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## The East German Cement Cartel : An Inquiry into Comparable Markets, Industry Structure, and Antitrust Policy

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*Dresden Discussion Paper Series  
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**The East German Cement Cartel:**  
**An Inquiry into Comparable Markets,  
Industry Structure, and Antitrust Policy**

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*Dresden Discussion Paper in Economics No. 04/04*

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# The East German Cement Cartel: An Inquiry into Comparable Markets, Industry Structure, and Antitrust Policy\*

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## Abstract:

Maintaining sufficient levels of competition ranks among the core interests of any national – and increasingly international – antitrust policy; however, the formal proof that a cartel really functioned economically and did not only exist in a legal sense is hard to deliver: market power is not identical to the existence of a legal cartel unless the monopolistic frontier is reached; the legal proof of a cartel does not imply that the market was harmed. From an economic point of view, focusing on legal proof of a cartel is fruitless unless collusion resulted in excess profits or excess revenues. This economic evidence, however, rests empirically on the proper definition of comparable markets, and a sound statistical methodology.

When in spring 2003, the German Antitrust Agency (GAA) fined the German cement industry €661 million for having established quotas in each of the four market regions through the end of 2001, the legal issue seemed beyond doubt as, beside formal inquiries, two of the industry members had acted as key witnesses. However, the economic implications drawn by the GAA remain doubtful. In this paper, we use the quota agreement in the East German market, the region for which these allegations are undisputed by all major suppliers, as a reference case. We challenge the GAA's computation of excess income of 10 €/ton on two grounds: (i), the comparative market period chosen, 2002, does not meet the requirements of a reference market, especially regarding a certain level of stability and converging prices; (ii) three parallel developments could have triggered the price decline: the openly announced end of the quota cartel, which generated general price-setting insecurity (ii-a), the price war triggered by one of the oligopolists, who desperately tried to improve poor utilization of capacity and squeeze out competitors (ii-b), and the general decline in construction activity (ii-c). Within the framework of an econometric model based on data of one German cement producer, we find that sufficient levels of competition prevailed throughout the cartel period. Furthermore, the demand structure did not change from 2001 to 2002 so as to suggest a fundamental change in competition. Finally, no excess income or profit can be computed. In fact, we show that the general demand regime estimated for the period 1995 to 2001, which is the period of alleged market power, equally well describes the market condition of 2002. Price war and a collapsing construction market lead suppliers to maintain levels of production and capacity utilization, thus sacrificing profits at the expense of the market shares of small and medium-sized suppliers independently from the cartel issue. This empirical finding of an agreed but ineffective cartel is supported by theoretical evidence on the conditions under which cartels can work effectively – which did not exist in the East: strong import competition, a high level of transparency limiting the effects of “cheap talk” and spatial pricing that generates local market power in the absence of cartels. Furthermore, general supply-side conditions in the cement industry suggest that a considerable level of imperfect competition is structurally unavoidable; antitrust possibilities that in the short run enforce additional competition based on the wrong assessment of effective collusion may lead to exits and less competition in the long run. We conclude that the methodology described may be useful for antitrust policy as it offers a credible analytical tool to compute excess income and profit.

JEL-Classification: L4, L8, C2

Keywords: antitrust, cement, competition, collusion, Germany, econometrics, excess income, excess profit, quota agreement

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# 1. The Economic Perspective of Antitrust Policies

## 1.1 The General Antitrust-Policy Background

Antitrust policy generally concentrates on the legal questions of identifying collusion in markets. As KÜHN (2001) observes, economic research has made considerable progress in identifying conditions, under which collusion is likely and / or can be maintained. However, antitrust policy focuses on legal aspects of collusion, i.e. formal proofs for the existence of price or quota settings. Thus, verification in court is much easier with respect to legal aspects, i.e. through crown witness arrangements, than with respect to the incurred economic inefficiency. If prices and quantities were at the monopolistic frontier, the economic issue could be resolved easily; however, this is rarely the case. Then, the methodology employed identifies comparable markets that analyze the price mechanism and provide references with respect to normal prices and normal profits. However, how can the case be resolved if no comparative market exists?

