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MARKET RISKS MANAGEMENT INSTRUMENTS FOR AGRICULTURAL MARKETS AND EU POLICY

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Abstract: *Most economists congregate on the idea that commodity price instability should be reduced. Since at least one century a variety of instruments have been designed to that end, without much success, especially for agricultural commodities. The failure might be a consequence of the fact that most policies have neglected the reason for price fluctuations. The latter's are endogenous, caused by the market equilibrium local dynamic instability, which means that any measure relying on the "law of large numbers" is likely to be inoperative. In addition, because, in agriculture, the production function is homogenous and of degree one, any effective stabilisation leads to over production. Only production quotas can cope with these difficulties. They may be designed in such a "way as to maintain the essential feature of market equilibrium, i.e. marginal cost equating price.*

Keywords: equilibrium point, exogenous/endogenous fluctuations, insurance (price) storage /retriveral, limited quantities, marginal cost, market operators,. market volatility, production techniques, risk of producers, volatility/fluctuations in agricultural prices

Market risks management instruments for agricultural markets and EU policy

Agricultural price volatility is not new a phenomenon. For instance, figure 1 below displays the wheat producer price in France from 1701 to 2013. It seems even more volatile in the early 18th century than nowadays.

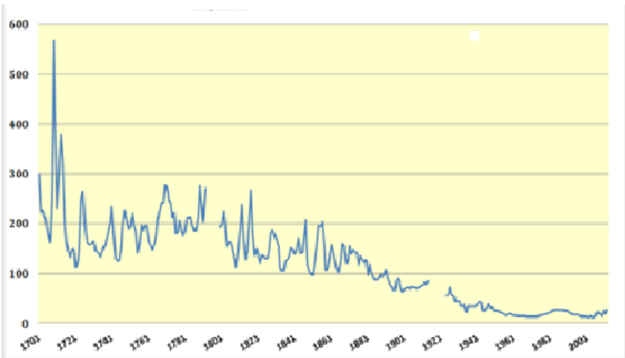

Figure 1 Wheat producer price in France, 1701- 2014[2]
Prices expressed as number of non qualified working hours per ton

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[2] Fourastié (1966) is the main source for this diagram. From 1701 until 1950, this author compiled wheat prices in current currency on as many markets records as possible. Then, he computed the

But much earlier sources, such as the Bible and Joseph's story in the genesis book, mention a virtually infinite volatility in Egypt during the 18th century BC[3]

Now, such a situation is never "good" for anybody. Of course, farmers benefit from high prices. But in such situations, their gains are smaller than the losses for the consumer. Conversely, consumer gains from low prices do not offset producer losses. After a few rounds up and down, everybody is worse on, as demonstrated in any first year course of economics…In effect, the marginal cost equating demand is socially "optimal" in some sense. With a volatile price, this equality never holds, meaning volatility is always "bad" for any market. Now, agricultural prices are exceptionally volatile, as illustrated on figure 2: while car prices fluctuates modestly (and decrease in the long run), retail tomatoes prices vary from one to four in a few weeks (and are stationary, if not increasing). The same sort of diagram could have been obtained with many couples of agricultural and non agricultural commodities. Then, the question arises of how to prevent (and cure) price volatility?

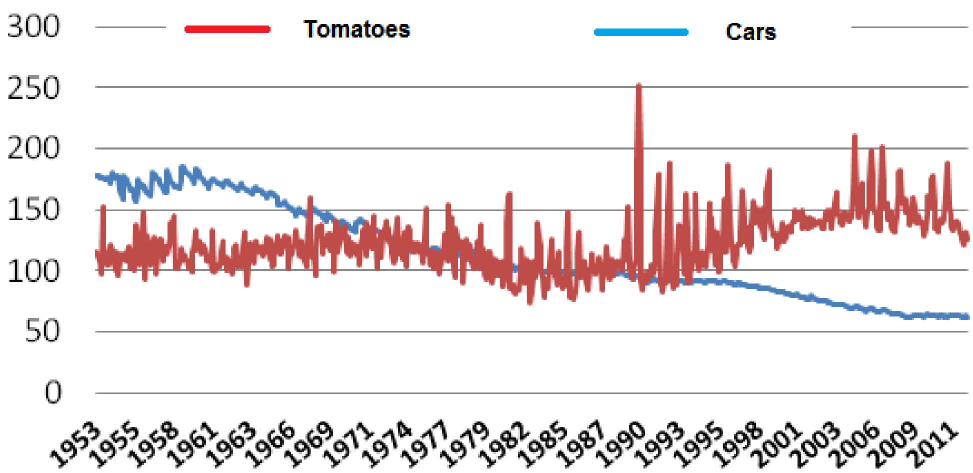

Figure 2 Retail prices of tomatoes and cars in large American cities, 193-2011

Seasonally adjusted indexes base 100: 1984-86. Source: Economagic

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quantity of wheat a non qualified worker could buy at the time with one working hour. The price of the working hour itself derives from the compilation of parochial archives, which indicate the cost and working time for the renovation of church seats. Eventually, the series was augmented using the legal minimum wage rate as the labour price, and the INSEE's price of wheat.

[3] Joseph predicts a famine, and urges the King to set up a granary. In effect, the first year of dearth, people from the Middle East come to the granary to buy grain. The second year, the famine is still lasting, but all the available money has been spent. "And when money came to an end in the land of Egypt and in the land of Canaan, all the Egyptians came to Joseph, saying, give us bread! for why should we die before thee? For our money is all gone…". And Joseph, in a way, creates money by taking a mortgage over the regional herd… In other words, without the Joseph's genial invention of the mortgage, the food price in Egypt at that time would have virtually reached infinity!…

No scientist can escape the idea that, in order to answer this question, one should try to understand the deep reasons which, beyond appearances, explain such a situation. It is clear that, if prices are volatile in the case of agricultural (and a few other) commodities and not elsewhere, then, there should exist some specificities explaining this phenomenon. In what follows, we shall present the hypotheses which have been under discussion in this respect, and the associated remedies.

Possible causes of agricultural prices volatility

On this subject, there exist a large consensus on what can be called the "primary causes", as well as deep dissensions regarding the "secondary causes" – although the later are essential from a practical point of view.

