Public opinion and the media often suggest that futures markets have made the price of oil more unstable than it otherwise would be. It is argued in this paper that one must distinguish short-term price instability, associated with the functioning of commodity futures markets, and medium-term instability, associated with the processes that adjust production and consumption. Futures markets appear to be price destabilizing at times, though they also facilitate the management of trade in oil. But in the medium term, price stability and instability are determined by the mechanisms that adjust production and consumption.

L'opinion publique et les médias accusent très souvent les marchés à terme d'accroitre l'instabilité du prix du pétrole. Cet article montre qu'il faut distinguer l'instabilité à court terme, liée au fonctionnement des marchés à terme des produits, et l'instabilité à moyen terme, liée aux mécanismes de régulation entre production, consommation et prix. En fait, les marchés à terme sont épisodiquement le siège de phénomenes destabilisateurs même s'ils ont pour fonction de faciliter la gestion du commerce du pétrole. Mais à moyen terme, ce sont les mécanismes et les conditions de l'ajustement entre production et consommation qui déterminent la stabilité ou l'instabilité du prix.

Futures Markets and the Two Dimensions of Instability in Commodity Markets: The Oil Experience

SERGE CALABRE

Introduction

The extent and rapidity of oil price increases during the summer of 1990 following the Iraqi invasion of Kuwait (the price of oil increased by 150% between the beginning of July and the end of September) has been partially attributed to developments in the oil futures markets.[1] But the effect of futures markets on the level of oil prices is far from obvious. As their remarkable development did not occur until the 1980s, they cannot be held responsible for such events as skyrocketing oil prices in 1979.[2] In the recent market disruption, while spot prices climbed to more than $40 per barrel in September and October of

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1/ The main oil futures markets are associated with two commodity exchanges: the New York Mercantile Exchange (NYMEX), where futures contracts are available on crude oil, leaded and unleaded gasoline and home heating oil, and the International Petroleum Exchange (IPE) in London, where future markets include crude oil, diesel fuel, and naphtha. There is also the Singapore International Exchange (SIMEX), which deals with fuel oil and crude from Dubai. See Hersent and Simon (1989), Bilet (1984) and Angelier (1990). To date, attempts to establish oil futures markets at the Chicago Board of Trade, the New York Cotton Exchange and the Rotterdam Energy Futures Exchange have for the most part failed.

2/ See the article by J.-P. Angelier in this issue.

1990, they fell back to between $28 and $32/b in the latter part of the year, before plummeting to $21 when the UN-mandated alliance went on the offensive against Iraq after the January 16, 1991 deadline expired. Prices fell to as low as $19/b two days into the military campaign.

Attitudes towards futures markets appear to involve a paradox. On the one hand, commodity futures markets have developed phenomenally over the past two decades and futures prices are used as benchmarks in international trade. On the other hand, futures markets have been singled out for harsh criticism. Regarded as mysterious, closed institutions dominated by price-manipulating speculators, they stand accused of aiding, even provoking, price instability. An analyis of how these markets operate and how prices are determined can demonstrate that this paradox is unfounded.

At the outset it is useful to recognize that analysis and comment on the subject of international commodity markets frequently tend towards ambiguity and vagueness. Daily or weekly press reports on market developments generally give equal weight to a host of factors that are actually widely disparate in nature, origin and effect (inventory levels and movements, information on production and consumption, monetary or societal events not directly connected with the product, speculation, hearsay, etc.). The result is a somewhat confused picture of price trends, which are seen as determined more by chance than by explicit economic mechanisms.

The ambiguity of this kind of analysis is illustrated by the way the terms "supply" and "demand" are used. Sometimes they refer to production and consumption (without explaining how they interact in the market); sometimes to the actions taken by market participants; and sometimes they are related (without further detail or explanation) to the overblown myth that speculation "fixes" prices. Price levels are frequently confused with price variations and the concepts of price or market stability and instability are too often used carelessly. Distinctions between the short, medium and long terms are generally based on arbitrary and vague time frames, whereas only analytical definitions based on careful distinctions among the various mechanisms can produce operational explanations.

In fact, in order to understand the mechanisms behind commodity prices and their movement, a more prudent and rigourous approach is required, one that distinguishes among phenomena according to certain basic time horizons.[3] Activities on the trading floors of the exchanges and their impacts on price are principally short-term. But there is a second dimension to commodity market instability that belongs to a longer time horizon, defined here as the medium term. It is within this dimension that the mechanisms governing adjustment between production, consumption and price operate.

The theoretical literature has usually treated these two time-related aspects of commodity markets as completely separate. One body of research has concentrated on the role of speculation in commodity futures markets and its effects on market stability. These authors have developed a number of models for handling expectations (which are variously considered as extrapolative, adaptive, or rational), and some of them have focussed on the question of the "efficiency" of futures markets.[4] Another large group of studies has examined the problem of the instability of international commodity prices over multi-year periods in order to assess possible approaches to market regulation, particularly in the context of international accords or commodity agreements.[5] More recently, certain authors have attempted to deal with both of these phenomena in their investigation of the potential for stabilization and the role of futures markets.[6]

3/ See Calabre (1980), (1986), (1990a), and (1990b).

4/ There is a considerable body of literature on this subject. Some references will be provided in the text. For partial summaries and references, see Calabre (1980), (1986) and (1990a), Streit (1983) and Smith (1978). For oil futures markets, see, for example, Serletis (1991) and Bilet (1984).

5/ For references, see Badillo and Daloz (1985) and Calabre (1990b). See also Adams and Klein (1988) and Newbery and Stiglitz (1981).

6/ See, for example, Badillo and Daloz (1985), Calabre (1980), (1986), (1990a) and [1990b], Ntamatungiro (1988) and Smith (1978).

The purpose of this article is to describe a framework that accounts for the relevant time dimensions of commodity market instability and offers a way to resolve the paradox between the phenomenal development of futures markets and the criticisms levelled at them. While much of what follows applies to commodity futures trading in general, some of the unique characteristics of oil futures are highlighted:

- the fact that production response times are faster for oil than for most solid mineral and agricultural products;
- that certain major producers play a pivotal role in supplying the world market (which affects the production/consumption adjustment mechanisms); and
- that the vagaries of oil exploration and the length of time required to develop new discoveries restrain the tendency to overreaction which is so evident in the production capacities of many other commodities.

Section 1 deals with the role of expectations in determining prices on futures markets. Section 2 analyzes medium-term price dynamics.