In this paper, we take up the case of the East German Cement Cartel. We use the case as an appropriate reference structure to show in the theoretical sections

- the limits of using the concept of “comparative markets” in highly specialized industries;
- the appropriateness of defining “hypothetical reference markets” which leads to a reference model of competition in a certain industry – in our case: the cement industry;

We further proceed, in our empirical sections, into the econometric analysis of demand in order to inquire into potential changes in market power stemming from the end of the cartel at the end of 2001. This is imbedded in the historical case of the privatization of the East German Cement Combine (Kombinat) that very strongly determined the initial market structure.

## 1.2 The Ruling of the German Antitrust Agency

In April 2003 the German Antitrust Agency (GAA) levied a fine of €661 million against the leading six German producers of cement. They were accused of having illegally increased prices by establishing regional quotas; furthermore, they were accused of conduct that resulted in reduced competition in this market. The fines set were as follows:

**Table 1: Main Defendants in the Cement Antitrust Case**

Company	Controlling Interest	Fine (in € million)
Heidelberger Cement AG		252
Schwenk Zement KG		142
Dyckerhoff AG	Buzzi, Italy	95
Lafarge Zement GmbH	Lafarge, France	86
Alsen AG	Holcim, Switzerland	74
Readymix AG	RCM, England	12
<b>Total</b>		<b>661</b>

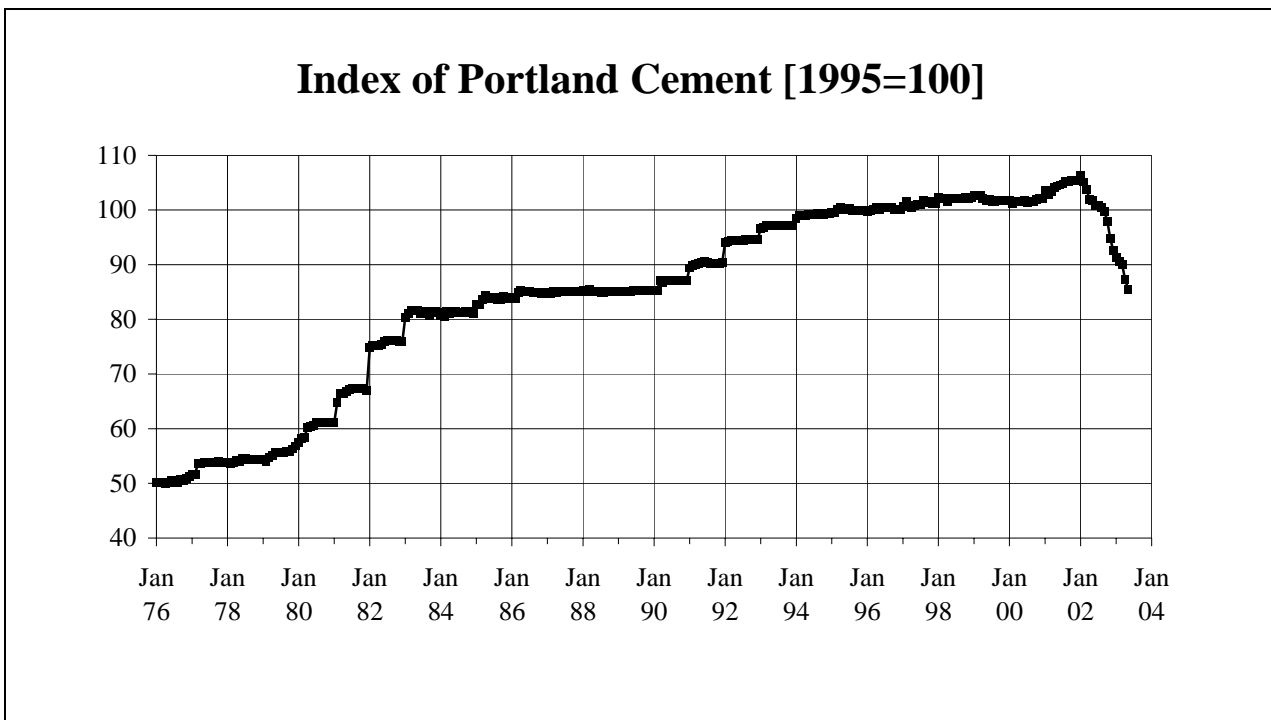
The fines levied by the GAA were set within the framework of the German Act Against Restraints of Competition (GWB)<sup>1</sup>. First, the illegal behavior is punished; then the additional income and the additional profit are measured in order not to make illegal behavior worthwhile; finally, increases or

<sup>1</sup> Gesetz gegen Wettbewerbsbeschränkungen, §§ 81, 34 GWB.

reductions to fines may be made to account for especially high levels of misconduct, i.e. a repeated offense, or cooperation, i.e. a key witness privilege.

