Price risk management instruments in agricultural and other unstable markets

Discussion paper
Comments welcomed

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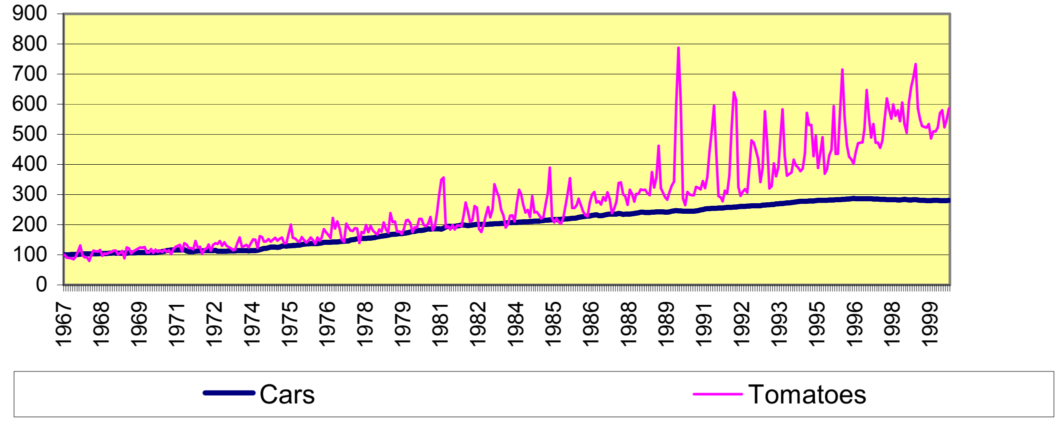
Summary

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.

Commodity markets are unstable. This is well known. Instability is rarely a blessing. This is also well known: when prices fluctuate, in a market economy, marginal cost and price differs. But price equating marginal cost is requisite for market optimality –whatever the precise meaning of optimality. Thus, volatility may contradict the common wisdom regarding the benefits of a market economy.

Figure 1

Tomatoes retail price index in large American cities, as compared to new car retail price index
Source: Economagic.com



Clearly, the car price varies, but slowly. Throughout the period under consideration, car purchasers probably paid a price which was not very different from the marginal cost. By contrast, nobody can imagine that the production and processing costs of tomatoes could vary fourfold in only a few weeks—note there is no periodicity in the tomato price variation, even seasonally.

Figure 1 illustrates the problem in the particular case of tomatoes in US large cities. It is clearly impossible for the cost of producing tomatoes to be multiplied or divided by four within a few weeks[1], which means that, depending upon the moment, any customer benefit from half price tomatoes (at the expense of producer) or pay twice the cost. None of these situations are satisfactory from a welfare point of view.

Actually, price fluctuations are undermining what is normally the basic role of price: standing as a messenger between consumer and producer, informing producer about consumer wishes, and the latter of the difficulty of producing. With constantly changing prices, the message is scrambled. Investments will be made in the wrong direction, production decisions will be awkward, resources will be wasted.

This also implies that steps must be taken in order to protect ourselves from such detrimental consequences, reconciling prices and marginal costs. A large number of ideas have been

[1] Notice the cost of tomatoe production may be much higher in winter than in summer: one would therefore expect a clearly seasonal pattern in the series. It is not present…

proposed to that end, ranging from the radical socialist view of replacing all markets by one central planning bureau, to the liberal instruments embedded in futures and similar markets.

The palette of proposed remedies

Nowadays, the central planning bureau is not very fashionable, and it has been made responsible for the fall of the Soviet Union. We shall therefore not devote much time on it[2]. Rather, let us turn our attention toward solutions proposed in the framework of market or semi-market economies as we observe them everyday around us. Preventing or curing price fluctuations in such economy has been sought for along a variety of lines:

1°) *Public intervention on markets*.

They may be designed in a variety of ways: The government may fix prices authoritatively, buying and selling any quantity at that price (Such a solution implies either a public stockpiling scheme, or an active government participation to international trade, with alternating exports subsidies and import taxes, or both). The corresponding price may be imposed on the domestic market, as in the 1960 Common Agricultural policy (CAP), or a complex system of deficiency payment may be set up, as in the US (and the CAP after 1992). In this latter case, producers are guaranteed a fixed reward for producing, and certainly define marginal costs accordingly, but consumers pay the "international market price". Price guaranty may be unlimited, for any quantity supplied, or limited by quotas (or allotments), in which case the government decides not only of price, but also of quantity. Other possibilities involve interventions through import and export taxes, along a line similar in principle with the "fixed domestic price" philosophy, but maintaining a certain degree of price volatility, as well as communications between domestic and international markets[3].

