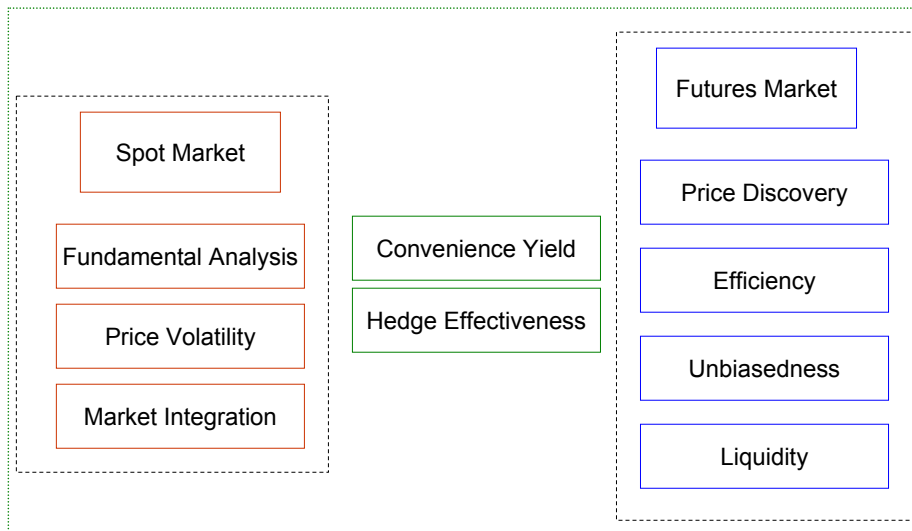


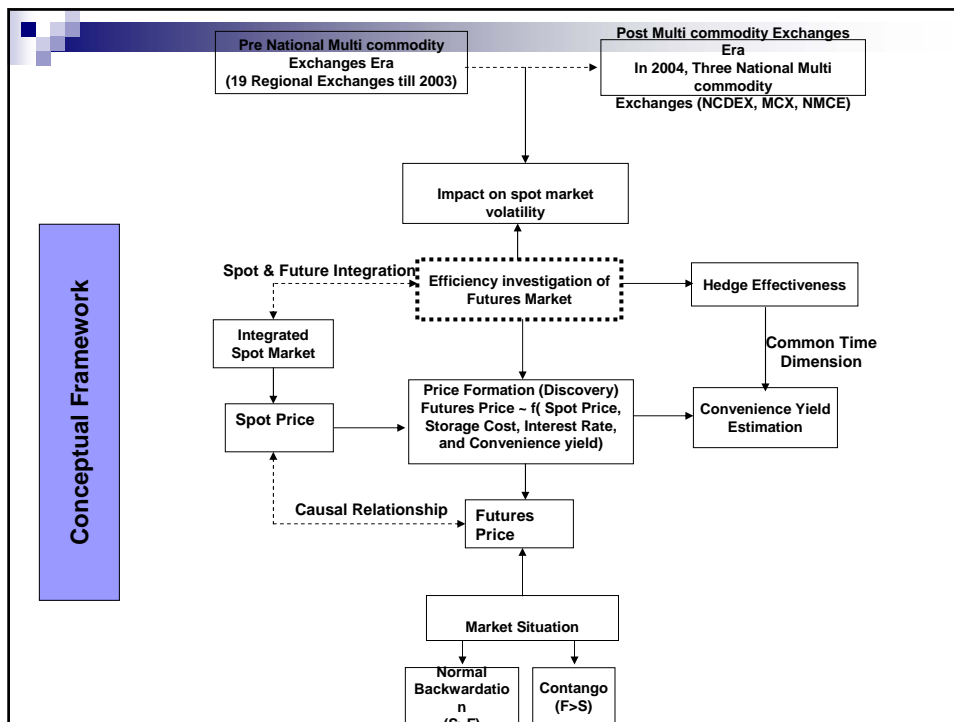
**International Conference on Agribusiness and
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Opportunities and Challenges
IIM Lucknow**

