferences over characteristics of the work environment should also be included. Thus, construed as an extension of consumer sovereignty, «worker sovereignty» is seen to prevail; namely job structures and wages reflect workers' trade-offs place between pecuniary remuneration and job satisfaction. That is, inefficient organizational forms will weed out over time (in the process of competition as new forms replace older ones) provided that no externalities are present).

The advantages of the minute division of labor, were first expounded by Adam Smith in a famous passage [48, p. 7]: «This great increase of the

1. Simon argues that the former is the subject of administrative theory and the latter of economic theory. Such a dichotomy is untenable since in a world of perfect mobility, and over time, workers can move around and firms can alter organizational forms in response to market conditions. See also how he contrasts the theory of the firm (F-theory) and the theory of organization (O-theory) in [47].

2. We may leave temporarily aside the issue of whether this is construed over the short—or the long—run. This has important political and economic implications. See Marglin [34], Gorz [21;24].

quantity of work, which, in consequence of the division of labor, the same number of people are capable of performing, is owing to three different circumstances; first, to the increase of dexterity in every particular workman; secondly, to the saving of the time which is commonly lost in passing from one species of work to another; and lastly, to the invention of a great number of machines which facilitate and abridge labor, and enable one man to do the work of many.» This constitutes, an essential component of the usual defense of the hierarchical organization of production which goes as follows [21; 23; 24]: technical efficiency implies minute division of labor and for coordination, hierarchical division of labor is needed.

Yet, the economic efficiency aspects of work organization in contemporary industrial societies have been attacked from several directions. First of all, as Marglin [34] and others have pointed out, Adam Smith later develops some severe criticism of his own for the minute division of labor: «The man whose whole life is spent in performing a few simple operations... becomes as stupid and ignorant as it is possible for a human creature to become.» [48, p. 734]. Second, the worker dissatisfaction which is reported nowadays can be translated into some form of concrete criticism of the minute division of labor and, by implication, of the neoclassical theory of the firm. The collection of (albeit indirect) evidence [7; 15; 21; 22; 33; 34; 49; 59] against the efficiency of contemporary work organization is impressive. As Blumberg points out, findings of such consistency are rare in social research [7, p. 121]. Third, some of the arguments in *Work in America* [58] contend that not only the organization of work is inefficient (in the strict economic sense) but also that the hierarchical organization of production—the most prevalent type of job design—is actually *technically inefficient*. Fourth, the experimental literature from industrial social psychology does not support the usual defense of the hierarchical division of labor. As reported by Vroom [51], worker participation in decision-making improves productivity. At the same time, as Gintis points out, «however the hierarchical structure of power fits into the logic of profit maximization, task fragmentation will follow as a result. All that we can derive from this experimental literature (Vroom, *ibid.*) is that if centralized control is posited, then Adam Smith's minute division of labor will be relatively more productive.» [20, p. 6].

We will not pursue these complex questions further. Instead we add some words of caution. Facts like the ones reported in *Work in America* cannot be easily interpreted outside particular social science

disciplines, and at any rate since it is hard to have an objective measure of human welfare a degree of ambiguity will always remain. At the same time a historical perspective is indispensable for a correct interpretation of scientific propositions. The factory system—with its foremen, its manager, and its minute division of labor—did not come into existence overnight. In this context, Marglin's study [34] of the origins and functions of hierarchy in capitalist production is very significant in that it is primarily historical. Marglin argues that the factory system did not prevail because it was superior on grounds of efficiency; it prevailed because it facilitated control over the process of production and investment. We do not intend to duplicate such historical analyses, yet the study of classical commentators provides useful reference points. For concrete examples we may now turn to Charles Babbage and Karl Marx.

An interesting observation about how the division of labor affects productive efficiency was made by Charles Babbage [4, p. 109]: «The master manufacturer by dividing the work to be executed into different processes, each requiring different degrees of skills and force, can purchase exactly that precise quantity of both that is necessary for each process; whereas if the whole work were executed by one workman, that person must possess sufficient skill to perform the most difficult and sufficient strength to execute the most laborious of the operations into which the work is divided.» [4, p. 190].

