Chapter 5

PRICES AND MARKET INTERACTIONS IN THE OPIUM ECONOMY

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I. INTRODUCTION

Given the enormous economic importance and development implications of drugs in Afghanistan,[2] prices and price movements in the opium economy are of great interest:

- Prices are a critical determinant of the overall level of opium/opiate revenues in the Afghan economy, and of the distribution of revenues within the drug industry, i.e. how much goes to farmers, traders at different levels, processors/refiners, long-distance traffickers and wholesalers, and retailers.
- As in the case of other market activities, prices provide market-based signals to producers, traders, other actors, and consumers which influence their decisions; however, the characteristics of the product, the producers, and final demand, and the status of the opium economy as a set of illicit activities may affect the impact of prices on decisions by the different actors.
- Since opium is a durable good and is widely held as an asset, opium prices directly affect asset values, capital gains, and decisions on building, holding, and selling inventories.
- The large amount of opium-denominated debt in Afghanistan's rural economy (well into the hundreds of millions of dollars by all accounts) means that opium prices can have an effect on the level of opium-related debt, debt distress, and associated adverse consequences including for rural poverty.
- And finally, price behavior–structure, movements, fluctuations–may shed light on the characteristics of opium markets and of the drug industry, which could provide indications on how to respond to the opium economy effectively.

This chapter analyzes available data on prices of opium and opiates in and around Afghanistan, with a view to better understanding (i) **price structure**–including the vertical structure of prices from farm-gate to and beyond the border (and through processing), and the pattern of prices across different parts of Afghanistan; (ii) **price trends**– overall, and in different markets; (iii) **price behavior**–including price formation, price volatility, and responses of prices to economic shocks (e.g. drought) and changes in counter-narcotics policy and practice; and (iv) **extent of market integration** between different opium markets in Afghanistan. The chapter will draw out to the extent possible what this analysis of opium prices implies about the functioning of the opium economy, including in particular price formation, and also implications for counter-narcotics policies. Unlike studies of pricing and industry structure for licit activities (where the focus may be on structural or other impediments to efficient market functioning, with a view to removing them), in the case of the opium economy the ultimate objective is to find weaknesses and vulnerabilities in the market and industry structure that can be exploited as part of the counter-narcotics strategy.

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[2] See Ward and Byrd (2004), and for a shorter discussion, Byrd and Ward (2004).

A number of caveats and constraints need to be kept in mind in conducting this analysis and especially in drawing out implications. First, the quality of opium price data is weak and variable (see Annex A for further discussion). Understandably, there is nothing like posted or transactions-based price data available; the best information on prices comes from UNODC's local offices which periodically inquire about and compile raw opium prices in key market areas. Information on downstream wholesale prices, including those of processed opiates and prices in neighboring transit countries, tends to be less regularly available and is likely to be even weaker in terms of quality and reliability. Second, although there are opium price series for an increasing number of localities in Afghanistan, price data are available over a significant length of time only for two points (Nangarhar and Kandahar). Third, most price series are monthly, whereas fieldwork suggests that there are substantial price fluctuations on local markets on as short as a daily basis, reflecting sizable buying activity (see Chapter 4). Fourth, the narcotic content of raw opium (as well as the moisture content and therefore weight of "wet" opium freshly harvested), and the purity of processed opiates (morphine and heroin), may vary somewhat. And fifth, changes in the "product mix" at different stages, for example the increase in the proportion of opium processed into morphine and heroin within Afghanistan, complicate product mix and value calculations.

Nevertheless, price data provide useful information about the opium economy and shed light on how it functions. They are essential for building rough estimates of the distribution of gross opium economy revenues among the different actors, as is done by UNODC in its annual opium surveys on Afghanistan . More specifically, price data can also tell us something about market structure, price formation, and the degree of integration among different opium markets in Afghanistan. Recent price developments on Afghanistan's opium market indeed do provide valuable insights. The Taliban ban in late 2000, and to a lesser extent the sharp reduction in opium production in Nangarhar Province in 2004-2005, are "natural experiments," in which the opium market responded to major shocks. Analysis of these episodes can facilitate better understanding of the functioning of opium markets and of the drug industry more generally.

This chapter is organized as follows. Section II provides an overview of the evolution of opium and opiate prices over the past decade or so, including price trends and the changing volatility of prices. Section III analyzes the spatial pattern of farm-gate prices in Afghanistan and how this has changed over time, with some attention also to prices of opiates in neighboring countries. Section IV examines the "vertical" structure of opiate prices, from raw opium at the farm level through traders and processors within Afghanistan to the markets in neighboring countries. Although the chapter will not look in any detail at prices further downstream–long-distance trafficking, wholesale prices in major consuming countries, and retail prices for final consumers–there will be a brief overview of this end of the "value chain" to provide perspective and inform the analysis of the upstream portion. Section V analyzes market integration in the opium economy, based on available data for farm-gate prices of raw opium and making use of several econometric techniques. The concluding section highlights the key findings and their possible implications for counter-narcotics strategy and policies.

The preliminary nature of the analysis in this chapter should be emphasized. Data weaknesses and gaps mean that the picture painted by price patterns and the results of technical analysis need to be treated with caution, and reinforced with qualitative information

where possible. Nevertheless, it is hoped that the chapter will shed light on broader issues related to the structure and functioning of Afghanistan's opium economy, with significant implications for counter-narcotics strategy and policies.

II. THE EVOLUTION OF OPIUM AND OPIATES PRICES OVER TIME

The last decade has seen major changes in opium prices in Afghanistan, reflecting most notably the Taliban ban, its aftermath, and more recent counter-narcotics efforts, as well as changes in the global structure of opium production, which have left Afghanistan in a dominant position accounting for close to 90% of world illicit opium production. These global changes reflect successful counter-narcotics efforts in some other countries (most recently in Myannmar) and the major advantages that Afghanistan offers as a center of opium production–good climatic and soil conditions (resulting in the highest illicit opium yields in the world); poverty and associated plentiful labor supply (including skilled labor for opium poppy harvesting); weak governance and lack of rule of law; and more generally (except briefly during the Taliban ban of 2000/2001) a conducive overall environment for opium production at least in large parts of the country.

Due to among other factors the illegality of production and trade in opium, price data and information about price formation on opium markets are difficult to collect (see Annex 5A). However, some price data are available, most notably from UNODC (see various publications listed in the References section, and summary information and analysis in Pietschmann, 2004). These price data are based on periodic inquiries in major opium producing areas (interviews with some 170 farmers and 160 traders) on a monthly basis. Although it is not possible to select the traders and farmers on a random sampling basis each month, comparisons with the results from much larger samples of randomly sampled farmers as part of UNODC's annual opium survey have yielded similar results. There is a complete series of monthly data stretching back to 1997 for farm-gate dry opium prices in Nangarhar and Kandahar. Since 2003 price data are available on a systematic basis for four more provinces (Helmand, Badakhshan, Herat, Mazari-i-Sharif). More recently, estimates of prices in a total of some 25 provinces were compiled by UNODC (2006, pp. 18-38). These data can be used to analyze price trends and volatility (discussed in this section), as well as spatial price patterns (see Section III).

Price Trends

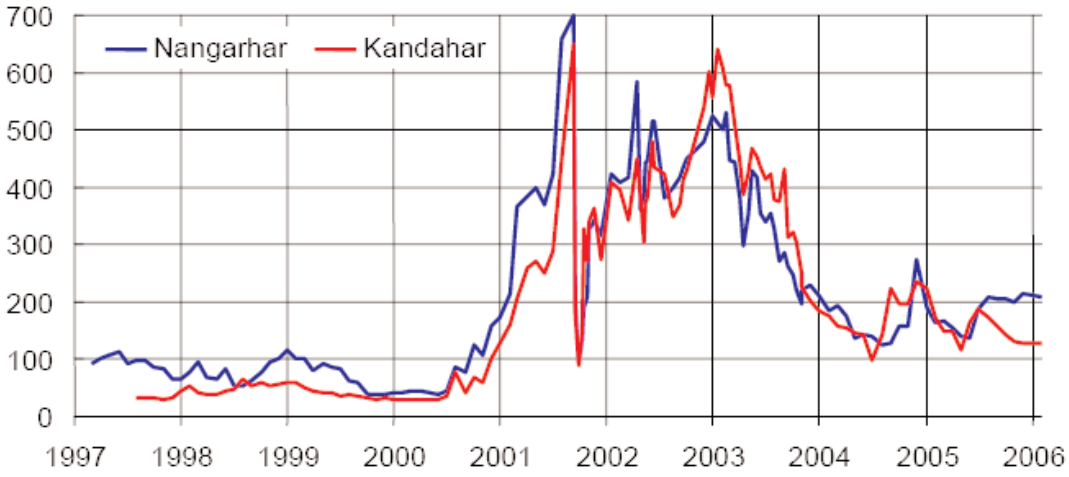
As shown in Figure 5.1, changes in farm-gate opium prices have been dramatic since the Taliban ban in the second half of 2000. After years of relatively low prices, farm-gate opium prices rose very sharply in late 2000 and especially in the first half of 2001. There was a sharp but very short-lived decline coinciding with the post-September 11 war against the Taliban, followed by maintenance of high prices lasting well into 2003. The second half of 2003 and first half of 2004 saw progressive large price declines followed by a degree of stability since then, albeit at a level around three times as high as that prevailing immediately before the Taliban ban. More specifically:

- Before the Taliban ban in October 2000, opium prices ranged from US$ 30-100 per kg of dry opium.
- The Taliban ban induced a very sharp increase in opium prices, reflecting the nearly

complete stoppage of production, peaking at US$ 700/kg in September 2001, approximately a 10-fold increase from September 2000.

- Prices subsequently fell sharply during the post-September 11 war that ousted the Taliban,which may reflect temporary disruption of markets, traders getting rid of stocks for fear of having them destroyed, or other expectations of future price declines. However, prices recovered very rapidly in late 2001 and remained very high and unstable during 2002 and until early 2003, probably supported by the re-building of inventories. During this period prices peaked at US$ 600/kg, with large monthly fluctuations.
- Starting near the beginning of 2003 and especially in the second half of the year, opium prices declined progressively and somewhat stabilized during 2004-2005, but at levels above US$ 150/kg in the main markets–around three times what was seen at the end of the 1990s. Most recently, in 2006 prices have further softened, most likely reflecting expectations of a bumper opium harvest.

Figure 5.1: Dry Opium Prices in Kandahar and Nangarhar, 1997-2006 (US$/kg)

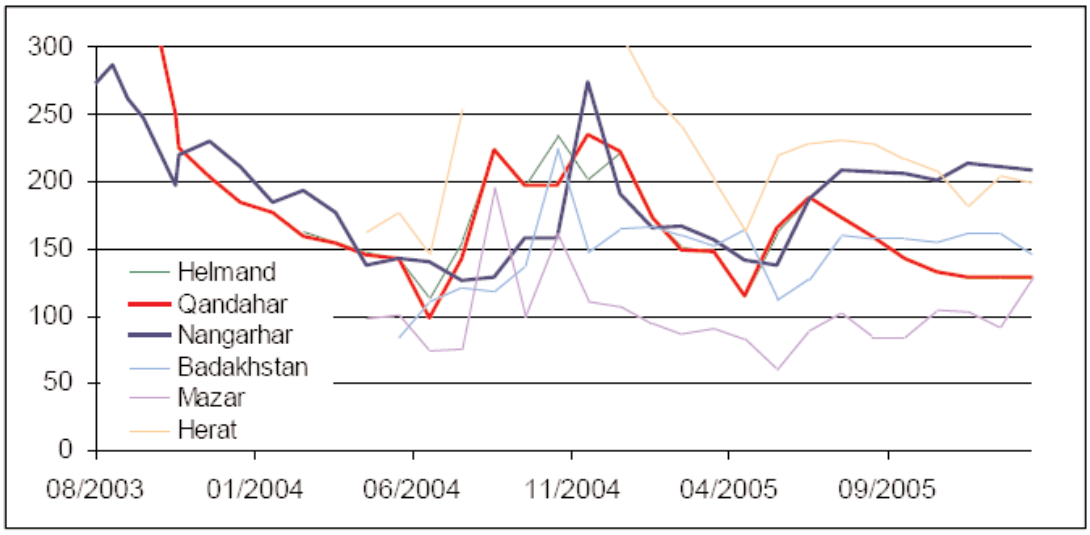


Source: MCN/UNODC Afghanistan Opium Price Monitoring.

