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Power, innovation systems and development

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ABSTRACT

Development is studied by combining normative, theoretical-factual, prospective and propositional approaches. Sustainable Human Development is the normative basis. Agency connects values and proposals. Evaluating its possibilities leads to the study of power. For that a Marx–Mann conceptual scheme is proposed; it considers technology, social relations and the interactions between them. It is used for analysing the role of power in National Innovation Systems and the rise of inequality. Strategies for fostering knowledge democratization in the context of Innovation Systems are considered. Problems and possibilities of developmental coalitions are discussed.

KEYWORDS

Power; inequality; Innovation Systems; development; agency; interactions between technology and social relations

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1. Introduction

The starting points of this paper are, first, the assertion that the National Innovation Systems (NIS) conceptualization needs to be linked with the study of power (Lundvall 2010, 340) and, second, that such conceptualization can help to study power stemming from the interactions between technology and social relations. Taking as a guiding thread the analysis of the connections between power and NIS can help to understand the growing knowledge-base of actual inequality, because the last is closely related with which actors are effectively incorporated to a given innovation system and with the role they play in the system. Thus, coping with inequality requires knowledge democratization fostered by the agency of underprivileged sectors in the contexts of innovation systems. These assertions will be elaborated in the following steps which are based on previous work (Arocena and Sutz 2014, 2017; Arocena 2016) and related with a general study about universities, innovation and knowledge democratization (Arocena, Göransson, and Sutz 2018).

Section 1 summarizes a notion of Sustainable Human Development (SHD) as the normative approach that orients the analysis of possible contributions of Science, Technology and Innovation to improving material and spiritual conditions of life. Development has to do with values, facts, trends and proposals, so development studies need to combine normative, theoretical-factual, prospective and propositional approaches, starting with the first one, that is, with the ethical orientation.

Section 2 presents what can be called a Marx–Mann conceptual scheme for the study of power that considers technology, social relations and the interactions between them. The

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focus on such interactions stems from Marx's theory of history. Following Mann paramount importance is assigned to economic, military, political and ideological relations. Such scheme suggests a characterization of underdevelopment today and of three interconnected causes for increasing inequality.

Section 3 offers a tentative analysis of power stemming from NIS and of the distribution of power within those systems in connection with economic, military, political and ideological relations. Special attention is given to what can be called the 'core triangle' of NIS with vertexes representing the productive structure, the government, and the scientific and technological infrastructure. Different distributions of power between them are considered as well as their consequences. The approach is related with Evans' conceptualization of 'embedded autonomy' of developmental states.

Section 4 aims to sketch proposals for development that are desirable in terms of the normative approach presented in Section 1 and seem minimally feasible in the context discussed in Sections 2 and 3. It starts analysing actual connections between the rise of inequality and threats to democracy. Strategies for coping with both problems have to prioritize knowledge democratization. For that a main issue is the active involvement of subordinated groups in advanced learning and innovation processes, so they can become agents in developmental coalitions. Some difficulties and possibilities are discussed.

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2. A normative approach to development

A synthetic characterization of development in normative terms must be consensual but not trivial, in order to inspire many different but compatible efforts in plural settings. It has to be widely shared and ethically sound as well as an orientation for studying and acting.

SHD has been characterized by the expansion of substantive freedoms and capabilities of people today without compromising those of future generations (UNDP 2011, 2; Sen 2013, 11). This widely accepted characterization combines the by now classic notion of sustainable development with Sen's notion of human development, where the expansion of freedoms and capabilities defines the goals of development and also constitutes the fundamental means of development (1999). Thus a sound normative approach to development is also an orientation for propositional approaches as stressed by the emphasis on agency: 'we need a vision of mankind not as patients whose interests have to be looked after, but as agents who can do effective things – both individually and jointly' (Sen 2013, 7). Summing up it can be said that *SHD* is (i) the expansion of people's freedoms and capabilities, both individual and collective, (ii) in order to lead lives that they value and have reason to value, (iii) in ways that preserve and enlarge the possibilities of future generations for living such lives, (iv) assuming that the expansion of freedoms and capabilities is both the defining aim of development and its main tool, which (v) implies treating people as agents, not as patients.