The primary cause of agricultural prices volatility is tied with the famous "King's law", that is, the low elasticity of food demand with respect to price. In effect, small changes in the quantities supplied on markets engender large price variations, because consumers (like the Egyptians in the Bible) are ready to leave their whole wealth when their survival is threatened, while they would not increase their food consumption by the smallest bit even if price fall near zero. As a consequence, a fall of 1% in the supply of almost any agricultural good will rise the corresponding price by far more than 1% - perhaps 5 or 10% - while an oversupply will trigger a price decrease of the same order of magnitude. All economists congregate on such an explanation of the large volatility of agricultural and food prices. But this explanation is not sufficient, since, at this stage, one does not see why supply is changing, even if changes are modest. Here is the core of the disputes between economists regarding this question. Some of them invoke "exogenous causes"– weather, plant and animal diseases, etc… - while others argue on the possibility of "endogenous causes", tied with the intimate functioning of markets. We shall now discuss these two approaches.

Exogenous fluctuations

Nobody can deny the fact that a farmer's harvest depends on weather or on sanitary hazards. But are such events likely to affect supply on markets?

The answer is certainly positive whence only small local markets are at stake. This is because if my own harvest is bad, there are all the chances that my neighbour's harvest of is bad too. Thus, climatic conditions are likely to result in variable supply (hence large price fluctuations) on a small market, collecting goods over a narrow region. Yet, the reasoning cannot be extended beyond very particular cases and for large markets.

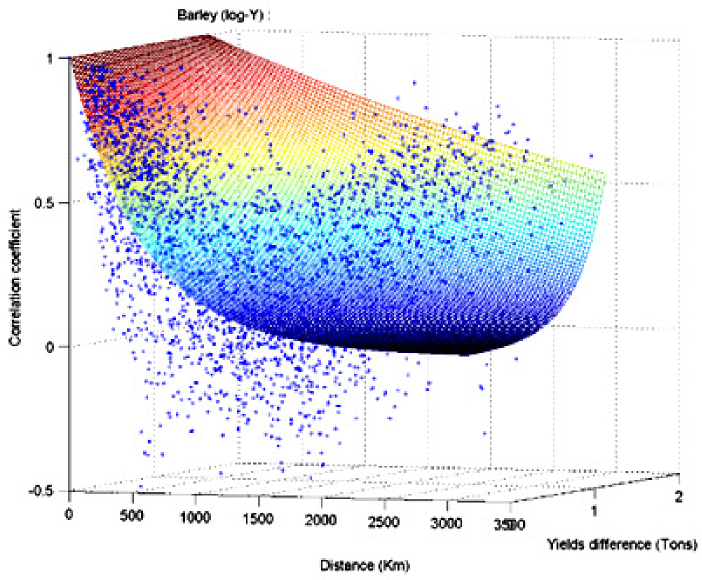

Figure 3 Correlation between barley yields in European small regions according to distance and differences in mean yields (source: Tarasov, 2011; Boussard & Tarasov, 2013)

Mean yields in small regions (Ukrainian oblast, French department, German lander, etc..) are observed, and a linear tendency determined. Differences in mean yields (reflecting differences in production techniques) and distances between regions are determined. Correlations are computed between the residuals of tendencies in each regions. Each point corresponds to one correlation according to distance and yield difference. The surface is built upon the least quadratic difference between points

First, even at the local level, meteorological hazards might not affect all farmers at the same time: a hail storm can devastate my field, and leave my neighbour's untouched! But above all, the correlation between yields in two different locations is decreasing with the corresponding distance, as shown on figure 3. It shows that the correlation between yields hazards in two European regions becomes negligible as soon as the corresponding distance encompasses 500 to 1000 km. In this way, as soon as a market basin is larger than about 1000x1000 km, the "law of large number" holds, and the supply on such a market should remain independent of exogenous shocks. This result is not surprising. For instance, Cobble *et al.* (2007) shows that yield variation coefficients are relatively small when measured at the federal US level, even if they are large in general when measured at the county level. An this reasoning has been a strong argument in support of agricultural liberalisation (e.g. Bale & Lutz, 1974)

And this is easily understandable. For what concern meteorological events, contrary to a common creed, they rarely affect large areas uniformly. Indeed, on a map, they look like "leopard skins", with multiple "good" spots in the middle of large unfavourable perturbations, and *vice versa*.

Figure 4 illustrates this point. It shows the variations of the NDVI index[4] over northern America during the corresponding weeks (week 32, beginning of August) of two noticeable years: 2011, often considered as a severe drought, and 2014, a very "normal" year. Indeed, one does not see very large differences between these two maps, even if the locations of green and red spots are not the same.

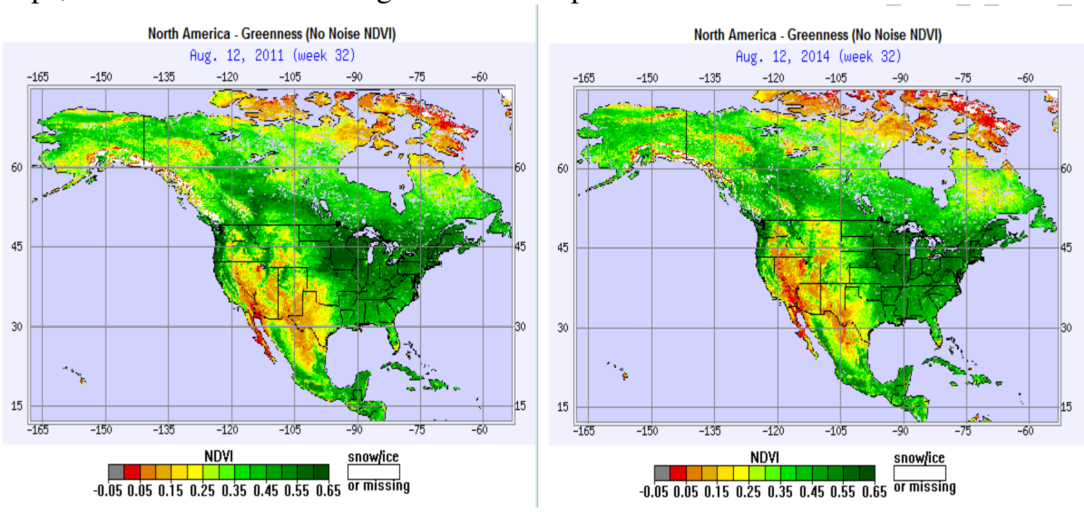

Figure 4 - NDVI over north America during week 22 of two different years
Situation 2011 (outstanding drought) *Situation 2014 (first normal year after several droughts)*

Regarding the consequences pests and diseases, the chances that they affect large areas simultaneously are not nil. Yet, they are small, and sanitary precautions are most of the time successful.