2°*)Insurance schemes*

Insurances are designed to pool contemporaneous risks in the hope that many small shocks will cancel out each other. This may be done either domestically, through appropriate institution building, or more simply by widening markets : the underlying reasoning, in this case, is that a drought is possible in Europe, or in the US, or in Australia, but not simultaneously in these three locations, so that one market for the three would probably reduce significantly the impact of a drought in one of them.

Insurance has limitations, however. It works very well in he case of contemporaneous small independent risks. In this context, because of the "law of large numbers"[4], insurer does not

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[2] Let us only remark that the Soviet Union was very far from being totally deprived of markets. Especially in agriculture, the kolkhosian market played a considerable role in adjusting supply and demand, if not for staple food, at least for milk and meat products. It did not produced outastanding results in terms of efficiency. On the other hand, according to the famous reference by Paul Bairoch (1992), during the 60's and the 70's, the rate of growth was slightly higher for "socialists" (= at least officially centrally planned) than for "liberal" developing countries.

In effect, no general conclusions can be derived from these observations, except perhaps that a true centrally planned economy is probably not feasible, and that some sort of planning is not necessarily catastrophic.

[3] The Thaï rice market before 1990 is a good example of such an organization, with import (export) licences being sold by the government when domestic prices were to high (too low).

[4] Many theorems have been published under this heading, stating that the mean sum of "many" "independent" "small" real variables "converges" toward the mean of the underlying probability distribution when the number

take any risk. It is not the case with highly correlated (as with price) risks. In addition, it does not work when risk compensation occurs through time. In this case, the only possibility is that the insurer holds a buffer stock (either real, as with grain stockpiling, or in money). But even with a Gaussian annual difference between supply and demand, the stock volume is a random walk, reaching zero level or infinity with probability one after an unspecified elapsed time, which means that, with probability one, the insurer will go bankrupt sooner or later[5].

Unfortunately, price risks are not contemporaneously Gaussian. When prices fall, they fall for everybody at the same time, so that the correlation coefficient between all contemporaneous risks equals unity. They may be intertemporally Gaussian, allowing for insurance schemes based on a compensation between "bad" and "good" years[6]. But insurance, as we just have seen, does not work in this case.

3°*) Financial solution*

Here is the liberal line, advocated for developing countries by, especially, the World Bank[7]. Risk averse producers can buy protection from risk loving speculators playing the game for profit. This is done through many institutional arrangements, the most popular of which being futures markets and options[8]. Public or private stockpiling can be interpreted the same way: the wise speculator buys when prices are low (thus raising depleted prices) and sells when they are high, thus lowering peaks. It therefore contributes to price stabilisation. Yet, for the reason indicated above, it should go bankrupt with probability one after a while, a consideration likely to put a cold shower on warmer enthusiasms. In addition, if they are wrong in their expectations, they reinforce market instability instead of curing it (and they go bankrupt as a punishment, which shows that cutting their heads, as was done during the French revolution, is not really necessary).

Relationships between instruments

Insurance and financial solutions are obviously complementary. In particular, in current practice, insurers are never in the situation which is required for the validity of the law of large numbers, if for not any other reason, because they have to take risks between the time they receive money from contracts subscribers, and the moment they pay indemnities in return. Therefore, they rely on financial markets to buy additional safety for risks not covered by the law of large numbers. The recent creation of "catbonds" (bonds which are reimbursable with large interests only if a specified catastrophic event does not occur, and which are lost for the subscriber otherwise) illustrates and makes famous this kind of mechanism, which actually exists for long, although under a less public form.

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of such variables is large "enough". They differ by the precise meanings attributed to the words "many", "independent", "converge", "small", and "enough". See for instance Bronshtein and Semendyayev(1997)

[5] Here is the basic objection to public stockpiling, as stated in the famous book by Newbery and Stiglitz (1981). Similar observations were made by Laroque and Deaton (1990)

[6] The "Joseph scheme", according to Mandelbrot (1966).

[7] See, for instance, Sarris (2003).

[8] Notice that futures markets, so fashionable as they may be nowadays, are not new. Even the Roman knew the advantage of delivery contracts, based on the good faith of parties. The good faith of parties is certainly not guaranteed in the case of a "one shot" contract, for in this case, the looser may be tempted to break the contract before term. But on a regular basis, the once looser may hope to be the winner next time, and this is a powerful reason for the contract being enforced. An interesting description of the real functionning of futures markets is provided by Christensen (2003).