Human agency is the capacity that an individual or a group can have 'to process social experience and to devise ways of coping with problematic situations'; social entities that 'can be said to have agency' are social actors; they can be 'individual persons, informal groups or interpersonal networks, organisations, collective groupings and what are sometimes called "macro" actors' (Long 2001, 182, 241).

Inclusive development refers to processes that benefit marginalized sectors and in which such sectors take part. An agency-promoting notion of development requires that social groups take part in the processes that are supposed to benefit them. Thus, inclusive SHD is SHD focused in the problems of marginalized groups. Solving such problems requires inclusive innovation, defined as '*new ways of improving the lives of the most needy*' (Bryden et al. 2017, 7; italics in original). This view is not restricted to formal innovation: 'innovation in informal settings can be seen as an expression of collective action' (Cozzens and Sutz 2014, 20) where communities are involved as agents in the solution of their own problems.

SHD is an actor-oriented notion of development. It

> begins with the simple idea that different social forms develop under the same or similar structural circumstances. Such difference reflects variation in the ways in which actors attempt to come to grips, cognitively, emotionally and organisationally, with the situation they face. (Long 2001, 20)

It allows, in general, the recognition of structures or patterns of interaction and of deep trends, without attributing to them deterministic effects and without neglecting social heterogeneity, because human agency is the capacity of giving different responses to similar situations.

The normative characterization of SHD and its emphasis on agency lead directly to the study of power because individuals and groups can be agents when they have some power. Given the increasing role of knowledge in power relations inclusive SHD requires knowledge democratization. So this section is the basis for the following ones.

3. A Marx–Mann conceptual scheme for the study of social power

Development means expanding people's freedoms and capabilities to be agents in pursuing the type of life they have reasons to value, while power can be defined as 'the ability to pursue and attain goals through mastery of one's environment' (Mann 1986, 6). Here environment will be understood to be both natural and social.

Cooperation and conflict are both part of power relations; they have an 'external' dimension, called collective power, and an 'internal' one, called distributive power. Collective power is the power that an organized group has over nature or other people. Distributive power is the power within an organized group that is held by those with a major role in coordination and direction. Such dimensions cannot be separated (Mann 1986, 5–6).

The starting point of the conceptual scheme under elaboration is the following assertion:

> The pursuit of almost all our motivational drives, our needs and goals, involves human beings in external relations with nature and other human beings. Human goals require both intervention in nature – a material life in the widest sense – and social cooperation. (Mann 1986, 5)

That points both to technology and social relations or, better, to the interactions between them, as main sources of power.

Social relations as sources of organizational power have been studied in depth by Mann (1986, 1993, 2012, 2013). Fundamental human goals and needs generate ideological, economic, military and political (IEMP) relations. In the context of such relations action of people and use of resources are coordinated, so organized networks of interaction are

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created and maintained. It can be observed that Taylor (2016) has carefully stressed the role of social networks in national innovation processes. According to Mann (1986, 2), power stems from IEMP relations because of the specific 'organizational means' each of them has for attaining human goals. This emphasis on organization can be related in particular with the work of Galbraith (1973) about where power resides in modern economies.

'*Ideological power* derives from the human need to find ultimate meanings in life, to share norms and values, and to participate in aesthetic and ritual practices' (Mann 1993, 7). '*Economic power* derives from the need to extract, transform, distribute, and consume the resources of nature' (Mann 1993. '*Military power* is the social organization of physical force. It derives from the necessary of organized defense and the utility of aggression.' (Mann 1993, 8). '*Political power* derives from the usefulness of territorial and centralized regulation. Political power means *state* power' (Mann 1993, 9). The focus on such relations as sources of social power characterizes Mann's IEMP model.

The model has been criticized for not giving an adequate place to science, even suggesting that it should be considered as a fifth source of power (Goldstone 2006). A better option would be to go back to the assertion that human goals require both 'a material life' and 'social cooperation'. The first can be seen as the source of technological power while the second generates organizational power as described by the IEMP model.

Productive forces give a fundamental example of technological power, closely connected with economic power; other examples are destructive forces, directly associated with military power, and communication technologies, which are fundamental for every source of social power.