This was noted by A. Marshall [37, p. 224; 38] but, as Braverman [11] correctly points out, it seems that economic thinking on the subject since then has not been influenced by the «Babbage principle.» If anything, Braverman argues, the Babbage principle has been misused in the *defense* of the process by which «the capitalist mode of production systematically destroys all-around skills where they exist, and brings into being skills and occupations that correspond to its needs.» [*Ibid.*, p. 82]. The process by which labor power—the commodity—is cheapened, by being broken up, goes hand-in-hand with the social division of labor. If this is true, then the historical development of economic structures have consolidated the employers' control of the work process. This power is derived from the minute division of labor and the associate hierarchical form of control.

Before we return to the critique of the neoclassical theory of the firm we should make a note of Marx's view on these issues as well. Contrary to Marglin's assertions in his study of the origin and functions of hierarchy in capitalist production [34] a reading of *Capital V. I.* generates the opinion

that Karl Marx was at least ambivalent about the origins of hierarchical organization of production. E.g. he argues that a central directing authority is needed yet he presents evidence that cooperative experiments can work—«Quelle horreur.» He recognizes the Babbage principle and quotes the same passage as Marshall but goes further in explaining its importance—in a way anticipating the impact of scientific management. «Every process of production, however, requires certain simple manipulations, which every man is capable of doing. They too are now severed from their connection with the more pregnant moments of activity and ossified into exclusive functions of specially appointed laborers. Hence, Manufacture begets, in every handicraft that it seizes upon, a class of so-called unskilled laborers... If it develops a *one-side speciality into a perfection, at the expense of the whole of a man's working capacity, it also begins to make a speciality of the absence of all development.* Alongside of the hierarchic gradation there steps the simple separation of the laborers into skilled and unskilled.» [40, p. 350, emphasis added]. He also notes the important role played by middle-level supervisory personnel [*Ibid.*, p. 332].

Regarding the effects of the division of labor, he was much clearer, although still undecided. «The one-sidedness and the deficiencies of the detail laborer become perfections... The habit of doing only one thing converts him into a *never failing instrument...*» (emph. add.). He also employs Adam Smith's familiar self-criticism of the minute division of labor, *op. cit.* Finally, regarding the «noble achievement of Arkwright» he says «order» was wanting in manufacture based on «the scholastic dogma of division of labor» and «Arkwright created order.»

But with regards to working conditions Marx was, of course, very emphatic: «The miserable routine of endless drudgery and toil in which the same mechanical process is gone through over and over again, is like the labor of Sisyphus... The factory work exhausts the nervous system to the uttermost... and confiscates every atom of freedom, both in bodily and intellectual activity.» [40, p. 422-423].

Much current theory depends on foundations laid out by R. Coase and H. Simon. Among those who have built on neoclassical foundations Alchian and Demsetz [1] should be emphasized. They present the essence of the firm as «a contractual structure with: [1] joint-input production; [2] several input owners; [3] one party who is common to all the contracts of the joint inputs; [4] who has rights to renegotiate any input's contract independently of contracts with other input owners;

[5] who holds the residual claim; and [6] who has the right to sell his central contractual residual status» [1, p. 794]. In addition they argue that no authoritarian control is involved and «the arrangement [i. e. the firm] is simply a contractual structure subject to continuous renegotiation with the central agent» [1, p. 794]. The firm is viewed as a «privately owned market» and, in fact, a market that is efficient at distributing the flow of information about marketwide possibilities. This rather ironic view topped by a view of the economy as an arena where «private proprietary markets» compete with «public or communal markets»<sup>1</sup> stands in sharp contrast with evidence in [7; 13; 15; 59], with the theory of internal labor markets [18]—incidentally, another awkward use of the term «market»—with theories of wage determination (including «sociological» ones [42], and the sociology of work [6; 27; 23]).