**A Comprehensive Assessment of
Wheat Futures Market: Myths and
Reality**

By
Ashutosh Roy & Brajesh Kumar
IIM Ahmedabad

Spot Future Integrating Framework

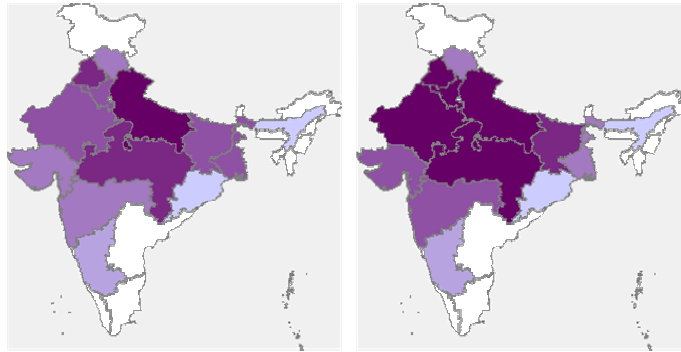
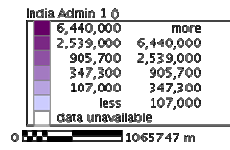




Issues of Futures Market

- Integration of Wheat Spot Markets
- Wheat Futures Market Liquidity
- Market efficiency and Bias
- Causal Relationship between futures and spot market
- Hedging Performance of Futures Market
- Convenience Yield

Wheat Production Map



1971 Wheat Production

2001 Wheat Production

MARKET INTEGRATION

Wheat Market Integration

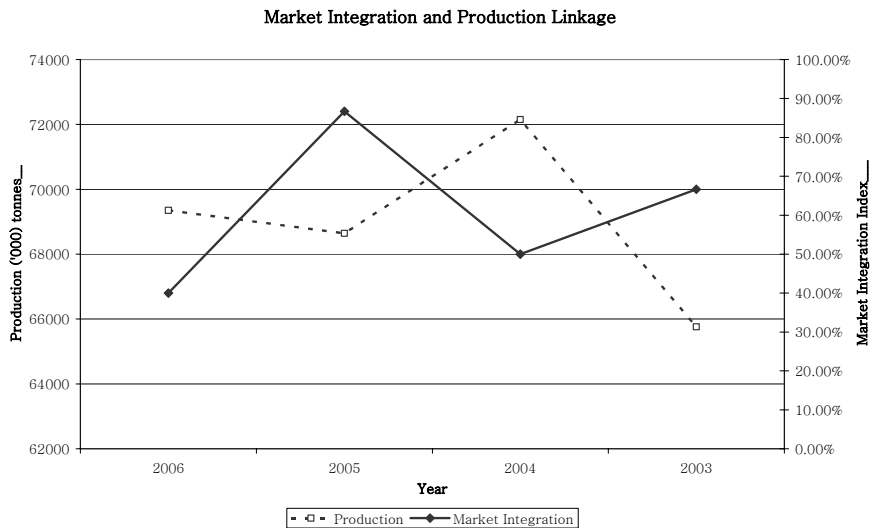
www.mapsofindia.com



Market Integration - Cointegration Test (Johanson Test)

Linkages		10%	5%	2003	2004	2005	2006
		CRITICAL	CRITICAL	Trace stat	Trace stat	Trace stat	Trace stat
U_P	M_P	13.31	15.34	7.62	12.70	17.28	5.71
U_P	Gujarat	13.31	15.34	6.15	17.38	17.75	12.50
U_P	Punjab	13.31	15.34	8.27	16.25	21.45	11.45
U_P	Haryana	13.31	15.34	16.12	18.12	23.68	12.44
U_P	Delhi	13.31	15.34	14.29	8.99	21.61	11.95
M_P	Gujarat	13.31	15.34	5.86	17.96	23.37	13.47
M_P	Punjab	13.31	15.34	9.54	12.54	16.81	14.56
M_P	Haryana	13.31	15.34	14.49	7.22	11.01	7.88
M_P	Delhi	13.31	15.34	13.36	6.81	25.85	7.68
Gujarat	Punjab	13.31	15.34	12.13	19.70	16.34	15.77
Gujarat	Haryana	13.31	15.34	12.26	12.73	15.55	11.50
Gujarat	Delhi	13.31	15.34	12.31	9.06	28.86	10.80
Punjab	Haryana	13.31	15.34	14.71	24.91	35.10	12.09
Punjab	Delhi	13.31	15.34	16.76	12.42	14.83	14.14
Haryana	Delhi	13.31	15.34	20.37	8.89	18.99	12.16
No. of Linkages cointegrated at 10%				7.00	6.00	14.00	4.00
Overall Percentage integration (# integrated links/ 15)				46.7%	40.0%	93.3%	26.7%
Pre and Post Exchange Market Integration				6.50 (Pre)		9.00 (post)	

