The normal backwardation theory

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The normal backwardation theory

and the theory of storage

aim to explain the relationship

between the spot and futures prices

- The theory of normal backwardation focuses on:
  - the balance between traders' positions
  - the risk transfer function of the derivative market
- The theory of storage is centered on:
  - storage costs
  - the motives of stock holding on the physical market

Section 1. The theory of normal backwardation : presentation

Section 2. The analysis of the risk premium towards the theory of financial markets

Section 3. Empirical tests

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Section 1. The theory of normal backwardation : presentation

1.1. The relationship between the spot and futures prices

1.2. The critiques of the theory

- Backwardation
  Spot price > Futures price

- Contango:
  Spot price > Futures price

- Basis:
  Futures price – spot price

- Backwardation = discount
- Contango = premium

1.1. The relationship between the spot and futures prices

- Normal backwardation theory focuses on the relationship between the **future** spot price and the futures price
- This relationship may be written:

$$F(t,T) = E_t\left[S(T)\right] - \Pi$$

- $F(t,T)$: Futures prices at t for delivery in T
- $S(T)$: Spot price at T
- π : Risk premium

H1. The future spot price includes a risk premium

Keynes (1930):

*«…in **normal conditions** the **spot price exceeds the forward price** i.e. there is backwardation.*

In other words, the normal supply price on the spot includes remuneration for the risk of price fluctuation during the period of production,

whilst the forward price excludes this.»

- **H2**. This risk premium is **positive**
  - Short positions exceed long positions (Keynes)
    Short positions : hedge against a prices fall
    (Producers selling the commodity)
    Long positions : hedge against a prices rise
    (Industrials buying the commodity)
  - Producers are more inclined to hedge (Hicks)

There is a market unbalance

There is a need of speculators to compensate for this unbalance

The relationship between the **current** spot price and the futures price

- If operators anticipate the stability of the spot price, the basis is negative: there is backwardation

$$F(t,T) - S(t) < 0$$

- When there are surplus stocks in the physical market, the expected spot price is lower than the current spot price: there is contango

$$F(t,T) - S(t) > 0$$

Meanwhile, the expected basis is in backwardation

$$F(t,T) - E[S(T)] < 0$$

Conclusion

- The risk premium is at the center of the theory
- In normal conditions, the futures price is inferior to the spot price

1.2. Critiques of the theory

1.2.1. Expectations

1.2.2. Risk premium

1.2.3. The function of transferring risk

1.2.1. Expectations in the normal backwardation theory

- Keynes J.M., 1930:

  « If this (future) price shows a profit on his costs of production, then he can go full steam ahead, selling his product and running no risk. »

- Only speculators operating in the derivative market have expectations on the future evolution of the spot price
- These expectations are homogenous: there are no transactions between speculators

- The expected spot price is not necessarily the same for all speculators
- Industrials and producers do not necessarily undertake pure hedging

1.2.2. The risk premium

- Telser (1958):
  - Derivative markets are usually characterized by:
    - the presence of numerous speculators
    - the absence of barriers to entry
  - In such a market, there is no reason to think that the future spot price and the futures price will be different
  - The risk premium does not exist

- Cootner (1960):

  The deposit and the margin calls must be taken into account when measuring the risk premium

- Hardy (1940):

  The risk premium is negative because speculators act as gamblers in derivative markets

1.2.3. The function of risk transfer

- Keynes (1930) :

