Managing Volatility & Risk
to enhance Cash-flows
in the Agribusiness Supply Chain
- A Practitioners perspective

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Abstract

- **The author presents a practitioners view of modern Agricultural Financial Risk Management (AgFRM) and its use for income volatility - reducing strategies, which are a win-win for producers and consumers.**
- **The natural or native volatility of individual commodities and their root characteristics and causes are discussed.**
- **A discussion of how implied volatility is priced and managed is presented along with a challenging review of a series of commonly held views on how volatility is calculated. The author concludes this is often from a marginal price series of market-clearing and consequently highly volatile farm-gate prices, exaggerating the true volatility of food prices.**
- **It is argued that policy makers must make a more determined effort to capture and report spot and forward prices to further the development of financial risk management and that it is only through a whole supply chain that the goal of reducing income volatility can be achieved – quite separate from observed historic price volatility.**
- **The role of academic, research, regulatory and market supervisory institutions is discussed and recommendations are made.**

- Keywords: *Volatility, Income, Price levels and changes, agricultural financial risk management, Monte Carlo, Options, supply chain management*

The Allocative Efficiency of Price

- **In a market economy we look to price to resolve supply demand imbalances ex ante. It is a prospective problem being resolved in response to the price signals of spot and forward prices. These prices are communicated to market participants in a variety of forums.**

- **Futures Markets**
- **Cash Markets**
- **Derivative Markets**
- **Forward Swap Curves**
- **Option Markets**
- **Capital Markets – Interest rates, foreign exchange, money supply (inflation)**
- **Macroeconomic Markets often reflect the collective information or most of the information in the above.**

"Speculators" are typically looking for a mismatch
in the price signal being sent and
the market clearing price
they believe is needed.

Policy Reasons to address volatility
Exothermic or Endothermic?

- **From an institutional (World Bank, EU, US etc) perspective reasons for addressing income volatility lie within the objectives of stabilising agricultural markets and ensuring a fair standard of living for farmers. (Velasquez, 2011). The policy mixes of various governments to attempt to achieve these objectives have been adapted over the last several decades to reflect changing economic, social and political environments. They are typically reactionary to events which have already unfolded, or retrospective rather than prospective. From a practitioners perspective we are clearly operating within a variety of differing types of agricultural commodity markets. However we can say that, in general, the factors of production are impeded from developing a true market economy. In a market economy the allocative efficiency of price balances supply and demand. It is important to further note that policy normally refers to income volatility and not price volatility, per se.**
- **Velazquez argues that the issue of volatility is central to the CAP debate for two reasons:**
- **(1) The medium-term perspectives for agricultural markets are expected to be characterised by gradual recovery supported by structural factors (demand growth, biofuels consumption, decline in food productivity growth).**
- **(2) The move towards greater market orientation has exposed European farmers to higher market volatility, and they are also more sensitive to changes in the macroeconomic environment.**

The Political Economy of food means it is not a market economy

Instruments used to address volatility: ex post or ex ante?

- **Price Support – Intervention. In the CAP this meant high domestic prices and some degree of tariff to prevent import substitution, and export subsidies for surpluses.**
- **Supply Control – Quotas. These were primarily aimed, in the case of milk and sugar to manage the budget volumetric exposure to unlimited export ("restit") payments.**
- **Demand Control – Artificial (subsidised) demand – Biofuels.**
- **Price Guarantee – Counter Cyclical Payments – the US LDP, loan deficiency payment. The Freedom to Farm Act in the US had a profound impact on the development of market economics in the affected markets and all factors of production, by displacement. The size of LDP's is highly unpredictable by governments, but not by market participants.**
- **Decoupled Support – Direct Payments. These are politically expedient and highly effective but economically treacherous. "Reducing the income variability gives (these) farms the necessary liquidity to survive crises, reduces investment risks and, thereby, contributes to maintain economically sound farms in the sector in the long-run". Velazquez, 2011.**
- **Income Guarantee – often linked to those with "rain & hail" insurance, expensive and administratively expensive.**
- **Enhancing the Supply Chain – Price Transparency & Efficiency / AgFRM. This drives market based financing.**

Not least of the reasons to manage income volatility
is budget variance of the CAP or USDA …

Which Price & Which Volatility?

