

The new organization of production, productive development policies  
and job creation

or

Thinking about industrial policy as industry becomes less central to  
development

Charles Sabel  
Columbia Law school

RELATIONS BETWEEN PRODUCTIVE DEVELOPMENT POLICIES,  
JOBS, WAGES AND HUMAN RESOURCES  
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Deep changes in the organization of production have made industry -- manufacturing -- less central to industrial or productive development policy, while increasing the relevance of agriculture, mining and services in both the public and private sectors. The same changes have diminished the importance of national or macro - level concertation and conceptualization of PDP's relative to the creation of lower level fora for completing and correcting broad, initial plans by addressing ground-level problems arising in policy implementation. Given the traditions of thinking about economic development in Latin America, it is natural to cast these changes as a shift from an old to a new structuralism from industrial policies centered on national business/government councils to industrial policies that encourage ongoing exchanges between higher level bodies with convening and coordinating capacity and ground level bodies addressing concrete problems, each correcting the shortcomings of the other.

The central claim of the old structuralism was that some activities are intrinsically rich in capacities generated at the frontier of world technological capability, while others are not. Activities that are rich in capacities are the core of the modern economy; those that do not are its periphery. Agricultural goods and minerals--commodities--were thought to be inherently peripheral products. Countries that produce them were trapped far from the knowledge frontier, incapable of generating the skills to get there. Industrial goods on the contrary were seen as inherently central. Once a country started producing them it automatically gained the capacity to produce more and more sophisticated goods both in the original line of industry and in others. Hence modernization was equated with industrialization--whence the idea that development policy is industrial policy. More recent versions of structuralism, such as maps of the product space, say the same thing with greater technical sophistication, while emphasizing, as we will see, an important generalization about the association of capacity - building and growth. Contrast the view of neoclassical economics, according to which products are not associated with (capacity - rich or capacity - poor) production processes at all. Rather

in this view products can be made with varying combinations of capital and labor, with the most efficient combination determined in each case by the balance of the producer's particular factor endowments. It does not matter for present purposes whether the old equation of industry with central capacities was correct or not – – though there is substantial historical evidence that the equation was partial and incomplete.

### **Three Fundamental Changes**

Profound changes in the organization of production, resulting from self-reinforcing advances in technology and institutional design in a context of growing uncertainty or inability to predict future states of the world, have revalidated the most general claim of structuralism while invalidating its focus on manufacturing and dismissal of commodities and services. Three changes are key.

First is vertical dis-integration: the decomposition of production into tasks—research and design, production of components or sub-systems, assembly of the final product—accomplished by independent firms collaborating with many clients and linked in supply chains. The more uncertain the development of markets and the trajectory of technological change, the riskier it became for mass producers of goods such as automobiles or household appliances to own suppliers of components whose products could abruptly become obsolete because of unforeseen innovation or superfluous because of a shift in demand.

The second change is the globalization of supply chains—locating production facilities where the costs of production are most advantageous, or to serve important markets with distinct characteristics. Globalization was initially seen as part of a strategy of cost-cutting; only later did firms begin to see that production in new and distinct markets facilitated innovation in both manufacturing process and product design.

The third change is the shift within these supply chains to just-in-time or continuous improvement production and design systems based on immediate error detection and correspondingly short learning cycles. Mass – production firms hedged against breakdowns in operations by holding

large buffer stocks of work – in – progress inventory. Uncertainty dramatically increased the cost of these hedges. Firms responded by eliminating the buffers – – at the limit producing one piece at a time – – so that breakdowns would stop production and operations could only resume when the disruption had been traced to its source and corrected. Instead of concealing breakdowns through inventory hedges the strategy was to reduce the possibility of breakdowns by making production more vulnerable to them and firms more able to learn from what this vulnerability revealed.

There were analogous changes in the process of design. Traditional mass producers sought to reduce errors downstream in the implementation of designs through exhaustive upstream planning: given enough time, all potential flaws could be identified and eliminated. As the pace of innovation accelerated and the trajectory of technological change became more uncertain firms began to collaborate at the outset of new designs with key – – first – tier – – suppliers of critical components and sub-systems, and each step of these collaborations is likely to be informed by exchanges between the design department and manufacturing.

