

The 50th last years : A sketch of agricultural economics thought

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Nowadays, throughout the world, agricultural economics stands as a full-fledged discipline, with chairs in the universities, professional associations, specialized journals, etc...Even a *Handbook of agricultural economics* (with 4 volumes !) has been published in the prestigious collection of *handbooks* by North Holland¹. This is relatively new : Of course, since antiquity, many authors had provided opinions and advice regarding the management of farms, the methods of cultivation, and many similar subjects related to our own preoccupations². We celebrate some of them as our masters. Yet, none of them would have described themselves as « agricultural economist », even if, etymologically, « economy » is « the management of the household », thus involving the agricultural considerations which were necessary to sustain households in an agrarian society.

At the same time, another paradox should attract our attention : the emergence of agricultural economics arises at a time when the importance of agriculture in the whole economic activity has never been so lean. I do not mean here that agriculture is unimportant : quite the contrary, all of us, we know that a failure in the world agricultural system would entail a tragedy without equivalent in the past. But we also know that, in most industrialized country, agriculture *stricto sensu* does not represent more than a few percent of the GDP, a percentage which does not raise over 20% if we consider the share of food in total expenditures. Admittedly, these percentages are significantly higher in « poor » developing countries. Yet, even in the latter, it is clear that affluence cannot result of the expansion of the agricultural and food sectors only, and that the priority should be the development of non-agricultural activities. Therefore, at first glance, a body of economists specialized in agriculture and related fields does not seem urgent.

Thus, the emergence of agricultural economics as a discipline stands as a new phenomenon, which should be explained and discussed. The present paper is designed to tackle this subject, trying to link the evolution of the sector with the increasing complexity of the analysis, starting from the European 18th century, until the present era of de-liberalization, throughout the two world wars crisis, the reconstruction of the 50s, the liberalization of the 90s, and the « ecological » present time ,

I- From the XVIII to the XX centuries : Economists views of agricultural problems

During the early period of the economic science, writers were interested in agriculture by force, because the latter was the almost only productive sector. In effect, Quesnay³, the creator of

¹ Cf Gordon & Rauser (2001 & 2002) , for vols. 1 and 2 ; Evenson & Pingali (2007 & 2009) for vols. 3 & 4

² Thus, the first human being deserving the title of an agricultural economist is probably Joseph, the personage of the Bible (Genesis, chap. 41) who set up a system of storage guaranteeing the food security of Egypt, perhaps during the 18th century BC. On the Greek side, Xenophon, a writer of the 4th century BC published a treatise on how to manage a large domain. He provides a description of the techniques in use at his time -(not so different from those prescribed by ecologists nowadays). He discusses the respective merits of the « large » and the « family » farms, surprised that large farms do not seem to supersede small ones. Among other recommendations, he urges to carefully prevent slaves reproducing themselves, and, for that, to carefully separate male and female : for raising a child is costly, while there are always some wars somewhere, and this is sufficient to supply the slave markets with young persons ready to use. cf Ma-rein (2007).

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Among other references, see Quesnay & Mirabeau (1763). Quesnay was the personal medicine of the king Louis XV of

national accounting, was persuaded that agriculture (more precisely, the land rent) was the only source of wealth, to be subsequently shared between the merchants and the aristocracy. This analysis has been rightly criticized⁴.

Yet, these authors are not considered as « agricultural economists », because their preoccupations, although linked with agriculture, were wider. The same remark holds for Malthus : Anybody instructed in economics knows his pessimistic views regarding the capacity of the planet to feed the mankind, because of the limited area of land and the insufficient productivity of agriculture. It was a plain explanation of the history of Europe as a succession of famines, themselves at the origin of the epidemics and wars. Indeed, nowadays, Malthus could have been seen as a member of our profession.

He was not alone : For instance, Condorcet (1822) develops an almost formal model similar to the modern « predator /prey » model⁵, the human population (the predator) growing at the point of depleting food resources (the prey), thus creating famines and mortality, which themselves, by relaxing the pressure on the environment, allow food resources to increase, permitting another cycle of population expansion. Such devices, by now, feed the reflexions of many ecologists, although few of them dare applying the model to human populations.

Nevertheless, for all these authors, the depth of analysis was not the same as it can be by now. For instance, Malthus's care to check his hypothesis everywhere in the world (including China), and to take account of a few agricultural innovations, such as the cultivation of potatoes, did not prevent him to grossly underestimate the role of capital and of the technical progress in food production. As a consequence, his dismal predictions are not taken seriously anymore, although modern though movements are resurrecting Malthus's approaches, but with a different point of view.

Finally, two other questions, at the frontier between general and agricultural economics attracted the attention of the authors of that period. One was how to share the land rent, and should land be privately owned. The other was the protectionism, being it inter or intra-national. Both were not specifically agricultural, since land can be made use of for other purposes than agriculture, while trade involves food, but many other materials as well. Yet, at the time, their importance for agricultural development was probably even larger than now. In addition, the two are linked together, as shown by the famous intervention in favour of the Corn Laws by the future prime minister of Britain, Benjamin Disraeli at the house of common (Hansard, 1846)⁶.

The land rent has been the subject of many contributions throughout the 19th century. Authors

France. He was also the leader of an economic movement, the *physiocrats* (« Those who want a government by the science », see Schumpeter , 1954).

⁴ although perhaps exaggeratedly : if labour is the only cost of production, then it is true that the only possible surplus is the land rent : thus the Quesnay theory of value was not so far from those of Adam Smith and his successors. He should be freed from the accusation of an unjust bias toward agriculture, and credited with the invention of the « labour theory of value » !

⁵ The predator/prey model seems to have been introduced by Volterra(1926). It describes the co-evolution of two populations, the predators and the preys. The predators eat the preys, the number of which, therefore, decreases. But, with a small number of preys, predators starve, and die. Then, the pressure on the prey population is relaxed. Since they are reproducing themselves at an exponential rate, their number increases again. Depending on parameters (rates of birth for preys, rate of captures for predators, etc.,), the evolution of the two populations can be periodic, or converging toward an equilibrium, or « chaotic », that is never converging, never periodic, and never infinite. See Alligood et al. (1996).

⁶ Since the time of William the conqueror (and according to the feudal rules which prevailed in Europe since the Middle Ages), the aristocracy was entitled to the benefit of the « land rent », but not without counterparts : The Lord was a local administrator, representative of the King, in charge of various public services. He had "to endow the Church, to feed the poor, to guard the land, and to execute justice for nothing.". Thus, the land was very naturally attributed to these aristocrats who represented the King, hence, the collectivity. And since the abolition of the Corn Laws would have decreased that rent, they had to be kept, despite the (solid) arguments by David Ricardo pointing out the benefits of trade.

like Pierre Joseph Proudhon (« La propriété, c'est le vol⁷ »), or Léon Walras⁸, are noticeable in this respect⁹. The question was double : is the individual property the best way for an efficient use of the land ? And who should benefit from the associated rent, in view of the fact that the land is obviously a « common good » for mankind ? A common error of the time was the creed that, in view of the Malthusian predictions regarding the scarcity of food, the price of land was due to perpetually increase . We shall see later on how better approaches of the dynamics of land and other prices were developed in the 20th century.

On trade, the contributions are extremely numerous during the 18th and 19th centuries. Most of these authors speak of trade without distinction between food and other materials. Everybody knows the Ricardian theory in this respect, and the parable of the British clothing and the Portuguese wine. Nowadays, it is the basis of any course on trade, and very few economists would deny the validity of this approach. Yet, different points of view are possible, and even different justifications of trade. At least one of them leads to something specific to agricultural economics, and is worth being mentioned.