The cartel, which according to the GAA had existed in the four market areas of Germany, the East, the North, the Central West and the South, came to an end in 2001. This allegedly led to a sharp drop in cement prices in Germany. However, at the same time, one of the large suppliers had started a ruinous price war that extended, because of multi-market competition, with some time delay first to the North and the Central West and then to the South. In addition, a continuing decline in construction activity led to a further drop in capacity utilization and thus exerted further pressure on prices because suppliers needed to maintain minimum production levels.

**Figure 1:**



The GAA used the market structure, in particular the price structure of 2002, as the comparative market period and calculated an additional income for the alleged participants of 10 € per ton – which, if multipliers accounting for the severity of misconduct are included, yields the above-mentioned fines for the period covered, which covers 5 years before the GAA’s ruling, i.e. 1997 to 2001. These arguments put forward by the GAA leave the following questions open and make the issue interesting within a more international framework of antitrust policy:

1. What justifies using the 2002 period as an acceptable reference period?
2. What are the intrinsic characteristics of a comparative market period?
3. How can different influences on the price of cement, i.e. the end of the cartel, a steep decline in demand because of the downswing in the construction industry, and the price war started by one competitor be separated and attributed to the price decline?
4. What approaches are theoretically and practically suitable for a calculation of additional revenue, i.e. distinguish between fully competitive and monopolistic price regimes? To what extent do external influences such as the aggregate demand for cement or changes in risk-revenue profiles influence this reasoning?



5. How can market dominance or market power be identified, and has a sufficient<sup>2</sup> change in the level of competition occurred from 2001 to 2002, i.e. can it be shown that a pre-existing and allegedly effective cartel has been dissolved?

In this paper, we will analyze these questions with reference to the East German cement cartel, because this is the only cartel affirmed by the defendants. This cartel came into existence after the privatization of the East German Cement Kombinat. Because of the politically-driven push towards large-scale production in all industries, the German Democratic Republic (GDR) had only a few suppliers serving their districts and producing for export. Thus, the present East German market is rather “cleansed”, i.e. there are four major and a number of medium-sized suppliers with a limited technological spread.

We proceed as follows: we start with a brief survey of the development of the East German cement market after unification; we then show why economic rigor is crucial in antitrust cases; this is extended to three aspects, namely the appropriateness of the reference market chosen by the GAA, the search for changes in competition levels after the end of the quotas, and the price-setting strategies. An attempt to quantify excess income and excess profit is made based on data of one of the German cement producers who has – depending on demand levels - a share of 5 % - 10 % in the total market; finally, a summary of what antitrust policy can learn from this case is offered.

## 2. Historical Background

### 2.1 *Treuhand Requirements*

The rules set by the Treuhand Anstalt (The German Privatization Agency for Unification) required the priority of private over public reorganization and binding rules on employment and investments which accompanied public loans and subsidies. In many cases, East German assets were worth nothing – often they even had a negative value because of old loans on the books and environmental liabilities. However, an important interest of investors lay in the acquisition of market share as well as the securing of favorable production sites and qualified labor.

### 2.2 *Expectations of Investors in the East German Market*

Given the consumption of cement in West Germany and the necessity for reconstruction in the East, a steady state demand of 7,5m t. to 8m t. seemed realistic<sup>3</sup>. Short-term demand would exceed this level, however, and at the end of the Nineties demand plummeted because of a dramatic drop in construction activity, as we see in Figure 2. Imports played a decisive role until the end of the Nineties, because other countries, in particular Poland and the Czech Republic, dumped large quantities into the East German market in order to earn hard currency and utilize old capacities that would have to be closed with the ongoing integration into the European Union. This preceded the alleged breakup of the cartel; imports fell drastically with the modernization of the plants and the shrinking of the East German market from 2000 onwards.