It is far less obvious that state interventions can be related to insurance and finance. Of course, it is well known that, for instance, futures markets are not developing when prices benefit from governments guarantees: there is no point in hedging against a sure thing. In this sense, government intervention impinges on finance. But there are even deeper interrelations between these instruments, interrelations which cast a new perspective on agricultural and commodity policies. In effect, government intervention is just a slightly different method for performing the same tasks as those performed by insurance and financial markets. In some situations, it may be less efficient than the latter, but it may also perform much better, because it cures the ill at the root, instead of just hiding inefficiencies ascribable to market failures.

In effect, and contrary to common wisdom, these various instruments and intervention techniques possess more similarities than differences.

a) *Are insurances different from hedging ?*

Let us first examine the case of insurance and financial hedging. The effect on producer is the same: a farmer can in principle, be absolutely sure of the price he will be paid for a delivery. The difference is only in the fact that in the case of insurance - assuming it works according to assumptions - the farmer will get exactly the average price, but for a (in principle light) management commission. In the case of a financial hedging, he must pay a risk premium to the safety supplier. This is the famous Keynes's "normal backwardation"[9], the difference, at the time of the contract setting, between the price of the contract and the expected spot price at delivery time. Thus, the recourse to hedging is in principle more costly than with insurance. Yet, experience shows this is not true: many studies devoted to measure the "normal backwardation" conclude that it is close to zero in most cases. Two interpretations exist of this phenomenon.

According to the first, this is because hedging is even more efficient than currently assumed, as a consequence of the necessity, for speculators, to diversify portfolios: because no speculation is risk free, the best way, for a portfolio holder, of avoiding exaggerate risk exposition consists in investing in a variety of endeavours, each of these being as far as possible uncorrelated with others. In this case, the law of the large numbers holds, and the mean value of any such diversified portfolio may be remarkably stable. Buying catbonds or other commodity based future contracts is a solution for diversifying at no risk, and no cost, because these assets are in general weakly correlated with other portfolios segments. In such a situation, it is not necessary to expect any profit (in addition of the "normal" rate of interest) to buy futures contracts. The diversification motive is sufficient for explaining an apparent "risk preferer" behaviour from investors who, in fact, are just into the process of seeking a way for pooling risks. As a consequence, hedging through futures markets is fundamentally "cost free". And, again, it is true in view of the law of large numbers, just as any insurance contract. In addition, this interpretation is supported by empirical evidence displaying zero normal backwardation.

Yet, another interpretation of the same empirical result has also been proposed: the average backwardation of future contracts is zero only because these contracts have never been used by producers for hedging (at least on large scale). They are used by merchants for widening their markets, and getting information, but hedging is not the primary motive of operators… In support of this opinion, are quoted opinion pools, and the fact that in effect these future

[9] See, in particular, Williams (2001), and his discussion of futures markets – to whom a number of ideas expressed here have been borrowed.

contracts rarely stretch themselves over a time span long enough to allow a farmer to be covered at planting time for next harvest.

Without deciding between these two alternative explanations of the small size of mean backwardation, let us only notice that the key of the "liberal" argument supporting the efficiency of hedging is still the law of the large numbers.

b) *Is the guaranteed price system a public insurance ?*

Let us now turn our attention toward the relations between public and private instruments, and first of all, the guaranteed price system - certainly one of the most evil system in the eyes of a liberal. In its fundamental logic, it is nothing else than a public insurance scheme. Assume "international price" stationary and subject to random fluctuations (they may be "IID" - independently identically distributed - , or subject to any complicated schemes such as ARCH, GARCH and so on). Then a governments can decide that any domestic transaction will be concluded only at the corresponding mean level price, a positive or negative levy being established to adjust the fluctuating world price to the domestic constant price. In view of the properties of a mean, the algebraical sum of the government money flows should be zero.

The main advantage of relying upon government intervention in this case, instead of having a private insurance scheme, is that the official price will be the same for everybody, thus avoiding non negligible transaction costs. It avoids also distortions, if some of the operators are not risk neutral, thus accepting different from the average price at some moments.. In addition, it is possible to leave a certain flexibility to market, if, instead of fixing price once and for all, the government fixes only upper and lower bounds, triggering intervention only when the current market price approaches these limits.

Yet, experience shows that guaranteed (or bounded) prices rarely equate average mean international prices, whatever the way the average in question is estimated. Most of the time, the end of the guaranteed price story is most of the time with guaranteed price outrageously higher than "world prices", governments blamed for laxism in taming agricultural lobbies, enormous stocks, preoccupying export subsidies, etc[10]… Such a discrepancy between theory and practice have to be explained. Let us defer explanation until below.

c) *Production quotas and futures contracts*

Similarly, there is a close relationship between the "producing rights" (or quota) system and a futures market.