To the extent that just – in – time production implies co-location – – the physical proximity of suppliers to customers to reduce the costs of frequent deliveries and facilitate communication--it cuts against against globalization, at least as a strategy for securing static, rather than dynamic efficiency gains. Similarly, to the extent that just – in – time analogues in design imply the proximity of design to manufacture, they too reduce the attraction of globalization understood as simple cost cutting. These trade offs are under constant review by transnational firms; and for this reason alone – – quite apart from obvious political – economy considerations that make one location or supplier more attractive than another--their supply chain and globalization strategies are continuously adjusted (for example, by greatly increasing the number, and enlarging the roles of lead – company engineers co – located in the supplier's plant) and may change significantly (as for example when Nike in recent years required major suppliers to demonstrate capacity for just-in-time production).

## **What's Valid, What's not in Structuralism**

How do these fundamental changes bear on the validity of the structuralist claims? First, all together, but especially the decomposition of production into independently organized tasks, impose or re-enforce a distinction between capacity-rich and capacity-poor activities central to the structuralist thesis. Suppliers are routinely graded by competence, with the most qualified collaborating with their customers in design and production, and the least executing routine tasks. Because of the implications of just-in-time methods for co-location of suppliers and firm-level learning it is possible for some suppliers to advance up the competence hierarchy, acquiring additional capacities—upgrading. But this opportunity comes at a cost. The capacity to develop capacity itself has demanding prerequisites – for example an increasingly literate and numerate workforce or the ability to attract and coordinate complementary investments (a sterilization facility to foster development of a cluster of medical device makers, or a textile maker for a cluster of garment firms). These are just the kinds of prerequisites that middle – income countries in Latin America, with their disastrous education systems and limited capacities for policy coordination, may struggle to meet. If the chief lesson of structuralism was that countries should take extreme care to (be able to) choose economic opportunities that are capacity rich, then fundamental change in the structure of production has not lessened its relevance.

But while this general lesson remains valid, the structuralist insistence that industry is the privileged vehicle of capacity building seems partial and misleading. Modern manufacturing is characterized by vertical disintegration, short learning cycles, and globalization. But these same traits are coming to characterize agriculture, mining, and private, business – related services, as well as provision of service – intensive public goods such as education (though globalization in any straightforward sense is plainly less relevant in this last case). Manufacturing is no longer distinct. If modern industry is conducive to learning, so too are these other sectors. At the same time, and for reasons peculiar to it, manufacturing has changed in some ways that make it less availing that it has traditionally been as an instrument for capacity building. It would be too much to claim that everything but manufacturing is the new manufacturing, especially since, as we will see in a moment, there is an important and worrisome sense in which *nothing* replaces traditional manufacturing in all its developmental

functions. But even a cursory review of developments in the various sectors is sufficient to show that structuralist concern for capacity building should lead us to broaden the scope of PDP's beyond their conventional ambit.

### **Where Is Capacity Built Today?**

Start with the developments in manufacturing that diminish its attractiveness as an engine of productive growth. The first is a secular decline in the share of manufacturing employment at its peak in total employment of successive cohorts of industrializers. For early industrializers such as the U.S. and Germany manufacturing employment peaked at 30 percent or more of the workforce. For Brazil the peak came at 16 percent, for Mexico at 20 percent and for India 13 percent. Even in China the peak was 17 percent (which it reached in 1996).

Part of the explanation has to do with technological progress. As manufacturing becomes more productive the prices of manufacturing goods decline and fewer workers are required to make them, even accounting for the increase in demand that results from lower prices. But part of the explanation -- and a part especially relevant for present purposes -- has to do with globalization and trade. Developing countries with small and relatively weak manufacturing sectors are price takers. As the prices set for manufactured goods in the advanced countries decline because of technological progress, manufacturing becomes less attractive for the developing price takers. The result, reflected in the low employment shares of India and Brazil, is what Dani Rodrik calls "premature deindustrialization"; and this deindustrialization throws a spanner in the works of what he calls the "automatic escalator" by which manufacturing activity, starting at the most basic levels, has historically conveyed developing economies to higher productivity and secure jobs.