1. Commodity Exchanges and Short-Term Instability

After explaining the differences between short- and medium-term phenomena (Sec. 1.1), we will show how the functions of futures markets make futures the privileged vehicle for expressing the expectations of speculators (Sec. 1.2). It will then be possible to assess what role expectations play in short-term price instability, particularly for oil (Sec. 1.3).

1.1 Short- and Long-Term Market Phenomena

Patterns in the relationship between the production and consumption of a commodity generally emerge only over a fairly long period (several months at least). In fact, the output of any given month is usually not consumed until several months later, after passing through the stages of storage, transportation and processing. Consequently, production and consumption flows can only be compared using a time horizon long enough to ensure that the quantities produced have actually been delivered to the end users; only then is it possible to determine the extent to which production satisfies consumption.

Logically, then, a distinction should be made between short-term and medium-term price movements. The short term is the period in which changes in the relationship between production and consumption cannot be objectively perceived; it involves short-lived fluctuations, for example, those lasting only a few days, weeks or months. The medium term is the time horizon within which price movements linked to the changing relationship between production and consumption can be identified. It captures fluctuations lasting from a few months to a few years.

Thus price movements can be decomposed within three basic time horizons. The first two (the short and medium terms) are associated with price variations; the third relates to long-term trends in average prices. Short-term fluctuations can be found within medium-term fluctuations, which are themselves subsumed by long-term trends (see Figure 1). This decomposition of price movements assumes that the components of any price change respond to different sets of factors, although this does not rule out interaction between them.

The length of the minimal horizon for the medium term varies by product. For agricultural foodstuffs which are generally processed prior to consumption (preserves, chocolate, coffee, etc.), the horizon must extend essentially from one harvest to the next; in this case, comparisons are based on annual data. For oil, the medium-term horizon is shorter because some producers are able to react extremely quickly. A case in point is Saudi Arabia, which was able to boost its production by more than 50% in just a few weeks in late 1990 during the Gulf crisis. This increase of more than 3 billion b/d represented close to 6% of daily world consumption.

1.2 Functions of Commodity Futures Markets

The original purpose of futures markets — to offer a way of hedging price risks — is starting to be well understood. What is still not completely clear, however, is the role futures markets play in determining prices. Thus it is useful to

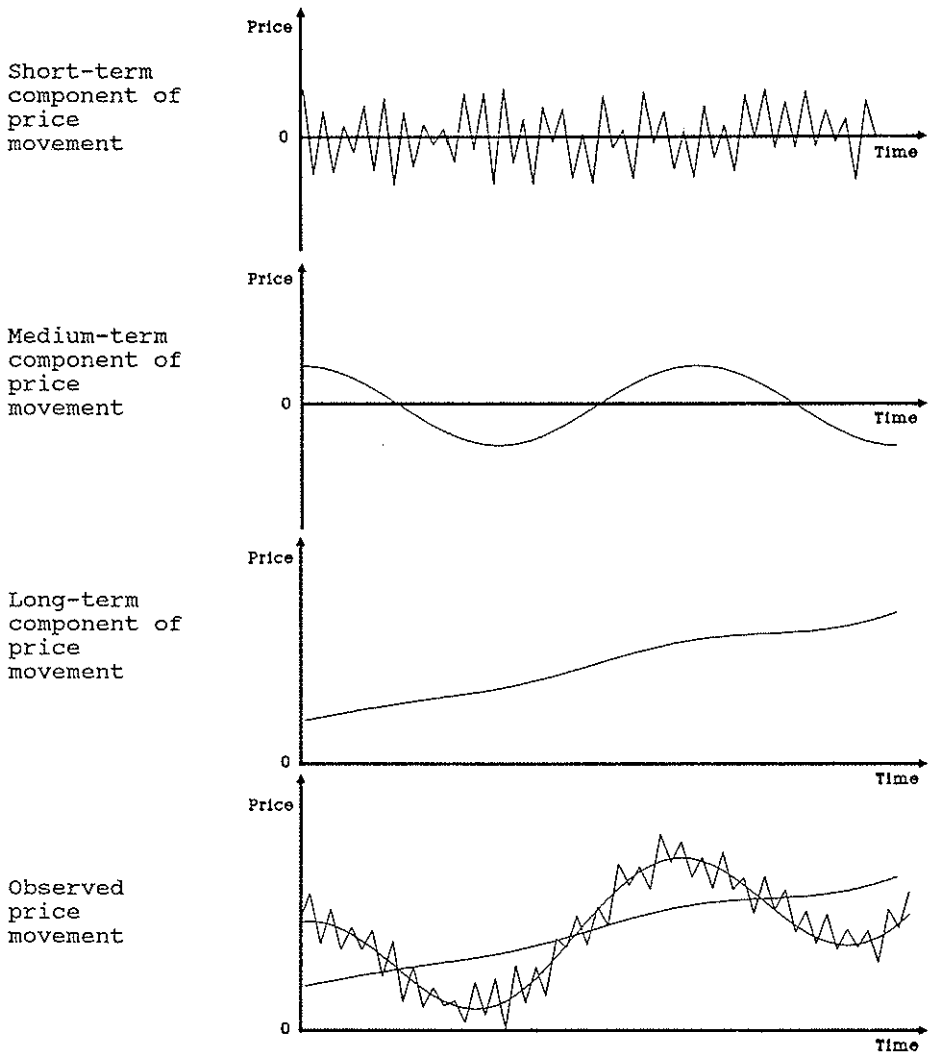

Figure 1: Components of Price Movements

present a general overview of international commodity markets and to describe how exchanges and futures markets fit in.[7]

Trading generally involves some kind of contract, which may require immediate delivery of the commodity traded or delivery at a later date. In forward-delivery contracts, the parties undertake to deliver and receive a specific quantity of product of a certain quality at some future date and location, subject to specific conditions. The price may be established at the time the contract is signed, or may remain "to be determined" on the basis of prices prevailing at the time of the actual transaction (for example, the average price over the last five working days before maturity).

Some of these physical transactions take place on the "free market" where prices vary continuously according to the interaction of supply and

7/ For a detailed analysis of the role, operation, and mechanisms of commodity futures markets, see Calabre (1986) and (1990a).

demand. In many cases, brokers act as intermediaries to bring buyers and sellers together. Sometimes the existence of a complex network of brokers in a particular city leads to a concentration of transactions there. Rotterdam's spot oil market is one such example.

Over the years, brokers and investors have occasionally elected to centralize their physical transactions in one location, thereby creating a commodity or trade exchange. An exchange is a place for organized trading where transactions are governed by strict rules, making a price quotation system possible. Buy and sell orders, which may originate with investors in another country, are placed with certified brokers (members of the exchange working on a commission basis) who must possess the reputation, experience, expertise and financial stability required to maintain their client base and to assume the risk of customer default.