From a different perspective, Williamson [55; 56] argues in favor of applying a generalized theory of market failure to the evaluation of different modes of internal economic organization. He sees that the interesting problems of economic organization «are mainly to be explained by reference to the conjunction of a set of human attributes with a related set of (largely nontechnological) transactional factors.» [56, p. 316]. The former include bounded rationality (the constrained capacity of human beings to deal with information) and opportunism. Transactional factors include uncertainty, the effect of small numbers, and information impactedness (informational asymmetry coupled with differential costs for attaining information parity). Williamson argues that individual organizations give way to collective organizations of the peer group association type so that they may take advantage of indivisibilities and risk-bearing, but productivity gains are even possible because of pure associational reasons. That is, «by mobilizing energies which, even if they could be monitored costlessly and priced accordingly, could not be exacted in the market by the assured prospect of pecuniary reward» [56, p. 321]. Such associations of workers are nonhierarchical and cooperative, involve some type of income sharing arrangement, but «do not entail subordination.» Individuals may also seek such associations for insurance purposes, and thus obtain insurance in a way superior to what the market would provide. Adverse selection («due to *ex ante* information impactedness») can be avoided and malingering and other *ex post*

1. «Could it be that the market suffers from the defects of communal property rights in organizing and influencing uses of valuable resources?» *Ibid.*, p. 795.

manifestations of moral hazard can be checked.

The disadvantages, however, may be important: first, Williamson argues, efficient utilization of indivisible assets may be hampered. Although an efficient rule for simultaneous utilization may be agreed upon and implemented collectively, an hierarchical solution would be simpler.<sup>1</sup> Second, peer-group associations are vulnerable to free-rider types of problems such as in individuals' withholding information about productivity. «To the extent that the cost of *ex ante* screening is high in relation to *ex post* experience rating, where the latter involves hierarchy, peer group organization is perforce limited» [55, p. 322]. This, however, is hardly obvious.<sup>2</sup> Third, hierarchies, it is argued, can better cope with malingering. Clearly this argument strongly depends on social values and it is crucial to the issue of work motivation in collectivist situations—especially when needs and «internal justice» are important determinants of labor remuneration.

A. K. Sen has dealt with this issue of work motivation in game-theoretic terms [43;44]. He argues that in terms of a «Prisoner's Dilemma» model where each party prefers not working hard to working hard, regardless of whether or not everybody else is working hard each party, would prefer everyone working hard to no one working hard. In such situations everyone ends up not working hard [44, p. 97]. Since it would be difficult to enforce a collective contract, material incentives may be employed. On the other hand, a small variation on the «Prisoner's Dilemma» game reveals its specific *cultural bias*. This variation produces the *assurance game* [43;44, p. 96]. According to this alternative model «each party would work hard given the assurance that others would too but would prefer not to put in the effort if the others would not.» In such situations where people's values reflect mutual confidence, and an optimal solution is arrived at. As A.K.Sen points out, people *would be better off even in terms of their own preferences* if they behaved «as if their preferences were as in the Assurance Game» [44, p. 98]. It is worth noting the significance of this simple argument (which links socialization at large and social organization in the work place) in considering the social feasibility of industrial democracy.

1. «[How] much simpler [!] if instrumental rules were to be imposed authoritatively...though the "leader" in these circumstances may merely be the first among equals.» *Ibid.*, p. 321.

2. See Arrow [2], Bowles and Gintis [9;10] and Jencks [31] for the economic functions of education. Whether the schooling system developed in response to business's demand for screening-signalling function is, of course, an important question.

To summarize now, a fundamental tenet of the neoclassical theory of the firm in its pure form is that once the employment relationship has been specified then (as far as economic theory goes) labor inputs can be treated symmetrically with other inputs. Gintis in his discussion of the Coase-Simon position contrasts that labor is not supplied in such an autonomous fashion. Labor must be extracted from workers, and much that is implicit in labor contracts must be enforced by political authority within the firm. «The power to enforce the intent of the exchange lies within the jurisdiction of the actors—namely, in the organization of the firm itself. Thus power configurations between employer and employee are *resultants* of economic organization, and cannot be taken as given prior to economic analysis. On this point the neoclassical theory of the firm founders.» [19, p. 19].