Thus, price fluctuations could have been explained by exogenous accidents a long time ago, when transportations were difficult and lengthy. Nowadays, in a matter of hours, a few trucks could suffice to carry over food in large enough quantities to feed the whole population of a large city. In such a context, the explanation of price fluctuations by exogenous events seems short.

A contrario, even if all conditions are met for climatic factors to be at the origin of fluctuations, they often do not explain *all* observed price changes. In his study of the price of Florida's orange juice, Roll (1984) provides a striking example in this respect. The orange tree Florida orchard extends itself over a relatively small area, about 100 x 100 km around Jacksonville. The whole production is sold on a specific market, which can be considered as well isolated from other sources of

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[4] The NDVI (('Normalised Difference Vegetation Index') is related to the health of the vegetation in a point. In fact, it measures the way the vegetation reflects solar light, which depends upon how much are plants turgescent. Here, "red" zones represent areas where drying plants are dominant, while "green" zones correspond to places where plants are normally watered.

orange juice. Orange trees are extremely sensitive to frost, a relatively rare accident in Florida, but which occurs from time to time. In case of frost, the whole orchard is devastated, and the harvest in jeopardy. Roll was interested in the price of the orange juice futures contracts – contracts passed in January for a delivery in July. In January, it is easy to predict a rise in July price if a frost occurred in December. In this context, expecting a relation between the climate and the price of futures orange juice contracts passed in January seems reasonable. In effect, Roll demonstrates the existence of a statistically significant relation of this type. Yet, this relation is far from explaining the bulk of the variability of the futures prices of the Florida orange juice… Other mechanisms are thus at work, and are to be identified…

All the above developments lead to the conclusion that one should envisage other sources of agricultural price variability than exogenous events. This is what we shall do now, with the endogenous theory of price variability.

Endogenous fluctuations

Endogenous prices changes have nothing to do with external factors. They are engendered by the dynamics of the market itself. The starting point of the reasoning is the "cobweb model" as made famous by Ezekiel (1938)[5].

The central idea of this model is the existence of a lag between the decision to produce and the delivery on markets. Because of this lag, production decisions are not based upon any observed price, but upon an *expectation* – the price guessed by the producer at decision time. Ezekiel assumes this expectation is simply the current price during the previous period. Then, assuming that, for some reason, the quantity supplied at time 0 was q0, the observed price at time 1 is p1 – a high price on figure 5. At that price, producers are bound to deliver q1 the next time. But q1 is too large, and the price falls at p2… At price p2, the supply is q3, and so on…

Such a process can result in three types of outcome: If the ratio "slope of the demand curve over slope of the supply curve" is less than one in absolute value, then the difference between each price and quantity from one period to the following one is decreasing in absolute value: the system "converge" toward equilibrium (this is the situation pictured on figure 5). If the ratio is greater than one, this difference is increasing as time passes: the system "diverges". Finally, in the special case of the ratio being unity, the system is "periodic", the same prices and quantities coming back each two periods.

[5] Despite the legend, Ezekiel (he was one of the President Roosevelt advisor for agriculture during the 1930 crisis) is not the author of the model, which apparently had been developed by Kaldor (1934) as a follow up of works by Timbergen on the dynamics of maritime freight.

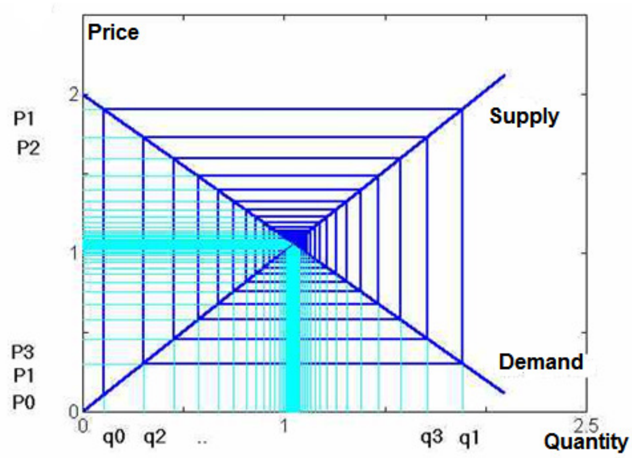

Figure 5 - The cobweb diagram

Of course, the two last situations cannot be observed in the real word: a periodic motion is not observable because, after a few rounds, producers would have noticed the high profitability of counter-cyclical production, which would lead them to take opportunity of it. By so doing, they would destroy the above mechanism, which would have therefore disappeared. Also, the "diverging" situation is not possible to last any more, because, after a few periods, it implies negative prices and quantities which are not feasible.

Thus, the cobweb model is no realistic. Yet, it delivers one main message that any economist should keep in mind: with an inelastic demand – this is the case of agricultural products – a market equilibrium point is *unstable,* like a ball at the top of a pencil, while it is stable in the opposite situation, like a ball at the bottom of a cup. Consequently, in the case of "luxury products" – those for which the demand is elastic-, market solutions lead to the optimal point where marginal cost equates price, and the price stays there. On the contrary, in the case of first necessity products, those with a rigid demand, the chances of converging toward the optimal equilibrium position are lean.

Now, the problem is to know what happens to markets when the demand is inelastic. Clearly, the original cobweb, with linear supply and demand curves, does not bring much information on this point. Ezekiel himself was perfectly aware of that. He suggested to solve the problem by assuming S shaped supply and demand curves, but this is not very convincing, because one does not see why should these curves be S (or any other letter!)- shaped. We need more subtle and deeper explanations of the fact that markets are still functioning even if they permanently stay away from equilibrium, and what are the consequences of this situation.