In the France of the 1770s, harvests were weather dependant, and irregular. At the same time, transporting grain from one province to another, for various reasons, was more or less forbidden. In effect, in such a situation, merchants are tempted to make money by buying grain in the provinces where harvest had been normal (and thus, prices « reasonable ») to resell it at high prices in the province in deficit. Doing so, they create the conditions for prices rising even in the « normal » province, thus « transmitting plagues ». In the 1770s, it was argued by authors like Turgot that this policy of isolating provinces in case of local famine was more dangerous than useful, and that, on the contrary, by uniformizing prices across the whole country, since bad harvest were not occurring everywhere at the same time, merchants were bringing relief at a small cost in places where famine would have been dramatic otherwise. In addition to the justification of trade by differential productivity, as promoted by Ricardo, this reasoning by Turgot, nowadays, would have been approved by most of our colleagues.

Yet, it was opposed by the French - Italian clergyman Ferdinando Galiani. Of course, he said, if merchants had been completely rational and well informed, then, the above reasoning would have been right. But are merchants so well informed ? Imagine a situation with a famine occurring in Stockholm (it was outside the French Kingdom !) A merchant from Bordeaux can very well load a boat with cheap grains to bring them in Stockholm. But the winds are not in the right direction, and the boat arrives in Stockholm only after one month. Meanwhile, a Russian merchant from St Petersburg (much closer from Stockholm than Bordeaux !) brought two boats of grains from his reserves.

⁷ « Property is robbery » Cf Proudhon (1841) . He justified this affirmation by the fact that the land is a human common good. Thus, giving it to a particular person deprives the others of their rights, a situation which must be called a robbery. Yet, at the same time, he was aware of the social benefit to be expected from the personal management of the owner, whose interest is to make the best possible use of the land, at the difference of what happens when different persons are in conflict for each decision. In that sense, he was close to Adam Smith, and very far from Marx, who preferred a collective management system...

⁸ He was the author of the first idea of general equilibrium. He was invited to speak on the land problem by the Vaudoise society of natural sciences (cf Walras, 1876). In his view, the land is a common good. Thus, the rent must accrue to the collectivity. But it would be an error and an inequity to deprive from their rights the persons who acquired land with their savings . Thus, the only solution would be to let the State buy back the land to those who acquired it a long time ago. Then the land would be leased at market price to competent farmers. And since the land rent is continuously increasing, the proceeds of the leases should allow for an easy reimbursement of the loans which would have been necessary to buy it..

⁹ Surprisingly enough, Karl Marx (1867) tackle the problem differently, by the side of efficiency : The small farmer cannot have access to enough capital to be efficient, while the « large farm », which are efficient, must have recourse to salaried workers who are exploited. The question of the scarcity of land is ignored, and the confidence in the economies of scale unjustified, although the difficulty for a small peasant to access capital is rightly underlined.

Then, the arrival of a third boat in Sweden makes prices collapsing. Everybody is ruined, while penury begins to occur both in Bordeaux and in St Petersburg... Thus, the best way to avoid such scenario is that the government, the best informed of all participants in trade, could exert a prudent regulation, and take care of the necessary transportation...

Two different conclusions can be derived from this story: first, trade might be justified not only by the productivity differential in various locations, as contended by Ricardo, but also by hazards and risks which could be sufficient to support the idea of free trade. Second, state interventions might be justified by market failures in presence of wrong expectations... In addition, Galiani notices that all his reasoning is specific to food products, for which (in modern terms) the demand is rigid. Of course, nowadays, transportation is much easier, and the scenario imagined by Galiani is quite unlikely. Yet, the question of market failures and false expectations remains. In this way, Galiani should remain as a precursor of modern agricultural economics...

Finally, a third question identified in the 19th century and still unsolved is the location of crops. The basic reference, here, is Von Thunen. His idea of concentric rings for each crop around a central market is well known. The difficulty is that nobody ever observed these rings... Yet, his line of reasoning is still interesting, and make him another precursor of our field. It has been followed up by many subsequent contributions, from Christaller (1933) to Krugman (1995), Fujita (Krugman, Fujita & Venable, 2001), and many others. They escape from the too narrow subject of the geographical allocation of land between different crops, and adopt a widened point of view concerning all sorts of economic activities. Indeed, the location of crops cannot be envisaged without consideration of other activities...



Thus, at the end of the 19th century, the agricultural sector was not identified as a specific problem, except perhaps by a few authors as Galiani. Yet, it became more and more evident that « agriculture was different ». It was a consequence of technical progress...

II - End of 19th and beginning of 20th century : Technical progress and capital

In the midst of the 19th century, the Malthus dire predictions were not forgotten, but it was clear that the corresponding catastrophes were at least delayed, as consequences of the technical progress. Together with increased quantity of capital, technical progress augmented yields everywhere. An additional reason to be optimistic was the possibility of exploiting the « virgin lands » which existed in most regions, especially in America.

Yet, both the technical progress and the existence of virgin lands raised new problems : before the 1800s, even in the most developed countries, the bulk of the agricultural production was self consumed, almost out of any monetary circuit¹⁰. The utilization of capital (fertilizers, machinery, etc...) to implement technical progress as well as the necessity of paying for the transportation of products over long distances, both implied the mediation of large quantities of money. And obviously, the use of money also implied questions regarding the functioning of markets.

At the same time, the utilization of the virgin lands required not only capital, but also manpower. Most of it came from migrations from Europe, but it was not sufficient. Hence, the solution

¹⁰ This is not completely true ; for instance, during the 1590s , a famous speech of the French prime minister, Sully, celebrated agriculture as the « udder of France », because selling food to Spain was the only way to extract gold from this country... This means, of course, that some of the French food production was sold. Yet the share of the commercial agriculture in the total production of the country was probably very small.

of slavery, which begun to raise problems by itself when it was considered as too much inhuman¹¹. Finally, the increasing geographical distance between the location of production and consumption, as well as the competition between very different modes of social organization in different places led to the emergence of protectionist policies which, of course, stimulated the discussion in the intellectual scenery.

Finally, among other changes, between 1800 and 1900, transportation was made incredibly easier, machinery replaced workers, crop yields were multiplied by 4 or more, etc...The strange thing, for our present concern, is that these tremendous changes did not trigger many comments (no more than analysis) by economists. The latter were preoccupied with money management, general equilibrium, and similar questions. And few of them were interested in the specificity of agricultural production.

The protectionist issue was probably the only one having led to serious analysis, as well as to actual policies¹². In this respect, it is necessary to mention Friedrich List (1841), who was protectionist in industrial matters, because it was impossible to develop any solid industrial firms without protection, while liberal in agricultural matters, because cheap food was a condition for cheap manpower, and cheap manpower a condition for industrial competitiveness. In this respect, at least, List came back to the old Galiani's distinction between agriculture and industry, although for different reasons, and with opposite practical conclusions. In any case, with respect to practical policy, the opinions varied, with a « liberal phase » between 1840 and 1870, followed by an hyper protectionist fashion between 1880 and the beginning of the First World War, in 1914.