Futures markets may be organized for some of the products traded on such a commodity exchange. In a futures market, transactions are based on "futures contracts," which are commitments to receive or deliver a specified amount of product of a specific quality (an example on the New York Mercantile Exchange is 1000 barrels of West-Texas Intermediate crude) on a specific future date at a location accredited by the exchange. Every working day, the prices for contracts with any given maturity date are established by the interaction of supply and demand. Futures transactions, then, concern *standardized* futures contracts *traded on an exchange*, as opposed to forward-delivery transactions, which involve product bought and sold in advance outside of the exchange for a price either known in advance or determined later.

Because of the clearing system set up to handle the purchases and sales of all market participants, a futures contract bought on the futures market may be resold before maturity in order to "close out the position." Similarly a futures contract that is sold on the exchange may be offset with the purchase of a corresponding contract. When an investor uses this strategy, a "paper" transaction takes place, but no actual merchandise is delivered.

Transactions of this kind are used in "hedging" operations; that is, they provide protection against the risk of an adverse price change. By definition, any transaction in which the price involved is not permanently fixed may be said to carry a "price risk." In a forward contract, where delivery takes place later but the price is set at the outset, there is no price risk. But when the price is not set by contract or when an investor intends to carry out a transaction but has yet to sign a contract, the investor can implement a hedging strategy on the futures market in order to eliminate or reduce the price risk. Hedging involves combining a real transaction that will occur at some future date with a mirror-image paper transaction (through a futures contract), so that changes in the price of the physical commodity are at least partially offset by changes in the price of the contract. Broadly speaking, spot and futures prices will tend to move in the same direction. Consequently the purchase and resale of the physical commodity will be covered by the sale and repurchase of contracts. If prices fall, a loss on the physical commodity will be offset (at least partially) by gains on the paper transaction.[8]

Thus one of the main functions of futures mar-

8/ As an illustration, consider a bulk oil dealer who owns a stock of oil purchased earlier and expects to be able to sell the oil two months from today for $20/b, a price acceptable to him. To hedge against a fall in the price over that two-month period the dealer can sell a futures contract which commits him to deliver an equivalent quantity of oil at specified date (e.g., three months from today). Suppose the futures price is $19.50/b. Now assume that the dealer's price expectation was wrong: the spot price of oil two months later turns out to be $19/b and the price of the futures contract has fallen to $18.50. The dealer loses $1/b on the "cash" sale of the oil relative to his original expectation, but makes it back by buying a futures contract, with the same delivery date as the one previously sold, for $18.50. The futures position is cancelled out with a gain of $1/b. By hedging he has "locked in" the $20 price. If instead the spot and futures price had risen, a gain on the cash sale would have been offset by a loss on the future contract. (This example, intended only to illustrate the mechanics of "locking in" a price rather than speculating, is admittedly overly simple. In reality it is necessary to account for the liklihood that the change in the futures price would not be exactly the same as the change in the spot price.) For more on hedging, see Calabre (1980), (1986) and (1990a), Simon (1986) and Bilet (1984).

kets is to provide risk protection instruments. Indeed, this "insurance" function was one of the original reasons these markets were established. Good examples include the grain markets of the Chicago Board of Trade or the trade in copper, tin, and tropical product "arrivals" in London in the latter half of the 19th century. More recently, price instability was the driving force behind the successful launch and phenomenal development of a number of futures markets in the 1970s and especially in the 1980s (rubber, palm oil, financial and interest-rate futures, petroleum products and crude oil, options, and so on).

Futures markets have three other main functions and one secondary function:

- Under the quotation system, prices determined by the free interaction of supply and demand can be publicly observed. Spot prices are determined by exchange trading in physical commodities, and futures prices are determined by trade in futures contracts. These prices necessarily reflect the statistical situation in the marketplace, though what prices mean and how they are determined are complex, multi-faceted problems. All of this information, and the expectations that drive investor actions, are processed by the quotation system and are reflected in the prices that may be observed by all market participants.
- Futures markets have a commercial function, in that some futures contracts are held until maturity and thus do result in merchandise being delivered. Commodities are purchased and sold on the exchange through futures contracts.
- Because spot and futures prices are determined simultaneously, transactions on futures markets can act as a guide for the intertemporal allocation of a product according to present and anticipated need and availability. In fact, this is the basis of the spot/futures adjustment mechanisms that keep the characteristic relationships between spot and forward prices, consistent with the statistical situation in the marketplace: *backwardation* when there is a shortage (resulting in spot prices higher than futures prices) or *contango* when there is oversupply (resulting in futures prices higher than spot prices). These mechanisms are examined in greater detail in Section 2 of this paper. They are based on the information processing function of markets, which is diagrammed in Figure 2.
- Futures markets also have an investment function in that they make possible a variety of speculative transactions. Speculation is a normal part of the operation of futures markets and is essential to their development. Speculation helps futures markets to fulfil their other functions by broadening trading activity and information. At the same time it influences the movement of prices and contributes to their "instability."

A commodity exchange may thus be regarded as a sophisticated institution within which futures markets perform certain specific functions. The exchange operates like a business: it offers services to market participants — its clients — at the lowest cost and with the lowest risk. That is the rationale behind many of its features, including the clearing house, deposits, margin calls, trading suspensions, etc. On the other hand, operations on a commodity exchange are tricky; effective functioning of the exchange necessarily involves some participants in gambling in the form of "uncovered" transactions, which are inherently speculative and risky; (and price-fixing scandals, which create a bad impression among the clientele of the exchange, are to be avoided).

1.3 Expectations and Short-Term Price Instability

The bulk of transactions on futures markets are guided by expectations, which therefore influence prices, especially when they are based on widely shared assumptions (such as the fear of a shortage).[9] They can be formed in two ways.

Expectations may arise exogenously, such as from the belief that a monetary, political, social, or international economic event that will affect a particular commodity is imminent. If such events are likely to affect the relative returns from alternative investment vehicles (currency,

9/ Calabre (1980) Chap.7, (1986) Chap.4, and (1990) Chap.3.