Obviously, the market does not "explode" (with prices and quantities going toward plus and minus infinity) because something forces it to come back toward the optimal equilibrium as soon as it is sufficiently far away of it, just as a ball which would be attached at the top of a pencil by an elastic string. But what, here, plays the role of the elastic string ? Many hypothesis have been envisaged to answer this question. Two of them seem valuable, one linked with risk, the other with financial considerations.

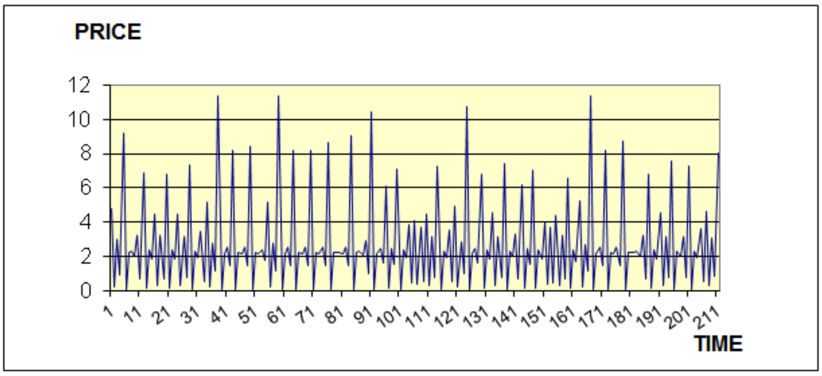

Figure 6 - A sample result of the « risky cobweb»
Marginal cost: P=0.35 Q + 2; Demand function: P= -3.5 Q +10;
Risk aversion =0.05 ; Expected mean price: 6 ; Starting point : Q=1,5

Let's first consider risk. Market operators know that prices are volatile. Even more, they are aware of production and demand conditions. Therefore, they can very well detect any "anomalous" condition, implying a risk of "shifting regime". Thus, even without expecting any immediate change in the mean price, they can associate an increased risk with a situation really too far away of equilibrium. Now, risk is an important determinant of production decisions. Actually, producers never equate marginal cost with demand price, but with its *certainty equivalent*[6]. As a consequence, since the certainty equivalent of a price is always less than its mean, the quantity produced in an uncertain environment is smaller than it would be under "price certainty", and the mean price higher. This illustrates the perverse effect of risk, and the inefficiency of volatile prices. It may also help understanding why are prices prevented to reach infinity: as they become more volatile, production decreases, and mean price increases. But this increase in mean price is an incentive to increase production… at the end, the complex interaction between these two contradictory forces pulls back the system in the direction of the equilibrium whence it stays far from it, just like the elastic string does for the ball at the top of the pencil…

[6] The certainty equivalent of a price is defined as the certain price which would lead to the same decision as do an uncertain one. For instance, nobody would pay 50 $ to have the right to be given 100 $ subject to one toss with probability 0.5. Yet, many would accept such a risk if the stake is 1$ instead of 50 $. In the between, there exists a number x – say, 40 or 30 $ - for which a given decision maker is *indifferent* between playing or not playing. Then, it can be said that, for this decision maker, the certainty equivalent of the 0.5 probability of a 100$ gain is precisely x. It is to be noticed that x is a personal (and transitory) characteristic of each decision maker…

Figure 6 shows a sample result from a fairly simple "risky cobweb" model built on this basis (Boussard, 1976). Expectations are constant, (here, 6.0.). Risk for period t is measured by the square of the difference between this expectation and the price at time t-1. The linear equations of the demand and supply (=marginal cost) curves are as indicated. Such a graph is not really similar with a true agricultural price series, like those of figure 1 and 2, at least because it is perfectly "stationary" instead of "trendy". Yet, it displays some of the characteristics of a random price, although it is not random at all, and perfectly deterministic. In fact, it is a "chaotic" series, in the sense of the word in mathematics: the solution of a differential equation which does not converge, nor diverges, nor is periodic. Not only the precise values of the terms of the series, but even its general shape are "sensitive to initial condition", as shown by figure 7, obtained with the same model and the same parameters except the starting point of the series (1.51 instead of 1.50): of course, the two curves of figure 6 and 7 are completely different, despite very similar parameters!

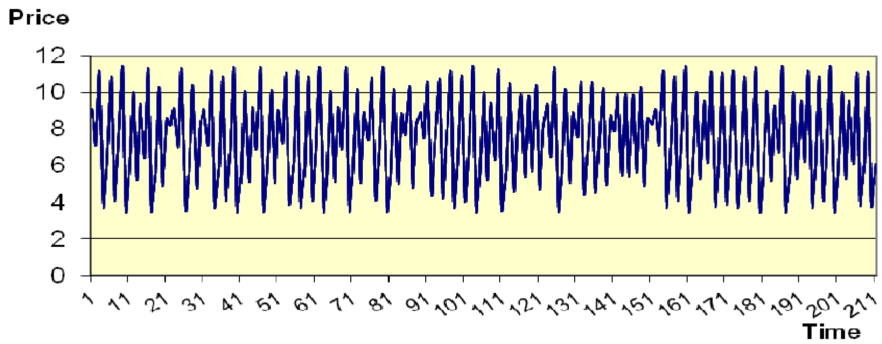

Figure 7 - Another result of the same model as for figure 6
All data identical with those of figure 6 except the starting point: q= 1.51 instead of 1.50

It means that predicting prices on the basis of past series is impossible, except in the very short run. Indeed, this model helps understanding the futility of such an exercise. Finally, the succession of large fluctuations and of relatively steady spells must be noticed.

The risk is not the only way to generate chaotic market motions. Financial considerations could interfere with the above mechanism, and might add a few complications to the system. In effect, even if farmers expect high prices, they cannot increase their production rapidly. Even with credit, they have to accumulate a certain quantity of own money before envisaging investments and production growth. Conversely, after being indebted, if they do not stop completely in bankruptcy, they must continue to produce at whatever price. Again, the corresponding constraints are likely to change the time path of the adaptation of production to market signals, and to lead to a chaotic motion of price throughout time, in place of the simplicity of the original cobweb.