Price observations for a larger number of locations, available only since 2003, are shown in Figure 5.2. These exhibit broadly similar trends to those for Kandahar but at different levels and with fluctuations. Moreover, it is interesting that the price in Nangarhar started deviating from that in Kandahar from the middle of 2005 (after Nangarhar became a minor producer following a largely successful ban and associated law enforcement efforts starting in late 2004) and has stayed at a higher level of around US$ 200/kg as compared with most other localities. Spatial price patterns will be discussed in more detail in Section III.

The interpretation of opium price trends requires different factors to be taken into consideration. Some are classical price determinants for agricultural goods–demand, supply, weather conditions. Others are more specifically related to the characteristics of opium as an illicit product and a durable good which maintains value as it is held (losing some weight through drying, but thereby gaining a higher price as "dry" opium).

Figure 5.2: Dry Opium Prices in Six Localities, 2003-2006 (US$/kg)



Source: MCN/UNODC Afghanistan Opium Price Monitoring.

First, as is normal in the case of agricultural products especially in developing countries, prices are subject to seasonal variations, with modestly lower prices at time of harvest (in the spring or early summer, varying depending on climate, altitude, and planting time) and prices rising outside the harvest season. This is particularly true for fresh ("wet") opium prices, as fresh opium is mostly available during and immediately after the harvest period, and sometimes no fresh opium can be found in some regions outside the harvest season. Seasonal price variations are not surprising given the characteristics of opium as an annual agricultural crop and the high cost of capital in Afghanistan's rural areas and in the drug industry, as demonstrated by the extremely high implicit rates of interest on loans against the opium harvest. These seasonal effects are most probably dampened by other factors; for example, large quantities of opium produced by farmers to repay their debts and not sold directly on the market (instead held by the creditors as inventories to respond to subsequent price opportunities) might well tend to reduce the supply effect of the harvest on prices.[3]

Second, weather conditions have an impact on yields and hence on overall supply, and thereby can cause substantial changes in prices. In 2004, for example, insufficient rainfall combined with other factors induced lower yields, and opium prices stopped declining, although the area under cultivation increased by a large margin. The opposite impact was seen in 2005, when prices decreased despite a decline in the area under cultivation–with higher yields due in part to better weather conditions, opium production was almost stable. Weather conditions also can influence the moisture content and narcotic quality of opium; for example, heavy rains in 2003 led to a larger gap between fresh and dry opium prices, as the fresh opium contained more water and therefore would lose more weight while drying.

Third, the influence of final consumption demand on prices cannot be easily measured, but consumption is assumed to be fairly stable in mature OECD markets although it may be growing in some new markets (outside Europe and North America), including in particular in most countries neighboring Afghanistan and in several countries along trafficking routes beyond. Overall, the global demand curve for opium and opiates appears to have shifted out. Global supply appears to be quite responsive to global demand but not necessarily influenced by current global prices in a systematic way in the short run. Given the long and multiple-

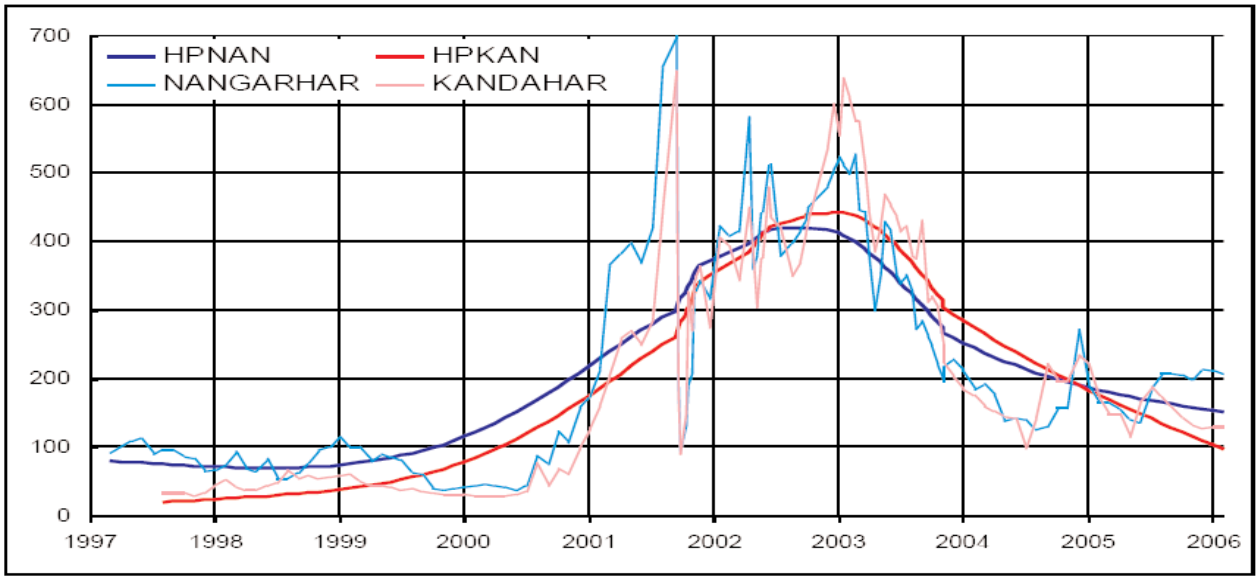
[3] The complexity of the opium markets prevents us from using normal techniques of de-seasonalization, as other factors would necessarily affect the analysis.

stage value chain and the enormous margins between downstream stages (discussed in Section IV), this is not surprising. Supply shocks (including weather developments, production bans, eradication, and other law enforcement efforts) are major determinants of prices, mediated by inventory adjustments which could be expected to respond to prices and price expectations. For example, uncertainties during the late 2001 war against the Taliban regime, and associated expectations that it might become more risky to hold inventories of opium, appear to have led to substantial release of opium inventories onto the market and hence to a sharp (albeit very temporary) decline in prices. The Taliban ban of 2000-2001, by raising prices sharply, must have elicited a massive depletion of inventories which enabled supply of opium and opiates to downstream stages to be largely maintained.

Fourth, the illicit nature of opium production and trade makes it very dependent on the political situation and on law enforcement: (i) the measures undertaken by the authorities can have a direct effect on opium supply (through seizures, eradication, etc.), and (ii) strong law enforcement and political pressure can affect prices by increasing the "risk premium" that opium traders charge. Moreover, the risks taken by farmers can be to some extent rewarded by a price increase (even if the farmers have little influence on prices) when the threat of eradication is high.[4] This second channel provides a possible explanation for the maintenance of relatively high (in relation to the late 1990s) opium prices as observed recently. Just as the de-facto legal status of the opium trade under the Taliban regime may have helped keep prices low, increasing criminalization and law enforcement efforts subsequently have tended to induce higher prices through higher risk premia, even if success in reducing opium production has been limited.[5]

In order to focus the analysis on underlying price trends as opposed to seasonal or other short-term fluctuations, smoothed price series were obtained after application of the Hodrick-Prescott filter, as explained in Annex 5A (see Figure 5.3). The smoothed price trends give rise to similar findings as the unsmoothed price series.

Figure 5.3: Opium Price Trends in Nangarhar and Kandahar



Note: Obtained after application of Hodrick-Prescott filter, lambda = 14.400 (see Annex A).
Source: MCN/UNODC Afghanistan Opium Price Monitoring.

[4] However, since many farmers have sizable opium-related debts, they may reap little if any of the benefit from higher opium prices. See Zia et al (2005) for a discussion of opium debt in the context of rural finance in Afghanistan.

[5] Supporting this hypothesis is the findings of rural research which indicate that farmers have become well aware of the changing legal status of opium and eradication risks etc. See various works by Mansfield.

Price Volatility

As can be seen from Figures 5.1 and 5.2, opium prices exhibit considerable volatility. An important question is whether the extent of price volatility has changed over time, and if so why. The indicators chosen to assess price volatility are:

- ***Monthly rate of change,*** in absolute value terms. Repeated large monthly changes are a sign of short-term instability and high point variations.
- ***Relative standard deviation,*** calculated as the ratio of the standard deviation of prices in the last six months to the average price during that period. Hence it is com parable across the different price series which have different average levels. This is an indicator of price instability over multi-month periods.

Table 5.1 shows annual averages for monthly rates of change in prices in different markets over the years for which data are available. There is substantial price volatility, with prices changing by more than 10% each month on average in most localities, even apart from the period of the Taliban ban in late 2001, a time of very high price volatility due to the large step-change in prices. But it is hard to draw any conclusions about changes in price volatility over time. In fact the hypothesis that price volatility did not change significantly in recent years as compared with the late 1990s cannot be rejected. This suggests that market factors–in addition to, for example, changing intensity of enforcement efforts against opium–are major contributors to price volatility.

There do not appear to be major differences in volatility among the six localities for which recent data are available. However, there were high monthly variations in all areas in 2004, indicating greater instability of prices. Monthly variations decreased in 2005, except in Helmand where there have been unsuccessful counter-narcotics efforts and serious problems of insecurity. In early 2006 only Mazar-i-Sharif experienced high monthly price variations, possibly because of recent eradication measures.

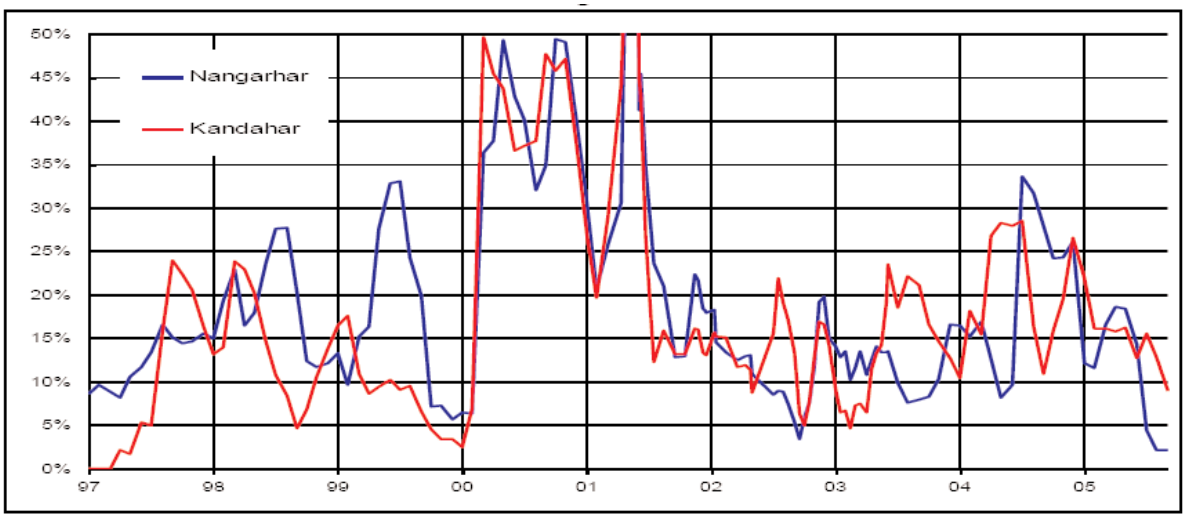
Table 5.1: Yearly Averages of Monthly Rates of Change in Opium Prices

	1997	1998	1999	2000	2001	2002	2003	2004	2005
BADAKHSHAN								13.13%	9.05%
HELMAND							4.34%	13.40%	13.56%
Herat								8.25%	10.24%
MAZAR								27.47%	13.94%
NANGARHAR	8.32%	17.04%	11.72%	23.92%	26.76%	11.67%	9.53%	14.11%	10.06%
KANDAHAR	2.54%	15.43%	6.94%	28.19%	34.19%	15.89%	8.97%	16.46%	13.19%

Note: The averages are of the absolute value of monthly rate of change.
Source: MCN/UNODC Afghanistan Opium Price Monitoring.

Longer-term trends in the second measure of price volatility are shown in Figure 5.4. Volatility increased significantly during the Taliban ban and immediately afterward, before returning to somewhat less volatile patterns in recent years.

