

# TECHNICAL PROGRESS AND ECONOMIC DEVELOPMENT IN THE MODERNIZATION PROCESS OF CAPITALIST AGRICULTURE<sup>1</sup>

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## ABSTRACT

This article examines the relationship between technical progress and economic development in agriculture. Two explanatory categories concerning the capitalist modernization of agriculture are analyzed. Some of the effects of technical and economic modernization on the process of agricultural production are presented.

**Key words:** rural development, agricultural modernization, technical progress.

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## 1. Introduction

Modern land income theory (Vergopoulos, 1977; Silva, 1981) leads to the conclusion that there is a specific process of capital valorization in agriculture, whose main result is the subordination of agriculture to overall capitalist production. Such subordination, however, does not occur through the upgrading of agricultural production to industrial production. Instead, it occurs by peculiar means of appropriation of rural labor by productive capital.

This article shows the different kinds of relationship developed in the simultaneous process of technical and economic transformation in agriculture, by the above mechanism of capitalist production in agriculture.

Firstly, it is necessary to consider the mistaken conception that technological development in different branches of capitalist production have always corresponded to their economic development. In fact, this assertion only partially reveals the nature of transformations. It is true that economic development in production leads to technical progress. However, both processes are highly dependent on the economic rationality of production agents. As such, the introduction of a technical individuality in a productive system is always subject to the perception of economic advantages by its agents.

Furthermore, the linear relationship (often associated to technical and economic progress in production) between technical composition and different kinds of capital can only be truly applied to industry. In such a case, the technical support based on machinery subjects innovations to the addition of productive values by means of new investments.

However, even in such a case, both the technical and the organic composition of capital behave as independent variables. Identical magnitude and composition of capital are not, by themselves, equivalent in the different stages of production development. Capitalist agriculture reinforces such differences.

In capitalist agricultural production, both the organic and the technical imposition of capital behave in peculiar ways. Land, although playing a major role in the technical composition of capital – can not be given a production price in terms of value. The reason is that land originally is not a product of labor, but a nature product appropriated for capitalist production. Therefore, our analysis of the existing relationship between technical and economic evolution in agriculture will not be undertaken by comparing the organic composition of capital in agriculture to that in other branches of capitalist production. The analysis will concentrate on effects of technological innovations on the productive consumption of land in general, the true basis for capitalist land income (Silva, 1981).

This article draws attention to the organic composition of agricultural capital. As economic representation of capitalist development, the ratio between the use of constant capital and variable capital in agriculture expresses the index of social productivity of rural labor. It reflects, in values, the level of technical composition of agricultural capital and the consumption capacity that it provides labor in the immediate process of production.

Likewise, the technical and the organic compositions of capital behave as measurements for the socially necessary labor time for different cycles in capitalist production. The former indicates how much use value is produced in other branches and later transformed into means of agricultural production. The latter indicates how much value is transformed into means of productive consumption in the agricultural cycle, both as input and raw material (Silva, 1981).

The above indicators are useful to the extent that they allow for a better understanding of the modernization process in agriculture as undertaken by the productive initiative of capitalist investors. As in other branches of production, capitalist farmers seek maximum profit. Both land income and remuneration of the capital invested in production depend on it. Because it is less expensive for capitalists to produce with higher organic compositions of capital, their economic rationality leads them to increasingly intensive and competitive production systems.

## 2. Two conceptual approaches to capitalist modernization of agriculture

For Amin, the above mentioned aspect of capitalist development in agriculture brings about inherent problems for the analysis of capitalist production as applied to agriculture. According to him, the dissemination of intensive production systems in capitalist agriculture consists of the applicability of the same economic laws of capitalism in general, to agricultural production. On the one hand, they express the overwhelming homogeneity of capitalist forms of production over agriculture. On the other, they involve a deep economic change within the technical basis of capitalist agricultural production. What really matters are the equipment and inputs already added to it, e.g., the productive capital previously invested (Amin, 1977).

The logical conclusion of Amin's reasoning is the acceptance of the industrial paradigm for the analysis of capitalist development in agriculture. It consists of a process of constant approximation of rural productive systems to the factory model of industrial production – therefore leading to the mechanization of productive tasks and the dissemination of wage labor in agriculture<sup>3</sup>. According to Marx, land (as non-reproductive natural resource) is transformed into agricultural capital only to the extent that it incorporates the development of social productivity (Marx, 1980). If this is true, then the existing essential differences between the physical basis of agricultural and industrial capital, reveal themselves as determiners of the possible economic development in capitalist agriculture.