In a producing rights scheme, producers are guaranteed a sure fixed price for a limited quantity. This sure fixed price is normally greater than the expected "current world price", in order to be sure that the quantity under quota will be produced (since the fundamental rational for the government to establish such a system is to be sure of the delivery of the quantity under quota, thus securing food for the nation in any circumstance). As a consequence, rents are linked with holding production rights. Rents have bad repute amongst economists, which explains why are quotas so rarely recommended.

[10] See the famous "farm problem" paper by Gardner (1992).

Quantities in excess of the allotment may be disposed of, or down graded (a solution made possible if the commodity can take various qualities, as is the case, for instance of wines in Europe) or sold on the world market at the current price. Production rights may or may not be traded, within regions or outside, this is not so much important (yet, in some cases, limiting the transferability of production rights may help maintaining certain traditional aspects of landscapes and producing amenities which blind market would not permit). The domestic price may be fixed at the "under quota" price, or it may be the current "world price", the state commitment of a producer guaranteed price being fulfilled through a deficiency payment. None of these modalities are essential.

What is important is that the essence of such a system is exactly the same as a futures contract: this is a contract for the delivery of a stated quantity, at a certain date, for a fixed price. The fact that the contract is passed between a State and a farmer, instead of between a merchant and a farmer is anecdotic. The State bears the risk (and capture the benefit, if, as often, the world price eventually becomes higher than expected). Within the framework of the "normal backwardation" theory of futures markets alluded to above, this is not inefficient a solution, since the State is not normally risk averse, and thus, can be content from a profit which would not be sufficient for a private operator. In that framework, the intervention of State produces a gain in efficiency, which is precisely the traditional role of the State in economy (quite analogous, for instance, with what happens when it builds roads)[11].

If, on the contrary, the alternative theory of the absence of hedging at farm level holds, then the intervention of State here provides the benefits that would produce futures markets if they were to be feasible.

In any case, a last remark is of utmost importance: while the benefits from insurance and other schemes discussed above required the law of large numbers to hold, here, nothing of this kind is invoked to explain the benefit of the system. We shall now explain why is this remark so important.

Why are commodity prices volatiles ?

In effect, no serious remedy to price volatility can be expected but from an analysis of the underlying reasons of the phenomenon.

A first explanation, often proposed in the 50's by pseudo Marxists, is the bad will of wick multinational companies. It does not resist to examination. In effect, even the biggest multinational companies have no control over demand, and very rarely over supply. They are price taker, at least for what concerns commodities (one might be more prudent when shipping and transportation costs are at stake). They are not happy of fluctuations: just as any bureaucracies, they don't like the necessity of continuous adaptations and reforms.

This being said, two other sources of fluctuations deserve consideration.

a) The "climatic explanation" :

According to this line of though, climatic fluctuation are responsible of price fluctuations. The price of coffee raised because of a frost in Brasil. The price of grain fall because of an

[11] Remember the old classical argument by Arrow and Lin (1970), along which it the role of the State to bear risks whenever risk markets does not exist or do not work efficiently.

exceptionally good year in Ukrain. It is easy to observe, and even easier to understand (especially for those not being too acquainted with agronomy, and not aware of the efforts made by farmers to avoid this kind of hazard…) . The explanation does not hold for petrol, nor for metallic ores. Obviously, it holds for agriculture *sometimes*: the recent "mad cow crisis" in Europe demonstrated the dramatic effects of a widely spread event which was both unpredictable and independent of any human will[12] . Yet, for that such an accident be of significance for agricultural markets, a number of conditions are required, especially that:

i: the accident be of biologic significance (that is, it must really affect plant or animal growth and yields)

ii: the accident covers such a large area that the production of that area be of significance for markets;

It would be absurd to deny the fact that these conditions may actually be met. But it would be just as frivolous to overestimate the frequency of such events. For instance, in a study over the Sahelian countries, Martineu and Tissot (1992) show that the "correlation distance" (the distance in excess of which the correlation between two geographically distant points becomes insignificant) between agronomic events is about 100 Km. Given the low productivity of the country, this means that a few big trucks would be sufficient to provide a good insurance among droughts in this region – implying also that the idea, often conveyed by NGO's and other institutions, of uniform drought caused disasters from Dakar to Modagiscio are pure speculation.

Similarly, Roll (1984)investigated the effect of meteorology on the price of Florida juices. *A priory,* this effect was expected large, given the fact that Florida orchards are very sensitive to meteorology – especially frost- and planted over a relatively small area, thus likely to be struck all at the same time by the same accident. In addition, the importance of this small region in the world juice trade is notorious. Yet, he founds that if meteorology actually do matter in explaining juice price, it is far from being the only explanation, nor even the most important.