Figure 5.4: Volatility Ratio (Standard Deviation/Mean) in Kandahar and Nangarhar

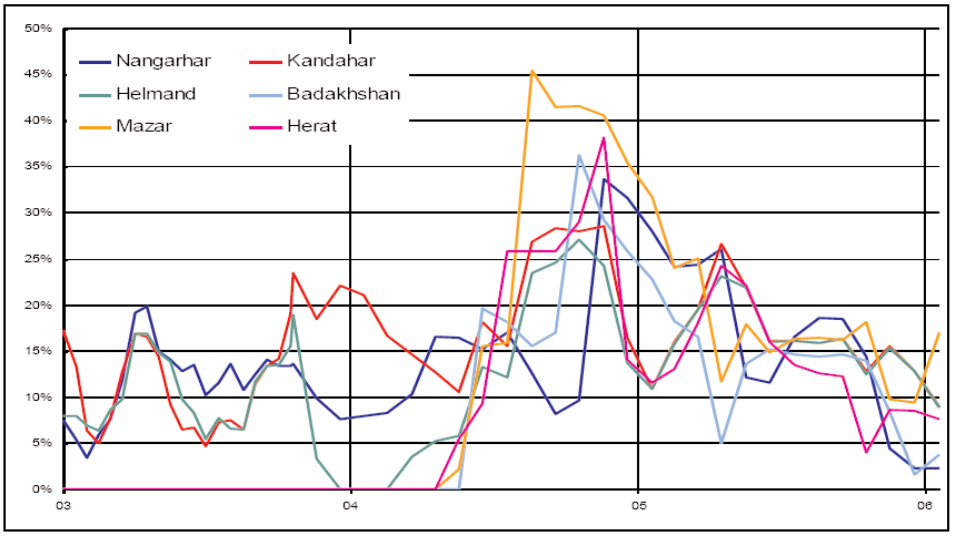


Source: MCN/UNODC Afghanistan Opium Price Monitoring.

Turning to the more recent period, volatility as per the second indicator was high in 2004 in all six areas for which price data are available, especially in Mazar-i-Sharif (Figure 5.5). Since mid-2005, however, there has been much less volatility in all localities.

This discussion has brought out the impact of the strong pressure on opium markets between late 2000 and mid-2003. The behavior of opium prices appears to be settling down somewhat. However, this could be only a temporary phenomenon, depending on whether additional law enforcement measures and political pressures are brought to bear against the drug industry.

Figure 5.5: Volatility Ratio (Standard Deviation/Mean) in Different Regions



Source: MCN/UNODC Afghanistan Opium Price Monitoring.

Implications for Counter-Narcotics Strategy and Policies

While it is difficult to draw hard and fast conclusions from the price data, it is clear that strong and effective counter-narcotics actions–which reduce the production and supply of opium–can have a major effect on opium prices. This was evident most notably in the Taliban ban of 2000/2001 but also, at a more local level, in the sharp reduction in opium production in Nangarhar Province between 2004 and 2005. The price effect of the latter was not at all comparable to that of the Taliban ban, however, as overall national production (helped by higher yields) did not decline significantly. Nevertheless, a gap opened up between the price in Nangarhar and elsewhere, which is most logically explained as being a result of the extremely sharp (95%) reduction in opium production in Nangarhar and associated disruption in the local opium market.

Thus a first implication that can be tentatively drawn from this review of price trends is that supply changes (taking into account inventory adjustments) are manifested in changes in farm-gate prices, and that prices therefore comprise a reliable signal of the overall supply situation and expectations of supply changes. However, higher prices also send signals to market actors, to increase opium production (perhaps by moving to other provinces where law enforcement pressure is less, or by getting into production in marginal areas where yields are lower and poppy cultivation is justified only if prices are high), and to release inventories onto the market, often with handsome capital gains. Moreover, higher opium prices tend to exacerbate the problems of heavily indebted poppy farmers, most notably as a result of the sharp price rise after the Taliban ban.

In this context, the maintenance of farm-gate opium prices during the last couple of years at levels several times those prevailing in the late 1990s suggests that, despite the failure to significantly reduce opium production, the "risk premium" for farmers to cultivate poppy has increased significantly. This is not surprising, given the de-facto legality of opium under the Taliban until their ban was imposed, and the erratic but nevertheless significant eradication campaigns and other law enforcement efforts since 2002, especially in late 2004. The higher underlying price structure at present may also reflect increasing extortion from farmers by authorities and payments of "protection money" on a regularized basis, whereas during the Taliban period there appears to have been a relatively low and fairly regularized levy on opium.

III. HORIZONTAL STRUCTURE OF PRICES (CHANGING SPATIAL PATTERNS)

Opium prices vary considerably across different parts of Afghanistan. A "snapshot" of the spatial pattern of prices as of December 2005 is available from UNODC (2006, pp. 18-38) and is shown in Table 5.2. Very significant regional differences are apparent from the table. The highest prices are encountered in the eastern zone, where law enforcement has been vigorously pursued. Especially in Nangarhar, where opium production fell sharply, prices reported at the end of 2005 were more than twice as high as in the Northern zone, where they are the lowest.

Table 5.2: Spatial Pattern of Dry Opium Prices

	Rapid Assessment	Price Evolution	Cultivation Change in 2006
North-Eastern zone			
Badakhshan	132	+	++
Takhar	106	+	=
Eastern zone			
Nangarhar	207	+	++
Kunar	175	+	=
Laghman	191	+	++
Nuristan	190	..	-
Northern zone			
Baghlan	106	..	=
Balkh	100	+	-
Bamyan	100	..	=
Faryab	101	+	+
Jawzjan	156	..	+
Samangan	96	..	-
Sari Pul	99	..	-
Central zone			
Khost	169	..	+
Parwan	200	..	=
Kapisa	191	..	+
Southern zone			
Kandahar	140	-	=
Helmand	141	-	++
Uruzgan	135	..	++
Zabul	146	..	..
Western zone			
Herat	156	-	+
Farah	177	-	=
Nimroz	205	..	=
Ghor	155	-	++
Badghis	99	..	+

Source: UNODC (2006), Opium Price Monitoring.

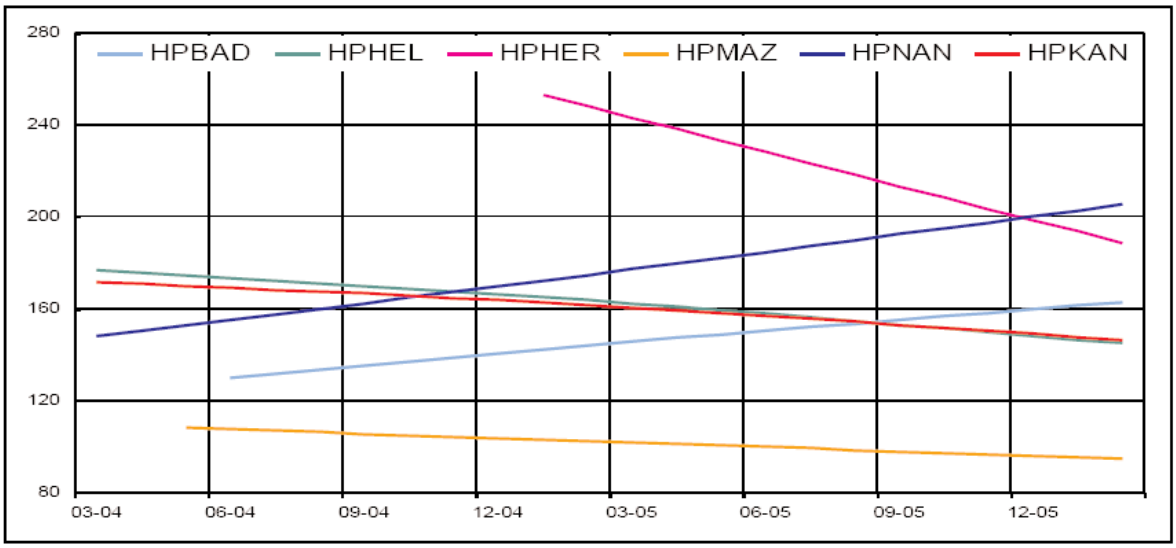
Recent price developments suggest that the regions where progress has been made in law enforcement, particularly in the Eastern zone where eradication threats were the most credible and effective (Nangarhar), are the ones where prices are significantly higher or increasing. More generally, looking at price evolution together with cultivation trends reported in the Rapid Assessment Survey, there is to some extent an expected inverse correlation between price movements and changes in cultivation. The most notable exception to this pattern (Nangarhar and Laghman in the eastern zone) can be explained by the fact that production in these provinces is rising from extremely low levels resulting from strong law enforcement efforts which are continuing.

As can be seen from Figure 5.6, recent smoothed trends in opium prices in the six localities for which data are available show some signs of convergence, albeit partial. The main exception is Nangarhar with a rising trend since 2004, most probably reflecting the largely effective ban on opium production in that province (previously one of the major opium producers in Afghanistan). In Helmand and Kandahar, prices have been on a downward trend, with production and poppy cultivation rising and apparently not much real pressure from authorities to prevent opium poppy cultivation. The significant downward trend for prices in Herat may be related. As can be seen from these figures the trends are becoming relatively stable and flatter, despite some recent contradictory moves.

Thus the spatial pattern of opium prices in different parts of Afghanistan shows considerable variation, which might be in part explained by factors like the following:

- Proximity to borders where cross-border transit is occurring; proximity to the Iranian border explains why prices in Herat, Farah, and Nimroz are so high.
- Distance from central markets in Afghanistan like Helmand/Kandahar, or previously Nangarhar. The farther away a local market is from these central markets, the lower the price tends to be, since higher transport and other costs (including risk of interdiction or theft) are incurred in reaching the central market.
- Climatic and agricultural conditions affecting the ability to achieve high opium poppy yields and morphine content. Major producing provinces tend to have lower prices, as was the case in Nangarhar before the ban and is still true in Helmand / Kandahar and Balkh, as well as Badakhshan.
- Eradication and law enforcement efforts. These appear to have a major impact on prices. Prices are higher in provinces where eradication and law enforcement efforts are vigorously pursued, as in the case of Nangarhar and other Eastern provinces.

Figure 5.6: Trends of Opium Prices in Different Regions of Afghanistan



Note: Obtained after application of Hodrick-Prescott filter, lambda = 14.400
Source: MCN/UNODC Afghanistan Opium Price Monitoring.

The spatial pattern of prices has varied over time, as illustrated in Table 5.3. Between June 2004 and February 2006, prices in Badakhshan increased by 70%, whereas prices in Helmand and Kandahar fell by 10%. Prices in Badakhshan were the lowest in June 2004 but are now significantly higher than in Southern or Western provinces. Between June 2005 and February 2006, prices in Balkh and in Nangarhar rose sharply (by 120% and 50%, respectively), considerably affecting the spatial pattern of prices.

In addition to the short-term changes noted above, significant changes in spatial patterns of prices have occurred over longer periods. This suggests that local factors have had an important influence on prices, and that such factors can change over time. In 1997 the price for dry opium in Nangarhar was up to three times as high as in Kandahar. Then the prices in the two markets approached each other by 2000, and in October 2001 prices were considerably lower in Nangarhar than in Kandahar (58% less). But they then were higher in Nangarhar in 2002 before returning to lower levels than in Kandahar until recently, when prices in Nangarhar rose due to the sharp reduction in opium production. Implications of such price trends for market integration are discussed in Section V.

Table 5.3: Recent Evolution of Prices in Six Localities (US $/kg

	June 2004	June 2005	February 2006
Nangarhar	143	137	208
Kandahar	143	165	129
Helmand	143	162	129
Badakhshan	84	112	145
Mazar	101	60	130
Herat	176	219	199

Source: UNODC (2006), Opium Price Monitoring.

Turning to the spatial pattern of prices for processed opiates, Table 5.4 presents data for prices of raw opium and opiates in different regions in Afghanistan and in neighboring countries. There are very large spatial differences in opiates prices, both regionally and between countries. Opium prices are especially high in Iran, where law enforcement is strict and where a large share of the opiate consumption market is still for opium rather than heroin. Not surprisingly, it appears that very significant profits can be made by crossing the Iranian border or by entering Central Asian countries like Tajikistan. Differences between heroin prices are much larger, and are very significant even within Afghanistan. Heroin prices in Herat and Kandahar appear to be pushed upward by the large cross-border profits related to the Iranian and Pakistani markets. Badakhshan's prices for heroin are surprisingly low, as proximity to the Tajikistan border might have been expected to raise the price. Large differences can also be observed between border regions of neighboring countries and their big cities, as illustrated by the large gap between Sistan-Baluchestan and Teheran prices for both opium and heroin, indicating that substantial profits can be made by transporting the products within the country, but at higher risk due to strong law enforcement.[6]

Table 5.4: Geographical Pattern of Opium and Opiates Prices (US $/kg)

Country	Region	Opium	Date	Heroin	Date
Afghanistan					
	Badakhshan	145	02/06	2500	12/05
	Balkh	130	02/06	2620	01/06
	Herat	199	02/06	3952	01/06
	Nangarhar	208	02/06	2351	01/06
	Kandahar	129	02/06	4350	01/06
Iran					
	Teheran	3400	02/05	4400	02/05
	Sistan-Baluchestan	930	02/05	2300	02/05
Pakistan					
	Peshawar	266	02/06	3349	01/06
Tajikistan					
		~ 400	03/05	~ 5000	03/05

Source: Various UNODC reports.