Machines, for instance, as industrial inputs depreciate and have

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<sup>3</sup> Lenin had already related the development of capitalism in agriculture to the dissemination of wage labor relations in the countryside: "It is commonplace to infer the development of capitalism in agriculture from data about the spread of farms or the number and importance of large farms (according to their area). We have already analyzed some of these data, and will still analyze others, but we must emphasize that all of them are indirect data. Farm area can not always, nor directly, explain the real magnitude of farming and its capitalist character.

"On this aspect, data referring to wage labor are significantly more reliable and convincing". (Lénin, 1980).

their value decreased, in spite of individual preservation, due to technical development. Land, however, being transformed into agricultural capital, may increase in value even if it is not directly involved in immediate agricultural production. In this case, land is potentially available for the incorporation of means of production involving gains from the social productivity of rural labor.

For us, the main characteristic of developing capitalist agriculture is not its incorporation into industrial production, but the confrontation between the process of capitalist value production – e.g., labor – and the natural technical basis for agricultural production. Land can not be immediately transformed into a branch of industrial production (Goodman; Sorj; Wilkinson, 1990).

The above has led to considerably different interpretations of capitalist agriculture, within the scientific community. Their conclusions have usually been contradictory. Nonetheless, they have departed from the very same crucial problem: the relationship between agriculture and industry within the capitalist mode of production. Two interpretations are of particular interest, due to their contributions to the analysis of technical and economic transformations in the modernization process of capitalist agriculture.

According to one interpretation, the formation of agro-industrial complexes in the development of capitalist agriculture is a result of transformations in the rural structure of production. Such transformations have occurred as of capitalist relations replace traditional forms of production. Their main stages correspond to three different and successive sets of modifications in the rural productive basis that brought about the new foundations for production.

The first consisted of agricultural modernization, a process of changes in the technical basis of capitalist agriculture due to the introduction of new tools, machinery, chemicals and crop varieties unknown to traditional crop production. Such modernization fosters the increase in consumption of intermediary commodities and industrial

inputs needed by agriculture. Only the labor force, among all production factors, is still totally recruited within the rural areas and subject to old labor relations (Kageyama, 1990).

Agricultural modernization was followed by agricultural industrialization. In this case, not only the technical basis of agriculture, but also its productive basis was transformed. Agriculture started producing commodities for intermediate consumption, therefore attaching itself to other branches of capitalist production. Modernization of the technical basis was made irreversible due to the process of reunification between agriculture's own productive basis and the emerging industry. Three immediate consequences followed this intermediate stage of capitalist development in agriculture.

As agricultural mechanization expanded, machines replaced not only physical strength but also the workers' manual abilities. Immediate productive labor was replaced by collective and cooperative labor, therefore transforming labor relations in agriculture. This led to a specialization level that limited the possibilities for family labor in agriculture. Finally, the internalization of producing branches of agricultural machinery and inputs into the agro-industrial productive basis, provided agriculture with endogenous capacity for modernization and establishment of the final conditions for technical and economic evolution leading to the age of agro-industrial production (Kageyama, 1990).

The third and last stage following the agrarian evolution has consolidated the formation of modern agro-industrial complexes. Agriculture was no longer an independent economic sector. Productive chains replaced it. Natural economy was definitely incorporated into the industrial productive basis. Agriculture became subordinated to industrial and urban capital. This process from indirect to direct subordination to capital in agriculture has occurred by means of production specialization. As far as circulation is concerned, external markets for rural complexes were largely replaced by national markets.

These were able to create demand and income, as well as provide resources for the agro-industrial cycle of capital reproduction. Such transformations allowed production to reach the level for capital integration, resulting as concrete features for the incorporation of agriculture into industrial production and for the organization of agro-industrial complexes. From then on, capital became the unifying element in agricultural production (Kageyama, 1990).