### 2.3 *Division of Markets*

Four large investors, *Dyckerhoff*, *Lafarge*, *Readymix* and *Schwenk* entered the East German market, which was split up according to the delivery structure of the East German cement *Kombinat*. *Schwenk* (21 %) acquired Bernburg, *Dyckerhoff* (22 %) Deuna, *Readymix* (25 %) Rüdersdorf near Berlin and *Lafarge* (32 %) Karsdorf (the figures in parentheses represent rounded average market

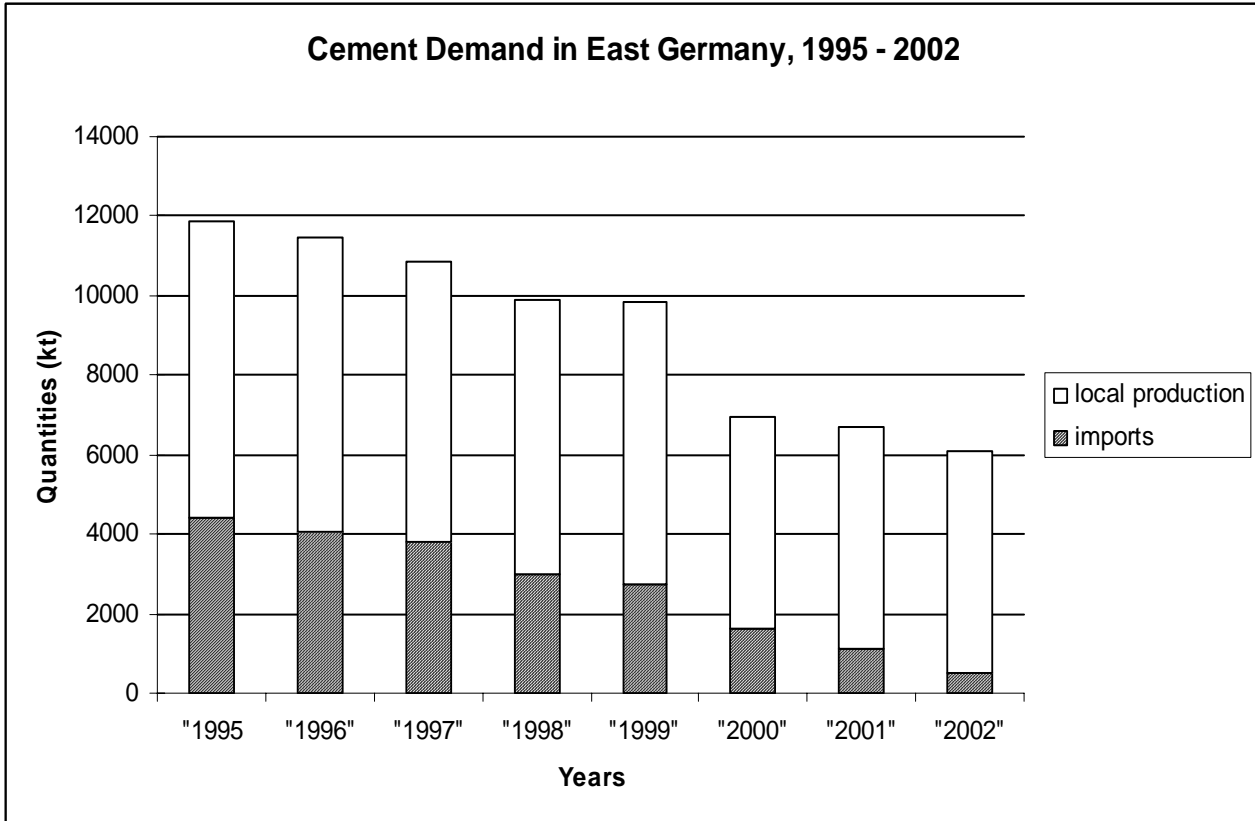
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<sup>2</sup> We assume a change in the competition level to be relevant if its identification is possible in the demand function.

