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Welfare Effects of Commodity Price Volatility

by

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Welfare Effects of Commodity Price Volatility. Should Volatility Always be Corrected? Applications to Coffee Producers in India and Ethiopia.

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Introduction

- Commodity price volatility has been researched extensively by academics, international organisations such as UNCTAD, FAO and World Bank over many years.
- Evidence shows that for many primary commodities there exists high price volatility.
- Causes of volatility are varied:
- Endemic supply and demand conditions; production cycles; global value chains;financialisation;natural factors such as weather and harvests.
- Volatility has been greater in response to market liberalisation (eg end of many ICA's in the 80's and 90's).

Introduction

- Market liberalisation of commodity markets in many countries was often accompanied by other macroeconomic reforms such as:
- **Currency adjustments** (usually devaluation or a move to a more flexible currency).
- **Abolition of Marketing Boards** (eg in coffee).
- Increased role for **private suppliers of commodities**.
- This makes analysis of the causes of price volatility complex as these many factors have to be disentangled.

Measuring volatility

- Various ways to measure volatility such as: standard deviation (or *variance*);*coefficient of variation*; and more technical tools such as the ***GARCH*** method.
- GARCH models provide a framework for analysing the potential for the variance in any time series to be time-varying and to discover whether volatility (measured by the variance) ***decays* or *persists over time***.
- Has econometric implications, but also important policy implications.
- Firstly, the presentation assesses the *price risk* faced by coffee producers in two coffee producing countries-**India** and **Ethiopia** using the ***generalised autoregressive conditional heteroskedasticity (GARCH)*** econometric technique.
- Secondly, it estimates potential **welfare gains** for producers from eliminating this price risk.
- Thirdly, we ask whether intervention to offset volatility is always desirable and cost-effective.

Coffee in India

- Coffee is an important commercial crop for India, with annual exports varying from 250-300,000 tonnes .
- Production is divided between Robusta and Arabica varieties (60%:40%).
- Circa 90% of India's coffee is exported and it represents ~4% of world exports of coffee
- Circa 5 million people depend for their livelihoods on the coffee industry, including nearly 590,000 directly employed workers (Coffee Board of India).
- Classic "***Minifundia***" structure : 80% of coffee holdings <2 hectares; 98.8% < 10 hectares.
- **DATA**: Monthly coffee producers' prices obtained from the International Coffee Organization (ICO) database.
- 458 observations (from 1 January 1973 to 31 December 2011).
- The prices are in US cents/lb and relate to average farm gate price paid to producers.

Figure 1: Percentage change in monthly coffee prices over previous period (January 1973 to December 2011; i.e. months 1-220 pre- and months 221-458 post-liberalisation)

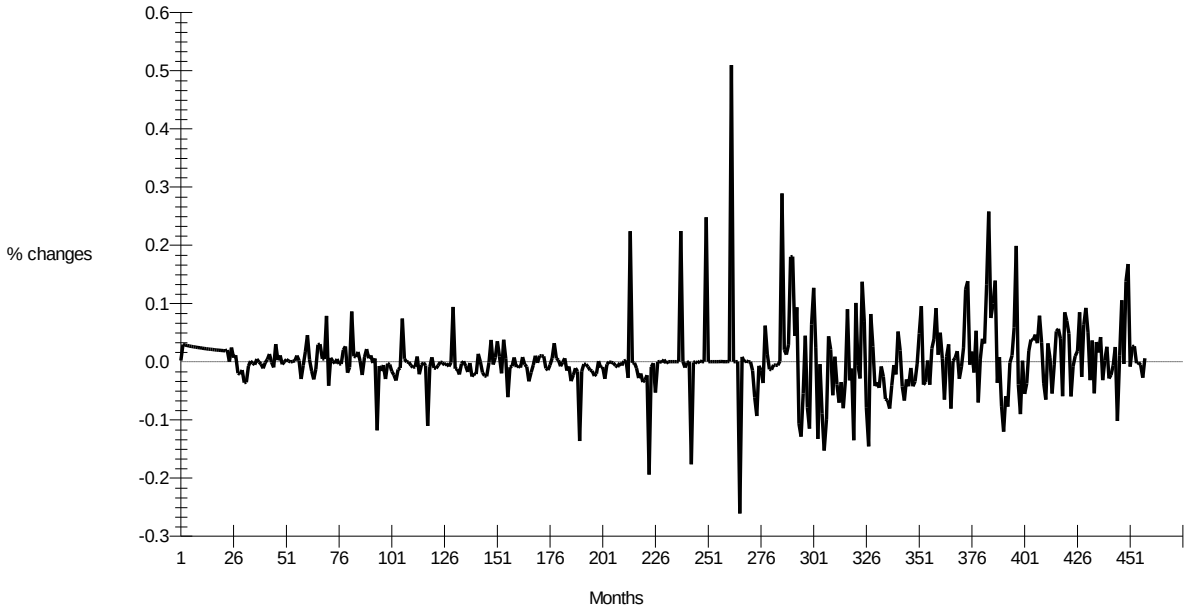


Table 1:Descriptive Statistics

Pre-liberalisation period: January 1973 - December 1992

Mean	75.47
Standard Deviation	17.49
Skewness	0.12
Excess Kurtosis	-0.80
Coefficient of variation	0.01