Production and Integration Linkage



Market Integration Result

- Intra State Integration Exists (Mandis in a state moves together)
- Inter State Integration is Absent
- Post 2004, Inter state Integration has improved.
- Futures Market has helped in Market Integration
- Poor Production year Exhibits better Integration
 - Search Cost is high

TRADE VOLUME & MARKET LIQUIDITY

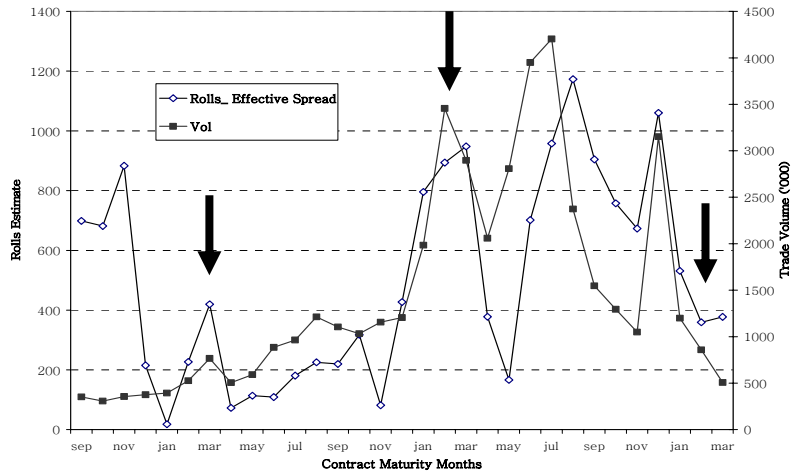
Descriptive Study of futures Contracts

■ Preliminary Finding

- Wheat Contracts shows Positive Skewed Return
- Futures markets demonstrates mat-month dependent Volatility
 - Contract maturing in harvest period shows higher volatility vis-à-vis contracts maturing in lean period
- Futures markets demonstrates maturity - month dependent Liquidity (Rolls Estimate / Trade Vol.)
 - Contract maturing in harvest period shows higher liquidity vis-à-vis contracts maturing in lean period
 - C is the effective spread
$$c = 2\sqrt{-\text{cov}(\Delta p_t, \Delta p_{t-1})}$$
- Above finding is supported by lit. (High Liquidity leads high Volatility)

Wheat Market Liquidity – Closing Price Based Estimate

Linkage of Liquidity and Trade Volume

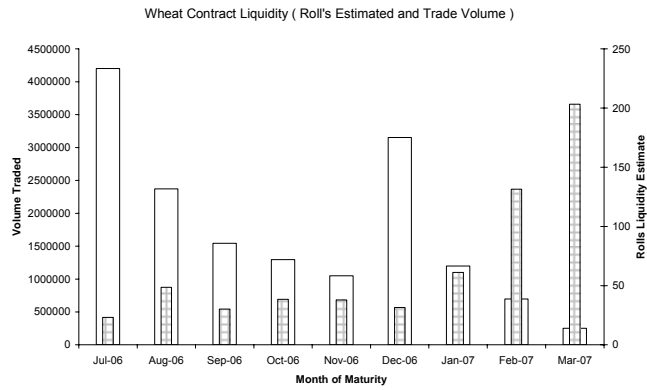


Arrival Pd. –High Trade Volume- Low Liquidity (High Spread) –
Counterintuitive (Trade volume and Rolls Estimate)

Wheat Market Liquidity – Intra Day High Frequency Trade clearing Price

Sl. No.	Contract	Roll's Estimate	Trade Volume
1	Jul-06	23.13	4202990
2	Aug-06	48.65	2373060
3	Sep-06	30.12	1546040
4	Oct-06	38.38	1294600
5	Nov-06	37.99	1049350
6	Dec-06	31.55	3152130
7	Jan-07	61.16	1199700
8	Feb-07	131.54	698230
9	Mar-07	203.19	251920

Linkage between trade volume and Roll's Estimate based on intra day high frequency trade data



Opposite pattern of effective spread (high frequency) and Trade Volume

**PRICE DISCOVERY
EFFICIENCY AND BIAS**

Price Discovery Efficiency & Bias

$$S_{t+n} - S_t = \alpha + \beta(F_t - S_t) + \varepsilon_t$$

$S_{t+n} - S_t$ = Difference between spot prices on expiry date and today

$F_t - S_t$ = Basis.