Notwithstanding the usefulness of the concept of agro-industrial complexes for the understanding of specific processes of capitalist development in agriculture, a considerable number of authors discuss its applicability for the analysis of relationships between agriculture and industry in modern capitalism. For them, the specificity of the technical basis in agriculture plays a differentiating role within the forms of production where they find themselves. It forbids the full organization of agricultural production according to the industrial capitalist production model:

*“The total yield of a crop or livestock is a result of the sum of individual yields per plant or animal belonging to it. Therefore, it is not possible to talk about serial production according to the industrial meaning of the term” (Veiga, 1991:177-8).*

Likewise, the process of agricultural labor is significantly different from industrial labor and can not, therefore, be organized on similar bases:

*“In the process of agricultural production, human intervention does not intend to transform raw materials, as opposed to what occurs in other productive processes. In agriculture, human labor seeks to sustain or control environmental conditions where animals and plants grow and reproduce themselves. There is a transformation time in this labor process, but it is done by natural-organic mechanisms and not by human labor. Therefore, the*

*process of agricultural labor requires a specific and independent concept” (Veiga, 1991: 178).*

Goodman, Sorj and Wilkinson (1990) developed the concepts of appropriationism and substitutionism as denominators for the processes of integration between agriculture and industry within the capitalist mode of production. The concepts resulted from their search for systematization of new concepts for the differentiated analysis of the development process in capitalist agriculture. Such concepts shouldn't use theoretical models based on the interpretation of industrial development, although showing their elements of association.

The authors above start with the overall natural limitations of the technical basis in agriculture, which forbid its incorporation into the factory mode of capitalist production. In fact, the natural processes of biological conversion of energy, the biological growth and reproduction time of crops, and the productive space (portion of land) needed for the development of agricultural activities, are serious limitations for development of the industrial mode of production in agriculture. That is, the adaptation of the time required by the productive cycle, to the needs of capital circulation and restructuring by means of new machinery and automation of successive steps.

Success of the industrial model in modern capitalism has been mainly defined by the plasticity that such organization of production provided manufacturing primitive labor. As main effect of such plasticity, capitalists were able to control their workers' production time, either by accelerating or slowing labor intensity and capital circulation through the successive stages of the productive cycle. However, machinery was technically successful in manufacturing because its raw material consisted of natural inputs produced either during an early agricultural transformation, or in the process of handcraft production. This allowed capital to freely circulate within the design of machines.

On the other hand, the production of primary commodities in agriculture is organically tied to their productive bases. In this case it is

the machine, and not the raw material, that must circulate. For this reason, the successful use of machinery could only be generalized initially, among those secondary activities of production where nature had become a product. The tractor led to the performance of the strictly agricultural tasks according to technical standards demanded by industrial development. Even though, the last technical barrier - that consists of the fact that agricultural production remains based on land - has not yet been removed by machinery. Machinery effects are limited to modifications in the standards of agricultural demand and labor force productivity.

One last element could limit still further the real effects of mechanization on rural labor. If, as it is true for industrial production, the introduction of machinery initially tries to raise the productivity of agricultural labor, then there must be a complex automation process. Such a process should require scientific and technological development above the standards of industrial machinery, while providing similar results.

As an alternative, technical development of agricultural production should consist of progressive innovations of both processes and products due to new chemical and biological resources. These should be properly used for the expansion of agricultural productivity, both in terms of the physical productivity of soils and the economic productivity of rural labor. The most recent developments in microbiology and genetic engineering provide a framework for the process described (Goodman, Sorj & Wilkinson, 1990). However, its specificity requires a particular analysis of the association between agriculture and industry at the current stage of capitalist development in agriculture. As such, the concepts of appropriationism and substitutionism emerge as a reference for a new and more accurate approach to the study of capitalist agriculture.

According to Goodman, Sorj & Wilkinson (1990), the concept of appropriationism expresses the reincorporation of traditional agriculture elements into modern agriculture, as industrial inputs. As

new phases of production are incorporated into developed capitalist agriculture, the process of natural agricultural production is restructured and the importance of natural production processes and rural labor decreases. This is based on the historical impossibility of agricultural capital to overthrow, immediately and homogeneously, the barriers imposed by the natural systems of agricultural production in order to become a branch of modern industrial production.

The only alternative for agricultural capitalists to forge the modernization of capitalist agriculture was not by attaching it to the industrial development under way. It was, nonetheless, by providing it with a unique technical development able to support the expansion of capitalist domination in agriculture by means of multiple partial appropriations of rural labor and its byproducts. This was due to alternate introductions of mechanization and both chemical and genetic innovations in agriculture.