- **Many prices are reported.**
- **It is critical to use a price series that is representative of the market.**
- **All pig producers sell 1/7th of their meat at neither a porker nor baconer price – the sows and boars.**
- **It is very easy to have a price which is representative of the market surplus or deficit – and so not representative of the whole.**
- **It is not unusual to have prices reported inaccurately – by design or otherwise.**

- **It is critical to gather historic forward prices on a daily basis as integral forward curves. All commercial trading entities do this. It is one of their greatest assets and rarely made available to other market participants or research institutions**

The price for contracted liquid milk is not
The same as that sold in the “open market”

Market-based Solutions for Volatility
Cash-flow volatility: AgFRM ex ante

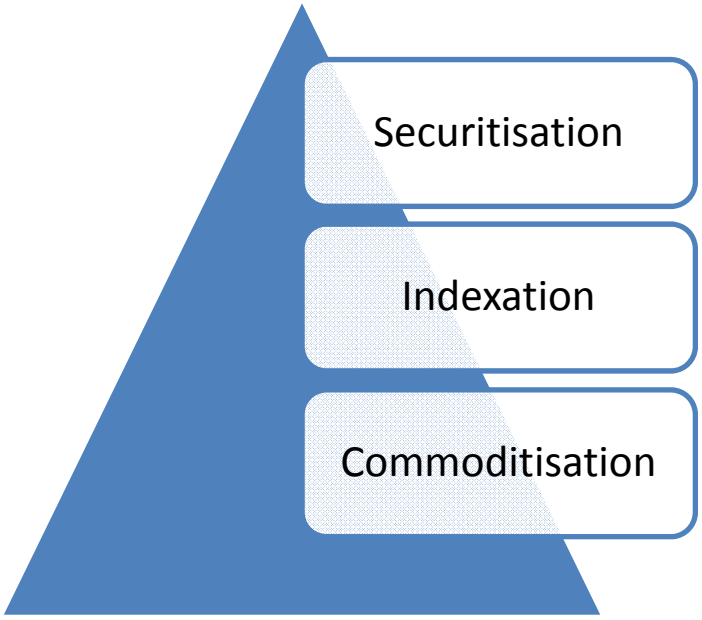
- **In many papers, and not least the classic "Price Determination in Agricultural Commodity Markets: A Primer", a CRS Report for Congress (Schnepf, 2006), a three-pronged approach is taken to tackling the subject of this paper:**
- **(1) A review of economic fundamentals of Agricultural commodity markets**
- **(2) A review of Futures markets for storable Agricultural commodities, and**
- **(3) the role of Government institutions (here the USDA) in monitoring and disseminating Agricultural market information.**

Any market based solution will require
Government institutions (including Academia)
to gather and report market information.
This is NOT an Agricultural problem
– all markets need this -

- **Agricultural Financial Risk Management, which manages the financial risks of producer – to – consumer flows has the capability to align the cash-flows of both parties and reduce volatility (or budget variance) of each.**

Making Volatility Reduction work?

- **We typically need all 3 of these to be in place to operate efficiently and scalably in any country or region or chain to significantly reduce volatility via AgFRM.**
- **In addition we need a favourable macroeconomic environment**
- **With all of these we can forward sell fixed price to customers – a known price.**



Converging Finance & Economics: $Vega

- **From the perspective of an economist we must have a proposition of fundamental value for a coefficient before we run a regression and accept or reject the analysis. The same applies to the "value of volatility".**
- **It too is a commodity, or asset class, and does not have a single descriptor which can be applied to time, uncertainty or specific price or market scenario.**
- **It must have a value and descriptors.**
- **Financial market participants refer to $Vega – the monetary impact on a volatility portfolio per unit (usually 1%) change in implied volatility.**
- **In a world of financial risk management we are managing the change in value of a portfolio (statically) from close – to – close of a futures markets option pit estimate of implied at the money volatility.**
- **In a world of agricultural financial risk management (AgFRM) we are managing a portfolio of customer transactions – lets say sales to emerging markets, managing the correlation of price changes between that underlying and the greeks of any embedded optionality, all offset to leave some residual exposure managed by the business based hedge in a futures pit or purchase from another customer – lets say an OECD producer.**
- **If it is managed well and there is a transfer of undesirable volatility between parties or AgFRM provider it is a win-win.**

The moniness of volatility is the root of all problem solving

Market Wizard or Market Sorcerer?

- **Markets do rally in contango.**
- **Economically this is illogical.**
- **Financially it is quantifiable.**
- **"In addition to global food security concerns, higher commodity prices have stoked the flames of food price inflation and its potentially deleterious effects on lower-income households while raising costs for livestock feeders and food processors. Because the rising prices have been associated with unexpectedly large price volatility, they have also increased the risk and costs of grain merchandising all along the marketing chain. Finally, the high, volatile commodity prices have dramatically increased the cost of routine hedging activities (i.e. pricing commodities for purchase, delivery, or use at some future date) at commodity futures exchanges and thereby diminished "forward contracting" opportunities for grain and oilseed producers who are eager to take advantage of record high market prices." Schnepf, 2008.**

Historic, or Realised, volatility is of very limited use –
to manage or assess risk

The Failure & Success of Financial Mathematics in Agricultural Commodity markets

- **The economic analysis of realised volatility and its consequences is widespread (Keane and O'Connor, 2009).**
- **The financial analysis of commodity dynamics and the forward curve is well covered too (Geman and Nguyen, 2005).**
- **The financial analysis of commodity markets with stochastic volatility and jump-diffusion is present also (Jiang, 1998).**
- **The financial analysis of P&Q and its resolution has been documented (Geman, Karoui and Rochet, 1995). This leads inevitably to monte carlo analysis, describing distributions which closely match observed more than theoretical distributions.**
- **The use of antithetic variables to enhance and optimise speedy resolution of the monte carlo simulations has been reviewed (Cheng, 1982).**

The goal of this paper is to drive an appetite for the
convergence of the two fields
of economics and finance
In a forward price environment.