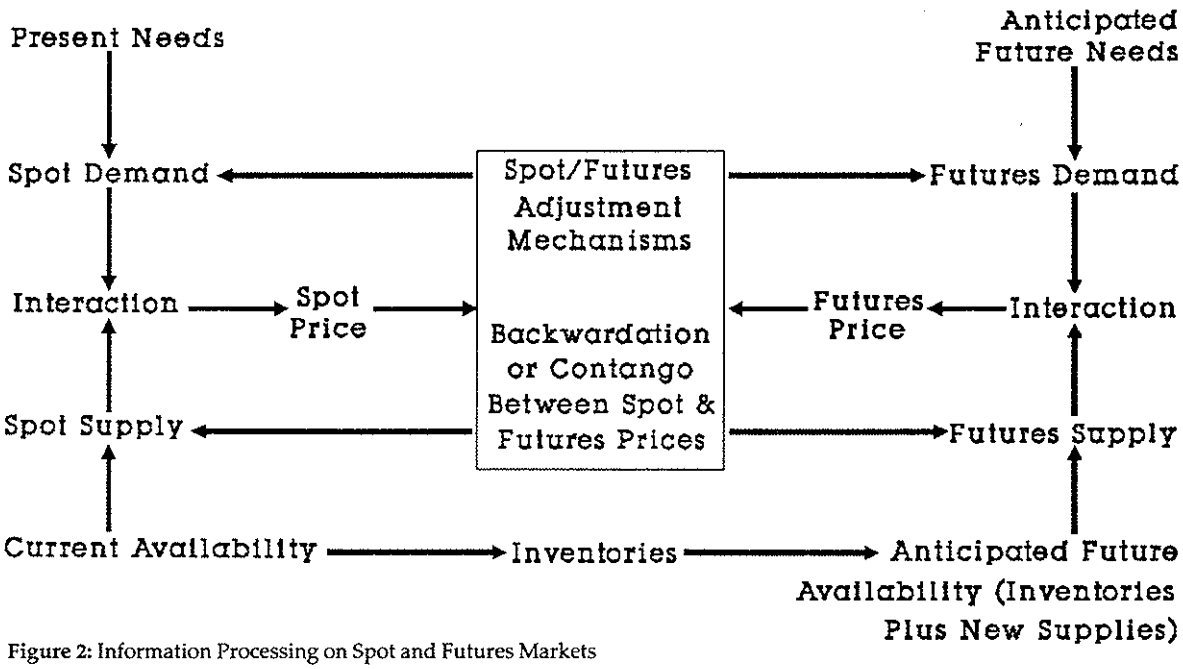

Figure 2: Information Processing on Spot and Futures Markets

securities, stocks, treasury bills, gold, and other commodities, etc.), they will trigger a shift in short-term investment capital from one asset to another, resulting in increased demand or supply for futures contracts on the product involved. It is not surprising, then, that elections or social strife can cause fluctuations in commodity prices.

Expectations may also arise inductively (i.e., from an endogenous source). When lack of reliable information makes it impossible to predict the future with certainty, investors are forced to rely on past price trends or on a "typical" pattern of price change.

These two basic types of expectations — independent and inductive — can interact to produce:

- self-induced expectations (e.g., bullish attitudes are reinforced by an actual price rise, or vice versa); and
- second-round expectations — predictions can quickly end up being based not on some future event but on the predictions of other investors, each trying to second-guess the expectations of others. All investors know, for instance, that bullish attitudes on the part of a number of investors will inevitably generate purchases that will cause the price to rise. So in order to profit from the rise, you have to beat the others to the punch!

Expectation-based movements can easily lead to cumulative price increases or decreases because of two factors: first, because speculation-based behaviour tends to be a self-fulfilling prophecy; and second, because any change in price generates expectations in that direction.

The interaction between price changes and inductive expectations can create self-sustaining processes with potentially explosive results. Such flare-ups tend to be short-lived, however, because they are based essentially on imitation and second-round expectations. Endogenous processes like these may end up feeding off each other, instead of accurately reflecting the supply situation on the market.

Another important semantic distinction is between market stability and price stability; the former relates to the stability of a system and the latter to changes in the market price. A market is said to be stable if, following a shock that creates

disequilibrium, its inherent mechanisms act to restore the system's equilibrium. On an exchange, price levels at the daily close must equilibrate the forces of supply and demand during that session (and prices vary throughout the session in response to the interaction between supply and demand). However, when a cumulative price-change process emerges, the equilibrium price on one trading day will be in disequilibrium the next. Indeed, the price change that established equilibrium the first day will generate a new series of expectations that will cause the price to fluctuate the next day in order to correct the imbalance, and so on. That is how speculation can destabilize a market.

Price stability, as the term is conventionally used when commodity market prices are discussed, is a less precise concept.[10] It signifies normal or consistent patterns of change. In contrast, a price is said to be unstable or volatile when changes are irregular, characterized by abrupt and violent shifts. The expectation phenomena discussed in the previous paragraph are often a major cause. Speculation can be destabilizing in two ways: by amplifying price fluctuations and by generating its own price variations.

The impact of speculation on price fluctuations depends on how the underlying expectations were formed. If they are based on (and so reinforce) prevailing price trends, speculation will tend to amplify fluctuations and so be destabilizing (extrapolative expectations are an example of this case). If instead they are based on the typical price pattern and assume that the price will return to its previous level, then speculation is stabilizing (e.g., adaptive expectations). These two opposing hypotheses were extensively tested in the 1950s and 1960s, particularly for agricultural products, the prices of which tend to follow a cyclical pattern because of yearly harvests. If speculators act in advance of price turnarounds, their actions tend to smooth out price variation. If, on the other hand, they only modify their behaviour in reaction to price turnarounds, they tend to amplify fluctuations.[11]

Self-induced expectations, second-round expectations and the endogenous processes leading to cumulative price increases or declines are all clearly destabilizing mechanisms. In addition, speculation affects prices not only through a convergence of expectations on the part of a large number of investors, but also through deliberate attempts by major investors to influence prices. For example, one technique is the market "squeeze," which affects both physical and paper investments.

However, futures markets can also play a stabilizing role by facilitating the reconciliation of supply and demand, by guiding the inter-temporal allocation of commodities through simultaneous spot and futures price quotations, and through the security regulations of the exchanges. Here speculation helps to broaden the market, make transactions more consistent, and improve the information base processed by futures markets in order to determine prices. This informational aspect is linked to the quality of the information available to investors and the way their expectations are formed. There is a vast body of literature on this subject, ranging from the theory of "normal backwardation" to the informational efficiency of futures markets.[12]

The efficiency hypothesis assumes that market mechanisms process all available information in order to determine prices. It is linked with the "rational expectations" hypothesis. In this view,

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10/ In the formal terms of economic theory, the concept of price stability is also linked to the definition of market stability presented above, by considering price to be one of the adjustment variables in the system (i.e., the market). This is an analytical definition; interpreting and testing it for price movements can lead to useful generalizations about, for example, market efficiency, random walks, autoregressive models, etc. See Smith (1978), Streit (1983), Badillo (1985), Badillo and Daloz (1985) and Calabre (1990a).