Implications for Counter-Narcotics Strategy and Policy

Spatial patterns of opium prices in Afghanistan suggest some policy implications:

- First, the factors affecting local opium prices, and, their respective influence, are not very clear, suggesting the need for more detailed data and further research.
- Second, variations in spatial price patterns, both short-term and over time, suggest that opium markets are flexible and mobile. While specific regional actions against the drug economy can be effective locally and in the short run, they will tend to encourage a shift of production and trade to other, less targeted regions.
- Third, the regional differences in prices around Afghanistan and associated profits illustrate the importance of trade for opium markets. This might suggest, for example, strengthening controls at borders, but sealing remote, mountainous, and porous borders may be very difficult to accomplish in practice.
- Finally, the flexibility of opium markets and the profitability of transactions make the industry a very difficult target, especially in a country where government authority is weak; this reinforces the need for a realistic, well-sequenced strategy.

IV. THE VERTICAL STRUCTURE OF OPIATE PRICES

Opium and its products dramatically increase in price along the "value chain" from raw opium produced on rural farms in Afghanistan to local markets, wholesale trade, processing into heroin or morphine, trade in neighboring countries, transit to distant consuming countries, and ultimately wholesale and retail prices in these countries. The "vertical" structure of prices can provide clues about how the drug industry is organized and its evolution over time. Although there are signs of stability (and a gradual downward trend) in prices at the downstream end of the value chain–at and near where final consumption occurs, in recent years there have been major shocks to and changes in prices at the upstream end, in and around Afghanistan. The impact of these price shocks on the vertical structure of prices sheds light on the structure of the drug industry and on price formation and how pricing deci-

[6] It is hard to explain how opium can sell at $3,400 per kg and, at the same level of market, heroin sell for only $4,400 (Tehran); the Sistan figures are only slightly better. The explanation may possibly be that the opium price is retail (sold at the gram level) and the heroin price is wholesale (multi-kg shipments). However, this requires further investigation.

sions are made.

Vertical Price Structure

Although price data are relatively weak for the parts of the opium "value chain" after the farm-gate level and before reaching prices in distant consuming countries, it is possible to piece together a rough picture of the vertical price structure and in particular the price margins at different stages. While the focus will be on those parts of the vertical price structure that pertain to Afghanistan and to a lesser extent the surrounding countries, brief summary background on downstream stages will be provided as context.

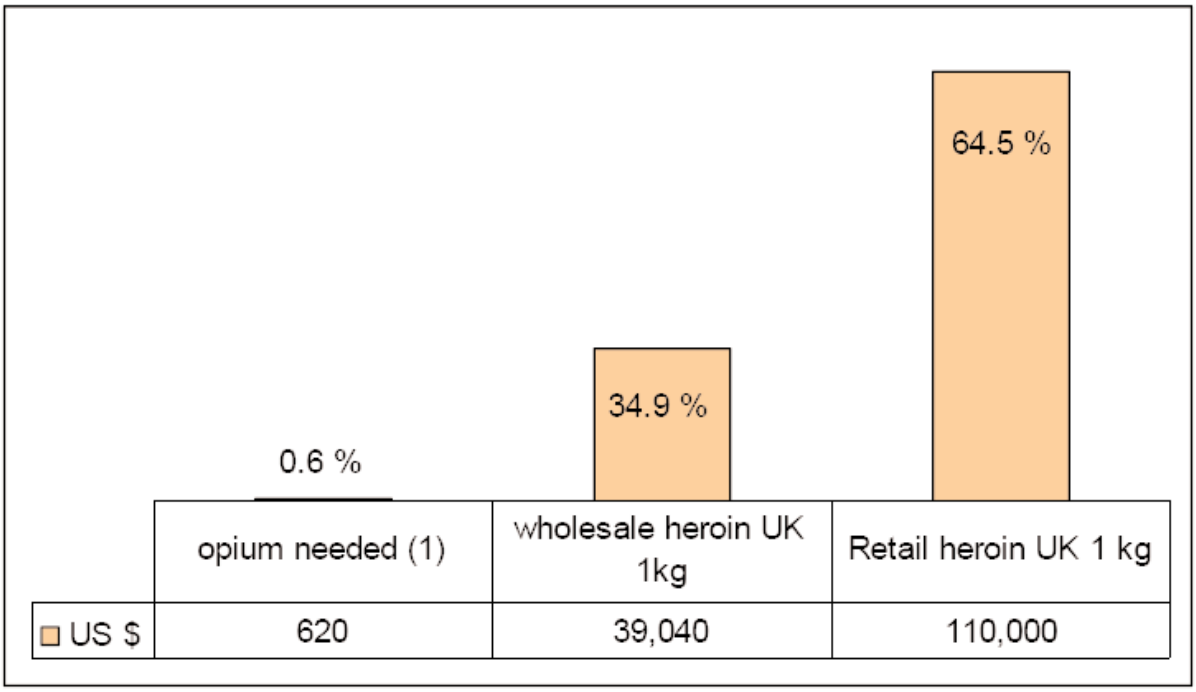
First, it is useful to review the main actors involved in Afghanistan:

- **Farmers** cultivate opium poppy for various reasons, based on complex livelihood strategies and coping mechanisms (see Chapter 3). Different types of farmers can be found, depending on the size of their landholdings and other resources. The poorer ones are often forced to cultivate opium poppy to repay high-interest debts.
- **Rural laborers** are numerous as opium poppy cultivation is a labor-intensive activity, although there is much reliance on household labor as well. Laborers are typically poor, even if wage rates are considerably higher for opium poppy laborers than for other rural laborers, since the labor is quite seasonal.
- **Small traders** buy and sell small volumes of opium at farm gate and in small general-purpose bazaars. Some of them get into longer-distance trade as well, some times involving processed opiates (see Mansfield, 2006, for some case studies of small opiate traders who run risks and frequently run into trouble).
- **Wholesalers** trade larger quantities of opium and often organize the processing of opium. They are also often involved in transferring the products across borders, and so merge with the cross-border smugglers discussed below.
- **Refiners** process the opium into heroin or sometimes morphine. Many of them are also involved in trading activities, and they often have powerful sponsors. However, there is evidence that they also process smaller volumes of opium owned by traders, on some kind of commission payment basis.
- **Government officials, warlords and commanders, and other local notables** are heavily involved in the opium economy; commonly they receive bribes and other payments at various stages of the opium chain, for "protection." At higher levels, some of them may be involved in facilitating large-scale transport and transactions, and more generally in oversight of the drug industry (see Chapter 7).
- **Cross-border smugglers** vary from small-scale individual traders to organized groups working for large traffickers. Many of them have connections (personal, family, tribal, ethnic) across the border, but it seems that the trade is taken over by other trafficking groups after entering neighboring countries.

Information is available on retail prices of heroin for final consumption in major consuming countries, and also for wholesale prices in those countries, as well as to a lesser extent for wholesale prices in the main transit countries surrounding Afghanistan. Taking the UK as an example, Figure 5.7 lays out an illustrative vertical structure of opiate prices from farm to final retail level. As is well known, the vast bulk of "value added" in the drug industry is generated outside Afghanistan, with a substantial chunk accruing in neighboring countries but even bigger price margins in transit to industrialized consumer countries, and

within those countries between wholesale and final retail prices. This has important implications for price formation at the upstream end, and for the effects of price changes in and around Afghanistan further downstream.

Figure 5.7: UK "Value Chain" for Heroin in 2004



Source: UNODC World Drug Report.
(1) opium needed for a kg of UK heroin was calculated as the price of one kg of afghan opium multiplied by the conversion ratio (8) and divided by 3 as the average purity of UK heroin is reported to be 33%.

Henceforth we focus on Afghanistan and to a lesser extent countries immediately around it. The analysis looks at "price margins," since information on costs incurred at different stages is largely unavailable. These include farmers' payment of wages to laborers, bribes paid to officials and warlords, other payments to people (e.g. salaries for those providing security at different stages), and other payments comprising part of the "value added" of the opium economy. There are also costs incurred for materials and other non-factor inputs necessary for cultivation (seeds, fertilizer), processing (chemicals etc.), and transport of opium and opiates, but these are small in relation to gross revenues (see Chapter 2). The level of uncertainty in the price information at each stage of the chain is high, so the numbers and percentages given below are very rough estimates.

Opium and opiates are durable goods (raw opium paradoxically has a longer storage life than heroin powder), enabling various actors to hold inventories, in aggregate quite large. As a result sizable inventories can be built up, held, and sold, with such decisions responding to prices, expected prices and supply conditions, political pressures, threat of law enforcement, etc. Indeed, the behavior of inventory-holders, and resulting supply and price effects, can be volatile, as the example of the sharp decline in opium prices in late 2001 suggests. However, it appears that inventory adjustments more often dampen price fluctuations, as for example most probably occurred through massive depletion of inventories after the Taliban ban and subsequent inventory accumulation when large-scale opium production resumed in

the post-Taliban period.

Another important aspect of opium markets, especially concerning opiates, is the importance of the quality and purity of products. Changes in purity can be an adjustment mechanism helping smooth nominal prices. In periods of low supplies, studies indicate that the average quality of opiates seized diminishes significantly, allowing the nominal price and quantities to remain closer to normal levels and introducing biases in price analysis. For example, McColm (2004) explains that very large changes in purity were reported by UK authorities in heroin imports. These changes were related to an increased level of cutting, as the products were cut outside the consumer country (up to two or three times before reaching UK) and also at the downstream end, inside the destination country. These alterations in purity allowed greater stability in nominal street prices.

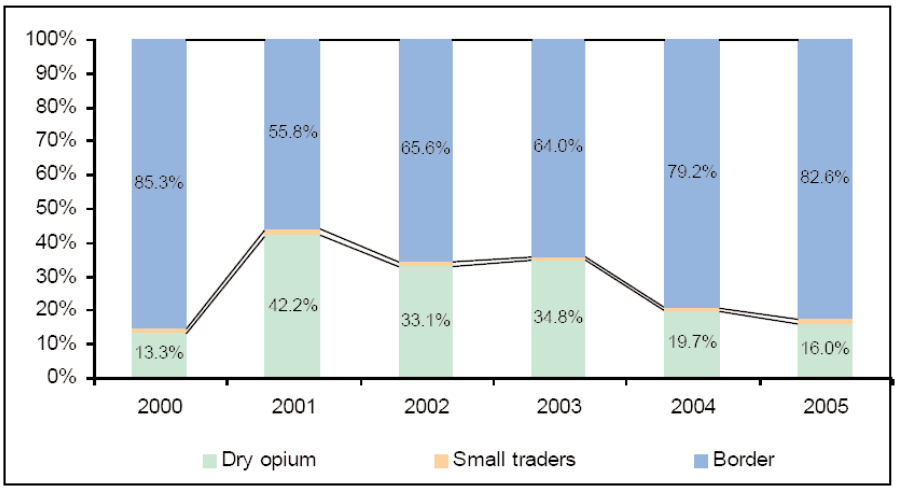
Estimates of the opium price chain and heroin price chain are presented and discussed below. However, the data weaknesses and very limited information about intermediate stages need to be kept in mind when interpreting the estimates.

The Opium Price Chain

As discussed earlier, data on farm-gate prices of fresh ("wet") and "dry" opium are available monthly for some localities in Afghanistan, as well as for opium prices in small bazaars. Estimates of wholesale opium prices in neighboring countries can also be found in some reports. These will be used as estimates for the border price and will be referred to as "final price," although as seen earlier they are far lower than prices further downstream in other transit countries and especially in the final consumption markets in industrialized countries. Specifics on the calculation of this final price and other data are given in Annex A. Not surprisingly, where data are available there is a large difference between the price in the last transaction in the exporting country and the first transaction in the importing country, representing the risk of smuggling. This difference is especially high in the case of Iran, not surprisingly in view of the strict law enforcement efforts in that country. Figures 5.8 and 5.9 present estimates of the price chain for opium based on UNODC data. They show roughly how the price for one kg of opium can be decomposed between the different stages of production and transfers.

Following the Taliban ban both the value and the share of opium revenue accruing to farmers increased, as the price for raw opium rose nine-fold between 2000 and 2001 (from US$ 50/kg to US$ 430/kg) and its share in the final price went up from 13% to 42%. The share of farmers remained high during 2002 (33%) and 2003 (35%) before returning to lower percentages subsequently, but still somewhat higher than those seen during the 1990s. The share of the final price accruing at the farm-gate level in 2005 was around 16%, as against 13% before 2000, and moreover this higher share is in relation to a considerably higher final border price. Thus the profitability of cultivation has increased, most probably reflecting compensation for the risks associated with stronger enforcement actions against opium and in particular threats of eradication.