In the process of subordination of all natural variables to the dynamics of capitalist industrial production, the appropriationist transformations simultaneously produce significant changes in its productive structure. They develop a sharp dichotomy between production and agricultural labor. Such is the case of extensive mechanization, which causes a deep subordination of labor to the new lifecycles of crops and leads to greater job seasonableness. It also leads to the emergence of new, independent and historically different branches of agro-industry (such as the seeds and fertilizers industry) within each independent and partial appropriation of biological cycles in agriculture.

On the economic point of view, they successively cause the emergence of new, selective opportunities for accumulation in agriculture as a result of agro-food productive chains. These are significantly favored by state agricultural policies that follow appropriationism. To the extent that baseline results are obtained, appropriationism reveals the inner profile of the transformations it produces. That is, the reconstitution of those economic features of agricultural production caused by discontinuous modifications in the overall technical productive basis.

In addition, the authors above refer to substitutionism as the incorporation of industrial products into capitalist agricultural production. These products, originally natural products, replace those natural resources originally used as factors of production. Agricultural production no longer relies on land as natural basis for production. As opposed to appropriationism – which departs from the natural, technical productive basis, substitutionism stimulates the economic recomposition of capitalist agriculture. It completely remodels agricultural production and creates new branches for the valorization of capital through the insertion of standard and homogeneous inputs in agriculture. Its production aim will be achieved by upstream industries.

Otherwise, the incorporation of industrial features to agricultural products enables substitutionism in agriculture. It may transform agricultural products into industrial inputs – therefore developing new productive chains of non-agricultural raw materials. It may also develop industrial substitutes for agricultural consumption commodities, such as production of synthetic material in both the food and fiber sectors. In this case, the agricultural product itself is exchanged by a similar product obtained by the use of different kinds of raw materials and more strict and volatile control of capital (Goodman, Sorj & Wilkinson, 1990).

### **3. Technical Progress and Economic Development in Capitalist Agriculture**

Agro-industrial complex, appropriationism and substitutionism as well, refer to the predominant relationship between agriculture and industry within the new capitalist economic dynamics. The former emphasizes the role of institutional regulations in agricultural production – such as rural credit and institutional regulations for upstream integration contracts -, by pointing out the mechanisms of economic integration between agriculture and industry.

The second deals with the role of technical transformations in restructuring production relations in agriculture. It emphasizes the role

of agricultural research and technical progress in the consolidation of new forms of integration between agriculture and industry.

Research to promote capitalist agriculture is linked to production as a factor for capital valorization. By providing the incorporation of its products to the actual production systems, agricultural research increases the control of nature by capital. This allows capital to reach the technical means for the efficient implementation of its valorization cycles in agriculture.

For Aguiar, however, even though the processes of research and development of new agricultural inputs and products are similar to those in overall technological development, the introduction of new knowledge in agriculture is unique. It corresponds to a kind of technical progress that is different from that in industrial research. That is, agriculture requires the new input to be in symbiosis with the natural environment. It also requires adaptation to particular weather, soil and crop conditions. Therefore, in order to obtain a relatively homogeneous final product, the utilization of the new input must have been previously widespread among non-homogeneous, region specific conditions of overall agriculture. (Aguiar, 1986).

It is now possible to understand how the above mentioned specificity constitutes the last natural barrier for technical development in agriculture, leading to the organization of agricultural research in terms of product chains. As such, funding for agricultural research may concentrate on the development of byproducts linked to production of economically predominant crops. This, in turn, causes concentration of technical innovations on those product chains rather than on a potentially generalized usage that could prove inefficient after all.

The concentration of funding and scientific efforts on a model of productive chains reinforces the predominance of crops and production systems that are more liable to capitalist valorization (export products or products for scale consumption in the internal market). It also allows for subsidiary branches of accumulation within the cycle of technological

innovations in agriculture. Among these, genetic engineering and specialized seed production are the most significant examples.

The situation above may even result in the hegemony of some regional productive sectors over others, despite the previously existing natural limitations. The determining factor, from then on, will be the installed capacity for technological development and control over products. A plausible example is the productive sector in the state of São Paulo, considered the national center for valorization of agricultural capital due to continuous leadership in the development of genetic varieties of economically predominant crops. Likewise, we may agree with the assumption that seed production plays a major role in the appropriation of agricultural income (Goodman, Sorj & Wilkinson, 1990).