  Speculators as insurers

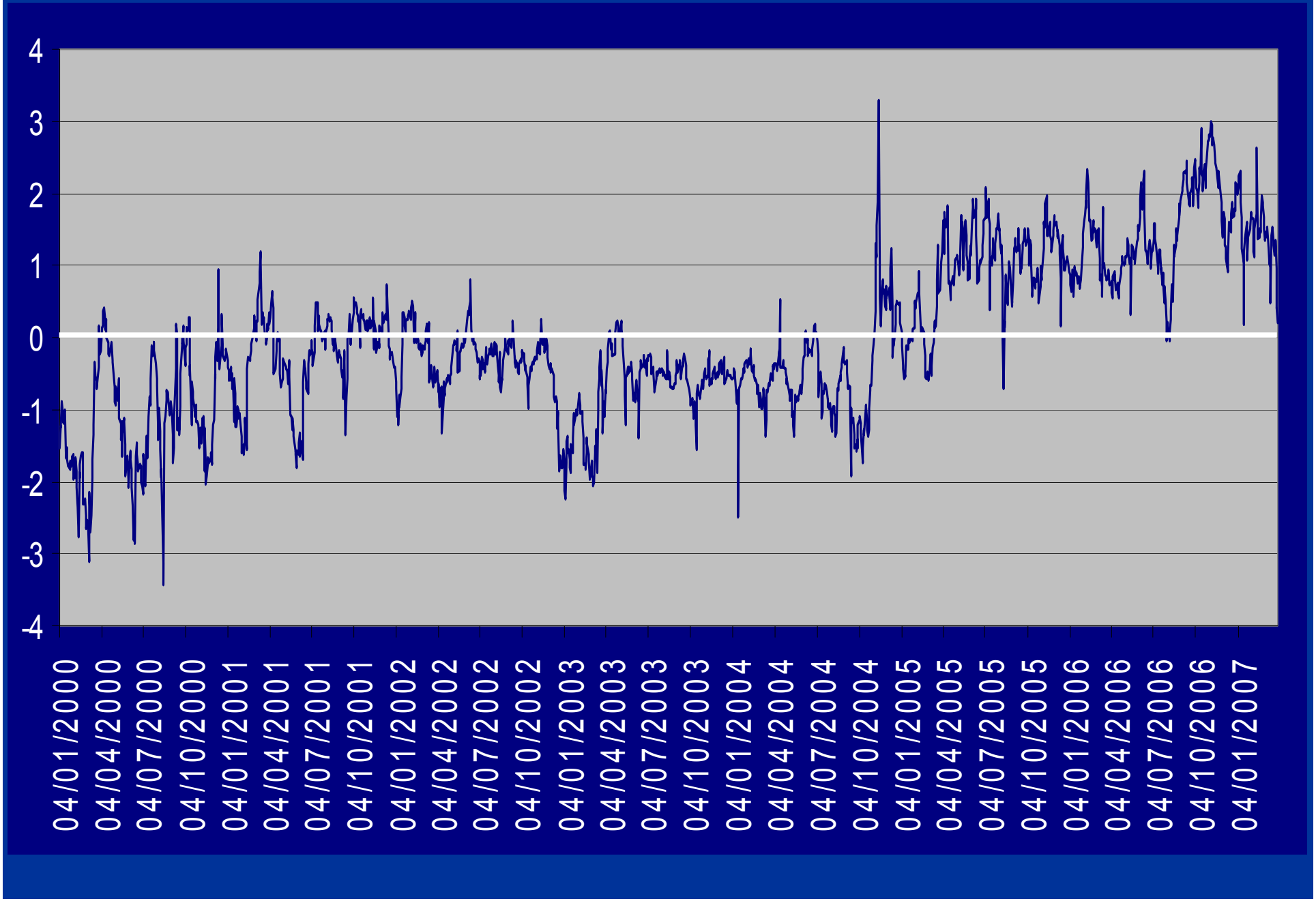
- Williams (1986):

  A analysis centered on risk transfer is unable to explain:

  - the volatility of the basis

  - the deformations of the term structure of prices

Basis on Brent crude (F- S), 2000 - 2007



Conclusion

- The relationship between the current spot price and the futures price can be explained by the presence, on the futures markets, of operators characterized by various risk aversions
- Towards the transactions on futures contracts, the operators exchange price risk
- The sign and level of the risk premium may evolve

Section 2. The analysis of the risk premium towards the theory of financial markets

2.1. The analysis of the individual optimization behavior

2.2. The application of equilibrium asset pricing models to commodity markets

2.1. The analysis of the individual optimization behavior

Johnson, 1960:

*« There is **no distinction** between the **hedger** and the « **ordinary » speculator** insofar as both are motivated by a desire to obtain a for-them optimum combination of E(R) and V(R) as determined by their respective utility functions. »*

- The production function is not anymore at the center of the analysis
- The utility function replaces it

2.2. Asset pricing models

- Futures contracts are not fundamentally different of other risky assets

  They are eligible to be included in a diversified portfolio, as well as stocks and bonds
- Relationship between the expected return of an individual stock and the market portfolio:

$$E[R_i] - R_f = \beta_i \left[E(R_M) - R_f \right]$$

- R_i : return on asset i,
- R_M : return on the market portfolio
- R_f : risk less interest rate,
- $ß$: sensibility of the asset

- Investors are remunerated for systematic risk only
- If speculators are paid for the holding of futures contracts, there should be a systematic risk associated to these contracts
- Empirical implication: the beta of a futures contracts must be positive

Advantages of the capital asset pricing model

- Analysis of the speculator
- Risk analysis

Limits of the capital asset pricing model

- Measure of the return on a futures contract ?
- What is the correct definition of the market portfolio ?

- Recently, this approach became more important
- Commodity as a new asset class
- Development of commodity indexes
  - CRB (Commodity Research Bureau)
  - S&P GSCI : (Standard and poors goldman sachs commodity index)
- New problems :
  - Commodity are used for diversification purposes
  - Massive investments in commodities because of their counter-cyclic nature
  - What drives commodity prices ?

Section 3. Empirical tests on normal backwardation theory

3.1. Empirical implications of the theory

3.2. Several studies of Working (1929-1931)

3.3. Normal backwardation and seasonality

3.4. The analysis of the return on futures contracts

3.5. Empirical tests relying on the CAPM

3.6. Various studies on the petroleum market

3.1. Empirical implications of the normal backwardation theory

1. Futures prices should raise during the life of the futures contract

2. Speculators should have a long net position on the futures market, and hedgers a short net one

3. Speculators should be rewarded for the holding of futures contracts

3.2. Working studies (1929-1931)

- Several studies on different commodity markets
- The study of the behavior of futures prices does not lead to the conclusion that there is a risk premium
- Backwardation does not correspond to the normal situation for every commodity markets
- Several commodity markets are sometimes in backwardation, sometimes in contango

3.3. Seasonality and the normal backwardation theory

- Telser (1958) :

  The evolution of the general level of prices must be taken into consideration

- Cootner (1960) :

  Hedging positions change along the year with the distance of the harvest date

3.4. The study of the returns on futures contracts

- **Fama & French, 1987**
- 21 commodity markets, from 1966 to 1984
- The normal backwardation can not be validated on at least one of these 21 markets

3.5 Empirical tests relying on the Capm

- Dusak (1973):

  The risk premium does not exist

- Carter, Rausser & Schmitz (1983):

  The risk premium does not exist

- Baxter, Conine & Tamarkin (1985):

The risk premium exists; there is normal backwardation

3.6. Empirical tests on the crude oil market

The normal backwardation theory is interesting in the case of the crude oil market because :

- Hedgers have often a short net position
- The market is most of the time in backwardation


WTI, 1989-2002
USD/b
40
35
30
25
20
15
10
1 M
12 M
03/01/1989
03/01/1990
03/01/1991
03/01/1992
03/01/1993
03/01/1994
03/01/1995
03/01/1996
03/01/1997
03/01/1998
03/01/1999
03/01/2000
03/01/2001
03/01/2002

A few results on the petroleum market

- Kolb, 1992 :

  Normal contango on the crude oil and on the fuel markets between 1980 et 1988

- Bessembinder, 1993 :

  Normal backwardation on the crude oil market

- Deaves & Krinsky, 1995 :

  Between 1980 and 1992, the crude oil market was neither in normal backwardation nor in normal contango

Conclusions

The theory of normal backwardation was never truly validated nor invalidated

Two questions remain:

- does the risk premium really exist ?
- how could we measure the risk premium ?

Use of new data:

- Open interest and volume
- Positions of operators (new database of the CFTC)