Thus, be it a consequence of the farmers' behaviour in face of risk, or of financial constraints, or both, this line of explanation of endogenous fluctuations leads to consider agricultural price series as chaotic. A rather unpleasant consequence of this situation is that any intervention in the system will modify its parameters, and, consequently, result in unpredictable consequences. Here is the main difference between the endogenous and the exogenous fluctuations. The latter are amenable to interventions which will not alter the source of the disorder, but only cure its consequences. In the case of endogenous fluctuations, the problem of intervention is that it has to tackle the engendering mechanism at its very source. Otherwise, any intervention will change the parameters of the series (for instance, the frequency of low prices), thus jeopardizing all the benefit /cost computations made beforehand.

The reality of agricultural price fluctuations

Thus, two sorts of mechanisms, exogenous and endogenous, might engender price fluctuations on agricultural markets. The former seems at work on isolated markets, such as in Africa, where supply comes from relatively small regions, within which all producers are submitted to the same natural hazards. The latter, on the contrary, stand as the sole possible explanation of price fluctuations in large international markets supplied from many remote locations. In such an environment, the "law of large number" holds, and precludes ascribing the origin of fluctuation to climatic or similar hazards.

In fact, it is possible to argue that both mechanisms jointly play a role in the two situations, although perhaps with a different intensity in each location and institutional setting. This is not a good new, because the remedies to be envisaged in order to avoid these detrimental phenomena are different in each case, and probably contradictory one with each others..…

We shall now discuss these contradictions in the light of the agricultural policies within the European Community. First, we shall examine the case of the policies designed to cope with exogenous fluctuations. Then, we shall see that such policies are very likely to fail, and lead to disasters in the context of endogenous fluctuations. And we shall end with considerations on how to replace them…

Consequences for EC policies: the case of exogenous fluctuations

In the case of exogenous random fluctuations, two main types of methods are available in order to mitigate the detrimental effects of prices changes: insurances and storage.

Insurances: extent and limits

Insurances are built upon the "Law of large numbers" (LLN). The LLN specifies the properties of the sum of a set of random variables, each of them "small" by comparison with the sum. If these variables are "independent" – or nearly so -, and if the number of variable is "large" enough, then the variability of the sum is very small, at the point of being negligible. Of course, this statement is extremely imprecise, because one should have defined the terms “small”, “independent”, “large”, “variability” etc… Indeed, several “laws of large numbers” do exist, differing by the precise meaning attributed to these words. Yet, the above formulation is sufficient to grasp the essence of the theorem, and to understand its usefulness, as well as its limits, when making use of it in the insurance business.

In effect, because of the LLN, an insurance company can promise its customers to pay them a sum of money subject to the occurrence of some random event, in exchange of a fixed non random premium, and that, without taking itself the smallest risk, provided that the above mentioned requirements are fulfilled: the probability of each random event must be independent of the others, the promised sums must be small by comparison with the total, etc.. If these conditions are satisfied, the sum which will be disbursed each year by the company can be predicted with great precision, in such a way that the premiums can easily be fixed at a rate which will cover all expenses tied with payment triggering events, augmented of the management costs and a reasonable benefit. The only real risk taken by the company would be to miscalculate the probabilities of damages… At the same time, the consequence of the system is a redistribution of the money collect through premiums: it flows from the “lucky” (who pay premiums without immediate benefits) to the “unlucky” (who’s indemnities are much larger than the premiums). For that reason, insurance companies are often called “mutual”.

Of course, the above mentioned conditions definitely exclude any “price insurance”: if price are low, they are low for everybody. It is therefore impossible to pay the damages suffered by the “unlucky” with the premiums collected from the “lucky”. In technical terms, we would say that the “price risk” is almost perfectly correlated between each subscriber, thus precluding any recourse to the LLN. The only possibility which would be open in this respect would rely on the independence of one year with respect to the others. But in this case (and assuming years are independent one from each other, which is still to be demonstrated), the problem would be essentially financial, since inter-annual transfers of money would be necessary. Above all, the financial equilibrium would require a “large number “ of years – in practice, something like 500 or 1000: the planning horizon of insurance companies is not so far!. And, of course, this infeasibility of the “price insurance” implies a similar infeasibility of any “revenue insurance”, since a revenue insurance contract would be the product of a yield insurance and of a price insurance contract…

By contrast, a yield insurance contract is theoretically feasible, although under conditions. Such a contract would guaranty a payment to a farmer whom harvest would have been less than normal for reasons out of his or her control. Such a risk is “small”, at least if the number of such contracts held by the same company is “large” – say more than 1000- 10000. Yet, if all these contracts are localised within the same geographical region, individual risks are highly correlated: it means that to be credible, a company will need to operate over continental sized areas. Notice that the European area is large enough for that, which could be a reason (among others!) for the European Union.

But the main problem for yield insurance is with the above proviso ”out of his or her control”. In effect, without adequate specifications in the contract, nothing prevent the subscriber to neglect all necessary cares, and discover at the end a very poor yield, justifying an indemnity… For this reason, yield insurance contracts must be carefully written[7], specifying the techniques which have to be employed on the insured crop, and the mean to check they have been actually put in operation. An alternative is to specify some sort of easily verifiable event triggering the payment (for instance, a hail storm). In this case, the payment is not really linked with the actual yield deficit, but with the occurrence of the specified event, whatever its actual consequences on the own yield of a particular beneficiary.

There is still another obstacle to yield insurance development: the damage reducing techniques. For instance, it is possible to develop irrigation systems to avoid the risk of drought, or use pesticides to prevent undesirable diseases. Such techniques are costly in general, but whether the corresponding cost supersedes the cost of insurance remains a question specific to each situation. Often, the benefit is larger with the risk prevention technique, which reduces the attractivity of the crop insurance contract.