Thus it is useful to think in terms of a 'Marx–Mann conceptual scheme', where the inspiration of the materialist conception of history leads to paying specific attention to technological power (including productive forces but not only them) and to interactions between technology and social relations (Cohen 2001, 386); following Mann, special attention should be given IEMP relations. The focus on interactions is stressed by Castells (1996, 18). In his presentation of Marx's theory of history, Cohen (2001, 47) says: 'Productively relevant scientific knowledge does pertain to the material task to be performed, and therefore is a productive force.' In a Marx–Mann scheme scientific knowledge appears as an ever increasing source of technological power. Summing up, it will be assumed that power stems fundamentally from:

(1) Technology enabling the use of material resources in ways that have been greatly increased and diversified since the so-called marriage of science and technology.
(2) Social relations that generate organizational power by coordinating different activities, mainly IEMP.
(3) Interactions between technology and social relations.

The emphasis on interactions between technology and social relations helps to characterize some main configurations of power that frame today the problems of development. Yesterday the last were posed in the context of the world expansion of industrial capitalist societies. If the 'structural principle under which surplus is appropriated and controlled characterizes a mode of production', then during 'the twentieth century we have lived, essentially, with two predominant modes of production: capitalism and statism' (Castells

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1996, 16). Both were industrial. Ways towards industrial society were opened by the so-called Revolution of Energy, initially centred in the steam engine, that fostered the mechanization of manufacture.

A comparable world historic transformation has taken place. Knowledge-based societies emerged because advanced scientific and technological knowledge as a whole has risen to the position of a fundamental source of productivity and power. Such transformation has been fostered by the Revolution of the Technologies of Information and Communication. That happened while different processes of interactions between technological changes and social relations took place; state socialism almost disappeared; knowledge-based and financially dominated capitalism became the main power configuration, located in the North and shaping the world process called globalization.

In such context underdevelopment can be characterized by (many different combinations of) the peripheral condition and external subordination. The former points to the weak technological positions shaped by specialization in producing goods and services with comparatively low-added value stemming from advanced knowledge and high qualifications. External subordination is rooted in the differences in technological power between peripheries and centres. It is seen in different configurations of economic, political, military and ideological relations. A telling example of such subordination is offered by several international agreements and treaties concerning trade and investment that are a consequence of power asymmetries between the North and the Global South, particularly in economic and political terms, and also concerning ideological aspects; they sharply curtail the policies available to developing countries (ECLAC 2016, 150, 151). Thus external subordination can consolidate the peripheral condition. Underdevelopment is a major case of interaction between technology and social relations.

The Marx–Mann conceptual scheme suggests that three intertwined factors foster inequality. The use of power stemming from social relations to improve the position of elites has been thoroughly documented and explained (i.e. OXFAM 2016). In the USA that is seen in 'the vicious cycle where the political domination of the top leads to beliefs and policies that enhance economic inequality and reinforce their political domination' (Stiglitz 2012, 267). If organizational power is a strong source of inequality, so is technological power. The increasing role of advanced knowledge favours highly educated people and often damages the less qualified, widening income distribution (Milanović 2016, 54). It favours capital in its confrontation with manufacturing labour. New technologies are also a source of inequality within the entrepreneurial realm because 'exponential, digital, and combinatorial change in the technology' fosters a 'winner-takes-all' situation where cheap replication and delivery of the most economically successful procedures allow a small fraction of providers to capture a large fraction of markets (Brynjolfsson and McAfee 2014, 69). A third source of inequality is located in interactions between technology and social relations. Unequal control over knowledge production and distribution means unequal access to its benefits, unequal exposure to its damages and unequal use of it for consolidating the social powers that be. For example in 'areas as public health, food supply, environmental quality, and lethal combat [… it] strongly affects who survives and who lives comfortably' (Tilly 2005, 122). In particular, 'In recent decades, the combination of financial capital and scientific-technical knowledge has gained unparalleled potency in the production of inequality between those who control the combination and those who do not' (Tilly 2005, 115).

4. Collective and distributive power in national systems of innovation

Reformulating the characterization offered by Freeman and Soete (1997, 291), the NIS will be the name given to the set of actors and institutions and the linkages between them that, at the level of a given nation, promote technological innovation; it includes public policies, production activities, generation and diffusion of science and technology, and higher education. It is an adequate framework for studying SHD, following the recommendation of Sen (1999, 8–9) 'to investigate the development process in inclusive terms that integrate economic, social and political considerations'.