With respect to the accumulation of capital, the authors of that period, in general, did not notice the novelty of the situation. Their only originality was probably the discussion regarding the best arrangements between land owners and tenants. Was it preferable for the owner to cultivate the land himself, or should he'd better have to lend it to a farmer or even to a sharecropper ? Or should he sell the land and reinvest the money into railways or other industrial ventures ? In these matters, the analytics is rather poor, and rarely goes beyond a simple accounting approach, even if the latter is loaded with ideology¹³. In particular, the literature is full of complaints against the lack of manpower, associated with the migration of workers to towns, without remarks on the fact that capital is a substitute for manpower.

Admittedly, there was an increasing awareness of the fact that the laws of economics were not absolutely the same in the food and agricultural sectors and elsewhere. But the general idea was that agriculture was just « backward », and would rapidly evolve toward a sector of large firms just as was the case for most industries¹⁴.

¹¹ Notice that some authors, such as Hicks (1969), ascribe the disappearance of slavery not so much to the inhumanity of the system, as to the arrival of many European migrants, which, accepting small salaries, destroyed the rent associated with the scarcity of labour, hence the benefit of the slave's masters. In the novel *the quadroon*, a contemporaneous Irish author, Mayne Red, contemptuously describing the ordeal of a slave lashed for a small error, adds, « At the same time, I remembered the white slaves of my country, the master of whom does not even need to care for their food » .

¹² In particular, it played an important role in triggering the civil war (1861-1865) in the USA : Of course the freedom of the slaves was an important advertised cause for this conflict, but the trade liberalization was another one, perhaps even more important : the southern agrarian party was liberal, selling cotton, tobacco and sugar against european (mainly british) industrial products ; the North was protectionist, because the nascent industry had to be protected. Notice that at the end, the former slaves became sharecroppers : the production did not decrease, while saving the cost of monitoring the slaves...

¹³ Unsurprisingly, the heirs of the aristocracy were in favour of continuing farming, complaining against the « mirages of the town », which deprived them from manpower, while the emerging middle class was more attracted by industry. Both sustained their options by accounting arguments. With fluctuating prices, good arguments of this type were easy to hold in both directions...

¹⁴ For instance, between 1901 and 1905 the French author Joseph Hitier (1901) published a large set of articles in the *Revue d'économie politique*, under the title *L'agriculture moderne et sa tendance à s'industrialiser* (modern agriculture

III- The birth of agricultural economics at the beginning of the 20th century

Things were changing nevertheless. The first impulse came from the USA, as a consequence of the Hatch Act (1877), the law which established the land-grant colleges, that is, a set of universities devoted to the improvement of the US agriculture through efforts in terms of research and teaching.

The Hatch Act itself was focused on technical matters, principally, agronomy. The economic science is just mentioned *en passant* (about milk and cheese !). But by creating an institutional framework for academic disciplines as applied to agricultural and food problems, it provided the possibility of developing also economic considerations. The latter were the most important as many researchers in agronomy or animal sciences were disappointed when farmers refused the application of what they considered as a potential enormous progress they had discovered. Then either all farmers were stupid idiots - and this was difficult to admit - or some sort of economic obstacles prevented these new techniques to be adopted, thus justifying research in that direction. The agricultural economics discipline was a consequence of this reasoning.

Institutions similar to the land-grant colleges and agricultural universities were soon established throughout the world, each nation wanting at least one of them. Everywhere, the necessity of specialized agricultural economic investigations were made evident, although with a lag : most chairs of economics were founded only after one generation of agronomists worked in the land grant colleges. Progressively, many countries (including the USSR) followed the same path as the USA, and developed agronomical research institutions, which, themselves, were preoccupied with the economic side of their findings.

Because of this origin of the economic preoccupations in the land-grant colleges, the economists there were obliged to carefully examine the farmers' behaviours, and to establish links with decision makers. For that reason, they were pragmatic and liked concrete cases. This led Wassily Leontief (1970) to highly praise them when, just elected president of the US Association of general economists, he intended to put shame on those who were developing abstract theories without checking their validity. At about the same time, Theodor Schultz (together with Arthur Lewis) got the 1979 Nobel prize, in particular for his book *Transforming traditional agriculture*¹⁵ (Schultz,1964). Then, agricultural economists gained a recognition they were deprived of before.

In addition, three circumstances contributed to this result : First, the 1929 crisis and the associated tragedies. Second, the development of computers, allowing for modelling large systems. Third, the development of the former colonized countries, and the problem of their recurrent poverty.

A/ The 1929 world economic crisis

It originated in agriculture : During the 1st world war, agricultural prices had been relatively high in the US, because, most European farmers being enrolled in armies, the European production had been in jeopardy. The US farmers took occasion of the situation to increase their investments, and, for that, contracted loans from the numerous small rural banks. The latter, themselves, borrowed from national banks, which were not aware of the nature of the associated risks. After the recovery in Europe, prices declined, and many farmers went bankrupt. But farmers bankrupts were a tragedy for

and its tendency to be industrialized) . In particular, he describes a farm raising 500 cows in St Denis (near Paris) and supplying most of the Parisian milk retailers with its own fleet of horse-driven cars. Of course, this agricultural factory did not survive the first world war...

¹⁵ This book by Schultz underlines the role of agriculture in the development, contrary to a then widely shared creed that « only industry matters » . It also introduces the idea of *human capital* , which was subsequently exploited by Gary Becker (1993). It is still to be read.

the small rural banks, the loans of which were lost. They became themselves in difficulty, and these difficulties were transmitted to the national banks. Then, a very small incident was sufficient to trigger the public's mistrust, and the jeopardy of the whole economy, first in the US, and then, the world over....

But why were agricultural prices so low on international markets, and so many farmers bankrupt, while so many people were dying from hunger ? The agricultural section of the President Roosevelt's « brain trust¹⁶ » played an important role in analysing the causes of this paradoxical situation, and proposing remedies.

The diagnostic was that the agricultural sector was too specific to be ruled by unstable markets, as the industrial sector could be. The contribution by Ezekiel (1938) was central here. This author demonstrated that an industry with a poorly elastic demand and long production delays, because of the role of expectations on producers' decisions, was due to generate unstable prices, thus making markets inefficient - a case for state intervention, in pure orthodox economic theory.

It was therefore necessary to cut the links between agriculture and market. This was done through guaranteed prices for farmers, and, for (poor) consumers, distribution of free (or at least subsidized) food. Obviously, in such a context, any free international market was out of question, despite the necessity of having recourse to foreign suppliers or customers to dispose of over production, or to buy non-locally produced commodities. The commodities sold on the international market were subsidized most of the time.

After World War II, this kind of policy was extended to all non-communist countries, The Ezekiel contribution (as well as, more generally, the US government policy) had a major role to drive agricultural policies throughout the world in the immediate aftermath of the Second World War, at least in non-socialist countries. In the Soviet Union, paradoxically, the market played a larger role in feeding the population than in the occident¹⁷.

But this new role of the State in Agriculture, at its turn, raised new specific problems that agricultural economists were called to solve : In the absence of markets, how to determine agricultural prices , capable of satisfying both farmers and consumers ? Should administered prices be defined for every product, or only for basic commodities ? What should be the respective roles of trade and stockpiling in managing temporary or permanent excesses or shortages ? These were serious policy questions addressed to agricultural economists.

Before they could envisage answers, they had to learn the theory of production, as it was developed in general economics for instance by Cobb & Douglas (1928) or Carlson (1965). They learned it. Even more, they contributed to it : for instance, the notion of « fixed factor ¹⁸ », as defined by Johnson (1965), is much more precise and useful than what can be found in most elementary

¹⁶ Together with Henry Wallace, Mordecai Ezekiel and Rexford Tugwell played a major role. See Leuchtenburg(1963).