Figure 5.8: Price Chain for Opium (Percentage of the Final Price)



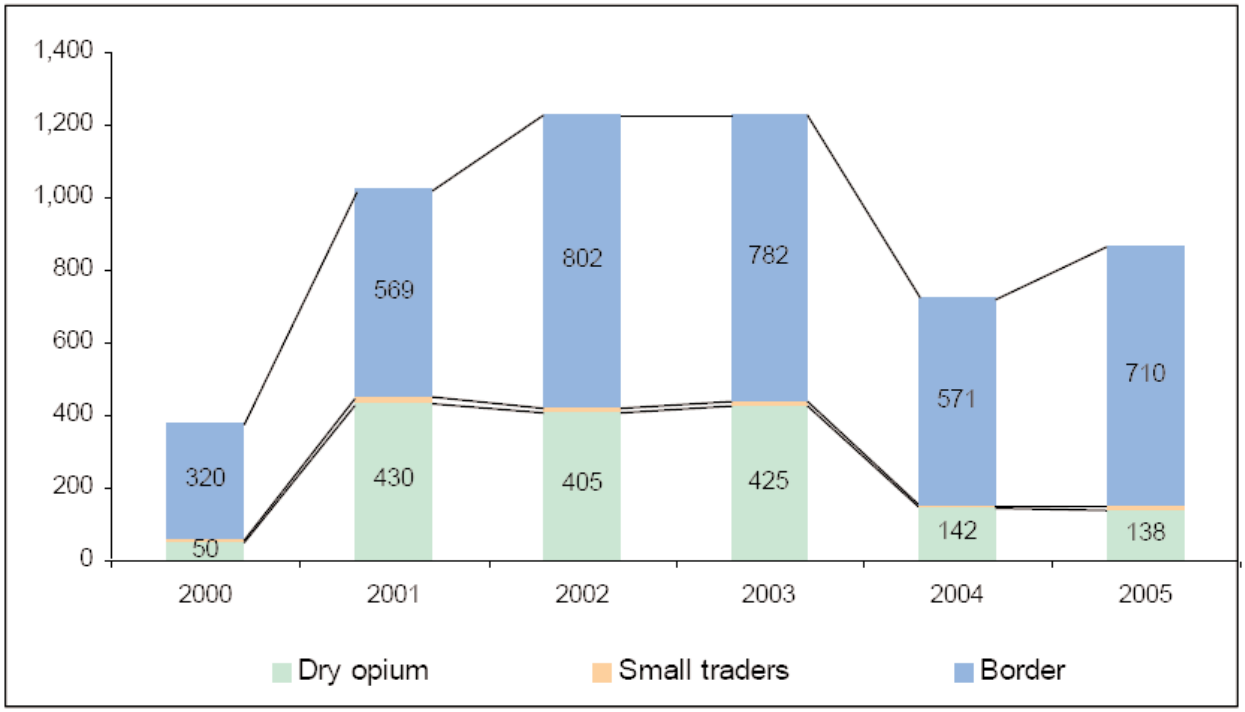
Source:Based on UNODC data.

The border price has been estimated in these figures based on UNODC data on opium wholesale prices in neighboring countries, especially Iran, which appears to be the major opium transit country around Afghanistan (and also is a major consumer of opiates including raw opium). As shown in Figure 5.9 and in Annex 5A, the "border" price also has been fluctuating by large margins, and price movements at farm-gate level and at the border are not always even in the same direction. While interesting and suggestive, these results are rendered less meaningful by the fact that, with most opium now processed into heroin or morphine within Afghanistan, raw opium prices in neighboring countries are less important than prices of processed opiates.

The Opiates Price Chain

The price chain for opiates is more difficult to estimate, as processing creates products of different quality and with conversion factors that vary with the quality of raw opium and the efficiency of the conversion process. The transformation of opium into morphine or heroin requires the use of different chemicals, whose quality combined with the skills of the refiner affects the output. Different opiates do not have the same purity, and their price depends on their quality and characteristics (e.g. brown/white heroin and different levels of purity). The conversion ratio globally is reported by UNODC to range between 6 and 10 to 1 for heroin and morphine (i.e. one kg of heroin or morphine is made out of 6-10 kg of opium). The actual ratio in Afghanistan by all accounts is toward the low end of this range, given the relatively high quality of raw opium. A 7 to 1 ratio appears to be commonly used when heroin labs in Afghanistan process raw opium into heroin on behalf of customers (see Mansfield, 2006, for some examples). Since the heroin labs presumably make some "profit" by actually converting at a better ratio, this suggests that the physical transformation ratio may well be slightly below 7 to 1. In any case, applying a ratio much above 6 to 1 in calculation of the price chain during the boom in raw opium prices would result in apparent gross losses for refiners, as heroin prices in neighboring countries did not experience such a boom as dry opium prices in Afghanistan. Therefore the ratio used to construct the price chain is 6 to 1.

Figure 5.9: Estimates of the Prices in US$ at Various Stages of the Opium Chain

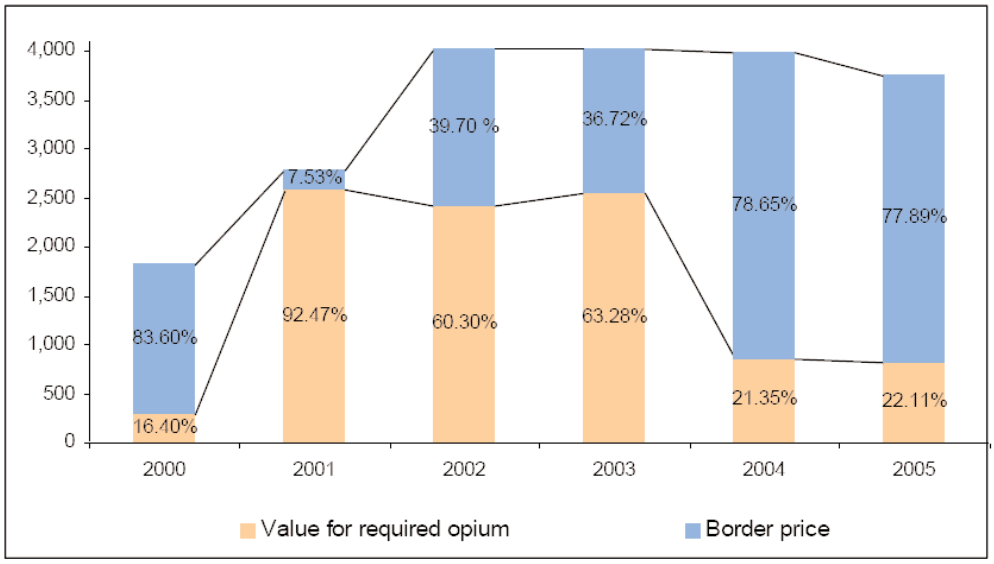


Source:Based on UNODC data.

Another difficulty concerns border prices, as they depend on restrictions imposed in the different neighboring countries (for example, Iran has a severe policy against narcotics, resulting in higher prices). Moreover, the export pattern of opiates is not well known, nor the share of opium processed into heroin or morphine within Afghanistan. (UNODC's estimates of these shares are based on information about seizures.) The border price chosen is a weighted average of prices in foreign markets around Afghanistan, especially Iran and Pakistan where a large portion of heroin seizures are made.

Figure 5.10 shows estimates of the price chain for heroin. The level of uncertainty in these estimates is even higher than for opium. The proportion of the final price of heroin attributable to processing and trafficking was greatly reduced during the boom in opium prices following the Taliban ban, and reached very low levels particularly in 2001. This appears to reflect an apparent lack of elasticity of heroin prices in foreign markets to opium prices in Afghanistan. This inelasticity can be related to numerous factors, such partial absorption of opium price increases by intermediate traffickers in the neighboring countries (resulting in a sharp temporary reduction in their profits), and also due to inventory adjustments (many traffickers must have accrued large capital gains on their inventories. On the demand side, some studies suggest that downstream wholesale and retail dealers prefer adjusting quantity and especially purity rather than price, which would dampen observed adjustments in prices at downstream stages.

Figure 5.10: Estimates of Heroin Price chain (US $/kg)



Source: UNODC; staff estimates.

These price chain estimates are consistent with UNODC's methodology for estimating gross opium export potential (discussed in Chapter 2). UNODC estimates the total opium production and share exported as opium or processed into opiates (heroin/morphine). With the calculation of a border price for opium and opiates, the gross potential export value for opium is roughly estimated. The results for export value and farm-gate value (calculated with regional prices and productions) are shown in Figure 5.11 and illustrate the same findings as the previous figures.

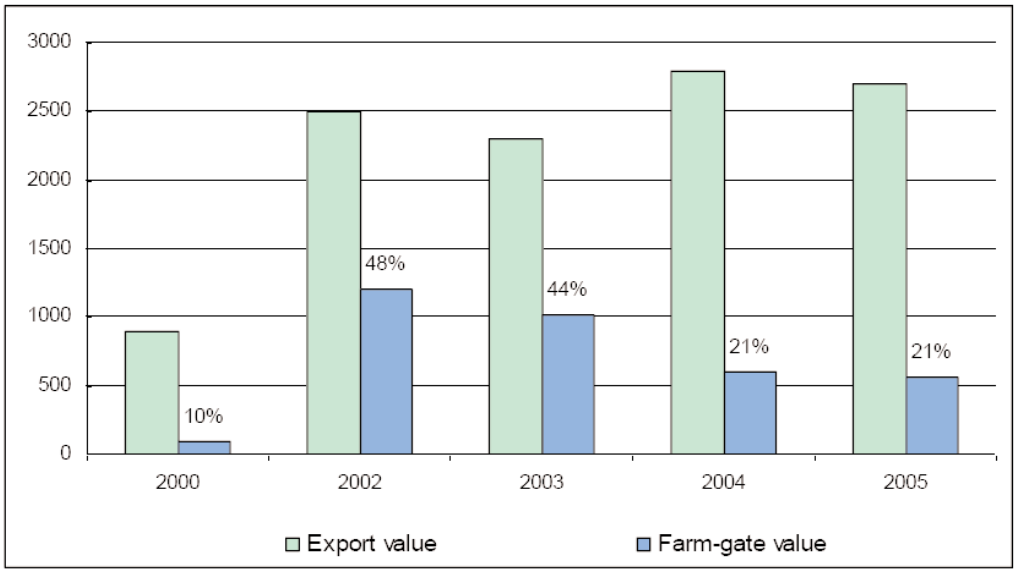
Price Formation and Pricing Behavior

The "value chain" for opium and opiates (heroin and morphine) has some important characteristics. The stylized facts are as follows:

- The value of raw opium at one end of the chain comprises only a tiny fraction of the final retail value of heroin in Europe or the United States. This feature is common among agricultural products that go through processing, branding, and packaging before final consumption (although there is only limited branding and packaging of opiates), but it is found in extreme form in the drug industry.
- These huge price differentials tempt some actors to bypass the stages of the chain and, for example, smuggle small amounts of heroin directly from Afghanistan or Pakistan to Europe. But this is a high-risk activity, and it appears that most opiates travel through each stage of the chain.
- There have been great price fluctuations at the upstream end of the value chain, whereas prices appear to have been much more stable at the downstream end (although there is evidence of substantial adjustments in purity). This means that there must be absorption of price shocks coming from the upstream end of the value chain, in transit countries and perhaps in wholesale markets of consuming countries. Inventory adjustments may also play a significant role, but on their own have not prevented sizable fluctuations in prices of opium or (in neighboring countries) heroin. Thus absorption of price increases (especially those perceived to be temporary), with a corresponding impact on profits, must be taking place.

- At both extreme ends of the value chain, markets are characterized by numerous actors who are "price-takers" and individually have little or no ability to manipulate prices. Both farmers producing opium and the traders who purchase directly from them are price takers (the traders from the next stage downstream). At the opposite end, final consumers are numerous, have at least some choice of suppliers, and individually have no ability to manipulate prices. The same is broadly true of the retail street dealers who sell to final consumers.

Figure 5.11: Estimated Farm-gate Value and Potential Export Value (US$ million)



Source: UNODC.

These stylized facts, together with qualitative evidence that the number of actors in the market is much smaller at some of the intermediate stages than at either end,[7] strongly support the argument that active price-setting and price manipulation is occurring in the opiates industry, concentrated at crucial stages around the middle of the chain (see Pietschmann, 2004). While it is not possible in this chapter to go deeply into the organization and behavior of the opiate industry in transit and consuming countries, some tentative hypotheses are offered below about the objectives and modalities of price-setting behavior. Clearly this is an area that needs more research and analysis.

First, there may be some premium placed on avoiding very sharp overall movements in wholesale and retail prices for individual consumers (before changes in purity are taken into account, see below).[8] In this context, adjusting purity (which is not observable by purchasers in advance, and perhaps not at all in the case of relatively small changes) may be considered a better adjustment mechanism than large adjustments in nominal prices per gram or other unit weight.