The creators of the NIS conceptualization during the 1980s were inspired by the work of Friedrich List in the 1840s on the 'National System of Political Economy'. List's aim was to elaborate policy recommendations able to foster the power of the German nation by then economically inferior to industrial Britain. Freeman (1987) explained the economic success of Japan after the Second World War by the strength of its NIS. Attention was driven towards the 'external' power of the system as such, that is, its collective power. Explanations were elaborated by considering both technology and institutions in a unified NIS framework that takes into account what different social actors do. Innovation as a social process includes both cooperation and conflict, so its actual outcomes are highly dependent on the 'internal' distribution of power among the actors that get involved in the process. The conceptual scheme sketched in Section 2 can help to understand why and how the innovation system of a nation influences both its collective power as a 'macro' actor and the internal distribution of power. Industrial capitalism can be seen as a set of specific combinations of modern industrial technologies and capitalist social relations. 'Industrial capitalism may have changed the whole population's lives more than any other power process in human history' (Mann 2006, 386). Why and how do specific combinations of technology and social relations take place? For answering this type of questions, the NIS tradition offers rich conceptual and empiric elements.

IEMP relations and NIS are clearly connected. A NIS exists to the extent that economic networks are able to obtain benefits by pursuing innovations in the national context. All the successful cases of late economic development combine political and ideological power in fostering the NIS. Military power was relevant in the German rise but the most outstanding example of its influence in fostering technological innovation is seen in the USA since the Second World War. The analysis of collective and distributive power in NIS must pay attention to the main actors in the system, to which we now turn.

Before the elaboration of the NIS theory and in a different context, a related model was proposed to study the connections between science, technology and productive development. It became known as 'the Sabato triangle' (Sabato and Botana 1968; Sabato 1975). Its vertexes represent the productive structure, the government, and the scientific and technological infrastructure; the connections between them are represented by the sides of the triangle. Those three 'macro' actors are the fundamental protagonists of innovation processes while the connections between them are the fundamental linkages that give a 'systemic' character to innovation processes considered as a whole: the Sabato triangle is the core of the NIS. One of its vertexes is the site of economic power; another one is the site of political and military power; those two vertexes define the 'upper side' of the triangle. Its technological basis can be identified with the third vertex. It is a useful metaphor for thinking about organizational power and technological change. Concerning industrialization

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the 'strategy that is most likely to be effectively implemented and enforced in a country can depend amongst other things on its internal distribution of organizational power' (Khan and Blankenburg 2009, 337). In general the configuration of power shapes national innovation processes, the internal distribution of its gains and losses as well as its consequences for the position of the country in the international order.

In the catching-up process of East Asia, the upper side of the triangle played a decisive role. That role was also remarkable during the period of regulated capitalism in the West when the state often established strong relations with labour, regulating conflict, allowing significant productive cooperation, strengthening the NIS and in some way incorporating trade unions to it (Evans 1995, 241).

The transition to the capitalist knowledge society means that advanced knowledge becomes decisive in the 'technological vertex' and in turn that this one is even more important than yesterday for the other two vertexes. Such knowledge is relevant to a widening set of activities, so innovation tends to be more distributed; new actors and linkages appear in the NIS; its collective power expands. Conflict also expands and deepens; winners and losers are related, for example, with research and innovation directions that are prioritized or neglected, learning and technical changes in working places, access and success in higher education, access to sophisticated health techniques, technological procedures in agriculture and food production, environmental impacts and living conditions. A losing sector has been industrial low-skilled labour in industrialized countries because delocalizations and the new technological conditions of production have severely weakened its organizational power and thus the bargaining position of trade unions.

In peripheral countries, the NIS is often reduced to a small upper side with, in one vertex, some second tier state organisms in charge of innovation policies and, in the other vertex, the relatively few firms that are interested and capable of taking profit of such policies. The ensuing national collective power is scarce. It grows if in the first vertex more relevant public organisms and officials are involved, and also if in the other vertex the set of productive units is comparatively wider; the distribution of such power will be less concentrated if, for example, such units show different sizes as well as different management and property structures. The possibilities of overcoming the peripheral condition are also highly dependent on whether the NIS is essentially reduced to that side or includes effectively the whole triangle. The role of the knowledge generation vertex in innovation processes is increasingly important for the configuration of NIS power. The issue is one of degrees: seldom is academy completely absent from national innovation but the situation is completely different – in terms both of collective and distributive power – if that involvement is restricted to a few research institutes concentrated in a privileged region of the country and dedicated to a few disciplines or it has a wide institutional, geographic and thematic scope.