Now, for the collectivity point of view, there is an additional benefit of using prevention techniques rather than insurance: Even if a crop insurance system can wipe out the damages caused to the farmer, it does not suppress their consequences for the consumer. The latter is still affected by the deficit in overall harvest, and the corresponding price increase. Such a consideration should especially be taken in account when designing an agricultural policy involving crop insurance subsidisation: the later is only a second best, which helps farmers, but not consumers. Even more, if one recalls the above considerations regarding the “mutual character” of insurance schemes, and the fact that insurances only shift the burden of damages between subscribers, then a subsidy to crop insurance is nothing else than a disguised price subsidy, which should be considered as such by the WTO[8].

From this last point of view, crop insurance is far from being a very efficient mean of coping with the instability of agricultural prices. Yet, by (to some extent) preserving farmers from bankruptcy, it can reduce the long run effects of a temporary accident which, otherwise, could have weakened the producing system for a while. Also, by avoiding farmers being submitted to exceedingly large business risks, it can

[7] The Spanish crop insurance scheme stands as an outstanding example in this respect.
[8] For some reasons – perhaps because the diplomats in charge of drafting the Marrakech treatise were not very acquainted with insurance economics - it is not the case, which constitutes a logical breach in the WTO agreements.

induce them to increase production, to the consumer benefit: these are not negligible benefits. But, as we have seen, this instrument cannot be employed everywhere any time.

Storage

Storage is an alternative to insurance in natural hazards remediation. Indeed, it is historically the first one to have been put in operation as a food security policy, as shown for instance by the Bible, which mentions it in Egypt about 1800 years BC. In effect, and contrary to insurance, since it is designed to avoid famines, it is directed toward consumer's rather than producer's benefit.

The mechanism at work is simple and well known: one buys commodities when harvests are good. At that time, prices are low, and this action tends to increase them, for the producer benefit. Commodities are stocked for a while, until another harvest is bad and prices high. Then, the stock is sold, which depresses the high price, for the consumer benefit. But the selling price is still higher than the buying price, in such a way that the storage operator has also a benefit. Because of this circumstance, there does not exist any reason for public authorities to be involved in such operations: the stockpiling mechanism can work within a perfectly liberal setting.

In addition, if the shocks are really of exogenous origin, with stationary probabilities, there exist efficient algorithms which minimize the risk of being out of stock, or of saturating the storage capacity[9].

Thus, storage results in a multitude of miraculous effects, benefiting to producer, consumer and storage operator, as well as stabilizing prices. They do not need any subsidy, as soon as the storage operator can keep the difference between purchasing and reselling prices. In presence of so many obvious advantages, it is surprising that it does not seem to expand itself spontaneously at its optimal level… Yet, experience shows that, most of time throughout history, in view of the inability of private operators to do the job, storage has been operated by public entities, be it the Egyptian Pharaohs, the *anonnes* of the Roman empire, the "lords" of feudality (and their castles as granaries), etc…. Worse, there exist many examples of private storage operators being called "speculators" and severely chastised (if not simply killed!) for being responsible of famines.

In fact, this is not so surprising. Often, operators are misled. Instead of "buying low and selling high", they (unwillingly) do just the contrary: because they are afraid prices could still increase, they buy "high", thus increasing price again, self fulfilling expectations, and creating penury. Or they make the same mistake in the opposite direction when prices are low…. These observations might lead to the conclusion that there exists a flaw in the above reasoning about the ability of storage to solve the volatility problem within a pure liberal framework….Actually, this flaw is not difficult to find: it lies in the assumption according to which we are in presence of

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9 In this respect, the pioneer work is by Gustafson (1958). A basic reference is William & Wright (1991). A recent contribution is Gouel & Jean (2011).

purely exogenous fluctuations, with perfectly defined probabilities, while expectation errors are tied with endogenous mechanisms.

Thus, the price stabilisation methods based on the “exogenous source of fluctuations” assumption are in jeopardy if applied in a different context of endogenous fluctuations. This is especially clear in the case of storage: the slope and location of the supply and demand curves are modified by the existence of storage in such a way that the probabilities of gluts or penuries are not constant anymore. This is the reason for why any operator, even in possession of the most improved Gustafson’s algorithms, will be mistaken at the end, and deserving people’s anger against speculators.

In such a context, we have now to turn our attention to price stabilisation within an endogenous fluctuation framework.

Consequences for EC policies: the case of endogenous fluctuations

As noticed above, whatever the cause of fluctuations, once the necessity to lower their amplitude is recognized, an economist is naturally tempted to find some sort of innovation capable of getting the desired result within a purely liberal framework, without public policies interventions. The “futures markets” seem to be able to bring such a solution. We shall first discuss the possibilities in this direction. Yet, their potential is probably smaller than expected. Thus, we shall have to envisage various methods for policy interventions.

Are futures markets sufficient to avoid the detrimental consequences of price variability?

On a futures market, operators exchange promises: for instance, the first of October, operator “A” promise to deliver x tons of wheat (with a specified quality) at location y, next 1st August, and operator “B” promise to buy it at that time for a specified price. There exist variants of this kind of promises: for instance, “A” can promise to deliver only if price is greater than z (or smaller than z’). This later kind of arrangement is an “option”. Yet, the typical transaction is the first one, upon which we shall focus our attention, the others adding unnecessary complexity in the analysis.

The main advantage of such a possibility is that the seller (here “A”) is perfectly sure of the price it will get at delivery time. In this way, “A” can organize production and decide investments on the basis of known prices. In such a setting, there are all the reasons for that marginal cost equates price, thus guarantying market optimality.

Yet, at delivery time, there are no reasons for that the “spot price” (the current price at that time) be the same as the “promised” price. This implies two consequences: first, the actual selling producer price is not the marginal cost anymore. Second, there are always one winner and one loser in each transaction.

A first consequence of this second remark is that the loser is tempted not to fulfil engagements… In view of this difficulty, futures markets operate under the supervision of an authority which calls losses and pays gains day after day, adjusting the (small) daily changes of prices all the time between promise and delivery. If one day, one of the participants does not comply with the adjustment, it is at once evicted out of the market and cannot operate any more…In this way, everybody is sure that transactions will be correctly ended at due time, whoever the loser.