The second limitation is that some of the most labor intensive manufacturing offers essentially no opportunity for skill acquisition. The paradigmatic case is final assembly of mobile phones or many kinds of computers by specialized contract manufacturers. The products are of course extraordinarily sophisticated and complex. But the sophistication and complexity are in the components. Final assembly consists of a sequence of very simple tasks or standard operating procedures defined by the lead firm; were it not for frequent model changes, assembly would be

automated. As it is jobs in these factories--the largest of which can employ several hundred thousand workers--are extraordinarily low-skilled. Many can be learned in 30 minutes, particularly demanding ones in several days. Maintenance workers are specialized in the repair of the single machine. Industrial engineers are limited to making slight adjustments in the standard operating procedures established elsewhere. Arrangements of this kind make it impossible to learn general skills on the job (though more experienced workers do acquire plant-specific skills on which the factories depend).

Some contract manufacturers operating under these conditions can climb the competence hierarchy by mastering additional capacities. But they do this as companies, using the returns on low-skill activities to diversify into new lines of work (robotics, specialized consumer electronics) and new workforces—current workers (and even industrial engineers) are in dead-end jobs.

It is of course very difficult to estimate what share of manufacturing employment in middle income countries is subject to these limits. The point in underscoring the limiting case is not to suggest that manufacturing can no longer make a fundamental contribution to development. Rather the aim is to interrupt the intellectual reflex that automatically associates manufacturing employment with growth. Malaysia and China -- and more recently Brazil -- went to great efforts to attract contract manufacturing in the last decades. The more prosperous Chinese provinces now refuse contract manufacturers' applications for zoning permission to extend production; Malaysia is having related second thoughts about the concentration of contract manufacturers in Penang. As a delayed developer Latin America is perhaps especially at risk of anxiously seeking some things it had best not want.

At the same time that manufacturing is suffering these reverses the new production disciplines such as just-in-time and its equivalents have spread to the other sectors. Developments have been most dramatic and extensive in agriculture, most conspicuously in the vertiginous diffusion amongst advanced producers of precision or no till planting.

As its alternative name indicates, precision agriculture does away with

plowing. Instead of opening the soil and then seeding, seeds are inserted (through the biomass remainder of the previous crop) essentially one at a time, to a depth and with a dosage of fertilizer adjusted to the conditions of each "pixel" of land. This avoids soil compacting and thereby erosion and increases yields; results are monitored pixel by pixel, and planting conditions are adjusted again to take account of micro-field conditions, unexpected effects of drainage patterns and so on. Starting in the 1990s the introduction of no till reversed the dramatic fall in the productivity of the Argentinian Pampas due to traditional mechanized plowing and aggravated by efforts to compensate for the deterioration in soil quality through increased use of fertilizer. Latin American is today a world leader in this new form of agriculture, and its productive growth rates in this sector are among the highest in the world.

The success of precision agriculture has had important spillovers in other sectors. It encouraged, for instance, the emergence of firms using sophisticated biotechnology to adapt seeds to precise local contexts while also developing important new traits. Some of these firms have become multinationals in their own right. It has also induced, in Argentina, the rise of a cluster of highly capable agricultural equipment manufacturers, specializing in the production of no till seeders and sprayers for targeted, low-dose application of pesticides and herbicides.

Developments in livestock raising are similar. RFID tags and user-friendly data-entry and retrieval systems allow comprehensive registration of movements and feeding of individual animals. Such complete traceability, combined with advances in genomics, leads to better breeding and herd management, again based on continuous improvement through short learning cycles. All this makes it possible to comply with existing -- and, in the case of Uruguay -- take part in creating new phytosanitary standards, thus opening new markets for exports of high-quality products.