<sup>3</sup> Total capacity was about 12 mill. tons in 2002.

shares of the four suppliers only). These four represented about 40 % - 80 % of the market of national suppliers, i.e. medium sized firms in the East and other importers from West Germany. In the mid-1990's, the four large investors only had a share of about 60 % of the market, as 30 % had been absorbed by imports from Eastern countries. Thus a varying share of about 10 % to 15 % was captured by smaller "Mittelstand" companies.

**Figure 2:**



**Figure 3:**

**Locations of Cement Producers in East Germany**  
(O no own *clinker* production)



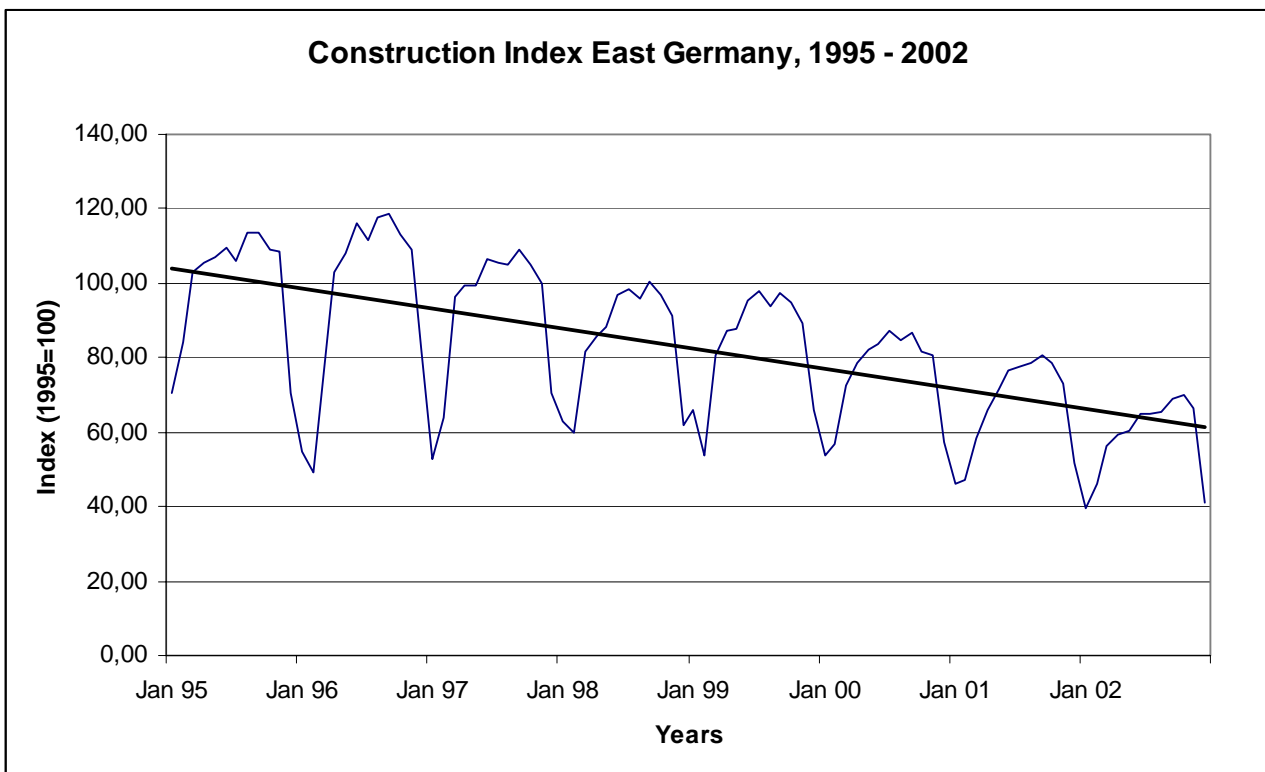
## 2.4 Import Competition, Unregistered Quantities, and Price War

As mentioned before, imports played a decisive role in the East German market. They were offered at delivered prices of about 5 €/ton below the price of local suppliers. This was considered as an offset necessary to compensate for less regular deliveries and sometimes non-existing quality guaranties that have to be offset by an increased input share in concrete production.