But the fact that any promise is sure to be fulfilled does not suppress the loser's frustration. The later can feel to have been a fool to let embarked in such a disaster… hence, the main draw back of price volatility does not disappear with the existence of futures markets. The decision to sell or buy trough these institutions is always risky, with the detrimental consequences of such a situation. In addition, the time between promise and delivery is usually short – six month to two years – which is often not long enough to cover the risk of agricultural investments, and facilitate credit opening to farmers. Most newly established young farmers would like to know how they will be (and at which price they will sell!) in 10 to 20 years from now…

Finally, futures markets are open to "speculators", that is, persons who promise to buy or sell, without the least intent to do it (because they "do not touch commodity"!), but because they hope to resell the contract to another operator with benefit before its term. In this way, they operate exactly like the above described storage operator. The only difference lies in the fact that the stock is now "virtual" instead of being "real". Therefore, those analysts who think in terms of exogenous risks are right to credit them with the faculty of lowering price volatility, just like the "real" storage operators. And just for the same reasons, these futures markets speculators, when their expectations are wrong, probably increase volatility, and ruin themselves at the same time[10]…

Thus, while futures markets may bring some help in face of exogenous shocks, there are no reasons for that they can stabilize anything in an endogenous fluctuation context. And since no other "liberal" solutions seem to qualify for that, we have to turn our attention toward the possibility and pitfalls of public intervention.

Public fixed price for unlimited quantities

If the very cause of price vagary lies in the market itself, then a solution to avoid it would be to severe all ties between agriculture and market… Historically, such is the conclusion reached by Henry Wallace and Rexford Tugwell, the agricultural advisors of the US President Roosevelt during the 1930's. Consequently, the Roosevelt administration began buying any supplied quantity of

[10] Notice that not all speculators ruin themselves. Some of them keep their profits. The mechanisms at work here might be instrumental in creating and maintaining wealth inequality.

specified commodity at fixed price. Then, goods were stored or resold on the market under administrative supervision.

We shall not here tell all the many events which accompanied the implementation of this decision[11]. At the end, after world war II, it was adopted (with variants of secondary importance) not only in the US, but also in almost all non socialist countries. It ended with outstanding successes: not only was the US capable of feeding post-war western Europe in 1945-50, but also, and above all, it avoided the world famine that many analysts of the 1950's forecasted for the years 1990-2000.

The reason is easy to understand: new techniques – machines, fertilizers, pesticides – were put in operation at that time. Such innovations requested large quantities of capital. With volatile prices, in the previous period, the corresponding investments had been impossible to finance. But with stable prices, lending without excessive risks was made possible for banks. Yet, the system was not sustainable, as we shall see.

In effect, figure 8 shows the problem: be it in France or in the USA (the same kind of graph could have been obtained with data from many other countries), yields, under such a regime, are rapidly growing, up to the point of encompassing all solvable needs. This is visible on these graphs, with the "kink" on the precise dates at which guaranteed price policies begun, either in the US or in France. Similarly, in the recent years, one see a conspicuous slowing down of the yields increase in France. There is at least a serious suspicion that it is linked with the abandonment of fixed prices policies in this country, even if some analysts ascribe it to global warming (but why should global warming stop yields increase?).

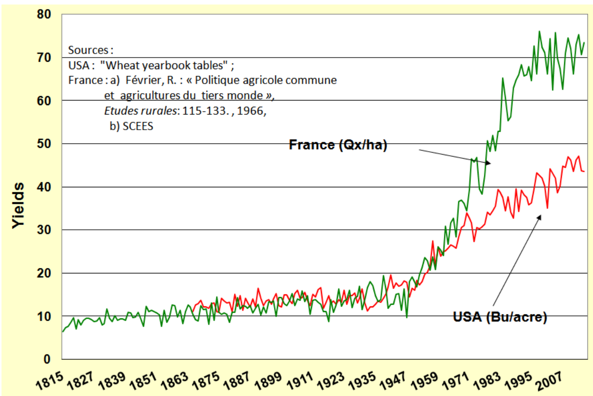

Figure 8 - Wheat yields in France and USA, 1815-2015

[11] The AAA (Agricultural Adjustment Act) was rejected by the Supreme Court because it was in some sense "socialist". It was issued again under "ecologist" considerations (to prevent the erosion of Middel West soils by the "dust bowl"…). Many other side events occurred.

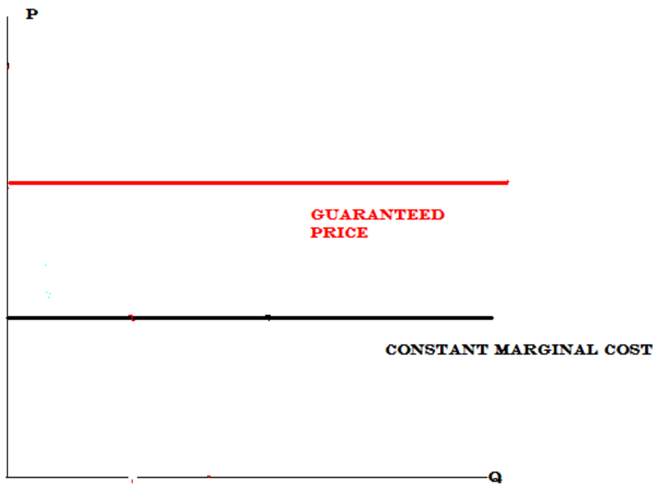

Figure 9 - Supply and demand with unlimited price guarantee

There is another approach (a little bit more abstract) to the same problem: If the agricultural production function is "homogenous and of degree one", then the marginal cost must be constant, meaning the supply curve is parallel to the "x" axis (figure 9). With a price guaranteed for any supplied quantity, the demand curve is also parallel to the same axe. Two parallel lines cross over at infinity… A price guaranteed policy for unlimited quantities unavoidably leads to an infinite production…

Here is the reason for which these policies were successful in avoiding famines. But at the same time, they necessarily lead to over production after a while. For years, the main producing countries avoided the problem by storing excess production at a huge cost12. Subsidizing exports was also a common practice, which raised diplomatic problems, because beneficiaries argued that, by selling quantities at dumping prices, developed countries prevented their own farmers to sell their products13. But such expedients have their limits. Alternative solutions had to be found.