Second, at the opposite extreme (opium at the farm-gate and small trader level), prices clearly do adjust in the face of supply shocks (e.g. weather conditions) and changes in risk premia associated with law enforcement etc. From the perspective of the drug industry as a whole, flexible price adjustment at the upstream end of the value chain may be seen to elicit the necessary supply and incorporate changing risk premiums.

[7] See, for example McColm (2004, p. 101); also see Chapter 7 for a discussion of apparent increasing control exercised over the drug industry in Afghanistan by a small number of actors.

[8] As noted in Reuter and Caulkins (2004), there is relatively large dispersion in retail prices of illicit narcotics, as well as great variation in purity. However, the extent of variability in purity-adjusted prices is found to be stable across drugs, market levels, and time.

Third, the possible dual objectives of avoiding sharp changes in nominal prices at the downstream end and flexible price adjustments at the upstream end would appear to be pursued through several main instruments: (i) inventory adjustments to maintain supply in the face of production shocks; (ii) partial absorption of changes in upstream prices by adjusting profit margins at key intermediate stages; and (iii) adjustments in purity rather than in retail (and downstream wholesale) prices in the consuming countries.

Finally, there has been considerable debate around the issue of whether price adjustments in response to price changes at upstream stages of the value chain (e.g. in the farm-gate price of opium) are "additive" or "multiplicative."[9] This issue is discussed in Box 5.1. Policy implications of these two different price mark-up patterns diverge. An additive mark-up process would imply that restrictions on the supply side would not strongly affect consumer prices, whereas a multiplicative pattern would mean that price changes at the upstream end would have large consequences for prices at the downstream end. Clearly, heroin price behavior has not been related simply and linearly to the evolution in opium prices. Pietschmann (2004) argues that prices for opium and opiates do not react in an additive or a multiplicative way but in a manner that falls between these two extremes.

Box 5.1: Additive versus Multiplicative Price Mark-ups

There has been considerable debate in the literature over whether pricing behavior in the drug industry follows an "additive" or "multiplicative" mark-up practice. It should be noted at the outset however that neither of these hypotheses is backed up by an explicit model of the behavior of the actors concerned, whether based on optimization or another approach. As a result the debate lacks analytical depth. At most there are some underlying assumptions about the factors (costs, risks) determining price mark-ups. These can be summarized as follows:

Multiplicative factors include most importantly the element of risk to the capital committed, i.e. the risk of loss or seizure of the shipment; a roughly constant risk premium in this regard would translate into a multiplicative impact of prices at the upstream end on prices further down the value chain. There could also be an element of maintaining a constant profit rate on capital committed.

Additive factors include costs that are related to the physical volume of shipments (transport costs, fixed bribes and other payments). The risk to persons involved in the shipment (i.e. the risk of being arrested, jailed, or killed) may also be to some extent of a fixed nature, i.e. the cost being related to the person(s) involved rather than to the value of the shipment per se.

However, the superficially neat demarcation of factors between additive and multiplicative types breaks down on close scrutiny. In particular, some factors that may be additive for relatively small upstream price changes may easily become multiplicative for large changes. For example, bribes paid could be expected to be adjusted upward in the face of large price increases and thereby higher shipment values, since prices would be known to the recipients of bribes. Similar considerations may apply to the risks and costs associated with persons, e.g. bribes to get transporters out of jail are likely to increase with the value of the shipment. (If smaller shipments are used as a risk management device, the larger number of individual shipments would likely preserve the multiplicative character of price adjustments.)

While multiplicative factors would appear to be important, on the other hand price adjustments may be dampened at the downstream end, although supply shortages are translated partly into reductions in purity rather than price increases. The more general point is that although some patterns are emerging, further research and analysis is needed into pricing behavior in the opiates industry, going beyond seeking simple rules of thumb.

[9] An additive mode of price adjustment would imply that a change of $1 in the original price (farm-gate price here) leads to a $1 change in the final price. A multiplicative price response would mean that a 10% change in the initial price results in a 10% change in the final price.

Implications for Counter-Narcotics Strategy and Policies

The first point to consider is whether, and if so how, counter-narcotics objectives would be served by efforts to trigger price changes at different stages of the value chain. There is evidence, most notably from the Taliban ban, that strong counter-narcotics actions can have a substantial impact on farm-gate prices, and also less dramatic evidence that prices at downstream stages can be affected by increased counter-narcotics activity.

At the upstream end, successful efforts to reduce opium poppy cultivation almost inevitably will stimulate as a side effect higher opium prices, at least for a period of time until other sources of supply emerge at the global level. However, there appear to be no good reasons that such price increases should be seen as desirable in their own right. In fact, increases in farm-gate opium prices have the following problematic effects:

- They increase the incentives for opium production, including expansion into new regions and localities and more marginal farming areas where opium cultivation becomes viable only at higher prices.
- They increase the value of opium inventory holdings, which in general enriches larger traffickers and others holding sizable inventories.
- If the price increase is due to eradication or other measures to force farmers not to cultivate poppy, then those whose crops are not eradicated will be better-off, whereas those eradicated or prevented from cultivating opium will be far worse off. Since the latter most likely tend to be poorer (unable to afford bribes, not well-connected with local officials), poverty would be exacerbated.
- The large amount of opium-related debt in Afghanistan's rural economy, well into the hundreds of millions of dollars based on rough estimates (see Zia et al, 2005), means that price increases exacerbate the burden of the debt, again worsening poverty since most of such debt is borne by poorer farmers.

Turning to the downstream end, it has been seen that rising prices emanating from upstream parts of the chain, and/or supply shortages, tend to be translated into reductions in purity as well as higher prices per gram (or other unit of measure). Lower purity does of course mean there is less actual supply of narcotic content in consuming markets. There is evidence that a "heroin drought" in Australia reduced heroin consumption and associated problems (see Mattick et al, 2004). However, since higher prices and lower purity may also have some undesirable effects (e.g. increased crime to fund more costly drug habits, risk of overdoses due to changes in and uncertainty about purity, adulteration of narcotics with other harmful substances, substitution of other drugs for the one whose price has increased, etc.), reductions in illicit drug consumption should be sought rather than higher prices as a goal in their own right. This highlights the importance of demand reduction in the global fight against drugs.

These considerations suggest that lower prices of opium/opiates, achieved through demand reduction measures, are more likely to support holistic counter-narcotics objectives. For example, a lower price of opium in Afghanistan, which could result from overall demand reduction or interdiction at downstream stages of the value chain to disrupt markets and demand for opium from traders, would reduce price incentives to produce opium, lower the burden of opium-related debt, and reduce the value of opium inventory holdings. This reasoning strongly suggests that the best targets for enforcement efforts in drug producing countries like Afghanistan are opium traders and refiners as well as their sponsors. At the down-

stream end, demand reduction would be difficult (particularly in terms of achieving a global reduction in demand, not just in one or a few countries), but this would not only be beneficial directly but would also help contain criminal behavior and other side effects (including substitution) associated with high prices of opiates, while not increasing incentives on the supply side.

While any tendencies toward lower prices might well be offset by other factors including shrinkage of supply, the key point is that the counter-narcotics strategy should not explicitly target higher prices in their own right, and nor should higher prices be seen as necessarily supporting the full range of broader and medium-term counter-narcotics objectives.

V. MARKET INTEGRATION IN AFGHANISTAN'S OPIUM ECONOMY

Combining time series and spatial patterns for opium prices (discussed in Sections II and III) further enriches the analysis. Use of econometric techniques can provide insights into the extent to which opium markets are integrated–the technical definition of market integration being that prices in different markets are closely related, generally move together, and do not get too far out of line with each other (although there could well be differences in price levels across markets due to transport costs and other factors).

A number of studies have attempted to assess the integration of geographically distinct markets for the same good, principally food markets, with the objective of detecting market inefficiencies and making recommendations to improve their functioning. Analysis of market integration to ascertain the flaws of a market so as to exploit them (in this case for counter-narcotics purposes) can use the same techniques, but for the opposite purpose. Assessing the integration of opium markets could provide, in this sense, better knowledge on how to respond to the drug industry and limit its size.

Several techniques exist to assess market integration, discussed in Annex 5B. The following data are used (see also Annex 5A). Monthly opium price data collected by UNODC cover the period from 1997 to March 2006 for Nangarhar and Kandahar and from 2003 or 2004 to March 2006 for four more markets: Helmand, Mazar-i-Sharif, Herat, and Badakhshan. Analysis of integration of wheat markets is also conducted for comparative purposes, based on monthly wheat price data collected by WFP/VAM on six markets from 1996 to 2005 : Kabul, Kandahar, Jalalabad (Nangarhar), Herat, Mazar-i-Sharif, and Faizabad (Badakhshan).

Analysis of Market Integration

Statistical and econometric techniques are used to analyze the relationships between geographically distinct markets for opium in Afghanistan, in the order in which these techniques were developed and with increasing sophistication. We start with simple correlation coefficients and move on to simple regression analysis developed for assessing market integration (Goletti-Ravallion), and then to more recently developed co-integration techniques and Granger causality tests.

Opium Price Changes Exhibit Some Strong Correlations. As shown in Table 5.5, there are very strong correlations between opium prices for some markets. Most notably, prices in Helmand and Kandahar are very strongly correlated. Nangarhar and Herat do not have as strong pair-wise correlation, but both them exhibit stronger correlations with Helmand and Kandahar, implying that these two markets are in some sense "central" (this point will be discussed more later). Badakhshan and Mazar-i-Sharif, on the other hand, are characterized by more individualized price moves and relatively low correlations with the other markets. This is not surprising, and reflects among other things distance from the main markets in the south and, particularly in the case of Badakhshan, access to separate trafficking routes through northern borders.

Table 5.5: Pair-wise Correlation of Opium Prices on the Different Markets

	NANGARHAR	KANDAHAR	HELMAND	HERAT	MAZAR	BADAKHSHAN
NANGARHAR	1.000000	0.935625	0.945638	0.235977	0.010075	0.342776
KANDAHAR	0.935625	1.000000	0.998463	0.820647	0.504112	0.141393
HELMAND	0.945638	0.998463	1.000000	0.842141	0.583061	0.249043
HERAT	0.235977	0.820647	0.842141	1.000000	0.063795	0.344527
MAZAR	0.010075	0.504112	0.583061	0.063795	1.000000	0.244513
BADAKHSHAN	0.342776	0.141393	0.249043	0.344527	0.244513	1.000000

Source : UNODC Opium Price Monitoring, correlation based on pair-wise time availability in the data

Market Integration Between Nangarhar and Kandahar Decreased after the Taliban Ban. The Goletti-Ravallion technique (using ordinary least squares regression of current price in one market against past prices in that market and current and past prices in another market– see Annex 5B) gives the results shown in Table 5.6. According to this technique, the opium markets of Nangarhar and Kandahar were integrated over the entire period from 1997 to 2006, but this result is probably biased by the very large, "outlier" price change induced by the Taliban ban, which had a massive, similar, and time-wise almost identical effect on both markets. Breaking the time series into two periods– before and after the Taliban ban–demonstrates that although all forms of market integration cannot be rejected for the period before the Taliban ban, market integration appears to have decreased after the ban, with only the hypothesis of long-run market integration remaining viable (see Annex 5B for an explanation of these tests).

Table 5.6: Tests of Market Integration Hypotheses (Goletti-Ravallion Methodology)

Hypothesis :	Whole period	Before the ban	After the ban
Market segmentation	No	No	No
Short-run integration	Yes	Yes	No
Long-run integration	Yes	Yes	Yes
Weak integration	Yes	Yes	No

Note: A "No" in a cell, means that the hypothesis can be rejected at 5% level, otherwise, we consider that the hypothesis cannot be rejected.
Source: UNODC Opium Price Monitoring.

[10] Possible reasons include Kandahar/Helmand's closer proximity to the main trading route for opiates through the southern border with Baluchistan Province in Pakistan; slight difference in products, transport costs, etc. In fact, transport costs can affect the relation as, for example, a linear model cannot take into consideration threshold effects of transport cost: arbitrage happens only when the price differential between the two markets is high enough.

Use of the Co-integration Technique Gives Similar Results. As in the case of the Goletti-Ravallion method, co-integration techniques indicate that when the whole period is considered, Nangarhar and Kandahar prices are co-integrated. This means that they share a common factor that prevents them from departing too far from each other in the long term. More specifically, the long-term elasticity of Nangarhar prices to Kandahar prices is estimated at 0.788. This co-integration coefficient is significantly different from 1, and a number of reasons can be proposed for this result.[10] However, as in the case of the Goletti-Ravallion methodology, the common shock on prices induced by the Taliban ban could lead to overestimation of the extent of integration between the two markets, so separate tests were conducted for the sub-periods before and after the ban. Before the ban, there is co-integration, with the long-term elasticity of Nangarhar prices to Kandahar prices estimated at 1.13.[11] On the other hand, there is no stationary co-integration equation after the Taliban ban, indicating a weaker relationship between the two markets.