11/ See, for example, Peston and Yamey (1960) or Telser (1959) for the first hypothesis and Aliber (1964) or Baumol (1957) for the second. For a discussion of the impact of speculation on futures markets and prices, see Calabre (1990a) Chap.3 and (1986) Chap.4.

12/ See Calabre (1980), (1986) and (1990a). The theory of normal backwardation was developed by J.M. Keynes (1930) and J.R. Hicks (1937). For research on informational efficiency, see Mensi (1987), Hirshleifer (1975) and Calabre (1990a).

a futures price should represent a preliminary, unbiased indicator of the future spot price. Recent tests of this hypothesis for oil, however, have revealed that futures prices are not unbiased.[13]

Some research has investigated the impact that the establishment of a futures market has on commodity prices. In the early 1960s, several authors (such as Hieronymus, Working, and Gray) studied a new onion futures market in the US. Their general conclusion was that the market exerted a stabilizing influence on spot prices. Only Johnson found no effect (Bilet, 1984). A number of other studies corroborated the conclusion that spot prices exhibited less variability after futures markets were organized: wheat in Chicago (Tomek, 1971), cattle (Taylor, 1974), pork and beef (Powers, 1970), various other products (Cox, 1976), etc.

Lastly, some authors have recognized that speculation may take a variety of forms depending on the circumstances; its characteristics are subject to frequent changes and its influence may switch between stabilizing and destabilizing (Badillo, 1985; Badillo and Daloz, 1985). Pauwels and Lauwers (1991) tested the impact of expectations on oil price movements over the period August-December 1990; they found an amplifying effect of $8-10/b for the months September through December (monthly averages).[14]

In the context of this article it is not possible to develop an overall conclusion as to whether commodity futures markets are overall stabilizing or destabilizing. Rather, the objective is to identify the two separate dimensions of the problem. In this section we have dealt with the contention that exchange transactions and inventory movements on the spot market belong to the short term. To study the second dimension — the medium term — one must look beyond markets and exchange mechanisms to study production and consumption decisions.

2. Price Dynamics and Instability in the Medium and Long Terms

Medium-term mechanisms and long-term trends are introduced in Section 2.1. In Sec. 2.2 we investigate how the medium-term processes influence the relationship between spot and forward rates. Finally, in Sec. 2.3 we examine how this aspect of instability applies to the oil market.

2.1 Reaction Lags and Medium/Long-Term Adjustment Mechanisms

International commodity prices respond to a variety of factors that differ in nature and origin. At first glance, prices might appear to fluctuate more or less randomly, and the task of predicting prices weeks or months in advance might seem virtually impossible without relying on scenarios incorporating exogenous factors such as political, social and economic events.

Analysis of exchange data tends to confirm this idea. Yet when daily quotes and conditions over several decades are examined, a long series of alternating phases of product surpluses and shortages can usually be seen, a cycle that generates price "waves" spanning many years. Is this simply an *a posteriori* statistical anomaly produced by the random conjunction of short- and medium-term phenomena? Or is it a reflection of some underlying forces? Whatever the answer, distinguishing between short- and medium-term price movements appears to be important (Calabre, 1980, 1990a, and 1990b).

If there is in fact a medium-term mechanism at work, would there not be a second dimension to market instability, one whose influence extends beyond market speculation phenomena to the actual production and consumption of the products involved?

Medium-term fluctuations in the price of a commodity are most often the result of two types of factors: cyclical adjustment between produc-

13 / These tests usually rely on either the theory of cointegration developed by Engle and Granger (1987) or the decomposition theory proposed by Fama (1984) for risk premium variance. See also the work of Serletis and Banak (1990) and Serletis (1991).

14 / Pauwels and Lauwers conclude that it is worth investigating an oil price stabilization mechanism, involving intervention in the futures market, using oil inventory management to offset speculative movements.

tion, consumption and price, and the impact of strong shocks.

Adjustment of production, consumption and price may take the form of a multi-year cycle, involving the combination of several factors:

- production reacts belatedly, gradually and, in the end, excessively to medium-term price movements; this behaviour is due to the inherent lag in installing or abandoning production capacity;
- the same is true of consumption because of the time needed to modify techniques and consumption patterns; and
- consumption is influenced by the general pace of the economy.

The interaction between consumption, production and price produces the following pattern of events. When there is a strong and sustained rise in consumption, producers may initially respond by making greater use of existing capacity. Once full-capacity is reached, however, and the price continues to climb, producers start to expand their production capacities. But it takes time before this capacity enters into production. Since the supply of the product is still insufficient to meet demand, prices continue to rise, prompting producers to invest even more, particularly since previously unprofitable operations have become profitable. Producers allow themselves to be caught in a trap spun by their bullish attitudes. Competition with other producers also encourages them to expand their respective market shares. Within a few years this race to invest has created potential overcapacity; when this capacity eventually comes on stream, prices start to fall. The price decline is hastened by the fact that the earlier high prices will have prompted substitution away from the product in question. The cycle then reverses. The swing from scarcity to surplus may be intensified by an economic slowdown in the consuming countries. The conditions of excess supply will last for several years. Low prices discourage capacity maintenance and renewal, a situation whose effects are only felt later. Market prices are often further depressed when the capital outlays made at the tail end of the expansionist phase inject new production into the process.

It may take several years before a lack of new investment and recovery in consumption due to low prices eventually reduce excess capacity, absorb inventories and trigger a price recovery. The internal lags in the process will then cause the cycle to begin all over again.

The cycle may be disturbed or altered by the occurrence of shocks strong enough to affect price trends for several months and to influence the decisions of producers and consumers. Shocks may include:

- unpredictable natural, social, economic, or political events;
- monetary developments;
- major movements in inventories (formation or freeing-up of strategic, regulatory, or speculative inventories); and
- in the case of agricultural products, weather conditions.

Multi-year price cycles are superimposed on long-term trends. The question again is whether this is simply an *a posteriori* statistical observation or whether it instead reflects the interplay of underlying forces. Thus, having considered the processes involved in price fluctuations, the next step is to describe the basic curve the price follows as it fluctuates: having studied price variability, the question of its average level has to be addressed.