In fact, efficient licensing systems for agricultural research byproducts, particularly seeds and agrochemicals for economically relevant crops, provide capital in general with new mechanisms for appropriating agricultural income. The development of technological packages for specific products leads to the association between the processes of both input development and agricultural production, and the industrial standards for the valorization of capital. Technological packages also lead to the consolidation of a sequence of technical innovations in agriculture similar to that of industrial assembly lines.

Meanwhile, the process of agricultural modernization can be efficiently adjusted to international production standards by means of competition among different kinds of capital invested in technological development. It may also be adjusted by means of state organization of agricultural policy tools for the development and adaptation of new technologies and their diffusion, as well as for credit for independent farmers.

As consequence of this new formation of agricultural production systems, capital controls the rhythm of technical innovations in agriculture. The efficiency of such innovations on crop production varies

according to specific features of technological packages and their widespread utilization in production systems.

The generation of technological packages itself, as predominant means for technical development in agriculture, results from economic transformations in capitalist agriculture. The main traits of capitalist development nowadays are broadly defined by the monopolist form of enterprise organization (Sweezy & Baran, 1974), as well as by the dissemination of flexible accumulation processes in different branches of production. They rely on technological packages for widespread usage in agriculture. This, in turn, continually reinforces the complementation and specialization profile of agriculture as a branch of the national economy. At the same time, it allows for the efficient internalization of its production conditions through the homogenization of available productive techniques.

The historic character of technological packages in the development of capitalist agriculture reveals itself as mediator in the process of economic subordination of developing countries to technology-generating countries. As a matter of fact, importing technological packages only means that developing countries have acquired the ability to use such technologies. It does not involve the transfer or acquisition of technologies themselves.

As a consequence of the incorporation of technological packages to agricultural production, the development of capitalist agriculture becomes associated to the new standards of the international division of labor. State intervention plays a major role at this point, as link for the internationalization of capital. It adapts each specific situation to the economic conditions leading to the early adoption of technological packages as dominant means for technical development (Aguiar, 1986).

The articulation between the state and the private sector of the economy for the development of agricultural research seeks primarily to reach a specific dynamics for technological innovations through the State. Such articulation is not possible by solitary private capital. Because

of its peculiar formation through scientific development, technological packages require investments by an ideal collective capitalist. For Aguiar (1986), state enterprises – one of the ways for value (income, we believe) appropriation in the economy - are properly inserted within those production sector whose *real* or potential monopoly stage enables the entrepreneur to behave selectively in production, due to the great concentration of investments and the high capitalist intensity within them.

Consequently, state enterprises enables the State to perform as ideal collective capitalist at the current stage of capitalist development in agriculture. In order to socialize costs, generate private profit and develop agriculture as integrated productive branch in capitalism, the State is required to update its traditional intervention means. These are historically linked to the neutralization of food supply fluctuations and, in early agrarian modernization stages, they were associated with transitional agrarian reforms. As a result, agriculture was transformed into a modern, widespread commercial activity.

In order to intervene on the trends of agricultural development, the State must organize agricultural research by subordinating agriculture to the integration mechanisms of the world market and its standards of technological development. This is done through the allocation of both financial and logistical resources for agricultural modernization, for the development of research and rural extension systems, as well as for the regulation of agricultural production fluxes. On the economic point of view, the latter involves fiscal, credit and commercialization regulations by means of state agricultural policies.

Therefore, contemporary agricultural policy must consist of state action for adapting the technical development of agricultural production to the new, dominating standards of crop production. Consequently, the capitalist State places agriculture within the cycles of industrial economies, modernizes agricultural production and overcomes those economic limitations that used to link the process of capitalist accumulation in agriculture to natural cycles of production.

Agricultural research acts as mediator for the transformations within capitalist agriculture and produces a new link between economic and technical transformations in agriculture. The role of chemical industry in modern agriculture is a clear example of this link. As a matter of fact, chemical industry itself propels agricultural modernization. It insures the widespread and virtually unlimited supply of agricultural inputs both by transforming them into industrial inputs and by substituting them for synthetic or processed products. It also fosters the development of new products for upcoming opportunities and markets, in substitution for natural rural products. At this point agricultural research reaches its highest efficiency in terms of links with industrial innovation and capitalist accumulation in agriculture.

On the other hand, the economic determiners of technological transformations in capitalist agriculture increasingly approach those leading to industrial innovation. In the strictly economic meaning and in the specific case of technological innovation, we may agree with Boserup (1987) and conclude that the overall technical transformations in capitalist agriculture are subordinated to industrial technical development.