¹⁷ This is because of a Karl Marx error of analysis : the latter (just as almost all authors of his time) was persuaded of the virtue of « large farms » to produce cheap food, because of the existence of « economies of scale ». Since the soviets were anxious to be truthful to the Master, they set up an agricultural production system based on a set of large « Kolkhozes ». But at this stage, they discovered the difficulty of monitoring workers spread over large surfaces. They imagined providing incentives by allowing small « family gardens », the production of which was to be self consumed by the kolkhozians themselves. In fact, a significant part of the family gardens output was sold on free « kolkhozian markets » which played a significant role in the total agricultural production of the USSR.

¹⁸ A fixed factor is such that its current marginal productivity falls between its acquisition value and its salvage value. So strange as it might be, economists frequently spoke of « fixed factors » without precisely defining the word. This definition, so simple it might be, opens the way for a reconciliation between the static and dynamic points of view.

manuals of general economics. Similarly, they brought significant contributions regarding stock-piling¹⁹.

At the same time, they discovered a strange specificity of agriculture : the quasi-absence of economies of scale in agricultural production, while their existence is so evident in industrial activities²⁰. This result challenges the Hitier's (and similar) analysis mentioned above. It entails a great lot of consequences for the future of agriculture : The productivity of any large quantity of money will always be greater in industrial ventures (where economies of scale do exist) than in agriculture. Hence the prevalence of specific agricultural financial institutions (in general mutualistic, with a relatively low profitability). Also, this permanency of decreasing returns to scale implies that, in the long run, agricultural entrepreneurs will stay relatively poor, since, as soon as they could be rich, they would have better to shift toward industrial activities rather than to continue investing in farming. This is important, of course, for the future of farming.

Despite these successes, the political questions remained unsolved. They would probably have stayed so without the third component of the changes in agricultural economics : the computer revolution.

B/ The help of computers

This innovation first provided incentives for making use of formal mathematics in economic reasoning. Of course, it was not completely new : for instance, Leon Walras (1849) developed his general equilibrium theory without computers at his disposal. But the computers provided the possibility of actually set up a numerical version of the Walras (or others) models²¹. Agricultural economists quickly seized this possibility.

A first set of models were based on linear programming (more generally, constrained optimization) as described by Hazell and Norton (1986), most of them at farm level, but also at national level²². It turned out that these models were in general deprived of pertinence to prescribe optimal plans to farmers or governments. But they allowed for an actually experimental approach : thus, Freund (1954) could demonstrate the role of risk in shaping agricultural supply²³.

Computers also helped in practising statistical calculations. Many models were built using statistical inference, which presents the apparently enormous advantage to allow for testing « significance²⁴ ». This is at the point that the term « econometrics » was restricted to this particular type

¹⁹ A major contribution on the subject was Gustafson (1958), specifying decision rules for increasing or decreasing a stock in presence of random shocks. His finding triggered a long list of famous papers, from Gardner (1979) to Gouel (2018)

²⁰ See Boussard (1976). It might be the consequence of the role of land in agricultural production. Monitoring a large surface of land requires a great quantity of travels from one point to another. Their costs per unit of production (the latter is assumed to be uniformly spread over the surface) is quickly increasing.

²¹ Notice the word « model » have two different meanings : either the thing to be copied (the « model » of the painter) or the copy itself (the Walras model, a copy of the whole economic system). Of course, the economists make use of the word in this second sens only.

²² Thus, Heady (cf Heady and Srinistava, 1979) developped a famous model to determine an optimal location of crops across the US, a sort of mix between Von Thünen (because of the role of transportation costs) and Ricardo (because of its focus on natural conditions).

²³ Developing a linear programming model of a typical farm in North Carolina, he finds optimal production plans deprived from maize. Now, maize stands as a main production of North Carolina. Something is wrong with this model ! Freund, then (and because of discussions with farmers) imagine that risk might play a role in this case. In effect, introducing risk considerations into his model, he found that maize occupied a large fraction of the available land in the optimal solution of his (then nonlinear) programming model. Thus, without risk, with the current set of expected prices, North Carolina would not have produced any maize. This stands as an experimental verification of the Freund model.

²⁴ Although with caution : The « null hypothesis » is sometimes misleading. See Bessler (2013) for a recent philosophy

of model, those making use of statistical inference to parameter estimation, while it should have covered all mathematical applications to economics. A pioneer study in this respect is the famous Nerlove(1979) model of the US agricultural sector²⁵.

Even without explicit formal models, computers allowed for complex calculations, as those necessary for productivity measurement, especially difficult in the case of agriculture, because of the importance of such inputs as land or family labour²⁶

Finally, computers also helped tackle dynamics. Dynamics involves a large amount of data, the treatment of which needed computers. Now, dynamic considerations are necessary to the treatment of most of the above-mentioned problems, since, obviously, the evolution of agricultural and food systems cannot be envisaged as a succession of equilibria. The situation of period t depends of the situation during period $t-1$, and stands as a major determinant of the situation in period $t+1$.

Dynamics is especially important for the analysis of the capital problem. In pure economic theory, the capital stands as the memory of the system, so that any question regarding capital must be tackled throughout time. In effect, the lack of capital stands as the main obstacle against innovations in agricultural production. But why were farmers so reluctant to buy the capital they needed ? And why did not capitalists press them to borrow money in spite of the high profitability of the same capital ? Risk plays a central role here. Many authors wrote on this topic²⁷, the macroeconomic (and political) consequences of which is of the utmost importance, because risk is a central aspect of financing decisions and capital accumulation. It can also come as a complement to the Ezekiel cobweb model, explaining why is the corresponding motion chaotic instead of periodic²⁸. It also explains the failure of farm linear programming models to really help farmers in their day-to-day decisions.

C/ Agricultural development in poor countries

The development of former colonial economies has always been an application field for agricultural economists. In effect, in these countries, agriculture was the main economic activity, and the main employer. With independences, the necessity of changing this situation, as it had been changed in « developed countries », was fairly obvious (Jorgenson, 1961). In order to supply the nascent industries with manpower, as well as to avoid recurrent famines, the agricultural productivity was to be

of model testing.

²⁵ A central feature of this model was the picture of expectations : instead of assuming, as did Ezekiel, that the last year price would be the current price this year, Nerlove developed a complex expectation scheme. The model performed well with administered prices of the time, because the authorities did not change prices by too large an amount. With free markets, price changes were so large that the system did not work too well. Notice that the Nerlove's model is no more self stabilizing than the plain cobweb if the market equilibrium point is unstable.

²⁶ Two schools exist in this respect : one (the most popular) is known as the « total factor productivity ». It relies on the estimation, by traditional statistical methods, of a production function, the evolution of the parameters of which allows for providing both all the partial and total productivity. The drawback of this method is the arbitrariness involved in the choice of the functional form of the production function. Other methods have been proposed : surplus accounting (Vincent, 1971) does not need any assumption on production function, except homogeneity of degree 1. It allows for a presentation of « who gain and who lose » in the observed changes of all prices and quantities. Data Envelopment Analysis, elaborated from an idea by Farrell(1954) , is even more flexible, but does not allow for a « gains and losses » presentation of results. (See for instance Boussemart *et al.*, 2012). None of these methods is fully satisfactory, in particular because they require strong assumptions regarding the production function.