Long-run price trends tend to follow the price equilibrium curve between production and consumption. Long trends are determined by changes in the technical, economic, social, cultural and political conditions of production (which affect production costs) and changes in how the product is used (technology, consumption patterns, income, and substitution phenomena, etc.) (Calabre, 1980, Chap.6, and 1990b, Chap.2).

Production costs are interpreted here in the widest sense, including macroeconomic factors that enter into the decisions of governments in producing country and major players in the private sector and relate to investment in production capacity (e.g., tax and royalty systems, facility maintenance, prospecting, rural development, living conditions of producers, public infrastructure, and social investment, etc.). Given

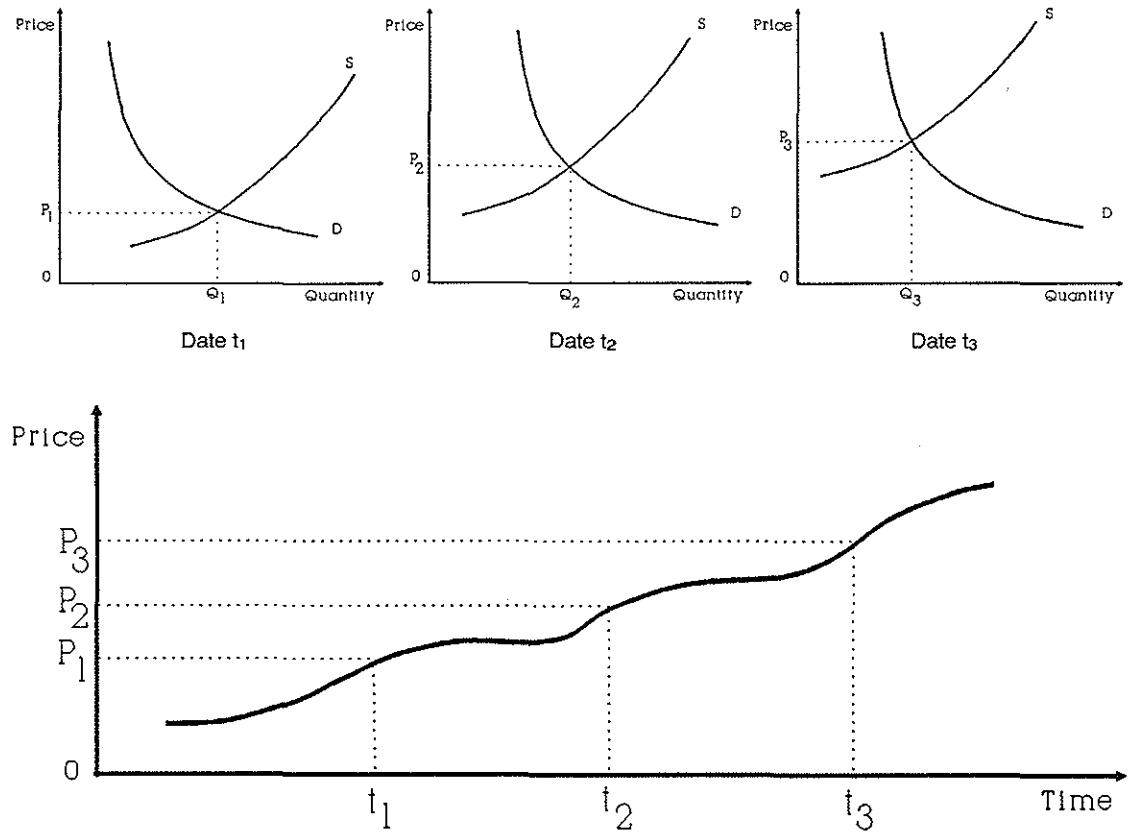

Figure 3: Trend Equilibrium Prices

these macro-related costs, and assuming competition among producers, a trend supply curve (i.e., a supply curve that accounts for long-term factors) can be drawn based on the prevailing structural conditions. A trend demand curve can also be plotted according to the economic calculations made by product users on the basis of present substitution potential and market opportunities (average living standards and consumption patterns, etc.). The intersection of these two curves represents a notional equilibrium price towards which the effective price would tend to move as a result of the forces discussed above. But the underlying conditions for defining these curves are subject to more or less continuous change (see Figure 3). The equilibrium price will shift accordingly, tracing a long-run curve in the process. Market adjustment mechanisms (i.e., the adaptation of producer and consumer decisions to price developments and the feedback loop between prices and decisions) are thus engaged in a never-ending game of catch-up. The medium- and long-term regulation mechanisms are thus likely to generate their own instability.

2.2 *Spot-Futures Relationships and Market Conditions*

A clear distinction should be drawn between

supply and production, on one hand, and demand and consumption on the other. Obviously, the relationship between production and consumption, which determines the current provision of a product and the extent to which actual physical needs can be met, is different from the relationship between supply and demand defined on a daily basis in the market.

However, on exchange markets prices are determined by the interaction of supply and demand. And the bulk of transactions are paper operations undertaken for expectation, speculation or investment purposes. This might lead one to either of two extreme views:

- that futures markets are completely separate from physical commodity markets, and the prices of futures are determined independently of the actual physical provision of the commodity on the market; or else,
- futures prices determine spot prices (meaning that spot prices lose their rationale and status as international benchmarks for the commodity in question).

Neither view is correct. Rather it appears that:

- spot and futures prices are closely linked;
- their relationship reflects the actual physical supply situation; and
- while movements in these prices are affected by expectations in the short run, in the medium and long term, prices respond to production/consumption adjustment mechanisms, so that the average price trend over a number of years is determined by the production and consumption conditions for the product.

The latter mechanisms governing the medium and long terms were discussed in the preceding section; here our concern is specifically with the relationship between spot prices and futures prices. The successive phases of product overproduction and product shortage in the medium term appear to be paralleled by successive phases of *contango* (when futures prices are higher than spot prices) and *backwardation* (spot prices higher than futures prices).

Holding a stock of a commodity involves a "direct inventory cost" for the trader (storage, financing charges, insurance, etc.), a cost that may be assumed to vary directly with stock volume and storage time. The direct marginal cost of storage is more or less constant. There are also indirect benefits of holding inventory, which may be collectively termed the "convenience yield." Having an inventory of a product, as long as it is voluntary, affords its holder certain advantages (being able to operate continuously, to avoid the higher costs of making frequent small orders, to respond to unexpected demand, etc.). The marginal convenience yield varies inversely with the amount of the commodity held and falls to zero with surplus inventories.

At the market level, define C as the direct marginal cost of storage, Y the marginal convenience yield, P the spot price, and F the futures price (given a contract with the same duration as the storage time). The market adjustment mechanisms are captured in the equation: $F - P = C - Y$.