References on the topic are rare, which is a considerable defect of our profession: it is surprising that a phenomenon credited of such an importance have so rarely been the subject of precise statistical investigations[13]. Thus, additional research is badly needed in order to assess the precise importance of meteorology over food security. In any case, it seems to be largely overestimated.

Of course, without invoking meteorology *sensu stricto*, one may think to "pseudo meteorological events" - random changes in consumer tastes, or any other "hand of God " intervention. It probably would explain the case of petrol… But is there not other possibilities? .

b*) The endogenous fluctuations hypothesis*

This second explanation is more tricky, but more plausible. It will require some roundabout, and a few mathematics to be presented.

[12] This is not to say that some aspects of the crisis management could not have been improved. But the core of the problem was fatality.

[13] Similarly, up till Galileo, very few peoples questioned the theory according to which the sun was running around the earth: it was so obvious from a mere glance at the windows!

First, let us recall the fact that, in agriculture as well as for commodities such as petrol, supply is very rigid in the short run. In the long run, on the contrary, it is very elastic. With constant return to scale, and very few fixed factors, the long run marginal cost is almost flat, and so is the corresponding supply curve. As a consequence, whenever a government guaranteed price scheme is operating, there are no reasons for supply not to growth up to virtual infinity. Here is the basic reason of the failure of such schemes, be it in the US with corn and soybean, in Europe with milk or wheat, in Ivory cost with cocoa[14].

In face of this cumbersome supply function, demand is poorly elastic. Prices does not change demand, at least in the vicinity of equilibrium. Here is the source of the "local dynamic instability of equilibrium". Actually, the key characteristics of an equilibrium in these conditions have been studied in a famous paper by Ezekiel (1938), more than sixty years ago. Assuming current price is the basis of expectations regarding next period price, Ezekiel shows that with reasonably elastic supply and demand curves, markets should dynamically converge toward a stable equilibrium, meaning that any situation with price and quantities away from equilibrium will eventually evolve in such a way that equilibrium will be reached after a while. On the contrary, with elastic long run supply, and rigid demand, in the same situation, market will always move away of equilibrium, and actually "explode" : prices and quantities will be growing up to infinity with an alternation of "plus" and "minus" signs.

Of course, Ezekiel "cobweb" model is not accurately reflecting the actual behaviour of commodity price series: obviously, the latter never "explode". Nobody never saw any price growing to infinity, without speaking of negative quantities. Nevertheless, this model correctly reflects the fundamental problem of the local instability of market equilibriums, which, under these circumstances, are "repelling", in the vocabulary of modern dynamic theory.

But modern dynamic theory emphasizes the fact that, in most durable dynamic systems (such as, for instance the solar system), along with repelling equilibrium points, there exist also "return strings" which force variables to return within the vicinity of the repelling equilibrium whenever they are "too far" from it. In such cases, the system becomes either periodic or chaotic.

Figure 2: example of a chaotic cobweb[15]

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[14] Obviously, because at least land (or rather space) is in limited supply, there exists at least one fixed factor, which means that returns are decreasing, as noticed two century ago by Turgot. Thus, of necessity, the marginal cost is at least slightly increasing. Yet, the rate of increase may be very small. More and more space may be available, at the expense of forest, fallows, and other land use categories. More importantly, capital and labour can very easily be substituted for land, thus making the supply curve, if not completely flat, at least virtually so for any practical purpose.

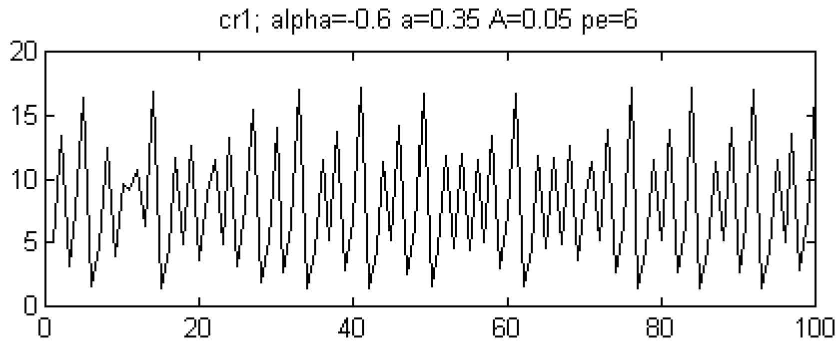
[15] This is the series of q_t for t= 1..100, determined as follows:

Let q_t and p_t being quantity and price over a market, with :

(1) $p_t = \alpha q_t + \beta,$ (demand curve, α and β are parameters) , and:

(2) $\hat{p}_t = a q_t + b$ (supply curve , $\hat{p}_t$ is expected price for year t, a and b , are parameters

While the traditional cobweb model assumes $\hat{p}_t = p_{t-1}$, here we take $\hat{p}_t = = p°$, constant. But p is apparently random, with expected variance $\hat{\sigma}_t^2$. Instead of equating marginal cost with expected price, as in (2),the producer equates marginal cost with the price certainty equivalent, that is (according to the classical Von Neuman model) :



Notice nothing is random in the generation of such a serie (see footnote 6).