From 1994 to 1998, one of the major suppliers dumped 1 million tons of additional cement (“unregistered quantities”) into the Eastern market in order to improve capacity utilization at its plant; these were not reported to the *Bundesverband der Zementindustrie*, whose statistics were used to equilibrate quotas<sup>4</sup>. He was forced to return to agreed quota levels in 1999. In early 2002, this supplier started a price war, again to improve capacity utilization. At that time demand for construction in East Germany had fallen to an all-time low. Constant decreases in increments translate into exponentially increasing rates of decline. Given an over-proportionate relationship between construction activity and cement use, this exerted accelerating pressure on the cement industry. Figure 4 shows the very cyclical nature of construction volume in East Germany which is neatly followed by cement consumption (see Figure 7).

Imports put pressure on the cartel. Maintaining the agreement made long-term sense to all participants, however, as the possibility of Eastern suppliers producing in dilapidated facilities that did not meet European environmental standards would have to come to an end with their countries’ integration into Europe, the subsequent need to invest as well as the upward pressure on the value of Eastern European currencies.

**Figure 4:**



<sup>4</sup> The reduced volumes delivered by other suppliers, who had the impression of a compressed market, can be seen in Figure 2; the argument will be taken up again in section 5.2.

### 3. Judicial Ambiguity and Economic Theory

#### 3.1 Entitlement and Legal Underpinnings

Because cement is a local good and because of its lack of effects on foreign markets, the case discussed here falls within the jurisdiction of the GAA.

In accordance with § 30 of the Act Regarding Offences (*Ordnungswidrigkeitengesetz*, abbreviated OWiG), the board of directors of corporations and unincorporated associations are regularly accused of committing an offence in their capacity as the legally authorized representative of the company, through whom duties are claimed to have been violated, which relate to the corporation or unincorporated association. Under § 30 OWiG, agreeing to a price-fixing scheme leads to a fine against the corporate representatives and a disgorgement of any excess profit derived by the company in accordance with § 81 GWB.

If the GAA is of the opinion that such price-fixing arrangements can be proven, then a fine is levied in accordance with § 81 para. 1 and 2 GWB and § 30 para. 1 Nr. 1 OWiG. Under §§ 81 para. 2 and 81 para. 1 Nr. 1 GWB, violations of the prohibition against anticompetitive agreements set out in § 1 GWB can be met with fines of up to €500,000.00 (base fine) and beyond this amount up to treble the amount of the excess profits earned on account of the violation (special fine). According to § 30 para. 1 Nr. 1 OWiG, the fine can also be levied against a company if the authorized representative body of a legal person has committed a violation through which duties which affect the legal person are violated, or the legal person benefits from, or was to benefit from, the violation.

The special fine, in relation to the maximum amount of €500,000.00 for the base fine, first becomes relevant if the excess profits exceed €166,667.00 (up to three times the amount of the excess income). Thus in measuring the amount of a potential fine, the issue of the amount of possible excess profits must be analyzed first. Within the resulting framework (base or special fine), the exact calculation of a fine, taking into account the nature of the violator(s) and the violation(s), is to be done in a second step. Here the general criteria for the setting of fines contained in under § 17 para. 3 OWiG are to be observed, including in particular the significance of the deed and the violation being alleged, the gravity of the restraint on competition, the issue of intentional or negligent conduct, the economic situation of the violator as well as principles of proportionality.

In setting the level of the fine the basis used is the additional proceeds, i.e. the additional sales, and not the additional profits. Actual receipts are looked at. Any taxes applied to such proceeds are not deducted in deriving any excess proceeds amount.

According to § 17 para. 3 OWiG, in setting the level of any fine the financial condition of the company is to be taken into account in addition to the significance of the competition law violation. In considering the financial condition of the company, the sales volume is primarily determinative. Losses tend to reduce the amount of any fine. A continued economic decline also influences the level of the fine, since a fine set too high could have a negative impact on the company. In the literature the view is presented that the existence and competitiveness of a company may not be jeopardized by a fine set too high. In the context of determining the abovementioned proportionality of a fine, one must also take into account to what extent jobs might be jeopardized because of a fine. Thus any fine may not disproportionately impact the company and as such may not result in the insolvency of the company. The ability of the company to continue operating can also be observed by arranging for installment payments in the setting of any fine.