²⁷ For instance ; Just *et al.* (1986) asks if the law of supply holds in presence of risk (of course, the answer is « no »). Just *et al.*(1978) investigates the distribution of gains from a reduction of risk as a consequence of price stabilization. The risk is also a powerful impediment for agricultural development in poor countries (Roumasset *et al.*, 1979).

²⁸ Cf Boussard (1996). Noticeable in this respect is a recent paper by Dubey *et al.* (2018), about not only agricultural production, but the whole supply chain as well.

improved. Technical innovations (such as the « green revolution » developed from the works of geneticists in international organizations, for instance the CYMMIT or the IRRI), were ready for that. As a consequence, the quantity of labour necessary to feed the nations should have been considerably decreased, thus allowing for « a world without agriculture »²⁹. At the same time, technology was nothing without the corresponding capital. The big question was therefore how to increase the quantity of available capital for agriculture.

Yet, in view of the fact that the « Industrial Revolution » in developed countries had been performed fairly spontaneously, without advice of distinguished economists, the corresponding theoretical basis was lacking. A host of works of all kinds - from local monographies to advanced mathematical constructions- were elaborated in this framework.

In this field, the most elaborated model is probably the Von Neuman (1938) « turnpike »³⁰, a macroeconomic device, not naturally at the forefront of the preoccupations of agricultural economists. The main lesson to be derived from this dynamic multiperiod general equilibrium model is that, under fairly general conditions, for a given state of the available techniques, different economic systems should « converge » toward similar proportions of different activities : Thus, whatever the initial conditions, after a while, all economies should have the same proportion of agriculture, industry, services, etc... , and these optimal proportions would guarantee the maximum feasible rate of growth.

Yet, this result (which corresponds to the intuitive idea of most analysts) is valid only under a condition of « indecomposability » of the whole economy : throughout the Leontief input/output table, each industry must be directly (because industry A buy something to industry B) or indirectly (because A buy something to C which buys something to B) linked to all others. On the contrary, if industry A can grow without requiring anything from industry B, then there exists two different turnpikes, each with their own rate of growth. Obviously, such a situation implies continuously increasing inequalities, with two (or more) diverging « sub-economies ».

Now, this is exactly what happens in many developing countries : the « modern » sector does not need inputs from the « traditional » sector, nor from any other subsector of the « economy of the poor ». Thus, there exists two almost independent economic systems, each with its own rate of growth, and without relations between each other. The situation could be summarized by saying that the rich do not need the poor. Of course, the trade liberalization increases the phenomena, since the « modern » subsector of the developing country can rely on the « modern » sector overseas, without recourse to the local « traditional » subsector.

At least, the above remarks might have led to a « theory of poverty » (Perroux, 1961) which remain to be built, but where agricultural economists should have something to say, in view of the prevalence of agricultural activities in these « economies for the poor ». Indeed, the first thing that the developed sector of developing countries should buy locally in the traditional sector is food). Unfortunately, when they examine the case of « traditional » agriculture, agricultural economists, nowadays, are often tempted to be interested into those « visible » farmers who wish to enter the « monetary circuit », and to neglect the core of the self-sufficient rural population which nevertheless stands as the real problem in these countries.

²⁹ the title of a book by Peter Timmer, himself echoing a much older contribution by Gervais et al. (1965) on French agriculture.

³⁰ Whatever the specification of the maximized « social utility function », the solution of such a model, in the long run, should converge toward an « optimal path » called the « turnpike » (a turnpike is a paying rapid road that anybody should make use of to go from one town to another if the distance between the two is sufficiently large). The Von Neuman's turnpike is the set of relative levels of each activity (agriculture, steel industry, etc...) such that, given a certain technological environment, the rate of growth is maximal. Whatever the objective in the long run (for instance, maximizing the stock of gold in the central bank, or enrich the poor, or enrich the rich) any government should aim at keeping all economic activities of the nation in the proportions defined by the Von Neuman's turnpike.

Instead, at the end of the period, a new kind of paper began to appear, inspired by Hayeck and his liberal school (Hayeck, 1979). The most famous of them was Hardin (1968). He revived the old debate on the property rights, and attempted a reinterpretation of the history to show how the enclosure policy³¹ of the 18th century had been beneficial. In fact, the origin of the Hardin success was to be found in the resurgence of the « liberal » approach of economic problems, rather than in the depth of his analysis. But at that time, the liberalism was going to occupy the front of the scene...

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Thus, the period between 1930 and 1990 was extremely fruitful for agricultural economists. Everywhere, they became advisers of the Prince, and their advice, in general were sufficiently pertinent as to reach the main objective of the period : avoiding any future famine, by increasing the agricultural production through an intensive use of capital, while releasing large quantities of manpower the need of which was acute in industrial activities. Except in countries under war, they were generally successful in this respect.

This is not to say that they were unanimous. Indeed, during the period between 1945 and 1990, the « neoclassical » approach described above has been challenged by another school of thought, the Marxism. The main preoccupation of the Marxists was not so much the agricultural sector : just as Marx himself, they were more interested in the capitalist system than in agriculture, a strange economic sector where the capitalism did not seem to develop itself.

Indeed, there were no signs of the development of very large firms in agriculture, something which called for explanation. The « neoclassical » economists were rather indifferent. Marxists, tackled the problem frontally. They sought inspiration in Chayanov (1925), a Russian author who explained the absence of large firms in agriculture by the fact that the farmers objective functions were different. It was not very convincing, Yet a few Marxist authors rightly conclude to the absence of significant economies of scale in agriculture, « because of the existence of small tractors »³². That was a real achievement.

Unfortunately, in occidental countries, because of their reluctance toward « neoclassical » economics, and also, because it was in contradiction with the Master, they rarely published these findings in conventional professional journals. In fact, their reluctance to make use of mathematics, which precluded any experimental checking of their theories, was their main weakness, and also, unfortunately, the main message they transmitted to their followers. In rejecting any experimental approach, they prepared the arrival of another dogmatism, which we shall here call « liberal ».

IV - From the 1990s until today : classical liberalism, heterodox views, and ecology.

Thus, at the time of the fall of the Berlin Wall, in 1989, in many countries, agricultural economists were divided between « Marxists » and « Neoclassical ». The formers were popular with the public, with their language deprived of mathematics. The latter were influential for govern-

³¹ Before the 18^e century , in England, villagers were authorized to leave their beasts grazing the « common » land surfaces. At that time, the aristocracy begun to enclose the corresponding plots, thus forbidding this practice. Hardin tries to demonstrate that, at the end, thank to the avoidance of overgrazing, the production increased in the enclosed plots. Thus, the « common » management of these pieces of land was inefficient, and while the submittance of production to an individual decision makers benefitted to all. The observation was not new, and Proudhon (1849) said the same thing more than one century before. Fairlie (2009) is a better interpreter of the significance of the enclosures, while Ostrom (1999) explains how a collective management of the commons could have been possible.

³² In France, see Gervais et al. (1965). In socialist countries, such an idea was also very much heterodox (Chayanov was sentenced to death in 1937), since the official doctrine relied on large kholkozoes.

ments, although many members of the younger generation were deprived of the analytical preoccupations of their fathers .

Now, in developed countries, they had to manage a new plague : the over production. In effect, with constant return to scale, and the « land saving » effect of an increasing use of capital, the long-run marginal cost of any agricultural commodity was flat, and the marginal curve parallel to the x-axis. With constant administered prices, the demand curve was flat too, and also parallel to the x-axis : two parallel lines crossing over at infinity, an infinite production was to be expected from this state of things ... Indeed, governments from developed countries were flooded by excess quantities they had to sell a low price on international markets. Governments from developing countries were complaining against the associated dumping policies. Such a situation (rightly predicted by Colin Clark in the 1960s : cf Peter, 2001) was untenable, and remedies were required from economists.