In economics, periodic system cannot last for long. The reason is that the detection of a period generally allows for profit through arbitraging. But competition prevent any arbitraging to be fruitful: as soon as any arbitraging possibility becomes public, prices move to make it uninteresting. This is the basis of finance theory. The same situation occurs with stockpiling, the real face of the financial coin. Rational stockpiling, by increasing stock when price is low, and decreasing it when it is high, dampens out price fluctuations, and, ideally, suppress them. If stockpiling were functioning that way, no stabilisation would be needed, and prices would not fluctuate. Since they actually fluctuate, other mechanisms are operating. Among these, the difficulty for stockholders of predicting turning points (the time at which price, for instance, instead of growing, are beginning to decrease) is not the least. But this implies that prices are not periodic at all. Therefore, they must be chaotic[16].

A chaotic dynamic system may be described as a set of variables, all of which look like if they were random, bouncing up and down in an unpredictably, such as on figure 2 . Yet, they are not random. They are purely deterministic. Their values are "sensitive to initial conditions", meaning that a very slight change in the value of one variable at time t may lead to enormous changes in time t+n. For that reason, chaotic variables are actually unpredictable, except in the short run (even if the precise definition of "short run" may be difficult). For instance, assuming the price of soybean in Brazil being chaotic, it is probably possible to predict next year price with a reasonable error margin, but certainly not the price in ten year from now. It is specially difficult to predict turning points.

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(3) $p^c_t = \hat{p}_t - A\hat{\sigma}_t^2 q_t$, where p^c_t stands for the certainty equivalent of $\hat{p}_t$, and A is an absolute risk aversion coefficient. Thus (2) becomes:

(2bis) $p^c_t = a\, q_t + b$

Finaly, the model is closed by a naïve estimate of the expected variance (4):

(4) $\hat{\sigma}_t^2 = (p_t - p_{t-1})^2$

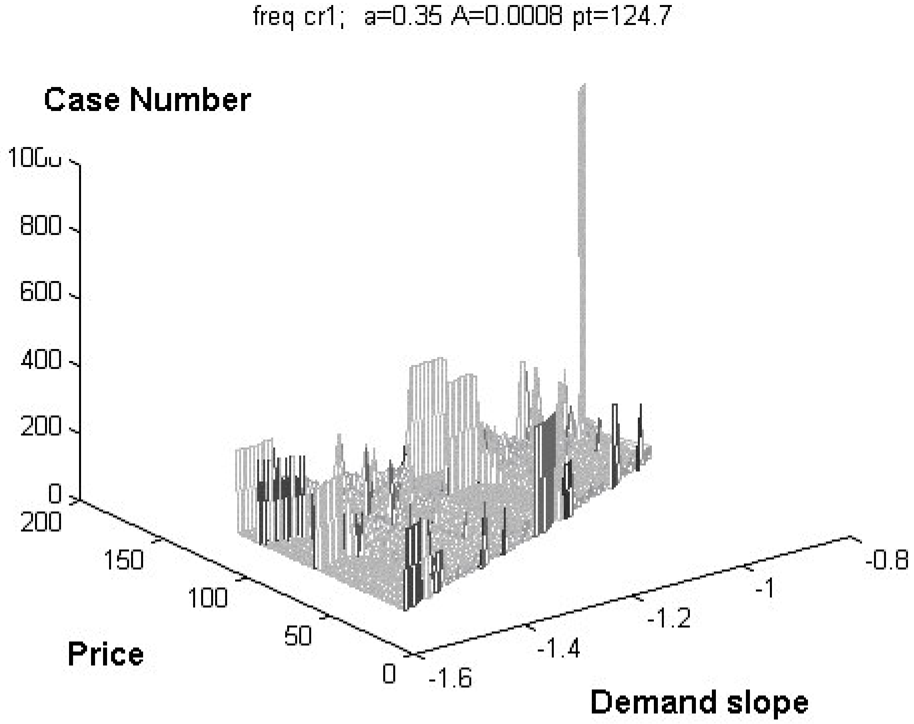
$^q{}_t$ is determined by solving recursively equations (1), (2bis) , (3) and (4), from an arbitrary initial q_0.

Here: A=0.05, a=0.35, b=0, $\mathring{p}$= 6, α = 0.6, β=10, x_0 = 5; Any other parameters would produce a quite different curve.