Up to now the main winner of globalization as a nation has been China. Its NIS is strongly expanding. Its upper side is defined by the unexpected alliance between the authoritarian state dominated by the Communist Party and global capitalist networks with an increasing role of Chinese entrepreneurs. Such political and economic power relations look quite attuned with the strong nationalist ideology that prevails and points to strength military power. A strong state effort in research and higher education consolidates the triangle. The collective power of China stemming from its NIS grows quickly. Its internal distribution is highly skewed.

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The conceptualization of NIS has been closely related with the rapid catching-up that took place in some countries of East Asia during the second half of the XX century. That happened with the 'upper side' as the main protagonist. The process inspired the notion of 'developmental state' (Johnson 1982). As characterized by Thurbon and Weiss (2016, 638), it combined the purpose of central actors to catch up with the West – a source of ideological power – a Weberian bureaucracy that enhanced state capabilities, and a strategy for technological upgrading that, particularly in the case of South Korea, was crucial in overcoming the peripheral condition. An interaction between technology and ideological power became relevant as 'technonationalism' (Nelson 1993, 3) which was a lever of technological upgrading in catching up orientated NIS of East Asia.

In South Korea, the upper side of the triangle fostered the external power of the nation and also an unequal internal distribution of power, to the disadvantage of labour (Evans 1995, 231). There the state could enforce productive upgrading and learning by entrepreneurs partly because the industrial elites were not strong enough for protecting inefficient rents nor could find support due to the weakness of landed elites (Khan and Blankenburg 2009, 350). A situation of that type is usually exceptional and tends to be transient: industrialists in general prefer a state with a smaller degree of autonomy (Evans 1995, 232). In Latin America protection to new industries was in general neither dependent on technological upgrading nor restricted to a period considered sufficient for it; that led Fajnzylber (1984) to speak of Latin American 'frivolous protectionism' as fundamentally different from East Asian 'learning protectionism'. The difference may be more one of political power than of policy design: in Latin America 'alliances between strong landed elites and emerging industrialists' hampered infant industry strategies (Khan and Blankenburg 2009, 359).

In Latin America during state-led industrialization, subordinated incorporation of labour to the benefits of the process was often significant and even the political basis of some of the most active industrializing governments, those with a 'national popular' orientation, in which national entrepreneurs were expected to play a relevant role. The situation changed with the shift to authoritarianism, when the political vertex was dominated by the military and the economic vertex by transnational capitalism, while labour was excluded. That concentration of power had different economic and technological results but the peripheral condition was not eroded.

If technonationalism was a main ideological factor shaping the catching-up East Asian NIS, aiming at social inclusion shaped in no small measure the welfare orientated Nordic NIS. Elite domination was relatively weakened during a long period (Mjøset 2016). Innovation was more distributed and moulded by linkages between a broader set of actors than in other cases. Such traits are apparent in the description of the Danish Innovation System offered by the Aalborg school (Lundvall 1985, 2002; Christensen et al. 2008).

Catching-up NIS has been dominated by the upper side of the triangle. 'In developmental states, connectedness has meant ties with industrial elites. Can embedded autonomy also be built around ties to other groups?' (Evans 1995, 228). That is, can less powerful sectors be effectively incorporated to NIS?

5. Learning upgrading in developmental coalitions

The capitalist knowledge society is generating serious threats for democracy:

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> *Currently democratic regimes that do not exercise new collective controls over financial capital, information, media, and scientific-technical knowledge and/or redistribute value produced by them will therefore risk de-democratization, hence decline in their subject population's well-being*. (Tilly 2005, 206, author's italics)

Winners of globalization are one source of such threats; it points to plutocracy. Since poor people and middle class could change the course, 'the focus of the rich is on democracy suppression' (Milanović 2016, 200). Risks of de-democratization also stem from a different source. The increase of inequality fosters in the West right-wing reactions backed by losers from knowledge-based and capitalist-driven globalization. Many supporters of such processes are people harmed by deindustrialization, with poor employment possibilities because of low educational levels (Tregenna 2016, 725). Such people feel harmed by immigration. The reactions they back are chauvinistic. Their leaders present other nations and foreign people as scapegoats. Political democracy is harmed by such processes and the concentration of power is increased rather than diminished. Those reactions attack at the same time financial regulations, the welfare state, international cooperation and environmental protection. They damage their less favoured supporters in particular and humankind in general.