- Does basis contain forecastability of spot price?"
- Further joint parameter test on $\alpha = 0$ and $\beta = 1$ tells about the market efficiency.
 - Rejection of $\alpha = 0$, Market is biased and seeks risk premium.
 - Rejection of $\beta = 1$, Spot and Future market are not integrated.
 - Simultaneous unbiased and integrated markets are the sufficient and necessary conditions for efficient market hypothesis.

Sample Result for Bias and Efficiency

Contract	Param	Est.	S.E	t	p-val	R- 2	Joint Test	p val
4-Sep	Intercept	-0.31	0.59	-0.53	0.60	0.49	135.74	<.0001
	basis_dif	-0.50	0.09	-5.36	<.0001			
4-Oct	Intercept	-0.26	0.47	-0.54	0.59	0.40	168.39	<.0001
	basis_dif	-0.45	0.08	-5.53	<.0001			
4-Nov	Intercept	-0.65	0.42	-1.55	0.12	0.32	640.92	<.0001
	basis_dif	-0.10	0.03	-3.22	0.00			
4-Dec	Intercept	-0.37	0.35	-1.05	0.29	0.12	280.15	<.0001
	basis_dif	-0.23	0.05	-4.41	<.0001			
5-Jan	Intercept	-0.09	0.26	-0.36	0.72	0.10	152.11	<.0001
	basis_dif	-0.23	0.07	-3.13	0.00			
5-Feb	Intercept	-0.09	0.23	-0.39	0.70	0.13	141.57	<.0001
	basis_dif	-0.27	0.08	-3.52	0.00			
5-Mar	Intercept	0.00	0.32	0.00	1.00	0.11	149.59	<.0001
	basis_dif	-0.39	0.08	-4.81	<.0001			
5-Apr	Intercept	-0.11	0.23	-0.45	0.65	0.08	1557.33	<.0001
	basis_dif	-1.08	0.04	-28.73	<.0001			

CAUSALITY FUTURES & SPOT

Direction and Causality Test

- Future Vs. spot market
- Volatility Vs. Trading Volume

Method - Garbade and Silber (1982)

$$S(t+1) - s(t) = \alpha_c + \beta_c [F(t) - s(t)] + \varepsilon_c$$

$$F(t+1) - F(t) = \alpha_f - \beta_f [F(t) - s(t)] + \varepsilon_f$$

⊖ (Theta) $\frac{\beta_c}{\beta_c + \beta_f} = 1$ Cash price converges towards futures prices

⊖ (Theta) $\frac{\beta_c}{\beta_c + \beta_f} = 0$ Future prices converge towards spot prices

$\delta = 1 - \beta_f - \beta_c$ "Delta" Rate of convergence for cash and futures market, over increasing time period

Table 6.7 : Causality Test Result		
Contract	Θ (Theta)	Causality
Sep04	0.712192	Spot → Futures
Oct04	0.672648	Spot → Futures
Nov04	0.672365	Spot → Futures
Dec04	0.495381	Futures → Spot (No relation)
Jan05	0.551577	Spot → Futures(No relation)
Feb05	0.567991	Spot → Futures(No relation)
Mar05	0.958587	Spot → Futures
Apr05	0.357318	Futures → Spot
May05	0.722789	Spot → Futures
Jun05	0.910565	Spot → Futures
Jul05	0.786804	Spot → Futures
Aug05	0.853242	Spot → Futures
Sep05	0.590002	Spot → Futures(No relation)
Oct05	0.952984	Spot → Futures
Nov05	0.734587	Spot → Futures
Dec05	0.298942	Futures → Spot