In this context, the storage of the excess quantities on the market could have been envisaged. The solution had been investigated by many authors such as Gardner (1979) or Wright & Williams (1982), starting from the seminal work by Gustavson (1958). Yet, storage cannot protect from a permanent surplus or deficit. In addition, a storage policy can be successful only if the process at the origin of the oversupply or of the shortage is properly identified : The optimal rules of storage³³ cannot be the same if fluctuations are engendered by false expectations, as in the cobweb model, or by a stochastic process, as most people think it is the case. But few authors wanted to look at such problems³⁴ !

Instead, the debate on liberalism came back with violence. Following Olson (1987)³⁵, Gardner (1992) explained that farmers, by requiring exaggeratedly high prices for their commodities, had just robbed other citizens, obliged to pay incredibly high sums to get the food they needed³⁶. Many similar papers were published. Some authors objected the risk of increasing price volatility, but the objection was wiped out by others, such as Newberry and Stiglitz (1981)³⁷. Jack (1986) tries to explain the 19th century's economic development by the liberalization only. Despite an impressive collection of historical data, he might have overestimated the role of a liberalization which, after all, did not last for long (between 1840 and 1875). In all these references (and many others !) the analysis by Ezekiel and his disciples during the 1930s were completely forgotten.

The objective was that, as in textbooks, for each commodity, international price reflects the world's marginal cost of production, and the marginal utility of consumers. Large benefits were expected from such policies. In order to evaluate their magnitude, many research institutions, making use of existing statistics, tried to set up computable general equilibrium of the world economy³⁸. Results, in general, were smaller than expected, for the reason indicated above : « without » subven-

³³ A « rule of storage » is a document (or a computer program !) which specifies how to increase or decrease the stock in response of any specified change in the economic or physical environment.

³⁴ However, see Brenan *et al* (1997), or Gouel (2014).

³⁵ The latter, in fact, was not an agricultural economist, even not an economist. He was a sociologist, and wanted to investigate the techniques of lobbying. He found farmers to be an expert in this kind of exercise, and took agriculture as a field of experience...

³⁶ In fact, he compared the (guaranteed) domestic prices of commodities in the US with the « free price » on international markets. But he did not take account of the fact that the « free price » was artificially depressed by the export subsidies generously attributed by all the exporting governments.

³⁷ They explained that the correlation between natural calamities was weak over large surfaces, so that the mutualization of risks would have a stabilizing effect. Even more, they developed a theory along which natural hazards were self stabilizing (at least, for what concerns farmers incomes), because, in case of bad harvest, the overall supply let prices increase, thus maintaining the farmers income, while the contrary occurs in « good years ». Of course, this reasoning does not take account of the possibility of a bad harvest when prices are low !

³⁸ The most outstanding achievement in that direction was made by the consortium GTAP (Hertel, 1999 ; Hertel et al. 2003)

tions, the equilibrium price is higher than « with », thus decreasing the benefits expected for consumers. Yet, there was a benefit (a plain consequence of the theory at the origin of these models), and that was essential.

Now, it turned out that, after more than 10 years of « free trade » in agriculture, the main consequence of these new policies was less a decrease in consumer prices than an increase in price volatility, as could have been forecasted by Ezekiel . This is a pity, because the cost of price risk in agriculture is high³⁹. Indeed, far from the Ricardo world, we are back to the 1770s, and the time of Galiani, when the fear of famine triggered the French Revolution. Would it be possible that, the same causes producing the same effects, a French Revolution at the world level could arise from this situation ?

Fortunately, the causes are not really the same. By now, there exists a shock absorber : the long chain of various operators between the field producer and the final food consumer. In developed countries, at least, the agricultural price is only a fraction of the final consumer price, while in developing countries, state interventions are still frequent, thus maintaining agriculture far from the market vagaries. In such a situation, agricultural economists, still preoccupied by food issues, are more and more concerned with the whole food chain. And the picture, here, is completely different.

Instead of facing a large number of small farms, all of them obliged to take price as it is, the economist of the food chain must consider a few big firms, each of them being endowed by a significant monopoly power, at least geographically. The consequences are important : first, the cost of food for the urban consumer is now almost independent from the farm gate price, thus mitigating the impact of the commodity price volatility for the later (but not for the farmer !). Second, if we want to lower the cost of food, increasing the productivity of agriculture is not the first priority : it might be easier to look at the productivity of the food chain, especially to decrease the volatility of prices, the cost of which is enormous (Karkuhl *et al.* 2016).

Other costs reducing instruments could also be envisaged, especially a better management of transportation. For that, one could have imagined agricultural economists following Von Thunen, and developing new models of space occupation. It did not occur. Instead, agricultural economists focused their attention on the distribution of value along the food chain. Since the end of the 19th century, they were interested in the cooperative movement, a system which was supposed providing farmers with a chance of getting back the benefits of the monopoly power which existed for technical reasons throughout the food chain. More than one hundred years after the elaboration of the theory, the real advantage of the cooperatives over the private system remains to be found⁴⁰.

While this liberalism quarrel was ongoing, another field came in the front stage, and is still there : How can we save the Planet from over-exploitation, and prevent the end of natural resources ? How to escape from the global warming ? How to prevent pesticides and GMOs from poisoning the whole inhabited areas ? Of course, this kind of question widely encompasses the normal domain of agricultural economics. But clearly, agricultural economists have something to say regarding such topics, insofar as agriculture stays at the heart of most of them .

Indeed, it is true that agriculture is more involved in such questions than most other human activities, insofar as it deals with very complex and sophisticated biological mechanisms which put it in direct relation with Nature. For these reasons, our colleagues are very much implicated in this field, much more than general economists. Often, they are more realistic than the latter, because of their better acquaintance with farmers and technical aspects of agronomy. For instance, when general

³⁹ As can be shown by Freund's results (1956), and by a host of papers after him.

⁴⁰ In most occasions, one can see that the cooperatives are operating on activities without (or almost without) economies of scale, while private food firms are exploiting the benefits of the latter. But there are many outstanding exceptions.

economists are often satisfied with the idea of a « carbon tax », agricultural economists, without denying its interest, are preoccupied by questions such as will it be paid by the poor or by the rich, or is it really possible to find a portfolio of techniques capable of making farmers sensitive to such a device, etc...

In addition, a complementary problem arises from the relative incompatibility between the new liberalism of the 2000s, and the preoccupation of « ecological issues ». For instance, in many countries, in the name of the necessity of keeping the Nature alive, the Law prohibits certain agricultural practices, such as the cultivation of GMOs. But at the same time, international treaties oblige them to import commodities made from GMOs. Insofar as the latter are really easier to produce, this situation creates a distortion to the detriment of the « virtuous » producers deprived from this facility⁴¹...

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Thus, after almost three centuries of agricultural economics research, we are still confronted with the same questions : liberalism (or not !), long-run food availability, and land property. Moreover, the emergence of the « political ecology » (and its economic consequences) reinforce the utility of the kinds of approaches made use of by agricultural economics.

The « liberal » question is far from being settled. Obviously, « Trade is a good thing », allowing for a more efficient use of resources. But trade requires well-functioning markets, and this is never guaranteed. In addition, what is true in a static environment is not necessarily so in a dynamic framework. This remark is valid in any context, but perhaps even more for food products with a globally rigid demand. Despite their abstractness and the difficulty of communicating results, the mathematics of chaotic regimes should be here at the forefront of investigations.