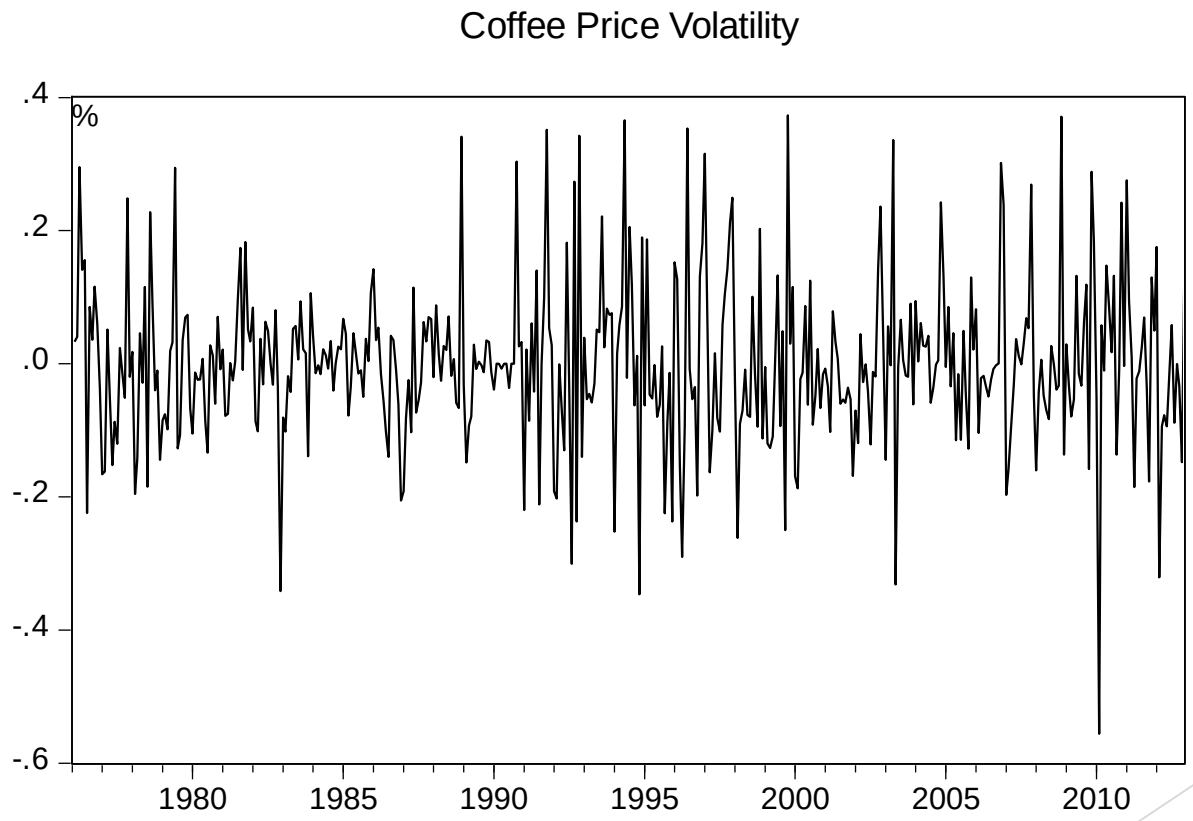
Post-liberalisation period: January 1993 - December 2011

Mean	93.60
Standard Deviation	45.82
Skewness	1.25
Excess Kurtosis	1.65
Coefficient of variation	0.49

Coffee in Ethiopia

- The coffee sector accounted for ~35% of merchandise exports and 16%-20% in years 2011 to 2013(ICO,2013).
- Over 4 million small farmers are engaged in coffee cultivation but ~15 million people are directly or indirectly dependent on income from coffee production.
- 95% of farmers operate on less than 2 hectares(with low average yield per hectare of~720kg-in 2013).
- **Data**: Monthly coffee producers' prices obtained from the International Coffee Organization (ICO) database.
- 444 observations (from 1 January 1976 to 31 December 2012).
- The prices are in US cents/lb and relate to average farm gate price paid to producers