Jan06	0.354566	Futures → Spot
Feb06	0.45006	Futures → Spot(No relation)
Mar06	0.45006	Futures → Spot(No relation)
Apr06	0.486516	Futures → Spot(No relation)
May06	0.773526	Spot → Futures
Jun06	0.791901	Spot → Futures
Jul06	0.59969	Spot → Futures(No relation)
Aug06	0.308226	Futures → Spot
Sep06	0.651014	Spot → Futures
Oct06	0.423701	Futures → Spot(No relation)
Nov06	0.812034	Spot → Futures
Dec06	0.58606	Spot → Futures(No relation)
Jan07	0.402098	Futures → Spot(No relation)
Feb07	0.534433	Spot → Futures(No relation)
Mar07	0.489529	Futures → Spot(No relation)

Lead Lag – Causal Analysis

- Out of 32 wheat contracts
- There are around 11 contracts where spot market was dominant over futures market
- There are 14 contracts where no causation could be established
- In case of remaining 7 contracts where futures market has led the spot market.
- Based on total available history of wheat futures trading, it does not indicate any clear cut, lead lag (causal) relationship between spot and futures price movements.
- Futures market can't be credited for inflation in prices

Hedge Efficiency
Measure

Hedge Efficiency Measure

■ The Minimum-Variance Hedge Ratio

(Benninga, et al. (1984))

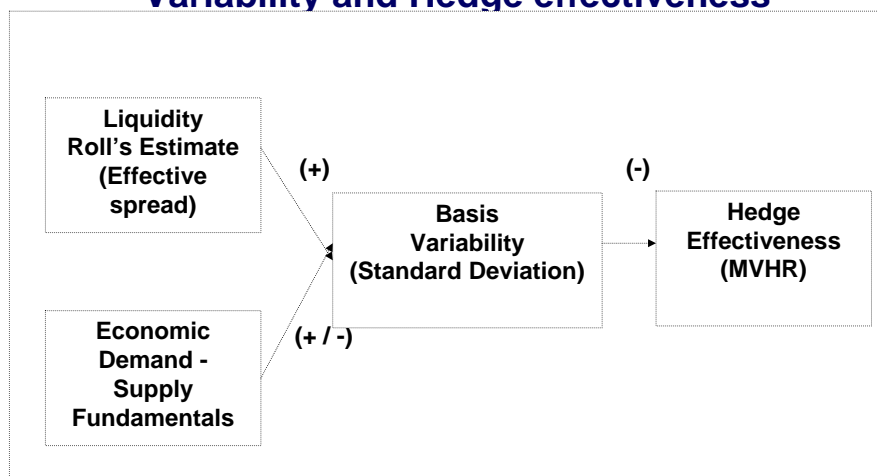
- Slope coefficient of the OLS regression, or equivalently
 - The optimal hedge ratio for any unbiased futures market
 - Covariance (Cash, Futures) / Variance (Futures)
- $$CP_t = a_0 + b_1 * FP_t + e_t$$
- R-square of above model gives hedge effectiveness

Hedge Efficiency – Wheat at NCDEX

- In 2004 – Avg. 10% Effectiveness
- In 2005 – Avg. 25% Effectiveness
- In 2006 – Avg. 5% first six, 10% last six
- Contracts with high liquidity exhibited poor Hedge Efficiency
 - Because High Basis Variance for Liquid contracts

Liquidity, Basis Variability & Hedge Efficiency

Linkage between Liquidity, Supply, Basis Variability and Hedge effectiveness



Bivariate Relationship

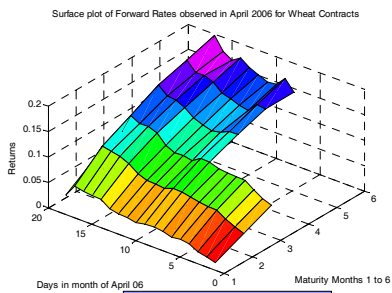
Correlation Matrix – Hedge Effectiveness , Basis Variation and Liquidity			
	Hedge Effectiveness	Basis Variation	Liquidity
Hedge Effectiveness	1.000		
Basis Variation	-0.668	1.000	
Liquidity	-0.431	0.381	1.000