Nonetheless, the assertion above only helps understanding agricultural development within modern capitalist economy to the extent that it allows for the identification of the effects propelled by technical progress on the economic profile of each branch of production. Obviously, we are not suggesting the notion of long-term equilibrium, as used by classical economists, to explain the relationship between economic development and technical progress.

On the contrary, we agree with Kalecki (1983) who, by analyzing the capitalist economic cycles, lists the following among the most important consequences of technical progress: increase in labor productivity and changes in relations between the maximum productive capacity of equipments and the total amount of fixed capital within them. Furthermore, technical progress raises the level of monopoly in

production, reduces the overall price levels in the economy and maintains high incentives for investments.

The two first consequences of technical progress influence increases in production, particularly by overcoming the initial labor shortage. The latter ones stimulate the continuous innovation of those productive branches where it develops itself, therefore continuously propelling the development of new technologies, the introduction of new products (as new consumption goods and new production equipment) and the discovery of new sources of raw material. Finally, the economic consequence of all of these transformations is the increase of investments in production, leading to its complete integration to the capitalist production market.<sup>4</sup>

#### **4. Conclusion: The Impact of Modernization on Agricultural Production**

Following Boserrup (1987) and Kalecki's (1983) analysis of investment fluxes related to technological innovation in production, we may identify the main effects of technical progress on the economic profile of capitalist agriculture and its links to other sectors of the economy as well. Firstly, agricultural modernization followed by industrial development causes an increase in urban populations. Consequently, there is a rise in demand for both food and rural raw materials. The countryside must thus produce progressively higher levels of surplus, basically carried out by means of new crop production

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<sup>4</sup> According to Kalecki, the notion of economic cycles is extremely costly for the formulation of capitalist development theory. Schumpeter, also departing from the same problem, analyzes capitalist development cycles by reinterpreting the dynamics of economic exchange. For him, innovations propelled by capitalist entrepreneurs appear in production as main elements for the existence of economic cycles. They appear both as strictly economic innovations – within the social aspects of production relations –, and as technological innovations – expressed on transformations of the concrete elements for production. Therefore, for Schumpeter, the innovating entrepreneurs play a significant role in development as economic agents propelling the rupture of the cyclic equilibrium as already reached in capitalist production. Schumpeter concludes that the "cyclical flux", a characteristic of development in capitalist economies, is closely associated to the capacity of economic and technical innovations to break the equilibrium of the current economic system. Its introduction in production follows the movement of social and economic forces that spread competitive advantages of innovating production systems, according to the laws of capitalist competition. As such, social development of productive techniques occur as a function of economic growth (Schumpeter, 1988). We have adopted the Kaleckian interpretation, for it seems to be most appropriate for our research on the multiple effects of reciprocal determination between technical progress and economic development in capitalist agriculture.

methods, until it becomes specialized in the production of agricultural surplus<sup>5</sup>. The countryside offers its growing labor force for urban production, particularly for commodity production and the services sector linked to national consumption. Thereafter, the dynamics of agricultural production will initially be determined by the expansion of the internal market.<sup>6</sup>

The development of biotechnologies by agricultural research has transformed the essence of the agricultural modernization process described above. By consistently breaking up the natural cycles of agricultural production, the new technical resources have led to the development of continuous production patterns in agriculture and the specialization of production units on economically predominant crops. The consequences of this new agricultural pattern have been a decrease in crop production seasonableness and the organization of intensive monocrop as dominant within agricultural production units.

New trends of agricultural production have also produced three other significant changes. As far as technical progress is concerned, it reorganizes the supply chain of agricultural products, as required by the economic development of intensive monocrop units. Meanwhile, it also modifies the current pattern of chains specialized in products. It thus transforms all agricultural products into potential inputs for industrial processing. As far as the labor market is concerned, the widespread

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<sup>5</sup>The specificity of industrial development in urban areas is usually explained by the need, required for successful industrial development, to create large labor and consumption markets. This, however, doesn't explain the lack of industrial development in agriculture following efficient means of transport and laborsaving technologies in industry. The specialization of production for agricultural surpluses more accurately explains the lack of industrial development in the countryside, during the latter period of capitalist development.