So the concentration of power in globalizing elites fosters plutocracy, while chauvinistic reactions against such elites may be even more harmful for welfare state and political democracy. Both are needed for common people to retain 'a degree of control over their collective fate' and have some protection from 'the unpredictable forces of economic change' (Judt 2008, 424, 425). Compacts or coalitions able to defend representative democracy as well as the welfare and regulatory state need to confront the roots of inequality. As previously argued, its rise has three sources that can only be separated in a very simplified description that aims to point out different ways of coping with it.

The first source has become famous under the label 'for, by and of the 1%'; it is the use of economic, political and ideological power to favour the top echelons of elites. Facing such actions requires among other things the construction of political coalitions with a broad social base and a redistributive agenda. Let us call them popular coalitions. Political and ideological power relations are involved. Their shortcuts notwithstanding, the so-called progressive turn seen in the government changes in several South American countries during the first years of this century showed that possibilities for diminishing inequality in this way have not disappeared.

Another source of inequality has to do with prevailing interactions between knowledge and social relations, mainly economic relations. They can be partially described by saying that only privileged sectors are really integrated in innovation systems. Coping with this problem requires fostering inclusive systems for generating and using advanced knowledge in socially valuable ways, where the problems of marginal groups are given priority. That is a fundamental example of what is meant by knowledge democratization. It seems to need the combination of public policies with initiatives and efforts of trade unions, cooperatives, social movements and the like, that is, collective actors related with not privileged social groups. The latter maybe loosely called popular actors. Usually neither the agendas of popular coalitions nor those of popular actors pay much attention to building inclusive systems for democratizing knowledge. Of course relevant exceptions exist.

A third type of inequalities stems directly from the actual social role of advanced knowledge. Access and success in higher education is on average an increasingly relevant

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source of income and influence that is still denied to many people. It is an almost necessary condition for participating effectively in decisions concerning research and innovation. It is a main way for rising to positions near the economic and political elites. Thus it is directly related with the previously considered types of inequality. Consequently it should not be a surprise that those opposing the expansion of free access to public universities often include today people who yesterday benefited from it. To make advanced education not a source of inequality but a lever of knowledge democratization it is necessary to generalize access and success to higher education.

Seeing people as agents is the main orientation for propositional approaches to SHD that stem from its normative characterization. Redressing inequalities has not been frequent in history without the agency of subordinated groups. It has to overcome differences of power, organizational and technological. The groups that coordinate and control the most important social relations have in general a remarkable organizational superiority over the rest of society. This is a first factual problem for the agency of popular actors. A not smaller factual problem stems from the increasing role of advanced knowledge in power relations. What kind of agency can subordinated groups have in the context of knowledge-based and capitalist-driven globalization?

It is a fact that such groups are often capable of reacting against damaging processes in ways that improve their situation. Governments based on popular coalitions can, if economic surplus is on the rise, foster redistribution and thus redress inequalities to some extent; but they are less able of promoting economic policies that differ much from prevailing ones. Trade unions are sometimes able to obtain significant improvements in working conditions; but technological evolution and actual social relations make that quite difficult, particularly in industry, while leaving small spaces for cooperatives or similar ways of organizing production of goods and services. Populations harmed by polluting activities of big firms often fight against them; but especially in underdeveloped countries they are curtailed by lack of own expertise, the power of their adversaries and because some people want to get a job related with such activities since they see no other opportunities.

Agency mainly against something (neoliberal policies, workers exploitation, contaminating activities, etc.) may be termed *reactive agency*; it is a factual and not normative denomination. *Proactive agency* of an actor is agency for promoting a project of that actor. For example, a group that acts in the context of an innovation system in order to promote specific projects for knowledge generation and use shows proactive agency.