Data


Coffee Price Volatility
%
.4
.2
.0
-.2
-.4
-.6
1980
1985
1990
1995
2000
2005
2010

Data

Pre -Reform:

Mean = 61 cents/lb
SD = 13.97
CV = 0.23 (23%)

Post - Reform:

Mean = 74.8 cents/lb
SD = 31.7
CV = 0.42 (42%)

Risk Aversion

- Many studies have argued that primary product producers are highly risk averse and apply an ***Expected Utility*** approach to their production decisions.
- Key question is whether the average farmer/producer would prefer a **high mean price for his/her products but with a high variance.**
- ***OR*** a **low mean price but also low variance**. This is an empirical question rather than a theoretical one
- We assume that the producer prefers ***certainty equivalence*** (a form of ***income (or consumption) smoothing***.
- **And this leads to the question: What would the producer be *willing to pay* for this certainty?**
- Producer's decisions about the appropriate levels of investment to make (eg, inputs such as fertilisers etc) will be crucially determined by this.
- Producer will be influenced not just by the Expected price (Ep) but also by the variance of (Ep)-and the relation between the two.

THE WELFARE GAIN FROM ELIMINATING COFFEE PRICE VOLATILITY

- The ***Constant Relative Risk Aversion (CRRA)*** parameter has been used in a number of studies of risk-averse behaviour: Moledina et al (2003); Schechter (2007) and Cardenas and Carpenter (2005);
- $\lambda = 1/2\gamma\sigma^2$
- This is derived from the standard CRRA function:
- $U(x) = x^{1-\gamma}/1-\gamma$
- Where U(X) is the utility of consumption, $\gamma \in (0,1)$ is the CRRA, **λ** is the welfare gain if all consumption (production) volatility can be eliminated. This will be a function of two parameters, the **risk aversion parameter γ** and the **amount of risk σ^2** ;(see Gemech et al, 2014;2016).
- Apply this concept to measure the possible welfare gain from eliminating unpredictable risk for coffee producers.
- Combination of GARCH model and the CRRA concept allows us to determine a value for the ***Conditional Variance*** but also the ***Unconditional* (persistent/ unpredictable) *Variance*.**
- This then allows us to measure the true welfare effect of the price volatility (at least for this **Expected Utility** approach).

Table 1	λ with γ =0.6
Overall variance = **0.095**	**0.057**
Conditional variance = **0.015**	**0.009**
Unconditional variance = **0.08**	**0.0480 (where γ is the CRRA and the variance has been split between the conditional variance and unconditional variance)**

Welfare Gains: Indian Coffee Producers

- The magnitude of the potential gain from eliminating price risk volatility using the unconditional variance of 0.08 and $\gamma = 0.6$ is equal to 0.048 (or 4.8 percent of revenue (income).
- An estimate of the revenue from coffee production is obtained from:

  $R = n * \gamma * p$ (n=output; p=mean price).
- For the crop year 2010-11, about 400,000 hectares of the Arabica and Robusta varieties were cultivated with an average yield of 852 kg/ha . The mean price of coffee over the sample period was US$2.4/kg.
- This gives R = US$817 million.
- An estimate of the welfare gain W is found by using:

  $\mathbf{W = R*\lambda}$
- Giving a welfare gain from eliminating price volatility of approximately US$39.3 million (US$817 million multiplied by 0.048 from Table 1 above) or approximately **US$65 per farm** when spread across 600,000 or so coffee farms.

Welfare Gains: Ethiopian Coffee Producers

- For the crop year 2011-12, about 450,000 hectares of the Arabica varieties were cultivated with an average yield of 720 kg/ha . The mean price of coffee for this period was $0.90/kg (ICO,2014)
- This gives R = US$291 million.
- An estimate of the welfare gain W is found by using:

  $W = R*\lambda$

- This gives a welfare gain of approximately **US$6.73 per hectare** (i.e. λ=0.01039** multiplied by US$291).
- **(The value λ=0.01039 has been calculated using the same formula used for India in Table 1 but applied to Ethiopian data).

Conclusions and policy implications

- In Ethiopia our figures suggest the potential welfare gain for producers from eliminating coffee price volatility is negligible .
- However, potential welfare gain for small Indian coffee producers is quite large.
- **Whether government intervention (and associated costs) to deal with price volatility (e.g. providing storage facilities, buffer stock systems etc) is desirable/cost-effective is the key question??**
- Are farmers willing to pay for *insurance* to mitigate price risk ? In the short term, providing information to farmers (**price discovery**) is beneficial.
- Market-based approaches such as those used by **the Ethiopian Commodity Exchange** may be a better way forward.
- Analysis assumes zero savings.
- Also depends on share of total household income from coffee revenues.
- Empirical findings of course will vary across countries and commodities.

Selected References

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