These results, as well as the similar findings using the Goletti-Ravallion approach, provide strong evidence that integration between the two markets decreased after the Taliban ban. There are a number of possible reasons, which require further investigation:

- The Taliban ban, although it applied only to production and not trade, may have upset relationships between different opium markets in poorly-understood ways which may have persisted after the fall of the Taliban. However, this explanation is not very convincing since the Taliban ban was effective in virtually all parts of the country under Taliban control, including both Kandahar and Nangarhar.
- Counter-narcotics initiatives in the post-Taliban period, which intensified in late 2004, have been implemented in an uneven and fragmented manner across different provinces and localities, which could have had a negative impact on the integration of opium markets by having differential effects on different areas.
- More specifically, the much stronger counter-narcotics efforts and sharp fall in production in Nangarhar during 2004-2005 (by some 95%) appears to have largely ended the latter province's status as a major production and trading center for opium, with associated effects on its integration with other opium markets. This is supported by the fact that the deviation in prices in Nangarhar from those in Kandahar and Helmand after 2004 was in an upward direction (see Figure 5.2).

Helmand and Kandahar Appear to Form a Central Market for Opium. The number of observations for other markets is too small to reliably implement the more sophisticated tests, so only a few comments based on simpler methods will be presented here. As mentioned earlier, the pair-wise correlation coefficients suggest that the six localities for which data are available tend not to comprise single integrated market. Indeed, Badakhshan and Mazar-i-Sharif seem to exhibit fairly isolated price behavior, whereas the links between Herat, Helmand, and Kandahar on the one hand and between Nangarhar, Helmand, and Kandahar on the other hand seem to be more solid.

More specifically, Helmand and Kandahar not only are very close geographically but also have very similar prices and price variations–indeed they have had exactly the same price since July 2005. Thus they can be considered as effectively one market. Despite the lack of co-integration between Kandahar/Helmand and Nangarhar after the Taliban ban, the correlation between their prices remains strong, suggesting continuing market linkages. More generally, two groups of linked markets can be identified, connected to each other

11 It should be noted that the coefficient is rather different, suggesting that the relationship between the two markets has not been very stable.

through the central market of Kandahar/Helmand: (i) Helmand, Kandahar, and Nangarhar and (ii) Helmand, Kandahar, and Herat.

Application of the Granger causality test (see Annex 5B) indicates that Helmand has a significant influence on three other markets: Kandahar, Nangarhar, and Herat. In other words, price developments in Helmand tend to predict future price developments in these other markets. Keeping in mind also the large volume of production in Helmand and the demise of Nangarhar as a major production and trading center since late 2004, this finding supports the conclusion that Helmand is a central market for opium in Afghanistan. Close to the Pakistan border, not too remote from Iran, and also by far the largest opium producing province in the country, Helmand clearly plays a central role in Afghanistan's opium economy. The lack of security and central government control in this province reinforces its status in this regard.

Comparison with Integration in Wheat Markets

The characteristics of wheat markets are different from those of opium markets. Wheat is a consumption good and is needed throughout Afghanistan (whereas opium is mainly destined for export). Markets are more likely to be integrated due to the legality of wheat, and improving infrastructure allows more trade between markets. However, wheat as a low-value bulky commodity faces higher transport costs than opium. Afghanistan is an overall net importer of wheat, contrary to the situation for opium.

Due to the larger number of markets, only co-integration tests are conducted for wheat, which provide a richer set of results than bilateral tests. The main finding is that integration of Afghanistan's wheat markets appears to be stronger than in the case of opium markets, while not being complete. A first look at the data for wheat prices shows that the correlations are a little lower than for opium markets. Two groups of markets seem to emerge: on one side Herat, Jalalabad, Kabul, and Kandahar, and on the other side Mazar-i-Sharif and Faizabad.

Turning to the co-integration tests, since the wheat market did not undergo such a major shock as the Taliban opium poppy cultivation ban, these tests can be straightforwardly applied to the whole period. A group of three markets (Herat, Kandahar, and Jalalabad) show complete co-integration at the 10% confidence level, with co-integration coefficients very close to 1. Moreover, the degree of integration is quite high overall, and the wheat market appears to have been less segmented than the opium market in recent years. Granger causality tests indicate that the price series for different wheat markets have strong connections and that the causality pattern is more complicated than in the case of opium. Given the fact that in most years Afghanistan imports large amounts of wheat particularly from Pakistan, it is likely that the driver of Afghan domestic wheat prices is the wheat prices in neighboring countries, especially Pakistan.

Implications for Counter-Narcotics Strategy and Policies

To summarize, the main findings that emerge from the econometric analysis presented in this section are as follows:

- There are strong correlations between prices in some of the opium markets in

Afghanistan, but with Mazar-i-Sharif and especially Badakhshan appearing to be more isolated.

- In the case of the two markets for which a longer time series of price data is available (Kandahar and Nangarhar), the markets appear to have been integrated prior to the Taliban opium production ban, but thereafter integration was reduced.
- Helmand and Kandahar for all intents and purposes can be viewed as a single opium market.
- Based on analysis of the price data available for recent years, Helmand/Kandahar appear to be functioning as a "central market" for opium in Afghanistan.

Several possible implications of these findings for counter-narcotics strategy and policies can be put forward. First, significant counter-narcotics actions can disrupt opium markets and apparently reduce the degree to which they are integrated. To the extent that efficient market functioning is good for the drug industry, this disruption is a positive outcome. More concretely, such disruptions could result in higher costs, less efficient adjustment to various shocks, and other difficulties for the drug industry. However, the impact should not be overstated, particularly in the case of more localized interventions.

Second, it is doubtful whether the Taliban ban was the major factor behind the reduction in market integration, since it applied to production of and not trade in opium, and since it was applied virtually nationwide. Moreover, there are signs of continuing close links between markets subsequent to the ban. The important finding that the opium markets in Kandahar and Nangarhar were no longer integrated after the Taliban ban most likely is primarily due to the subsequent sharp reduction in opium production and trade in Nangarhar, including raids on and closure of opium bazaars. More generally, the criminalization of the opium trade since 2001, significant (albeit patchy and selective) law enforcement efforts as well as eradication, and associated higher risk premia and likely more extortion of "taxes" from farmers and traders, have probably combined to reduce the openness and integration of opium markets in different parts of the country.

A final question concerns the implications of Helmand/Kandahar functioning as a single market and in particular the implications of Helmand serving as a "central market" for opium in Afghanistan as a whole. Would focusing counter-narcotics law enforcement efforts –notably interdiction of trade and destruction of processing labs and large stocks of opium etc.–on the Helmand/Kandahar nexus be effective in disrupting opium markets more generally in Afghanistan? This question demands further thought and analysis, as although such an approach would appear promising, the high mobility and flexibility of opium production may well reduce the effectiveness of such an effort. For example, the opium economy in Afghanistan overall has continued to thrive even after the successful counter-narcotics efforts in Nangarhar.

VI. CONCLUSIONS

This chapter has presented an initial analysis of prices in the opium economy in and around Afghanistan, along three dimensions: (1) the "time structure" of opium prices, i.e. their evolution over time; (2) the horizontal structure of prices–their spatial pattern, mostly within Afghanistan but with some consideration of the spatial pattern of prices in neighbor-

ing transit countries; and (3) the vertical structure of prices–along the "value chain" from raw opium to processed opiates (especially heroin). Econometric analysis of available time series of opium prices at different locations in Afghanistan has been conducted to assess (4) market integration in the opium economy(based on an explicit technical definition). Some possible implications for counter-narcotics strategy and policies are briefly summarized below (the concluding part of each section provided a more detailed discussion of policy implications).

While data weaknesses and limitations must be kept in mind, nevertheless some of the findings are of interest and have implications for counter-narcotics strategy and policies. These include, among others, the following:

- Opium prices at the farm-gate level do reflect supply factors, risk premia, etc., and hence provide useful information on such developments. However, the existence of sizable (in aggregate) inventories–decisions in respect of which appear to be responsive to price signals–needs to be factored into the equation.
- The value chain for opium/opiates, while anchored in price-taking behavior at either end, appears to involve much more active price setting in the middle stages, where flexible adjustments to shocks (including law enforcement shocks) appear to be the norm. This is not surprising in view of the very large profit margins and relatively smaller number of actors at these stages. It would appear that, however difficult, attacking and disrupting the more secretive and concentrated middle stages of the value chain could have high pay-offs.
- There do not appear to be good reasons to pursue higher prices (in particular at farm-gate level but also for opiates at downstream stages) as a target of counter-narcotics policy in its own right. The key focus should be on reducing illicit drug consumption. Thus demand reduction–whether for final consumption demand or for derived demand for raw opium at farm-gate level (by targeting drug traffickers and processors)–has clear benefits from a counter-narcotics perspective.
- Counter-narcotics actions within Afghanistan (notably interdiction) can disrupt markets and reduce market integration, which presumably is a positive result from the counter-narcotics perspective. In this context, an important question is whether such efforts should be focused, to the extent possible, on the identified "central market" for opium in Afghanistan, i.e. Helmand.

In closing, it should again be emphasized that the analysis, findings, and suggested policy implications put forward in this chapter should be considered preliminary. It is hoped that the paper demonstrates that even with their limitations, available price data on opium and opiates are useful and worthy of analysis. It is also hoped that the findings of the paper provoke further thought, discussion, and research.

ANNEX 5A: OPIUM/OPIATES PRICE DATA FOR AFGHANISTAN AND NEIGHBORING COUNTRIES

Table 5A.1: Opium Price Series

Date	Nangarhar	Kandahar	Date	Nangarhar	Kandahar	Helmand	Badakhshan	Mazar	Herat
01/01/1997			01/15/2002	423	407				
02/01/1997			02/15/2002	409	395				
03/01/1997	93		03/15/2002	416	343				
04/01/1997	102		04/14/2002	583	450				
05/01/1997	108		04/25/2002	361	385				
06/01/1997	114		05/07/2002	381	304				
07/01/1997	91		05/15/2002	444	376				
08/01/1997	97	34	05/20/2002	444	380				
09/01/1997	97	33	06/09/2002	514	480				
10/01/1997	86	33	06/15/2002	514	436				
11/01/1997	83	30	07/15/2002	380	422				
12/01/1997	66	34	08/15/2002	398	350				
01/01/1998	67	46	09/09/2002	418	370				
02/01/1998	76	53	09/23/2002	434	414				
03/01/1998	95	41	10/01/2002	450	430				
04/01/1998	70	38	11/30/2002	481	538	541			
05/01/1998	65	38	12/15/2002	506	602	602			
06/01/1998	83	44	12/31/2002	524	556	553			
07/01/1998	54	49	01/15/2003	512	640	642			
08/01/1998	55	67	01/31/2003	499	609				
09/01/1998	63	54	02/14/2003	529	577	579			
10/01/1998	78	59	02/28/2003	447	577	553			
11/01/1998	96	54	03/15/2003	445	509	509			
12/01/1998	101	56	03/31/2003	381	444				
01/01/1999	116	59	04/15/2003	299	386	386			
02/01/1999	100	60	04/30/2003	355	426				
03/01/1999	100	50	05/15/2003	430	469	470			
04/01/1999	80	45	05/31/2003	416	452				
05/01/1999	91	43	06/15/2003	353	436	434			
06/01/1999	86	41	06/30/2003	339	415	416			
07/01/1999	82	37	07/15/2003	353	423	425			
08/01/1999	62	39	07/31/2003	327	379	379			
09/01/1999	61	36	08/15/2003	272	375	376			
10/01/1999	40	33	08/31/2003	286	432	435			
11/01/1999	38	31	09/15/2003	261	312	311			
12/01/1999	39	32	09/30/2003	247	321	326			
01/01/2000	41	31	10/15/2003	221	303				
02/01/2000	43	30	10/31/2003	197	249				
03/01/2000	46	29	11/03/2003	219	225				
04/01/2000	44	30	12/03/2003	229	203				
05/01/2000	42	30	01/01/2004	211	184				
06/01/2000	38	31	02/01/2004	184	177				
07/01/2000	44	35	03/01/2004	193	159	163			
08/01/2000	87	78	04/01/2004	176	154	155			
09/01/2000	76	43	05/01/2004	138	145	147		98	163
10/01/2000	124	70	06/01/2004	143	143	143	84	101	176
11/01/2000	107	61	07/01/2004	140	98	113	111	75	146
12/01/2000	159	101	08/01/2004	126	142	156	121	76	254
01/01/2001	173	128	09/01/2004	129	223	224	118	195	
02/01/2001	214	162	10/01/2004	158	197	197	137	99	
03/01/2001	367	205	11/01/2004	158	197	235	224	161	
04/01/2001	383	260	12/01/2004	273	234	202	147	111	
05/01/2001	398	270	01/01/2005	190	222	222	165	107	310
06/01/2001	368	250	02/01/2005	165	173	173	167	95	263

Date	Nangarhar	Kandahar	Date	Nangarhar	Kandahar	Helmand	Badakhshan	Mazar	Herat
07/01/2001	424	288	03/01/2005	166	149	151	160	87	241
08/01/2001	657	446	04/01/2005	156	148	148	152	91	200
09/10/2001	700	650	05/01/2005	141	115	115	164	83	162
09/15/2001	194	180	06/01/2005	137	165	162	112	60	219
09/24/2001	95	90	07/01/2005	187	188	188	127	89	228
10/10/2001	134	150	08/01/2005	208	173	174	160	102	231
10/15/2001	190	327	09/01/2005	207	159	159	157	85	228
10/28/2001	210	270	10/01/2005	205	142	142	157	85	217
11/01/2001	327	340	11/01/2005	200	132	134	155	104	208
11/05/2001	330	350	12/01/2005	213	128	128	161	103	182
11/19/2001	343	364	01/01/2006	211	129	129	161	92	204
12/15/2001	316	275	02/01/2006	208	129	129	145	130	199

Source: UNODC Opium Price Monitoring.