In a situation of overproduction, the marginal convenience yield Y is zero and so $F - P = C$; thus $F > P$, the futures price is greater than the spot price, meaning that a "contango" relationship holds between the two prices.

In a situation of shortage, the marginal convenience yield is significant and so $Y > C$. Thus $(F - P) < 0$ and there is "backwardation" between the two prices.

When the marginal convenience yield is positive but below the direct marginal storage cost ($0 < Y < C$), the spot price is still higher than the futures price, but the contango is less than maximal, indicating a "quasi-shortage".

These relationships, which are summarized in Figure 3, arise from the spot/futures choices made by market participants and their use of "straddles" or inter-temporal strategies. While straddles are generally little known except to professional investors, they are an important aspect of paper transactions. A straddle consists of two mirror-image transactions, each with a different term. The purpose is to make a virtually certain profit from any change in the spread between two futures prices.[15]

Transactions involving the "lending" or "bor-

15/ See Calabre (1980) Chap.6, (1986) Chap.2, and (1990a) Chap.2.

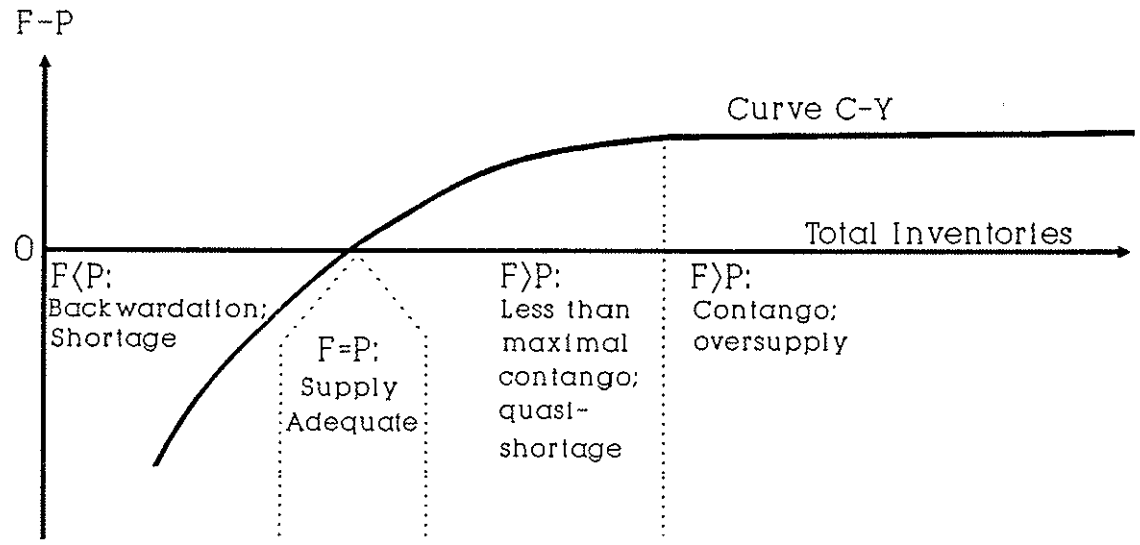

Figure 4: Components of Price Movements

rowing" of a commodity are among these strategies. For example, given that in a surplus situation F > (P + C), a sure profit can be made by buying a commodity for cash and simultaneously selling it via a futures contract. (This is equivalent to borrowing the commodity.) Buyers will focus on the spot market and sellers on futures markets. Increased demand in the spot market will bid up P and increased supply in the futures market will push F down. The gap between the two prices will narrow and equilibrium will be reestablished, such that F - P = C.[16]

This illustrates that the spot and futures of a commodity are determined simultaneously and that their movements are closely linked. This makes intuitive sense, since anyone wishing to buy or sell a commodity at a given moment can choose between a futures contract held to maturity and a cash transaction. Straddle transactions play an essential role in helping to maintain these relationships between spot prices and the various forward quotations.

While these results are consistent with empirical observation, the relationship is not strictly verified, since various shocks, adjustment lags, and sometimes speculative "squeeze" plays on the market may cause temporary shortages in the physical supply of a commodity.

The extent to which one market (spot or futures) can be led by the other at any particular moment is difficult to determine. However, since speculative transactions and expectation-driven behaviour focus more on futures rather than on the spot market (i.e., they tend to be paper transactions), it makes sense that in unsettled periods futures play the driving role, at least in short-term price movements. In the medium term, futures markets are more likely to be stabilizing: they process information, guide the inter-temporal allocation of a commodity, and provide price-risk protection. The availability of these services enables better management of product allocation and storage.

16/ For a detailed analysis of these mechanisms, see Calabre (1980), (1986) and (1990a).

2.3 Instability or a Mechanism for Adjustment?

The cyclical process of adjustment between production, consumption and price can be observed for most commodities (copper, tin, aluminum, cocoa, and coffee, etc.) (Calabre, 1980, 1991a, and 1991b). For example, production reaction lags and cycle phases are shorter for mineral products (3 to 5 or 6 years) than for agricultural products (up to 10 years and longer).

These cyclical mechanisms tend to operate, on the one hand, as a result of attempted collusion to fix prices at artificial levels over a prolonged period (i.e., failed attempts to establish cartels have their effects) and, on the other, due to adjustment and price stabilization in international commodity markets (given that international commodity agreements have their difficulties). Since there is no sign of an end to such phenomena in the near future, any commodity market forecast must generally take them into account (although certain products with highly controlled markets or with low production may be exempt). One consequence of these mechanisms is that the only way to influence long-term price developments is to change the trend line, which means focussing on the conditions governing production costs and consumption of the commodity.

Neither should one be mistaken about the role played by market forces in the process of adjusting production and consumption.Market forces flow from competition among producers, the efforts of users to minimize production costs (by substituting materials or techniques, exerting buyers' power, or resorting to political pressure), and the efforts of intermediaries to maximize their margins. As we have argued, cyclical processes themselves stem partly from lags and overreaction in consumption and, especially, production. Thus they are the result of a lack of coordination and agreement among market players, as well as myopia in their forecasting. We are still far away from the kind of systematic worldwide commodity planning that would sidestep the mechanisms of international markets!

Finally, cyclical processes also result from the urgency of the economic, political, and social problems faced by so many governments, which are forced by the political process to seek immediate, short-term solutions.

Most commodities, then, are subject to cyclical medium-term adjustment mechanisms on international markets. This leads to market instability and price fluctuations in the medium term, since any shock that affects (and widens) the gap between production and consumption tends to trigger another iteration of the cycle.