All of these developments are especially significant because, in contrast to manufacturing, there are substantial and increasing possibilities for on the job learning on farms and other parts of the agricultural supply chain. Moreover, the foundation of the generally applicable knowledge--in biotechnology, or equipment design or in database management--that they generate is intrinsically local. The farmer knows best what works in her fields. In a competition to customize seeds and tools to the farmer's needs



the domestic producer, who in effect grew up with the farmer, has an advantage that her foreign competitor cannot match. In this sense the particularities of place create a sheltered space for innovation in the new agriculture (and other sectors) that only marginally exists in manufacturing today.

Mining has long been more capacity – and knowledge – intensive than its reputation as a commodity – producing sector would suggest: 20% of Australian copper mining export revenues derive from copper mining related IP. As in agriculture the introduction of a new paradigm depended on the exhaustion of the old one. The current paradigm is open – pit mining: excavation from the (mountain) top down. But the deeper the pit the greater the energy costs of recovering ore from the bottom. And the bigger and deeper the pit the greater the environmental burden of dust and other particulate matter released by excavation.

"Continuous" or "subterranean" mining is the alternative. Production is largely automated. Drilling is from below, using small explosive charges and gravity to dislodge ore onto conveyor belts for transport to the surface.

So unlike the switch to precision agriculture, the switch to the "ore factories" will not generate possibilities for mass employment, and the transformation is incipient, not well established. But given the distribution of ore—30% of world copper reserves are in Chile—the new methods will certainly be introduced early in Latin America. The question is whether Latin American firms and workers participate in the development of the new technology and the important capacities in robotics, sensors, factory automation and software associated with it.

Consider finally the transformation of the service sector, public as well as private. The production of services, like the production of commodities, was traditionally thought to be resistant to innovation. Where commodities were thought to be by nature fixed – – unchanged and unchangeable – – services were thought to depend on idiosyncratic personal relations resistant to any systematization; and this assessment coincided with the self perception of professionals in law and medicine who traditionally viewed the rules of their craft as ineffable.

This view has changed in recent decades because of strong evidence of productivity gains in service provision, but perhaps more fundamentally because the boundary between production of goods and production of services is breaking down. A salient case is the production of continuous (productivity) improvement itself. The capacity for continuous improvement is, we saw, a characteristic trait of the new manufacturing. If that improvement is produced by an internal team of line workers and their supervisors, it is a manufacturing product and the productivity gain is fairly booked as an increase in manufacturing productivity. But now suppose, as today is often the case, that a standalone firm specializing in process improvement contracts with a manufacturing firm to reduce the latter's tooling costs (partly by introducing new, custom-designed appliances, partly by suggesting reorganizations in production) in return for a share of the cost savings. The standalone firm is now a provider of Knowledge Intensive Business Services or KIBS, whose own productivity increases as, though economies of scope, it learns to boost the productivity of its clients. Similarly a KIBS firm might contract to reduce the incidence of blow-outs in the tires of enormously expensive off-road mining equipment, or provide design or research expertise to improve products or seeds. Wherever the productivity gain is booked, it is clear that capacity generation is intrinsic to the provision of services in all these cases.

The service sector as a whole in Latin America is marked by low productivity; and its performance contributes importantly to the low productivity of Latin America overall. But many of the highest productivity service firms in Latin America are KIBS linked to the production of renewable resources.

Of the changes touched on so far one of--perhaps the--most important concerns reorganization of service provision in the public sector, especially reforms in education and in many social services such as child welfare, family support services, and labor market activation. These reforms are of a piece with the changes discussed so far because they, too, aim for the construction of organizations that can diagnose problems, monitor the effect of initial responses, and alter responses in the light of experience. Given diverse students, many of whom do not come to class equipped to learn by themselves, attendance will only improve educational outcome if the school is able to track individual performance and adjust pedagogy to individual need. Analogous customization is increasingly seen as

necessary in many other social services.