Convenience Yield Estimation

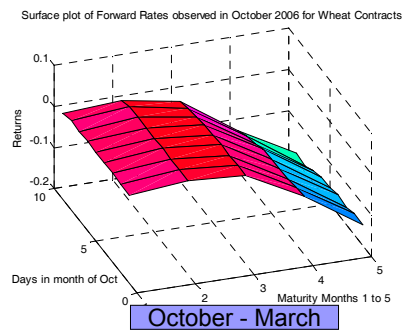
- CY Modeling - Cost of Carry Model (with given spot price, storage cost and cost of financing)
 - Future Price = Spot Price * $e^{(r+c-y)t}$
 - where r, c and y indicates interest rate (12%), carrying cost (2-5%) and convenience yield respectively.
- Since we know , Future Price , spot price and other incidental cost of holding , we can find Y – convenience yield.
- For each wheat contract we have estimated the convenience yield.

Convenience Yield

Reference Month - April		
Months	Origin - April	Average Return
1	May	3.88%
2	Jun	7.48%
3	Jul	9.96%
4	Aug	13.21%
5	Sep	14.86%
6	Oct	16.13%

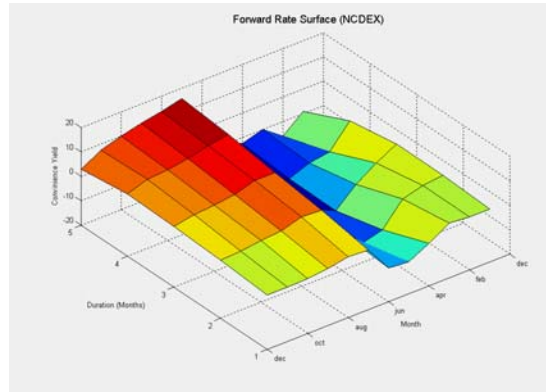


Reference Month - October		
Months	Origin - Oct	Average Return
1	Nov	1.53%
2	Dec	2.67%
3	Jan	0.95%
4	Feb	-7.31%
5	Mar	-16.19%



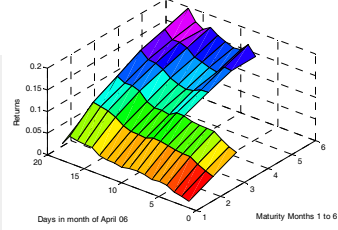
Convenience Yield- wheat

Wheat Forward Rate Surface



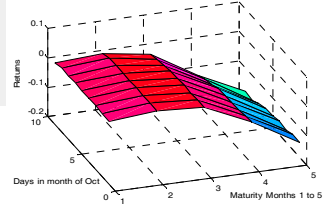
April - October

Surface plot of Forward Rates observed in April 2006 for Wheat Contracts



October - March

Surface plot of Forward Rates observed in October 2006 for Wheat Contracts



Summary and Conclusion

Summary and conclusion

- Post National Exchange Era, spot market integration has improved.
- Contract maturing during arrival period of wheat crop cycle (April – May – June) shows high Trade Volume and better Liquidity.
- Supply driven market shape (Backwardation and Contango).
- Since contracts get matured during the high supply period, the futures price expected would be lower than spot price during the contract cycle, contracts faces Backwardation , negative basis ($\text{Basis} = \text{Future} - \text{Spot}$).

Conclusion (cont'd)

- For the contract maturing during the arrival period, the whole contract cycle faces the supply shortage market scenario, and which gets reflected as high convenience yield.
- Poor hedge effectiveness (15%) has been demonstrated by contracts maturing in arrival period, has counter intuitive implication.
- Further exploration of this counter institutive relationship between HE and liquidity or trade volume means, market is thin and lean period high variance in basis leads to poor performance of contracts.
- The other reason could be due to poor market integration between spot and futures market.

Research Contribution

- To the best of author's knowledge, first time in the literature of Indian commodity futures market, the estimation of convenience yield, its association with storage and the explanation of market situation (backwardation/contango) have been looked into.
- Forward Rate surface has been computed for wheat futures contract.
- An integrated framework for linking market liquidity, basis variance, hedge effectiveness, market integration, futures trading bias has been proposed.

Thanks , Comments ?