There may also be some degree of interaction between the short-term instability described in the first section and medium-term mechanisms since:

- multi-year price movements encourage the development of expectation-based movements and cumulative price variation processes; and
- these in turn accentuate the highs and lows of price variations, with a correspondingly greater impact on the decisions of producers and consumers.

However, the effects of futures markets on medium-term market instability do not show up in highly sensitive tests. Simply because products with the most volatile prices have futures markets, it cannot be concluded that those markets are causing instability. The development of futures markets was in fact a response to that volatility (that is, in this view the cause-effect link would be the opposite way). To conclude otherwise we would have to be able to assess better how exchange-determined prices guide the inter-temporal allocation of commodities and the extent to which the trend line of free markets helps to contain overreaction in production and consumption (which become stronger whenever prices are kept too long at artificial levels relative to the actual situation in terms of production costs and user technology).

What we have established here is that it is essential to distinguish between short-term and medium-term instability in order to understand how commodity prices are determined and what causes them to change, and in order to address a question such as the effect of organizing futures markets.

The pattern of oil price changes during the international crisis sparked by Iraq's invasion of Kuwait clearly illustrates the distinction between the short-term and long-term components of commodity prices. From less than $16/b in June 1990, the price of British Brent crude rose to $40.35/b by September. After slipping back to around $25 in December, it then rebounded to more than $30 in late December/early January. With the onset of the military campaign, however, it started to plummet, falling to $20 in a matter of days.

The sharp increase through the summer months, therefore, was essentially a response to expectation-based behaviour on the part of professionals and other market investors. Bullish attitudes translated into purchases of both physical commodities and futures contracts. Yet the underlying medium-term situation on the market had still not significantly changed at that time, since the supply potential of Saudi Arabia and stocks on hand (estimated by the International Energy Agency at 96 days of consumption in private and public inventories in the OECD countries) ensured that there was no likelihood of a shortage in the medium term (i.e., in the next few years). Still, at the time there was no guarantee that the crisis would not escalate into a situation that might jeopardize the entire supply of oil from the Persian Gulf region (a fear that was reflected in backwardation between spot and futures prices).

Based on the current marginal cost of oil production and oil consumption (the latter referring to the costs of using substitute energy sources), the long-term trend would place the price of oil at somewhere between $20 and $23/b. (This takes into account long-run production costs, including the costs involved in long-term capacity renewal).[17]

Thus, the medium-term supply situation on the world market did not justify prices on the order of $35-40/b. Speculative positions at these levels could not be maintained for long, since speculative gains are linked not to absolute price levels, but to price fluctuations. The increases in the summer and fall of 1990 primarily reflected short-run expectation-based movements on the market.

Is it possible to say anything about whether futures markets exert a destabilizing effect specifically in relation to the oil market? Is the price of oil more unstable because of the existence of oil futures? The conclusions offered by current research should be viewed as speculation and conjecture, in need of further testing.

In the short run, it would appear that futures markets generally have an amplifying impact during periods of tension such as occurred during the Gulf Crisis, by way of the expectation-based phenomena and the cumulative price variation processes discussed in Section 1, but this effect disappears when there is smooth sailing. However, the development of oil futures markets coincided with a period of profound change in the structure of the oil production/processing industries as a whole (vertical disintegration, transition from "netback" contracts to long-term "formula sales" contracts, etc.) (Angelier, 1990). These developments gave a larger role to the spot market, and the need for ways to hedge price risks prompted the introduction of futures markets (where oil traders now carry out one third of their transactions). In light of this new leading role played by the spot market and the benefits which derive from being able to hedge risk effectively, some infrequent short-run amplification of price changes may well be acceptable.

In the medium term, price movements are determined by changes in the production/consumption ratio. One special characteristic of the oil market, however, is the speed with which production can react to these changes. This reflects Saudi Arabia's domination of the market; it can boost its output by 150 million tonnes in just a few months with extremely low production costs. Production thus apparently responds to trends in consumption, although the reaction of consumption to price changes and the resulting substitution phenomena occur to a significant extent over a number of years. And renewal

17/ Expert estimates of the medium-term equilibrium price range from $18 to $25 a barrel. For example, the Center for Global Energy Studies, founded by Sheik Yamani, set the equilibrium price at $21/b in 1990.

of reserves and production capacities belongs to a much longer time horizon.

Is there a medium-term cyclical process in the oil market? The following observations may be made:

- In the past, periods in which new discoveries were being developed (e.g., Texas in the first two decades of this century, the Middle East in the 1950s) may have at least partly coincided with phases of production overreaction to multi-year price developments.
- However, several factors make it doubtful that a true oil price cycle existed prior to the 1970s: the important element of chance in oilfield discoveries, the length of time required to develop new sites, and the pattern of vertical integration that formerly characterized the petroleum industry.
- On the other hand, the price increases of the 1970s and the declines of the 1980s appear to be indicative of the cyclical mechanisms described in Section 2.1.
- Finally, there are two hypotheses worthy of further testing: first, that the current situation on the world oil market may be regarded as one phase of such a medium-term cycle; and, second, that the cycle will continue to evolve in the years ahead. Changes in production and refining capacities over time, cost developments, the time horizons used by decision makers, and the sensitivity to price movements of decisions regarding investments in production capacity are all topics that merit particular attention.

Conclusion

In sum, research on the instability of international commodity markets must take care to distinguish between two separate aspects of the phenomenon:

- **Short-term instability**, which is linked to expectation-based behaviour and which is especially in markets which involve futures. It is difficult to determine the impact that the establishment of a futures market has on short-term price developments, because these markets have a range of functions (price risk hedging, guidance for inter-temporal allocation of product, opportunities for investment of short-term funds, etc.). More in-depth analysis and testing of these mechanisms is needed. Nevertheless, it appears that activities on the futures markets can indeed be destabilizing at times, but that at other times the operation of futures markets can actually assist in regulating the market and managing the oil trade.
- **Medium-term instability**, which is linked to lags involved in production/consumption/price adjustment mechanisms. The nature, form and influence of these mechanisms are different for each product; it is necessary to analyze all aspects of that product's market. The production of oil — a liquid commodity — can react quite quickly to prices and other factors, which gives low-cost producers a strategic role in supplying and regulating the marketplace. Nevertheless, medium- and long-term developments on the oil market are heavily influenced by the way production capacity and oil consumption react to prices, and it is still those reactions that threaten to generate potentially destabilizing forces for the development of the oil market over the medium term.

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