The recent experience of South America is quite telling concerning possible agency of popular actors. The convergence of political changes and economic bonanza driven by the increasing prices of commodities generated strong redistribution and the historically high inequality was diminished. Trade unions and several other social movements backed redistribution. But neither they nor political parties in general became agents of new learning and innovation policies. Such issues were scarcely incorporated in their agendas. Their agency was much more reactive than proactive.

As in other places, the estrangement between advanced knowledge and popular actors is apparent in South America. When the bonanza weakens, an old problem becomes more difficult to solve than yesterday: 'The problem of adding a project of accumulation to a redistributive agenda is even more daunting than the problem of adding a redistributive agenda to a project of accumulation' (Evans 1995, 239). After the commodity boom, it

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is apparent that productive structures have not been strongly transformed (ECLAC 2016). Progressive governments were scarcely willing or able to play a role as the 'articulating vertex' of the core triangle in NIS.

Nevertheless some important and promising new experiences took place in the realm of innovation policies. A relevant one concerns Local Productive Arrangements (APLs is the acronym in Portuguese) in Brazil. They have been influential concerning usually neglected groups, regions and productive structures. Relevant examples include expanding popular housing by means of the program 'My home, my life'. APLs have mobilized local potential in several regions of Brazil. The underlying theory, directly related with the NIS conceptualization, and the main orientations for connecting it with practice were elaborated by the academic network RedeSist, formally set up in 1997 (Cassiolato, Lastres, and Soares 2014, 74, 75, 88; Mazzucato and Penna 2015, 54, 55).

APLs show how groups, localities and productive tasks usually absent from Innovation Systems can get involved in innovative activities when they are effectively promoted by the 'side' of the triangle determined by the State, as the articulating vertex, and academy, as the knowledge supporting vertex.

Propositional clues stemming from the normative characterization of SHD as well as the NIS conceptualization for the study of interactions between technology and social relations, with its emphasis on linkages between 'distributed' activities, point to the need of (new type of) convergences or coalitions of several actors.

It is said that 'upgrading coalitions' (Doner and Schneider 2016) are needed to overcome the 'middle income trap'. Countries are caught in such trap when their production can compete neither by salary (with lower income countries) nor by learning and innovation capabilities (with high-income countries). The trap is located in the upper echelons of the peripheral condition. In fact 'many developing countries today are uncompetitive against a country such as China with respect to both unit labour costs and technology' (Tregenna 2016, 723). Doner and Schneider (2016) argue that business and labour should be the core constituencies of needed coalitions which are hampered by high inequality and fragmentation of social groups.

Mobilization of subordinate groups is usually needed for states to remain relatively autonomous from economic elites as well as connected or 'embedded' in society (Evans 1995, 246). Without incorporating subordinate groups to Innovation Systems, knowledge-based and inequality-diminishing development has a low probability, so the really important trap – which could be called the peripheral trap – is hard to overcome. Needed coalitions have to include popular actors, but that does not ensure its 'upgrading' character: they can be only distributional coalitions. The last happened in no small measure in the case of popular coalitions in South America. Aggregating different interests in a minimally coherent and long-term collective project is supposed to be the task of political parties that want to lead the state seen as the articulating vertex of the core triangle in NIS. That 'depends first of all on finding a "joint project" that unites the state apparatus and its societal constituencies' (Evans 1995, 246). A 'joint project' points to ideological relations. What can be today the ideological support of a project of the type under consideration? Technonationalism was part of the answer in the case of catching-up projects in East Asia fostered by the upper side of the core triangle in NIS. Technonationalism is potentially very effective since it points to combine organizational power and technological power. Several development efforts in the peripheral world during the last 60 years

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were inspired by (some sort of) technonationalism; but in general it was not the predominant orientation, and relevant successes seem to be concentrated in East Asia.

Coalitions or compacts for SHD can be termed developmental coalitions. By definition they need the ideological power that stems from democratic values: such values are centrally involved in the expansion of individual and collective capabilities and freedoms as ends and means of development. So SHD as an agency-based general project cannot be separated from democratization understood as empowering people. It is given substance by concrete processes countervailing distributive power. That is never easy, particularly because 'distributive power derives originally from collective power, i.e. […] stratification derives from social cooperation' (Mann 2006, 366). Distributed power is often increased by the interactions of technology and social relations; main contemporary examples of that can be seen in how elites control the generation and use of scientific and technological knowledge.