As experience in the advanced countries shows, constructing organizations with these capacities requires reconfiguring existing public bureaucracies and revisiting long-standing employment relation. It requires rebuilding existing training facilities for teachers and others, or creating new ones. It requires changes in union – management relations which are likely to be difficult for both sides. It is easy to think of reasons why such reforms will be both easier and harder to accomplish in middle-income countries, but nearly impossible to think of reasons why on balance they will be easy.

Daunting as prospects of reform are, they are doubly critical. Unless they succeed, Latin American economies will simply not be able to meet the requirement for a literate and numerate workforce which is the prerequisite for entry into the capacity building economy. But if they do succeed, the reforms will create substantial employment opportunities with wide scope for the the job learning.

What do all these sectoral changes amount to? In particular, will these shifts, by themselves, solve the vast employment problems faced by developing countries, especially in Latin America? The answer is almost certainly not. Given the attraction of cities, and the slow pace of change in the public sector even when change is possible, it is hard to imagine that the new jobs in the “new” agriculture, mining and services, public and private, will together in the short run absorb the current cohorts of unskilled workers and afford them chances for on the job learning. It is in this worrisome sense that the sectors comprising the "new" industry are nothing like a complete substitute for the old.

### **Back to the Core of Structuralism**

But recall that, stripped of historically contingent commitments, the core of structuralism is the idea that development requires access to activities that generate general capacities to get and stay close to the frontiers of world productive knowledge. From this point of view the key question is not whether the “new” jobs alone solve the old problem but whether they can contribute to growth by their spillover and multiplier effects effects--

whether, that is, the creation of a stock of generally applicable skills will foster development of domains of the economy beyond current reach. The important contribution of technically sophisticated versions of structuralism is to show that precisely this is the case. The shorter distance between two activities on neo-structuralist maps of the product space the greater the likelihood that the ability to do one implies the ability to do the other, with master activities--those that allow easy movement among the most demanding and lucrative tasks--at the center and those that are (almost) self limiting at the periphery. Looking at the product map of any particular economy, it is therefore possible in principle to identify the path of short (feasible) moves from activity to activity that leads most directly from the periphery to the general capabilities at the center. This is the economy's high road to growth.

These maps, however, capture and synthesize historical experience--the distance between activities as they traditionally were; and because they are in this sense backward looking they are an unreliable guide to the way forward in the current era of deep change. (Agriculture and mining, for example, are typically shown on these maps as very "far" from the core of the economy, when in, in fact, the distance as we have seen is rapidly decreasing.)

But even if these products maps are unreliable guides for policy, they are invaluable as documentation of the general propositions that less demanding capacities have spillovers into more demanding ones, and the more demanding ones do indeed have very general applications. From this vantage point -- the one faithful to the structuralist conviction that capacity building is the key to growth -- the importance of innovations like the ore factory is not the immediate needs it meets but the otherwise unreachable possibilities it generates.

Assuming then that skills do have important spillovers and multipliers, fostering the creation of capacity-generating jobs in all sectors—and especially those where Latin America is already performing well—is imperative. How can PDPs help?

## **PDPs and Uncertainty**

Recall that firms facing uncertainty respond not by hedging, but by increasing their vulnerability to disturbance and their ability to learn from the defects in goals and organization that failure reveals. PDPs whose aim is to encourage the growth of firms that can respond to uncertainty (and can therefore take advantage of upgrading possibilities in global supply chains) or encourage development of public services continuously adjusted to particular needs do the same: Like the firms themselves, and drawing on information that firms generate in their routine self monitoring, these PDPs use short learning cycles to correct problems in implementation, or if need be reset goals. Monitoring how projects are carried out becomes as important as the initial choice of projects because under uncertainty successful development plans are almost always modified in execution.

Continuous monitoring and adjustment of plans entails in turn qualified decentralization of authority to front-line decision makers, resolution of problems at the lowest possible level (because the lower the level of decision making the more likely it is to have key contextual knowledge), and as part and parcel of these requirements, inclusion of all actors with relevant expertise and experience. Decentralization of authority is qualified because lower – level actors, even if better informed than the higher ups, or hardly infallible; and in any case they depend on convening and coordinating capacities (in dispute resolution, regulation and budgeting) that only superior levels possess.