Data Collection

Two series of price estimates are available.

- UNODC conducts regular opium price monitoring, collecting fresh and dry opium prices from farmers and traders monthly in several provinces, (the data are shown in Table 5A.1). About 170 farmers and 160 traders are interviewed each month.
- Second, as part of the opium survey, price data are collected in Afghan villages, through surveys led by UNODC's field offices. Surveyors are selected from a pool based on their performance and are trained specifically for these operations. The sampling of villages is made following a stratified sampling method (each village was placed in a category depending on its irrigation or rain-fed situation). Six percent of villages were randomly selected in each category.

Important constraints which affect the use of these data are listed below:

- The frequency of collection is sometimes inadequate, and moreover as indicated in Chapter 4, substantial daily fluctuations in prices can occur, although only monthly prices are reported.
- Data are only available recently (2004 or later) for most of the regions and only since 1997 for Nangarhar and Kandahar.
- Price data are regulary collected only in a few provinces.
- They are published as provincial averages even though significant sub-provincial price discrepancies can be expected to exist.

All these caveats are related to the particular nature of the opium trade, and UNODC's data provide very useful information in an area where data are scanty and hard to collect. The methodology used by UNODC gives acceptable error margins, sufficiently low to support various estimates and statistical tests.

At the downstream end of the chain (see the following tables) data constraints are also severe and levels of uncertainty are high. Evaluation of opiates and opium prices in neighboring countries is made difficult by the general uncertainty related to the environment in which data are collected (urban versus rural areas, for example); the exact purity, quality, and origin of the products sold (there can be large differences); and the time at which price collection is made (often annual averages are reported).

Hodrick-Prescott Filter

Hodrick and Prescott (1980) have established a methodology to obtain smoothed time series. This methodology consists of optimizing, for a time series $\{p_t, t = 1,..., n\}$, a criterion represented below, with $\{\tilde{p}_t, t = 1,..., n\}$ the smoothed series :

$\min_{\tilde{p}_1,\tilde{p}_2,...,\tilde{p}_n} \left\{ \sum_{t=1}^{n} (p_t - \tilde{p}_t)^2 + \lambda \sum_{t=2}^{n-1} ((\tilde{p}_{t+1} - \tilde{p}_t) - (\tilde{p}_t - \tilde{p}_{t-1}))^2 \right\}$ where λ is suitably chosen (i.e. its value is adapted to the frequency of the data–monthly, quarterly, yearly…)

In this study, the value chosen for λ is 14.400 as this is considered to be an appropriate smoothing parameter for monthly data.

Estimates of the Border Price for Opium and Heroin

The border price for opium, shown in Table 5A.2, was estimated as follows :

- estimated share of opium going to Iran: around 90 %
- estimates share of opium going to Pakistan: 6 %
- estimated share of opium going to Tajikistan: 4 %

These export share estimates were made according to UNODC's estimates based on seizures in neighboring countries. They can differ significantly from the actual shares but are considered to be decent estimates.

Table 5A.2: Opium Price Estimates (Farm-gate and Border)

	Dry opium	Small traders	Opium price in Iran	Opium price in Tajikistan	Opium price in Pakistan	Border
2000	50	55	400	190	113	375
2001	430	450	1090	310	427	1019
2002	405	420	1300	480	590	1222
2003	425	440				1222
2004	142	150	745	600	445	721
2005	138	150	930	363	314	860
2006	150	160				

Source : UNODC Opium Surveys, and Drug Reports.
Border price in 2003 was taken as in 2002 because of lack of data

The border price for heroin, shown in Table 5A.3, is calculated as follows:

- estimated share of heroin going to Iran: 30 %
- estimated share of heroin going first to Pakistan (much of it onward to Iran): 50 %
- estimated share of heroin going to Tajikistan: 20 %

These export share estimates were made according to UNODC's estimates based on seizures in neighboring countries. They can differ significantly from the actual shares, but no firm information is currently available to improve the estimated shares.

Table 5A.3: Estimates of Border Prices of Opiates

	Dry opium : 1 kg	Dry opium needed Ratio 6:1	Dry opium needed Ratio 8:1	Heroin price in Iran	Heroin price in Tajikistan	Heroin price in Pakistan	Border
2000	50	300	400	2400	1270	1709	1829
2001	430	2580	3440	3312	3000	2392	2790
2002	405	2430	3240	3410	4750	4113	4030
2003	425	2550	3400				4030
2004	142	852	1136	3900	5500	3445	3990
2005	138	828	1104	3800	4375	3459	3745
2006	150	900	1200				

Source : UNODC Opium Surveys, and Drug Reports
Border price in 2003 was taken as in 2002 because of lack of data

ANNEX 5B: STATISTICAL TESTS OF MARKET INTEGRATION

Pair-wise Correlations

The pair-wise correlations are calculated as follows :

For two prices series $p_{t,t=1...n}$ and $q_{t,t=1...n}$, the correlation between the two series, noted $\rho(p,q)$ equals $\frac{\sum_t (p_t - \overline{p})(q_t - \overline{q})}{\sqrt{\sum_t (p_t - \overline{p})^2 . \sum_t (q_t - \overline{q})^2}}$, where $\overline{p}$ and $\overline{q}$ are respectively the means of the two series. So this statistic does not give information on the respective levels of the series, but on their variations.

Granger Causality

This concept of causality, introduced by Granger in 1969, consists of asking the question whether knowing the past values of a time series, together with the past values of a second time series, helps in explaining the present value of this second time series. This relation can be reciprocal and this notion is not exactly the same as the more common notion of causation; instead it refers more to a notion of precedence in information. A time series Granger causes another series when the knowledge of its past values provides statistically significant information on future values of the other series.

Testing for Market Integration

Earlier studies on market integration relied primarily on ordinary regression analysis, as developed in Ravallion (1986) and Goletti (1994), until the concept of co-integration was developed by Engle and Granger.

The notion of market integration is quite clear: the different sub-markets are all parts of a single market and share the same information and shocks. Practically, when working with price series, this means that there is effective transmission of a price shock or of a variation of price in one market to all the others, within a short period of time.

The concept of co-integration is based on the notion of integrated time series (i.e. of the form : $p_t = p_{t-1} + \delta_t$, an autoregressive time series with a unit root, noted I(1)). Such series are non-stationary, but some linear combinations of two or more of them can be stationary. When this is the case, the two or more series are said to be co-integrated, and the stationary linear combination is called a co-integration equation. For two price series, being co-integrated means having a long-term relationship which prevents them from moving too far away from each other. This concept is closely related to the notion of market integration.

It should be noted that neither definition requires that prices in different markets stay at or converge toward exactly the same level. Transport costs and other factors could result in long-term price differences for markets that are fully integrated. Thus the notion that prices move more-or-less in the same direction and do not diverge too much from each other over the medium-term is key.

It should also be kept in mind that assessing market integration based on price series is not straightforward, as common trends or variations can sometimes be caused by unobservable effects (common weather conditions for example) and different price evolutions could be caused by various reasons other than lack of market integration (institution of a tax in a particular market, for example).

Goletti-Ravallion

In this methodology, how prices in one market are determined by their own lagged levels and the lagged prices of other markets is assessed.

With respect to the analysis of opium prices in Nangarhar and Kandahar, this technique involves the estimation of the following equation:
$p_{n,t} = \sum_{i=1}^{L} \alpha_{ni} p_{n,t-i} + \sum_{i=0}^{L} \beta_{qi} p_{q,t-i} + X_{n,t}\gamma_n + \varepsilon_{nt}$ with $\varepsilon_{n,t} = \rho_{n,t}\varepsilon_{n,t-1} + \eta_{n,t}$ and $\eta_{n,t}$ is white noise, i.e. a random process normally distributed with expected value of zero and a constant finite variance. The term n refers to Nangarhar and q to Kandahar, $P_{n,t}$ is the price on the Nangarhar market at date t, is a vector of exogenous variables, and L the number of lags chosen. To refine a little (and as in the paper by Ravallion), we consider that the residual is AR(1).

Four tests can then be implemented, corresponding to different hypotheses :
- Market segmentation : $H_0 : \beta_i = 0$, for all i : the other market has no influence on the considered market.
- Short-run market integration : $H_0 : \beta_0 = 1$: all the variations in the prices of the other market are immediately and completely communicated to the reference market.
- Long-run market integration : $H_0 : \sum_{i=1}^{n} \alpha_i + \sum_{i=0}^{n} \beta_i = 1$: in the long-run, prices are constant over time and this causes . $p_n^*\left(1 - \sum_i \alpha_i\right) = p_q^* \sum_i \beta_i + X_n\gamma_n$.
- Weak integration : $H_0 : \sum_{i=1}^{n} (\alpha_i + \beta_i) = 0$: all the lagged effects compensate.

This methodology is quite simple, and allows the testing of different assumptions, but it is not adapted for analysis of integration across a large number of markets.

Co-integration

The main criticism of the Goletti-Ravallion methodology is the rigidity of the possible structures exhibited (only bilateral integration can be tested or radial market structure, i.e. a central market to which all the others are linked without having connections other than through the central market).

The first step leading to a co-integration analysis is to check whether the time series are integrated or not. For this purpose, an augmented Dickey-Fuller test on the log-prices in wheat and opium markets was used. The results are not presented here, but the main finding is that the hypothesis of the existence of a unit root could not be rejected at the 5% level for any of the series and the periods considered.

The methodology used in this paper to measure to detect and analyze market integration is the same as in Gonzalez-Rivera and Helfand (2002) and in Jha, Murthy and Sharma (2005).

It consists of evaluation of a VAR mechanism in the following form:
$P_t = A_{n\times s} f_t + \tilde{P}_t$ where $P_t = \{p_{1t}, p_{2t}, ..., p_{nt}\}$ is the vector prices in the different markets at date t. f_t is a s*1 vector of common unit root factors, and $\tilde{P}_t$ is a vector of stationary components. With this representation, the different prices move together in the long run, and this representation is valid when there are n-s co-integrating vectors. The elements of the matrix A and the common factors are determined using a vector error correction model (because of the Granger theorem, such a VAR mechanism can be rewritten as a vector error correction model), and the number of co-integration equations can be found. Complete integration is considered to be present when n markets share n-1 co-integration equations, and the methodology used here consists in searching the largest groups of *p* markets which share *p*-1 co-integration equations.

The use of such a methodology gives an idea of the spatial extent of market integration but there still lacks a conclusive way to analyze the degree of integration. So for the purposes of this paper, conclusions were drawn only about the spatial extent of market integration.

It should be noted that the co-integration coefficients can be interpreted as long-term elasticities when the logarithms of the variables are used. The demonstration is technical and appears in a paper by Johansen (2005) but can be more intuitively and imprecisely explained since the long-term equation with log prices could be written as follows:
$\log(p_{t,\infty}) = \alpha.\log(q_{t,\infty})$ with p_t and q_t the prices in two different regions.
This gives: $p_t = q_t^{\alpha}$ and α can be interpreted as the long-term elasticity of p_t to q_t.

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