Similar (but different) curves can be obtained from more complicated models, with capital decay, adaptative expectations, etc… Such a simple chaotic model is easily programmed over a spreadsheet.

[16] Alligood *et all* (1997) stands as an outstanding introduction to chaotic dynamics. See also Abraham-Froix (1995).

Figure 3: Frequencies of price in function of demand curve slope in a risk cobweb model



This diagram shows the frequency distribution of price values in successive runs of the cobweb model of figure 2, as a function of the demand curve slope. For a slope of –0.8, the cobweb converges, and equilibrium is reached. The whole distribution is concentrated on one point. As the slope absolute value increases (meaning a smaller price demand elasticity), the spread of prices increases. Yet, except for some values of the slope, the distribution is concentrated on a few values, instead of being more or less uniformly distributed.

Chaotic series can be considered as special cases of periodic series, with this particularity that the largest period is infinite, just as the number of sub harmonics. As a consequence, they are characterized by autocorrelation at every ranks, which implies that they are not amenable to standard statistical treatments and estimation methods. Yet, they are bound to stay over an "attractor" – usually a finite set of points, which means that they never exceed certain limits. They are constrained "within a pipe", even if the diameter of the pipe may be unduly large. This is in contrast with ordinary assumptions regarding random time series, often hypothesized to be described by "random walks", thus allowed to growth to infinity.

One of the most striking feature of chaotic time series in economics is that their main characteristics - the frequency distribution of values, the diameter of the "pipe" alluded to above, etc.., are determined by institutional settings and parameters such as demand and supply elasticity. This is because of the nature of the "return strings" the necessity of which have been noticed above. Two main return strings play a major role in commodity markets: the producer risk aversion, and the decay of capital.

Risk play a role, because any operator knows that price cannot stay for long too far from costs which they are usually well placed to evaluate. Therefore, if price happens to be extremely high, or extremely low, any operator knows it will not last. Of course, this is not a reason not to take profit from the situation. But this is a reason to be extremely prudent and conservative. Such a behaviour, usually, will lead market back toward equilibrium (or toward a "low supply" starting point from which the outward path is directed toward equilibrium). Similarly, a long series of low prices will prevent operators to renew their machines. As a consequence, such a situation will make the corresponding commodity scarce, and therefore, create the conditions for a price upsurge – in itself, a move in the direction of equilibrium, even if it may be overshooting. But of course, with investment subsidies, price regulations, etc…, the institutional setting modifies the characteristics of these "return strings", and thus, the regime of the chaotic motion, the basic feature of which may exhibit considerable variations (see figure 3) .

In particular, when speaking of agricultural commodity series, since farmers are extremely sensitive to risk, any change in policy modifying risk regime, risk aversion, investment rate of decay, etc… will have an immediate impact on supply. For instance, we have seen above that the perfect price insurance, the government guaranteed price, was due to result in infinite supply. But it is true also of any other price insurance scheme, based, as we have seen, on the assumption of random shocks submitted to the law of large numbers. Because of the impact of such device on the characteristics of what we have called "return strings", any such system is deemed to bankruptcy for a private institution, or to political deadlocks in the case of a government.

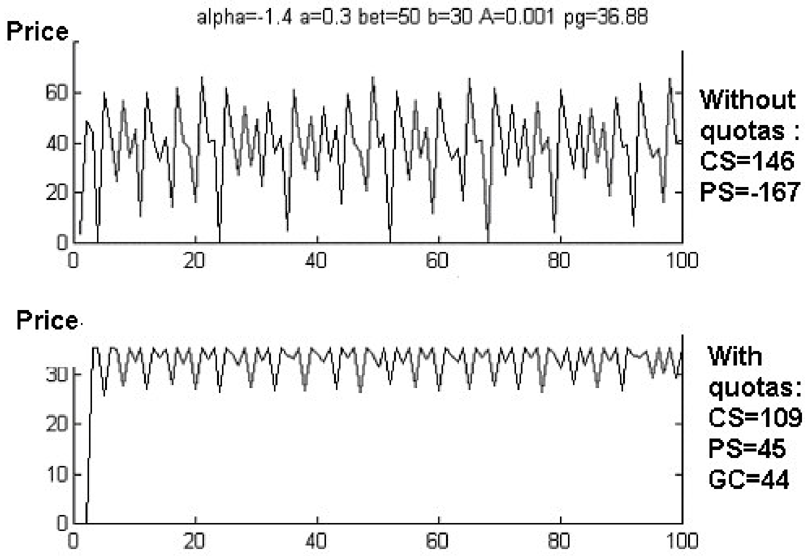
c) *Which evidence ?*

Of course, the results just presented are those of a model, not reality. But because the political consequences of this model, if it is valid, are enormous, it is worth trying to know whether is resemble to reality or not. Unfortunately, few empirical tests of such models do exist. Only history is of use here. But history is difficult to interpret. Too many anecdotic events come to bring noise into series, making them ambiguous.