An example--an illustration of a family of institutional possibilities, not a canonical model for emulation--of this type of PDP is the Malaysian Performance Management and Delivery Unit (PEMANDU). PEMANDU was formed in 2009 to organize public-private coordination in defining and carrying out ambitious plans for development in various sectors of the economy sector (palm oil, paddy rice, electronics, tourism) as well as public sector reforms and projects (transit systems and environmental cleanup in Kuala Lumpur; the reform of public schools and the police).

PEMANDU has developed a well defined governance regime for making and revising plans with broad stakeholder participation. Initial goals and provisional but detailed action plans to achieve them are fixed in lengthy (6- to 9-week) workshops (“Labs”) that include the key public and private stakeholders in a specific domain, such as the palm-oil industry or the national railway system.

The goals are translated into key performance indicators (KPIs). KPIs are used both to maintain pressure to decide and act and to trigger reexamination of goals and the means of achieving them. The plans are also “stress-tested” against resource viability and must be approved by a steering committee of decision-makers from relevant stakeholders.

Progress against KPIs is monitored in a regular cycle of meetings and committees across departments, agencies and (at times) entities from the private sector or civil society. This monitoring reveals coordination problems or flaws in the initial goals, diagnoses their causes and focuses efforts on solutions. If participants hoard information or reach a deadlock, disputes are “bumped up” to successively higher review bodies. If the deadlock continues, control of the situation passes to superior authorities, and ultimately the prime minister. Since these authorities are almost certainly unaware of the key facts in dispute, their decisions will likely make all parties worse off than they would be under a jointly agreed resolution; and the prospect of that outcome induces deliberation and compromise to avoid it. Hence the prime minister adjudicates one or two disputes a year.

When new information casts doubt on the viability of initial goals, a set of tools and governance processes—including procedures for reconvening Labs or more focused “mini” variants of them—allows for the accountable revision of projects, plans and targets. Between (infrequent) revisions of goals and (frequent) revisions in execution, PEMANDU's CEO estimates that 70% of initial plans are revised in the course of implementation. To underscore that the output of each round of review and revision is used as the input for the next round of implementation, allowing continuous adaptation and the fluid incorporation of the previously unexpected, call PDPs of this type recursive. Such recursive models of organization assume that information problems are continuous, so that planning and doing must be intertwined. They are neither top down nor bottom up; and the need to articulate the reasons for decisions across levels makes possible explicit learning that is hard to achieve when adjustment is tacit and local.

### **Instead of a Conclusion**

There are numerous examples in Latin America of PDPs with many of

those features, though seldom it appears with such highly articulated governance mechanisms. Many are at the provincial or sectoral level, and often at the intersection of the two--PDPs for a particular sector in a given province. Often as well they are directed to agriculture, or renewable resources more broadly. Examples include the Fundación Proarroz that orchestrates and carefully monitors coordinated improvement of rice growing and processing in the Argentine province of Entre Rios and a cluster of famously successful projects to improve wine production in the province of Mendoza. There are also quite successful agricultural extension services, national in scope but operating through regional centers with governance board's composed of local stakeholders, in countries such as Brazil (EMBRAPA) and Argentina (INTA). This list could easily be lengthened. PDPs With the partial exception of Mendoza none of these cases has been studied in enough detail to establish precisely just how they do, or do not correspond to the recursive model of PDP.

But much anecdotal evidence suggests that there is a strong family resemblance. If this is so there are no invincible systemic obstacles -- not macro economic instability, not the absence of a Weberian civil service, or traditions of contention or simply mutual suspicion between the public and private sectors--to the creation of recursive development policies. Perhaps these institutions and the principles of their success have gone unremarked in part because of their connection to the production of commodities, and therefore in the traditional structuralist view to backwardness. But as industry, and the jobs it once created, become less central to economic modernity, and the capacity for capacity building diffuses throughout the public and private sectors, perhaps it is time, or past, for Latin America to learn to generalize successes in economic competition and institution building that it has too often dismissed.