Articulating coalitions and carrying into practice their projects are the political and ideological tasks of elected officials, policy-makers, political parties and social movements. Academic work can at best suggest some points that could be useful to take into account. This is the content of the propositional approach to development; it is of course related with public policies but should be wider aiming to be of some use for different actors while they elaborate and implement their strategies in the general context of SHD.

Knowledge democratization needs to be considered as a fundamental orientation for such strategies. When combined with the NIS conceptualization, it gives up most priority to the incorporation of subordinated groups to the NIS as agents of generalized learning. From such premise several suggestions follow for acting in the context of the Sabato triangle.

The triangle as such is a working model. An example is the Uruguayan Extensionist Center. Academics made the original proposal. It was institutionalized as a partnership between the Ministry of Industry, the entrepreneur's Industrial Chamber and the University of the Republic. It fosters connections between potential demand of knowledge stemming from firms, especially small ones, and academic teams that can help in coping with such demand in ways that combine what different actors know.

University–industry relation is a widely studied issue. It can be seen as the usual interpretation of one of the sides of the core triangle. Sometimes, by talking about technological transfer, that side is assumed to be a one way street. Considering instead university relationships with industry and society puts the focus on interactive learning processes, where different actors contribute with their specific knowledge and all learn while trying to jointly solve problems in new ways, also called innovating. That aims at including subordinated groups in the innovation process, that is, in the definition of the problems that have to be solved, in the search for solutions, and in their implementation. Fostering such interactive learning processes requires that academic policies and incentive systems give them real priority. It also requires that governments connect innovation policies with usually neglected groups, regions and productive structures. Moreover, it requires coping with what is in this context the most difficult problem, access and success of not privileged groups in advanced learning processes. Without that, such groups will probably be patients rather than agents in several innovation processes and often just losers. The emphasis on agency remembers that popular actors should be main protagonists in overcoming such situation. In some cases, their interests may point in such direction: 'in a

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worker cooperative the workers are shareholders, with an interest in training workers with relevant skills' (Hodgson 2015, 379).

Learning upgrading is directly related to coping with unemployment, fighting the degradation of jobs, overcoming subordination and fostering human realization in work. It potentially benefits upgrading production, environmental protection, social improvement and knowledge expansion. It is a sine qua non condition for knowledge democratization and for SHD more generally. In the long term it benefits people in general. It should be a strategy that characterizes developmental coalitions. The problem is how to foster it in the context of contradictory interests and inherently conflictual economic, political and ideological relations. Here it must be remembered that learning takes place not only in educational institutes but also in any activity where a problem needs to be solved not by routine procedures but by doing new things. Advanced permanent learning will increasingly take place in creative working activities. When that happens, efficiency may be improved. Thus ways could be found to connect learning and working with two interrelated consequences: first, things are done better in the production of goods and services in general and particularly in public administration; second, material and spiritual interests of workers are better served.

Collective power requires coordination and systematic organization, while organization implies unequal distribution of power, social stratification and conflicts. But history shows that democratization is feasible. It means increasing collective power of subordinated groups and decreasing distributive power. What is called political democracy refers to some levels of democratization of political power that, in a historical comparison, are relatively high. They are far from perfect (in any sense of the word) and also contingent: they need to be protected. Protecting democracy in one realm requires both deepening and widening it; specifically, protecting political democracy requires both promoting political democratization and connecting it with democratization in other realms. Concentration of knowledge (i.e. knowledge de-democratization) threatens political democracy, for example, via the expansion of plutocracy, while the last implies conversely that the benefits of knowledge (in health, for example) become more concentrated. But things can turn the other way round: political democratization and knowledge democratization can help each other. In any case, it is increasingly difficult that one takes place without the other.

Linking political democratization with knowledge democratization is a typical task of what above was called the articulating vertex of the core triangle of the NIS. A democratic project in the XXI century requires articulating claims and efforts of popular actors in ways that back, and are backed by, generalizing advanced learning connected with productive work as well as with the expansion of research and innovation closely related with social priorities.

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