The food availability for all in the long run is far from being guaranteed . Here, we need first technical research to improve plants and animals, but also mathematical models a bit more complicated than those of Malthus⁴². Before their results could be communicated to the public, they should be carefully tested over past historical periods. One should avoid using them too prescriptively , as was the case for the general equilibrium models of the 1990's⁴³...

The land property question has been largely solved, at least in developed countries, thank to three circumstances : first, the technical progress, the use of capital to make food, and other circumstances prevented land prices to increase, thus making largely obsolete the question of the appropriation of the land rent. In addition, in almost all developed countries, many regulations regarding land use turn the notion of « property rights » into a bundle of many different rights of usage, each with its specificity. Finally, the taxation system and the « land taxes » are allowing the State to keep a

⁴¹ Of course, the term « virtuous » employed here does not mean that the author share the views of those who claim that all the GMO's techniques will destroy the Nature for ever ! « Virtuous », here, means only that the corresponding producers comply with the democratically issued laws of their countries. The dangerousity of the GMOs is another question, which the economist cannot tackle. Yet, insofar as biologists are almost unanimously persuaded that the GMO crops presently in cultivation do not present any threat, the persistence of the GMO rejection by the public raises a problem of sociology which encompasses the narrow question of the GMO alleged toxicity. Indeed, it extends itself to the role of science, scientists and pseudo-scientists in the Society .

⁴² Population growths as a geometric progression, while subsistences growth as an arithmetic progression...

⁴³ In the 1970s, Edouard Saouma , then the director of the FAO, was proposed to set up a team in charge of building a model of the world agriculture. He dismissed the idea, on the ground that such an instrument would have been a weapon in international negotiations, and that weapons manufacturing was not in the mandate of the FAO. He was perfectly right, even if many colleagues criticized him at the time.

significant share of the land rent, as suggested by Leon Walras⁴⁴, even if land-based subsidies have been set up in various countries in the false hope that they could be « not distorting ».

Are we in a position to solve these problems ? It is a question of chance, but also of method. In fact, the most interesting novelty of the discipline is the large number of monographies which are published from PhD thesis or field studies. Each day, one can find a new working paper about a « case study » linked with agricultural economics⁴⁵ on the Internet. But the mere description of what happens, so accurate and honest if can be, is not sufficient to be qualified of « scientific ». The core of the scientific method is experimental. A scientist should normally put some hypothesis and check if it is verified in the particular case at hand. This is not always the case, especially in environmental matters, where poorly founded prescriptions⁴⁶ are legions. If we want to maintain our discipline as a science in the long run, we must be able to meet this challenge, even if, in the short run, flattering politicians might seem more promising.

Finally, we have seen how our domain had been renewed by the creation of the land-grant colleges in the US to solve the specific problems of this country. Since now a couple of decades, China is going to launch an enormous effort to solve its own problems of food security coupled with environmental preservation (see Chaï *et al.*, 2019) . Will it be possible to expect a new start of agricultural economics from this new situation ?

⁴⁴ The case is different in many developing countries, where, until recently, land was not so much a constraint. There, the rights associated with land ownership are far from being clear, and several ones (traditional, colonial, modern) are in conflict. The same occurs not only for land but also for water, despite the fact that contrary to land, water can always be « manufactured », either by pumping into a lake, or even with sea water desalinization and long pipelines.

⁴⁵ There is certainly here a danger, as outlined by Schumpeter (1951) when discussing the « German historical school of economics » in his famous « History of economic analysis » : at the end of the 19^e century, thousands of German students wrote a host of well-done monographies which nobody could really make of, because they were too many, and, above all, too difficult to synthesize.

⁴⁶ Most of them are based on plausible but unchecked reasonings, or unverified generalizations.

REFERENCES

- Alligood, K., T. Sauter & J. York , (1996): *Chaos, an introduction to dynamical systems*. Springer, Berlin.
- Becker; G.(1993) *Human capital : a theoretical and empirical analysis* . University of Chicago University press, Chicago.
- Bessler, D. (2013) : On agricultural econometrics. *Journal of agricultural and applied economics* 45(3):341-348.
- Boussard J.M. (1976) The concept of economies of scale in a multiproduct industry and its implications for the future of agriculture. *Eur. Rev. agr. Eco.* 3 (1), pp. 53-70
- Boussard, J.M. (1996). When risk generates chaos. *Journal of Economic Behaviour and Organization*, 29 (96/05), 433-446.
- Boussemart, J-P. , J.P. Butault, & O. Ojo (2012) : *Generation and Distribution of Productivity Gains in French Agriculture. Who are the Winners and the Losers over the Last Fifty Years?*”, The 11th International Symposium Prospects for the 3rd Millennium Agriculture, 27th-29th of September, Cluj-Napoca, Romania
- Brenan, D., J. Williams and B.D. Wright (1997) Convenience yields without the convenience : a spatial-temporal interpretation of storage under backwardation. *The Economic Journal* 107 : 1009-1022.
- Carlson S. (1965) *A study in the pure theory of production* Kelley, New York.
- Chai, Y, P.G. Pardney, C. Chan-Kang, J. Huang, K. Lee, W. Dong (2019) : Passing the food and agricultural R&D buck ? The United States and China. *Food Policy* 86, July.
- Chayanov, A.V. (1925), *The Theory of Peasant Economy*, Thorner, Kerblay & Smith, 1966, 386 p.
- Christaller, Walter (1933) : *Die zentralen Orte in Sddeutschland , eine okonomisch-geographische Untersuchung uber dieGesotzmassigkeit der Verbreitung und Entwicklung der Siedlungen mit stadtischen Funktionen.* .Gustav Fischer edition, Iéna
- Cobb, C. W.; Douglas, P. H. (1928). "A Theory of Production". *American Economic Review* 18 (Supplement): 139–165.???
- Condorcet, Jean de Caritat, Marquis de (1795) : *Esquisse d'un tableau historique des progrès de l'esprit humain*. Published by Masson, Paris, 1822.
- Disraëli, B. (1846) : Speech delivered for the third reading of the Law for the repel of the corn laws . *Hansard*, Vol 86, N°3.
- Dubey, U.K. , Chavas J.P. and D. Veeramani (2018) : Analytical framework for sustainable supply chain management. *International Journal of Production Economics* 200 : 240-261.
- Evenson, R & P. Pingali (2009) *Handbook of agricultural economics*, Vol 4, Elsevier,

Amsterdam

Evenson, R & P. Pingali (2007) *Handbook of agricultural economics*, Vol 3, Elsevier, Amsterdam

Ezekiel, M. (1938) : *The Cobweb Theorem*. Quarterly Journal of Economics **53** : 225-280.

Fairlie, Simon (2009) : A short history of the enclosures in Britain. *Land*, issue 7 summer.

Farrell, M.J. (1954): „An application of the activity analysis to the theory of the firm“ *Econometrica* **22**(3), July:291-302.

Freund, R.J. (1956) : Introducing risk into a programming model. *Econometrica* **21** (4) : 253-263.

Fujita M., Krugman P. et Venables A. (1999), *The spatial economy. Cities, regions and international trade*. The MIT Press, Cambridge (Mass).

Galiani, F. (1770) : *Dialogue sur le commerce des bleds*. (A dialogue on grain trade) , new edition, Fayard, Paris 1984.