What are the assumptions behind the Black-Scholes model?

- 1) Constant volatility. The most significant assumption is that volatility, a measure of how much a stock can be expected to move in the near-term, is a constant over time. While volatility can be relatively constant in very short term, it is never constant in longer term. Some advanced option valuation models substitute Black-Schole's constant volatility with stochastic-process generated estimates.
- 2) Efficient markets. This assumption of the Black-Scholes model suggests that people cannot *consistently* predict the direction of the market or an individual stock. The Black-Scholes model assumes stocks move in a manner referred to as a random walk. Random walk means that at any given moment in time, the price of the underlying stock can go up or down with the same probability. The price of a stock in time t+1 is independent from the price in time t.
- 3) No dividends. Another assumption is that the underlying stock does not pay dividends during the option's life. In the real world, most companies pay dividends to their share holders. The basic Black-Scholes model was later adjusted for dividends, so there is a workaround for this. This assumption relates to the basic Black-Scholes formula. A common way of adjusting the Black-Scholes model for dividends is to subtract the discounted value of a future dividend from the stock price.
- 4) Interest rates constant and known. The same like with the volatility, interest rates are also assumed to be constant in the Black-Scholes model. The Black-Scholes model uses the *risk-free* rate to represent this constant and known rate. In the real world, there is no such thing as a risk-free rate, but it is possible to use the U.S. Government Treasury Bills 30-day rate since the U. S. government is deemed to be credible enough. However, these treasury rates can change in times of increased volatility.
- 5) Lognormally distributed returns. The Black-Scholes model assumes that returns on the underlying stock are normally distributed. This assumption is reasonable in the real world.
- 6) European-style options. The Black-Scholes model assumes European-style options which can only be exercised on the expiration date. American-style options can be exercised at any time during the life of the option, making american options more valuable due to their greater flexibility.
- 7) No commissions and transaction costs. The Black-Scholes model assumes that there are no fees for buying and selling options and stocks and no barriers to trading.
- 8) Liquidity. The Black-Scholes model assumes that markets are perfectly liquid and it is possible to purchase or sell any amount of stock or options or their fractions at any given time.

AgFRM: Volatility descriptors in “T+1”

- **Duration**
- **Term Structure**
- **Strike**
- **Underlying**
- **Liquidity**

- **In any case all Futures market volatility is calculated using the Black, 1976 model.**
- **Most customer transactions involve forward transactions of indexed transactions – indexed to non-Futures markets.**
- **Risk management involves using a Black, 1976 left hand side portfolio of greeks to offset the right hand side of the “portfolio balance sheet”, OTC customer transactions.**
- **Most AgFRM portfolios will have short dated hedges on the left hand side when compared to the right hand side so duration and convexity are immediate and real – this is bond math.**
- **The Black, 1976 and Black Scholes, 1973 models are seriously flawed but nonetheless acceptable and standard benchmarks for the indexation and securitisation and commoditisation of volatility.**

Value lies between where it can be bought or sold
Value tomorrow will likely be different

The first volatility descriptor: Duration

- **By duration we are referring typically to the supply side – Annual crops have the shortest financial duration as the planting decisions are made each year or twice a year (spring and winter crops) and an additional twice a year – northern and southern hemisphere. Duration lengthens as we move towards more continuous streams of production; dairy farming (milk), meat (cow, calf, yearling) and tree crops. The true continuous stream production commodities are petroleum, natural gas and metals.**
- **Note: sugar can be of widely different durations depending on type (beet or cane) of crop, type (raw or white) of commodity.**
- **Further note: volatility is not expected to be the same at different points on the marginal supply curve.**
- **Agricultural commodities are not particularly volatile when compared to markets like electricity where demand is highly elastic .**
- **Surging commodity prices and consequently high volatility are always a result of a mismatch of supply and demand (Balcombe, 2010).**

The higher the duration of the commodity supply side
the slower the response to market prices and
the higher is the expected volatility

The second volatility descriptor: Term Structure

- **In the long run fundamentals always assert themselves and we revert to a mean.**
- **The mean is dynamic and subject to structural shift.**
- **The forward curve of any commodity, including volatility, can be contango, flat or backwardated.**
- **The term structure of volatility will typically (at the money) follow that of the underlying commodity.**