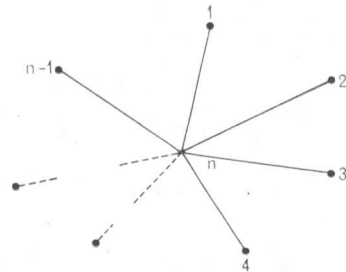
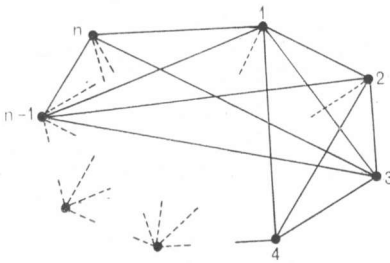
### III. hierarchies and macromechanisms of resource allocation

Having reviewed the theory of the firm in its various versions we now suggest that elements of the theory of mechanisms of resource allocation may be useful analytical tools. Before we proceed with this task, we may summarize here Williamson's arguments in favor of hierarchies. This would provide a helpful contrast since his models—contrary to those reviewed below—fail to deal adequately with the essentially asymmetrical nature of hierarchical relations (superior vs. subordinate).

Williamson's arguments in favor of hierarchies may be summarized as follows: Peer group or collectivist associations enjoy the advantages of productivity through higher motivation, of economies of scale, and of risk-bearing, but hierarchies decrease the costs of communication and joint decision-making and may better implement audit and experience-rating mechanisms. It is clear, however, that the issue of worker motivation is rather complex and yields no definitive answer. The argument regarding the cost of communicating is convincing, and can be easily illustrated:

The number of channels of communication for  $n$  individuals in a pairwise fashion is  $\frac{n(n-1)}{2}$ , while

with an intermediary the number is equal to  $n-1$ . Hence, what is needed—depending on the technology of information—is an intermediary, a position that does not imply a superior-subordinate relation and can be staffed on a rotational basis. We do not, of course, want to downgrade the important role expertise plays. The technology of



information would play a role in the selection<sup>1</sup> of organizational forms.

The fairly recent literature on mechanisms of resource allocation is best reviewed by L. Hurwicz [28]. Although it is cast in terms of the requirements of large-scale planning «this new approach refuses to accept the institutional status quo of a particular time and place as the only legitimate object of interest and yet recognizes constraints that disqualify naive utopias» [Ibid., p. 11]. It is precisely for these reasons that this approach may be applied to the theory of the firm. Organizations, however, are very complex structures and thus analysts often concentrate on their «viable» (equilibrium) states without assuming the absence of conflicts. From among different organizational structures there has been greater interest in those which are *incentive-compatible*.<sup>2</sup> In such structures no participant would gain by departing from his (assigned) behavior pattern if others do not.

It turns out that in structures which contain superior-subordinate relations individuals generally can gain by cheating «without openly violating the rules. A participant could try to cheat by doing what the rules would have required him to do, had his characteristics been different from what they are» [28, p. 23]. As Hurwicz puts it [Ibid., p. 24] this «has been recognized in connection with situations where targets and norms are set, whether for an enterprise in a Soviet-type economy or for workers on a piece rate under capitalism. In all of these cases there is a "superior" and a "subordinate," and the latter has an incentive to depress the norms when the penalty for failure to reach a target is severe.» In the presence of informational asymmetry among participants, it is natural to

inquire whether there can be optimal structures with associated reward systems which entail output sharing. That is, in the optimal combination of observation of subordinate, of authority delegation, and of a reward system efficiency gains from output sharing may outweigh loss to the superior from such sharing.

In fact, Hurwicz works out an example where the incentive structure is such that the superior can gain by misrepresenting the production characteristics while the subordinate is paid the value of his marginal product. In such a case,<sup>3</sup> output sharing would elicit optimal performance. Informational asymmetry usually takes the following form: a subordinate possesses more detailed information about his own productive possibilities and a superior knows better how subordinate fit into the entire operation. This example, however simple, does suggest efficiency gains from output sharing are plausible, even before worker preferences over work activities and the value from participation in decision-making are considered.