<sup>6</sup>Export production in large areas of developing countries leads to a new element in our interpretation: the foreign market determining economic relations over capitalist development in agriculture. In fact, the perspective of economic integration with foreign markets has led to the consolidation and growth of large agricultural regions, organized according to different export products (sugarcane, cocoa, coffee, orange and soybeans are examples of Brazilian agro-export cycles). However, even in this situation, the productive dynamics in agriculture remains intrinsically associated to the development of the national market, which will become the main provider of rural labor.

introduction of labor saving crop production techniques – particularly those used for planting and harvesting – increase rural unemployment. This demands a demographic movement of labor towards new economic alternatives. Finally, as far as commercialization is concerned, upstream integration through contracts definitely reinforces the role of genetic engineering in capital accumulation. It also transforms the technological package into a sine qua non condition for the valorization of agricultural production (Goodman, Sorj & Wilkinson, 1990). Altogether, they approach the economic organization of agriculture to the industrial patterns of production. They even transform part of the agricultural income into industrial income, therefore subverting the initial condition for rural production monopoly, and link it to the laws of capitalist competition.<sup>7</sup>

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<sup>7</sup> It is convenient to demonstrate how the new food industry is a good example of how overall industrial development and new products have transformed modern agriculture into a dynamic source of value and profit. Food industry is based on canning and cooling technological developments, as well as on a complete productive chain of strictly agricultural activities such as processing, preparation and distribution of food. Goodman, Sorj & Wilkinson (1990) show how the improvement of food preservation techniques and the development of crop varieties as inputs for industrial processing, produce effects on rural labor productivity which are economically identical to those caused by agricultural mechanization in the early stages of modernization. We must say that, in both cases, the heart of transformations in the relations between agriculture and industry moves towards the transfer of increasingly larger numbers of rural productive stages to industry. Consequently, some of the productive food market is transformed into source of industrial income.

#### 4. References

- AGUIAR, Ronaldo C. Abrindo o Pacote Tecnológico : Estado e pesquisa agropecuária no Brasil. São Paulo, Pólis / Brasília, CNPq, 1986.
- AMIN, Samir. O capitalismo e a renda fundiária : a dominação do capitalismo sobre a agricultura. In: AMIN, S. & VERGOPOULOS, K. **A Questão Agrária e o Capitalismo**. Rio de Janeiro, Paz e Terra, 1977.
- BOSERUP, Esther. Evolução Agrária e Pressão Demográfica. São Paulo, Hucitec, 1987.
- GOODMAN, D.; SORJ, B. & WILKINSON, J. Da Lavoura às Biotecnologias : agricultura e indústria no sistema internacional. Rio de Janeiro, Campus, 1990.
- HARVEY, David. A Condição Pós-Moderna : uma pesquisa sobre as origens da mudança cultural. São Paulo, Loyola, 1993.
- KAGEYAMA, Ângela. O novo padrão agrícola brasileiro : do complexo rural aos complexos agroindustriais. In: DELGADO et al (orgs.) **Agricultura e Políticas Públicas**. Brasília, IPEA, 1990. pp. 113-223(série IPEA, num 127)

KALECKI, Michal. Um teorema sobre o progresso técnico. In: MIGLIOLI, Jorge (org.). Kalecki : economia. São Paulo, Ática, 1980. pp. 118-128. (coleção Grandes Cientistas Sociais)

LÊNIN, Vladimir I. Capitalismo e Agricultura nos Estados Unidos : novos dados sobre as leis de desenvolvimento do capitalismo na agricultura. São Paulo, Ed. Brasil Debates, 1980.

MARX, Karl. O Capital : crítica da economia política - livro 3 - vol. VI. Rio de Janeiro, Civilização Brasileira, 1980.

SCHUMPETER, Joseph A. Teoria do Desenvolvimento Econômico : uma investigação sobre lucros, capital, crédito, juro e ciclo econômico. 3.ed. São Paulo, Nova Cultural, 1988 (coleção Os Economistas)

SILVA, Sérgio. Valor e Renda a Terra : o movimento do capital no campo. São Paulo, Pólis, 1981.

SWEEZY, P. & BARAN, P. Capitalismo Monopolista. 2.ed. Rio de Janeiro, Zahar, 1974.

VEIGA, José E. O Desenvolvimento Agrícola : uma visão histórica. São Paulo, EDUSP/Hucitec, 1991.

VERGOPOULOS, Kostas. Capitalismo disforme: o caso da agricultura no capitalismo. In: AMIN, S. & VERGOPOULOS, K. A Questão Agrária e o Capitalismo. Rio de Janeiro, Paz e Terra, 1977.