Gardner, B. L., 1979. *Optimal Stockpiling of Grain*. Lexington, MA: Lexington Books.

Gardner, B.L. (1992) : Changing economic perspectives in the farm problem. *Journal of Economic Literature* **30**(1) : 62-101.

Gustavson R.L., 1958. *Carover levels for grains : a method for determining amounts that are optimal under specified conditions*. United States Department of Agriculture (USDA) Technical bulletin 1178, Washington D.C..

Gardner, B.L. and G. Rausser (2001) : *Handbook of Agricultural Economics, vol 1* North Holland, Den Haag,

Gardner, B.L. and G. Rausser (2002) : *Handbook of Agricultural Economics*. Vol 2 North Holland, Den Haag,

Gervais, M., C. Servolin, et J. Weil (1965) : *Une France sans paysans* Le Seuil, Paris, 125 p.

Ginsburgh, Victor and Michiel Keyzer (1997) : *The Structure of Applied General Equilibrium Models*. MIT Press ; Cambridge (Mass.).

Gouel, C. (2014) Food price volatility and domestic stabilization policies in developing countries. in : *The economics of food price volatility*, Chavas, Jean-Paul, Hummels, David, Wright, Brian D.. Chicago : University of Chicago Press,. pp. 261-306.

Hardin, Garrett (1968) The Tragedy of the Commons, *Science*, 162:1243-1248.

Hayek, F.A. (1979): *Law legislation and liberty* 3 vol, Routledge and Paul Kegan, London

Hazell, P.B.R., and R.D. Norton (1986) : *Mathematical Programming for Economic Analysis in Agriculture*. Macmillan Publishing Company. NY.

Heady, E.O. and Srivastava (1975) *Spatial sector programming models in agriculture* Iowa State University press, Ames(Iowa).

Hertel, T. Ed. (1999) : *Global trade analysis*, Cambridge University press, Cambridge.

Hertel, T., R. Keeney and E. Valenzuela. (2004). *Global analysis of agricultural trade liberalisation :Assessing model validity* Paper presented at the AAAE meeting, Denver (Colorado), June 1-4.

Hicks, Sir John (1969) : *A theory of Economic history*, Clarendon Press, Oxford.

Hitier, J. (1901) : L'agriculture moderne et sa tendance à s'industrialiser. *Revue d'économie politique*. février, 1-30.

Isard, Walter (1968): *Location and space-economy, a general theory relative to industrial location, market area, land use trade and urban structure*. Cambridge (Mass.), London : MIT press.

Jacks, D. (2006) : What drove the 19th century market integration ?. *Exploration in Economic History* 43: 383-412.

Johnson, G. (1959) : Agricultural supply functions : some facts and notions in : Heady, E.O., Diesslin et al : agricultural adjustment problems in a growing economy. Iowa State University Press, 1959 : 74-93.

Jorgenson, D.W. (1961) : *The development of a Dual Economy*. Economic Journal, 71 : 309-334.

Just, Richard, Ernst Lutz, Andrew Schmitz & Stephen Turnowsky(1978) : The distribution of welfare gains from price stabilisation. *Journal of International Economics* 8 : 551-563.

Just, Richard E. & Daniel Zilberman (1986) : *Does the law of supply hold under uncertainty ?* The Economic Journal, 96 : 514-524.

Karlkuhl, D., M.J. Von Braun, and M. Torero (2016) : *Food price volatility and its implication for food security and policy* . Springer Verlag, Heidelberg.

Krugmann P.R.(1995) : *Development, geography, and economic theory*. Cambridge, Mass. : MIT Press.

Leuchtenburg W.E. (1963) : *Franklin D. Roosevelt and the new deal 1932-1940* Harper and Row, New York.

Leontief, Wassily (1970) Theoretical assumptions and non-observed facts *American Economic Review*, 61 (1): 1-7.

List, F. (1841) *Das nationale System der politischen Ökonomie* (The national system of political economy : published in French by Gallimard, Gallimard, Paris, 1998, with forewords by Emmanuel Todd).

Marein, Marie-Françoise (2007) : *L'agriculture dans la Grèce du IV^e siècle avant Jésus Christ*.

Marx, Karl (1867) *Das Kapital ,Kritik der politischen Oekonomie, Part 3* .Verlag Otto Meissner Hamburg.

Nerlove, M. (1979) : The dynamic of supply, retrospect and prospects, *American Journal of Agricultural Economics* 61 (5) : 874-888.

Neuman, A. Von (1937) : *A model of general equilibrium*. Review of economic studies, 13 (1, 1946) : 1-9. (English translation of the original in German : über ein ökonomisches gleichungs - system und eine Verallgemeinerung, Vienna, 1937.

Newbery, D-M-G., And J-E. Stiglitz (1981) : *The Theory of Commodity Price Stabilization*, Clarendon press, Oxford.

Olson, M, (1965). *The Logic of Collective Action : Public Goods and the Theory of Groups* Harvard University Press.

Ostrom E. (1990). *Governing the commons*. Cambridge, Cambridge University Press,

Perroux F. (1961) *L'économie du 20^e siècle* - Paris : P.U.F, 1961

Proudhon (1841) : *Qu'est-ce que la propriété ? Éssai sur le principe du droit et du gouvernement*. Paris, Librairie de Prévot, 1841. Reprinted in *Science*, New Series, Vol. 162, No. 3859 (Dec. 13, 1968), pp. 1243-1248

Peters, G. (2001) : *Colin Clark (1905-1986), Economist and Agricultural Economist* Queen Elisabeth House working paper series N° 69, University of Oxford, Oxford.

Quesnay, François et Mirabeau, Victor de Riquetti, marquis de (1763) : *Philosophie rurale ou économie générale et politique de l'agriculture*, Amsterdam chez les libraires associés.

Sadoulet, E. & de Janvry, A. (1995). *Quantitative Development Policy Analysis*. The Johns Hopkins University Press. Baltimore, Maryland, USA and London.

Schaffer, H.D. & Ray, D.E. Ray (2019) : Food sovereignty *MidAmerica Farmer Grower*, Vol. 37, No. 234, Aug.9th

Schultz , Théodore W.(1964) : *Transforming traditional agriculture*, New Haven and London, Yale University Press

Schumpeter, Joseph (1954) : *History of Economic Analysis* Allen and Unwin, Londres.

Stepanyan, D. (2016) : *From static to dynamic stochastic agricultural partial equilibrium models : the role of price expectation and storage*. Working paper, Humbolt universität zu Berlin.

Timmer C.P. (2009), *A World without Agriculture: The Structural Transformation in Historical Perspective*, The American Enterprise Institute Press, Washington D.C.

Vincent, L.A.(1971) Indices et surplus de productivité globale . *Revue économique* 22(1):1-42.

Volterra, V. (1926) : Variazioni e fluttuazioni del numero d'individui in specie animali conviventi. *Mem. R. Accad. Naz. dei Lincei* 2(1926)31-113

Walras, L. (1849) : *Éléments d'économie politique pure ou théorie de la richesse sociale*. Guillaumin, Paris

Walras, L. (1876) : *Théorie mathématique du prix des terres et de leur rachat par l'Etat*. Paper presented to the Société Vaudoise de Sciences Naturelle, Lausanne, feb. 16, 1876. Reproduced in: *Théorie mathématique de la richesse sociale*, Economica, Paris, .P. 97.

Wright, B. D., Williams, J., 1982. The Economic Role of Commodity Storage, *Econ. J.* 92, 596-614.