The term structure of forward volatility
like any commodity
Can be contango, flat or backwardated

The third volatility descriptor: Strike

- **Volatility is strike dependent. Economically or Financially this may seem difficult to appreciate but it is the markets attempt to price and manage the dynamics of a forward market not the current spot reality of cash prices.**

Skewness and Kurtosis are a reality

The fourth volatility descriptor: Underlying

- **When the underlying tends to gap and/or exhibit regime switching, implied volatility will reflect this.**

Fat tails are a reality
in real distributions
of price levels and price changes

The fifth volatility descriptor: Liquidity

- **The transactable price of volatility is, in any case, not necessarily reflective of any kind of equilibrium value.**
- **Forward markets do not attempt to predict the future, but merely capture the price of forward risk supply/demand today.**

When the best is gone
only the best remains

Which Volatility?: Survivor bias

- **Historic implied volatility analysis is ex post and inclusive of many events which are not in the forward volatility price.**
- **This allows survivor bias creep – assessing life insurance premiums from the autopsy dataset.**

As a practitioner the only worthwhile analysis is of
the historic forward implied volatility
i.e. something we could have done something about.

Volume has a price: the Income Conundrum (Completing the Triangle)

- **The transactable price of volatility in a futures based options market is in any case, not necessarily reflective of any kind of expected value, but rather the ebb and flow fair value of where one can manage a dynamic flow of transactions.**
- **The transactable price of volatility in an OTC based options market is in any case, not necessarily reflective of any kind of expected value, but rather the ebb and flow fair value of where one can manage a dynamic flow of transactions.**

Income is Price times Quantity
Many transactions are conducted on volume alone
For volume can be PV'd
To a cashflow
It has a price because
it can be securitised and indexed
for ANY commodity

Volumetric Production Payment - VPP

- A type of structured investment that involves the owner of a commodity production stream selling a specific volume production in that farm, energy field or property.
- The investor receives a stated monthly quota – often in raw output, which is then marketed by the VPP buyer – or a specified percentage of the monthly production achieved at the given property.

  A VPP deal is typically set to expire after a certain length of time or after a specified aggregate total volume of the commodity has been delivered. A VPP interest is considered a non-operating asset, akin to a royalty-payment system. If the producer can't meet the supply quota for a given month (or whatever schedule is used), the unmet portion will be made up for in the next cycle, and so on until the buyer is made financially whole.

  Buyers could include investment banks, hedge funds, energy companies and insurance companies.
- The buyer does not have to contribute any time or capital to the actual production of the end product. However, many investors in these types of interests will hedge their expected receivables (the volumes laid out in the contract) via the derivatives market to protect against commodity risk or otherwise lock in the expected profits.

  A VPP deal allows the seller to retain full ownership of the property while monetizing some of their capital investment. This ability to "cash out" some of the value of an oil field, for example, allows the seller to invest in capital upgrades, pay down debt or repurchase shares.

  The VPP investor will typically perform strong due diligence both initially and on an on-going basis, having inspections done of the site while constantly analysing production reports to ensure that the contract's terms are being met.

Using a VPP to manage Volatility

- **A consumer wishes to buy a forward fixed price and quantity of SMP. It is effectively linked to petroleum prices, the consumers main source of income. The budget is for 2012, and ideally 12 equal monthly payments will be made, preferably with 180 days credit. In addition a rebate is required should prices fall dramatically. In addition a working capital issue requires some comfort should interest rates change. Payment will be made against ex-warehouse delivery in the consuming country**
- **A producer of milk wishes to sell grass curve based price and volume for 2012. They are not linked to petroleum prices, do not forward sell in ratable prices, do not extend credit, do not manage interest rates for consumers, do not carry stocks in the consuming country nor have the securitisation capability to manage ex-warehouse delivery there. They certainly do not wish to rebate the consumer if SMP prices fall.**
- **Enter the AgFRM expeditor – the transaction gets done. A VPP is concluded with the Producer, un-priced. A forward ratable sale is made to the Consumer linked to oil prices with a knock-in rebate each month and interest rate protection. A bank intermediates the country risk and 180 day payment ex-warehouse.**

.. Where the objectives are to successfully progress beyond first level processing and commodity exporting to knowledge based internationally competitive food businesses, some form of new co-operative model is indicated (Harte, 2010).

Recommendations

- **The role of academic and research organisations is to be the gatherer and keeper of market based forward curves and the analysis thereof. This means building bridges to the commercial world.**
- **The role of regulatory and supervisory organisations is to fund academic research and staff themselves with experienced market practitioners. Furthermore they must exert pressure for curves to be made available from the market participants they supervise and drive an education programme through platforms like Summit Finuas in Ireland to foster Academic & Industry links.**

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