In the eyes of a standard economist, the most natural of them was to lower guaranteed price, in order to decrease incentive to increase production beyond limits. Such solutions had been envisaged in the EC during the 1980's. Yet, figure 9 make evident the associated difficulty: nothing change if price is lowered by a small amount, and remains greater than the production cost, while production falls to zero if the price change is large enough to reach a value under the later. None of these two

[12] In the EC, it had been envisaged to store excess quantities of butter in the ice of the Groenland, a solution which at least, would have avoided the cost refrigeration…

[13] An argument which is both true and false. It is true that, under free trade, subsidised imports make difficult for local producers to reach their "natural" local market. But they are not the only obstacle in this respect: lack of infrastructures and other characteristics of underdevelopment play also a role here. A tax on subsidized developed counties exports would have allowed developing countries to get governmental revenue for building infrastructures, while maintaining a minimal level of supply to urban consumers that the missing public investment would have prevented to get from local sources in the absence of such resources.

situations is satisfying. This is the rational for "production quotas", and the reason of their institution in the EC during 1980's, especially for milk[14].

Guaranteed price for limited quantities

"Production quotas" consist in an arrangement by which public authorities promise producers to buy a given quantity (the "quota") at a given price. It looks like a futures market contract (cf Boussard, 2002), except that the buyer is the government. Normally, all the quotas rights of the producers of one country sum up at a level close to the corresponding internal consumption. In that way, because farmers are interested producing at least this quantity, food security is guaranteed in the country operating such a policy. Here is the true utility of this system, and the reason to implement it.

Yet, there exist several variants in this implementation. The most important ones concern what to do if farmers produce beyond their allocated quotas.: In the case of sugar beets in Europe, producers could produce more than their quotas, provided the quantity in excess be sold at the international price and for export only. In the case of milk, producing more than quota brought penalties. We shall not discuss here the details of the system, but rather its principle.

It raises several problems. The first one is how to attribute the quotas between producers. Under a strict liberal philosophy, they should have been auctioned, in such a way that those with the larger comparative advantage could buy the more production rights. Yet, in Europe, such auctions have never been organized, and quotas were allocated on the basis of "historical references": a given farmer was entitled to produce x% of his recorded production during the two or three years preceding the institution of quotas. In cases of succession, retirement, sales, etc.., determining the exact extent of production rights was somewhat a headache. In practice, quotas were attached to land, which is far from being a satisfactory solution.

Another problem arises because, under such a regime, production structures are more or less "frozen". It is not necessarily a bad thing: for instance, there are reasons to think that, without quotas, milk production would have deserted mountainous regions, because milk collection is more difficult in this setting and thus more costly. Since tourists like watching cows on mountains, that would have been a tragedy for tourism. But in general, all the restrictions to the production system evolution do not make easier seeking low production costs. Organizing quotas exchange markets might be a way of escaping this difficulty. Such institutions have rarely been officially created, although in practice, it is generally possible to buy or sell quota rights on a side unofficial market.

[14] Notice that production quotas had been a very old idea for sugar, recognized in the 1947 "Havana chart", and actually implemented at producer levels in most European countries after this date. .

Finally, there is the over quota production problem. Even with a carefully managed farm, and plans not to encompass limits, there is a possibility that an “exceptional harvest” is larger than the quota. In addition, some farmers may be tempted to produce beyond their quotas.

The first case rarely raise any problem: it is usually possible to find a colleague in deficit who accepted to take the extra production on its account. The second is more difficult. We have seen that the international treatises on sugar permit over-quota production at the encompasser’s risk. Similar arrangements had been envisaged for milk in Canada (Mercier Gouin, 2004). They were rejected by the WTO Dispute Settlement Body, on the ground that, by subsidising the production under quota, the government facilitates investments, and thus, indirectly subsidises whole production. Although it is true that the existence of quotas makes investment easier, such reasoning is somewhat surprising, because it could be transposed to many other situations such as subsidized insurances…

Thus, production quotas policies are far from being free of difficulties. Yet, they guaranty a minimal supply for the domestic consumer, as well as survival for producer. These are not small advantages. The above difficulties can be solved. The main objection lies in the fact that support prices under quota might be unnecessarily large.

Indeed, there have been documented cases of obvious exaggerations. Then farmers extort undue advantages over other citizens, as described in the famous article by Gardner (Gardner, 1992). But this is precisely one of the advantage of quotas to bring a natural solution to this difficulty: the magnitude of the undue rent is easily known by the observation of the price of quotas on the (official or unofficial) market were quotas rights are exchanged, as noticed above.

In effect, in the long run, with a constant return to scale production function, and constant output price, production costs adjust themselves to price through changes in the price of fixed factors. Consequently, the price of production rights is the difference between the “genuine” production cost – the cost of all other production factors – and the current price. Too large such difference means that the output price is unnecessarily high, and could be reduced without jeopardizing production. At the same time, this price should not be null, since the quota constraint must be binding. Otherwise, the corresponding policy would not be effective. It is surprising that this method of guaranteed prices management seems generally neglected by policy makers…

Thus, in the whole, a quota system might be the most efficient way of coping with agricultural price variability, or, at least, the less inefficient. Yet, as we have seen, it may be implemented through a variety of specifications, each with their own advantages and drawbacks.

Conclusions

1. The negative consequences of agricultural price fluctuation are so detrimental that public intervention must be envisaged whenever natural market forces do not solve the problem by themselves. This is true even if such action can contradict the pure liberal *doxa*. Of course, it is out of question to let us deprived of the benefits of the comparative advantages, nor to keep afloat inefficient producers. But the message transmitted by prices must be meaningful, instead of delivering a difficult to interpret noise.

2. We do not have any undisputable solution for that, the more as proposed remedies are deeply different, depending upon the "exogenous" or "endogenous" character of the mechanisms and events which generate instability. Actually, both sources of instability are simultaneously at work, whence remedies which work in one of these situations are almost contradictory with those for the other.

3. This is a case for increased research. We badly need additional works in agricultural economics on this subject of price volatility. Above all, they should be free of dogmatism, be it "liberal" or "interventionist", just analysing the mechanisms at work, and deriving recommendations from the observation of facts, in the line of theexperimental method.

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