The "random shock" hypothesis is difficult to confirm, as we have seen. Regarding the "chaotic" hypothesis, setting a statistical test for chaoticity is very difficult. Most of proposed tests put emphasis on particular aspects of chaotic series (such as the possibility of defining a small "embedded dimentions"), perhaps not essential, and, in any case, difficult to measure from a small number of observations. Thus, only indirect test of the above hypothesis[17] are available by now. Statistics and econometrics are presently unable to decide which ones are correct, if any. Yet, without econometrics, the observation of events since the second world war, the considerable increase of production in price guaranteed countries, the failures of stabilisation schemes based on the random shock hypothesis, the failure, also, of all insurance schemes, all that seems to bring support to the chaotic interpretation.

Figure 4: Effects of imposing a production quota on a risky cobweb

[17] For instance, many tests of the sensitivity of supply to risk have been performed, with, in general, positive results (see, for instance Boussard and Gerard, 1992). However, the tested hypothesis are in general, much too narrow to make any general inference possible.



Same model as on figure 1. Price is guaranteed at equilibrium price plus 10%, for a quota set at equilibrium quantity less 10%. Quota is guaranteed by a deficiency payment. Consumer price is free. CS stands as "consumer surplus", and PS as "consumer surplus". GC are "government costs". Clearly, the overall welfare is far higher "with" than "without" quotas, while price is much more

Political consequences

The above reasoning are far from being innocuous for political economy. If the chaotic interpretation is accepted, then, all price stabilisation methods based on the law of large numbers is infeasible. We have seen this includes most of public as well as private instruments. The only instrument avoiding the law of large number malediction is the publicly supported production right system. Its main defect, for a liberal point of view, is to stand as a departure from the "free market" paradigm – which it is, since it cures the heal at its roots, the failure of markets- and, accessorily, to create undue distorting rents, which it does not, or not necessarily.

In effect, it is certainly possible to find conditions under which a generalized quota system would not be distorting, and would not create large illegitimate rents. It would not be distorting if the total quantity under quota were clearly less than domestic consumption, and if, in addition, producers are free to sell quantities in excess of quotas on markets. Then, average price equates marginal cost, and no distortion can occur. But the existence of quotas guarantees a minimum production, thus considerably lowering price volatility by the same token. Figure 4 illustrates this assertion[18].

[18] Of course, the definition of the model experiment reported here is to some extent absurd: if the Government knew where is the equilibrium standing, then fixing quota quantity and quota price at equilibrium levels would optimally solve the problem. Now, the difficulty of setting such a government scheme is precisely to guess the position of the equilibrium. Yet, figure 4 illustrates the fact that a 10% error on these values are of almost no consequence…

Similarly, in a dynamic framework, the guaranteed price under quota should be adjusted in order to maintain the quota rent low, and tacking account of technical progress. Notice the quota rent is easily measured if quotas are allowed to be freely sold on a quota market.

With such proviso's, one does not see why a quota system would be banned from the tool box of a liberal economist…

Concluding remarks

Thus, trying to set up a typology of public and private risk management devices, we found surprising and unexpected similarities between apparently unrelated and *a priori* opposite methods. This is because these methods are not arbitrarily based on ideology (as many ideologues try to let us think), but on empirical knowledge, and practice. There exists also theoretical explanations of their successes or failures. In this respect, the key issue is the source of volatility. If volatility is a consequence of random events not under control, then any kind of insurance, based on the law of large numbers, will be a very efficient method of risk management. But if it is the consequence of Man behaviour – especially through markets – then nothing like any insurance scheme can work. One must rely on more stringent solutions, involving supply control.

In this respect, and contrary to common wisdom, a quota system, once established, is not contradictory with a market economy. It is more efficient for solving the recurrent problem of price volatility than any other solution. Indeed, it is the only feasible one.

The main obstacle to enforce it is with the starting point: in most occasion where such a system has been envisaged, the fight between producers to get a maximum quantity of production rights has jeopardized the building of institution. A natural solution for doing it would be auctioning production rights. Even in this case, it is not sure that wrong expectation lead to big misallocations, as has been seen when European governments auctioned frequency bands for mobile telephones, and many large international companies grossly overbid, at the point of going bankrupt just after having won competition… Yet, one may prefer one big crisis, which does not change anything in real economy, to a recurrent invisible crisis permanently (although invisibly) lowering welfare by a large amount…

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