The views we express in this section constitute a technocratic dimension of the issues. There are also political and social dimensions. The workplace is a political milieu with social relations much too complex to be easily circumscribed. The technocratic approach helps to narrow the issues (and, perhaps, define them more clearly) and thus it facilitates analysis; yet it carries elements of bias. It is only social experimentation and political practice that may provide a way out of this «dilemma».

3. The example from Hurwicz [29 ; p. 25] goes as follows: A farmer produces by employing a worker. The farmer seeks to maximize output net of labor remuneration (in physical units) and the worker seeks to maximize income net of an index of disutility of labor. Output and the worker's earnings are determined according to competitive rules. Assuming that the worker remains a wage taker the farmer would gain by paying the worker according to a different marginal productivity schedule at a lower than optimum level of output.

1. This is also pointed out by Hurwicz [28] and many of the writers whose work is reviewed there. In particular, see Camacho [12, p. 65].

2. The notion of incentive-compatibility is formalized by reference to the game-theoretic concept of Nash equilibrium [28; 29; 30, p. 23].

#### IV. conclusions

This highly selective review—or, more appropriately, this journey through a seemingly diverse literature—is intended to illustrate the dangers of making direct use of neoclassical tools in analyzing the hierarchical division of labor and its welfare implications. Our main focus has been on how technology and forms of work organization are combined into patterns of job design which in turn, by «justifying» differential rewards can be used to preserve the stability of hierarchical relations and the controllability of the productive system. We took that side of the literature which maintains that neoclassical theory is inadequate since it fails to capture the nature of the power of employers over employees—power that is institutionalized in contemporary forms of work organization. Furthermore, from our point of view it does not suffice to attribute to presence of externalities<sup>1</sup> the inefficiency of the outcome of the development process for organizational forms.

Finally, it seems natural to ask for some concrete confirmation of the views we have supported in this essay. One possibility is to seek a link with the distribution of income for the following reason: to the extent that job structures and associated payment systems are devised to satisfy profit maximization, then job design may be seen as a determinant of inequality in income. There is two fold empirical support for this contention: first, the distribution of income in the U.S. has failed to improve in the postwar period in spite of impressive increases in the schooling and training of the labor force; second, many case studies have shown the unchanging character of industrial job structures. While most researchers have ascribed the problem of the income distribution to «deficiencies» in the supply of labor investigations of the role of the demand for labor (alternatively, the supply of jobs) in the persistence of an inequitable distribution of income have been few. Among those few are Thurrow and Lucas [50] and Bowles and Gintis [10]. In both cases the problem of the distribution

1. There is a *prima facie* case for the presence of externalities. First, the great variety of existing payment and incentive systems is significant [25; 41a; 57]. Not surprisingly, the motivational aspects of incentive systems tend to reflect prevalent social values. (This may well thwart productivity improvements but increases the stability of the system). Second, in all kinds of production there is indivisibility and joint production of output and training. This indivisibility precludes in most situations (as it is eloquently noted by Fitz-Roy [19] a unique allocation of costs. Thus the remuneration of labor may not reflect perfectly the acquisition of human capital. This, in turn, distorts the mechanism by which workers' sovereignty registers on the development of organizational structures.

of income is viewed as a structural problem. Bowles and Gintis have provided a robust explanation of how inequality is associated with the hierarchical division of labor. That is, first by the way in which earnings are set for individuals occupying positions of differential authority and responsibility, and second, by the nature of job ladders and promotions [10, p. 84-100].

Our discussion has not spared suggestions for future research. We would like, however, to emphasize two routes: First, a generalized theory of the firm should deal with how the objective of profit maximization in the long-run is translated into trade-offs between efficiency and controllability of the productive system. An important part of the latter is how technological change is related to hierarchical structures. This might be facilitated by combining the «Babbage principle» with theories of natural selection [58]. Second, comparisons of different socioeconomic systems (characterized by differing degrees of income inequality) may shed some light on the relationship between inequality and the social relations of production in the modern economy [32].

Most immediate, however, is the question of the political and economic feasibility of workers' control. This essay has emphasized the economic issues but the political and the economic are intimately related. We need not stress the importance of the political side. Political and economic democracy cannot be thought if independently from each other, and industrial democracy is an essential ingredient of economic democracy.

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