Under § 17 para. 3 OWiG the significance of the violation and the accusation made against the violator serve as the basis for setting any fine. Here as well the financial situation comes into play. The

significance of the fine depends upon the factual nature, duration and scope of the violative deed. The extent of the potential harm, the disadvantaging and gravity of protected legal goods and interests are all to be considered. The frequency and duration of similar violations and the way in which they were carried out are to be included in setting the level of any fine, because the fines are meant to prevent the violator and others from further violations.

### 3.2 The Reference Market

Because of the different conceptions of reference markets and the generality of the legal norms set in § 19 Par. 4 No. 2 GWB, the antitrust authorities enjoy rather broad discretion in making decisions in this area. However, they are not entirely free in their choices.

Fundamentally, no market power should exist in a reference market, or it should at least be more competitive than the affected reference market (IMMENGA/MESTMÄCKER 2001, § 19 GWB Rz. 162; BECHTOLD 2002, § 19 GWB Rz. 72). Furthermore, additional norms and limitations stem from the three aspects of reference markets, i.e. the product, geographic and temporal factors.

- (1) The variant of the comparable product market implies a production-technology related similarity between the relevant market, and similarities in input and output delivery structures (BECHTOLD 2002, § 19, Rz. 73). The uniqueness of the cement markets is well reflected in international literature<sup>5</sup> and suggests that essentially there is no way to find a comparable product market.
- (2) In practice, comparable geographical markets play an important role. Thus in the national context, such a choice of market is only possible if the case in question does not cover the whole country. Otherwise, the GAA has to resort to foreign countries (BECHTOLD, § 19, Rz. 73). In our case, as the GAA suspects quotas in all four (sub-) markets of Germany, a foreign market would have to be chosen that has, compared to Germany, a greater level of competition. As the following Table suggests, prices outside Germany in 2002 all considerably exceed those in Germany and it is difficult to imagine that in all cases these higher prices were the result of cartels.

**Table 2:**  
**Cement Prices in Europe, 2002**

Country	Price (US-\$ per t.)	Country	Price (US-\$ per t.)
Belgium	74	Netherlands	74
Denmark	61	Austria	74
Germany-West	46	Poland	66
Germany-East	41	Spain	66
Finland	66	Sweden	66
France	80	Switzerland	108
Italy	66	Czech Republic	74

Source: JP MORGAN 1/2003

- (3) The concept of comparable market periods has historically played a rather minor role. Thus, it is astonishing that it was chosen by the GAA in the cement case. In fact, the GAA used it in the Seventies. In one of these cases, it was heavily criticized for having been manipulated in favor of enterprises. Thus, it is generally accepted that the antitrust authority should only resort to a comparable market period if it is very clear that the preceding market was truly competitive. The argument could run in an analogous way for a later market.

<sup>5</sup> See references in the following chapter

### 3.3 *Conclusions for the Cement Case*

Besides these arguments, the user of reference markets is rather free in selecting the methodology if it is scientifically accepted and complies with the aims of § 19 Par. 4 No. 2 GWB. In fact, it has to be shown that (i) the period of 2002 is acceptable as a reference and that, (ii) because of the quota regimes, excess incomes and profits were generated, i.e. the cartel was effective.

If it can either be proven that

- 2002 is not a reference period, i.e. a comparable market period, or
  - quota regimes did not function and thus excess incomes and profits were not realized,
- the case could be closed.

As it is scientifically much more difficult to provide a general proof and much easier to test a credible counter-example, the latter approach is chosen here to test the solidity of the arguments of the GAA. We do not argue that the quota arrangement did not exist; the only argument is that the choice of a reference market by the GAA is not appropriate to support their case, i.e. for their calculation of excess revenue. We also propose a methodology to economically proceed in this and similar antitrust cases. This complies with the judicial reasoning that the generality in terms of legal prescriptions calls for high scientific standards with respect to the economic methodology, which thus should meet rigorous standards.

## 4. Reference Markets and Models of Competition

### 4.1 *From Relevant to Reference Markets*

The relevant comparable product, geographical market or market period has to be defined by the antitrust authorities. This reference market has to be more competitive than the relevant market in which competition was reduced by quota agreements. Furthermore, the reference market should provide a reference price level, i.e. should benefit from some stability. Figure 5 below comprises these aspects.

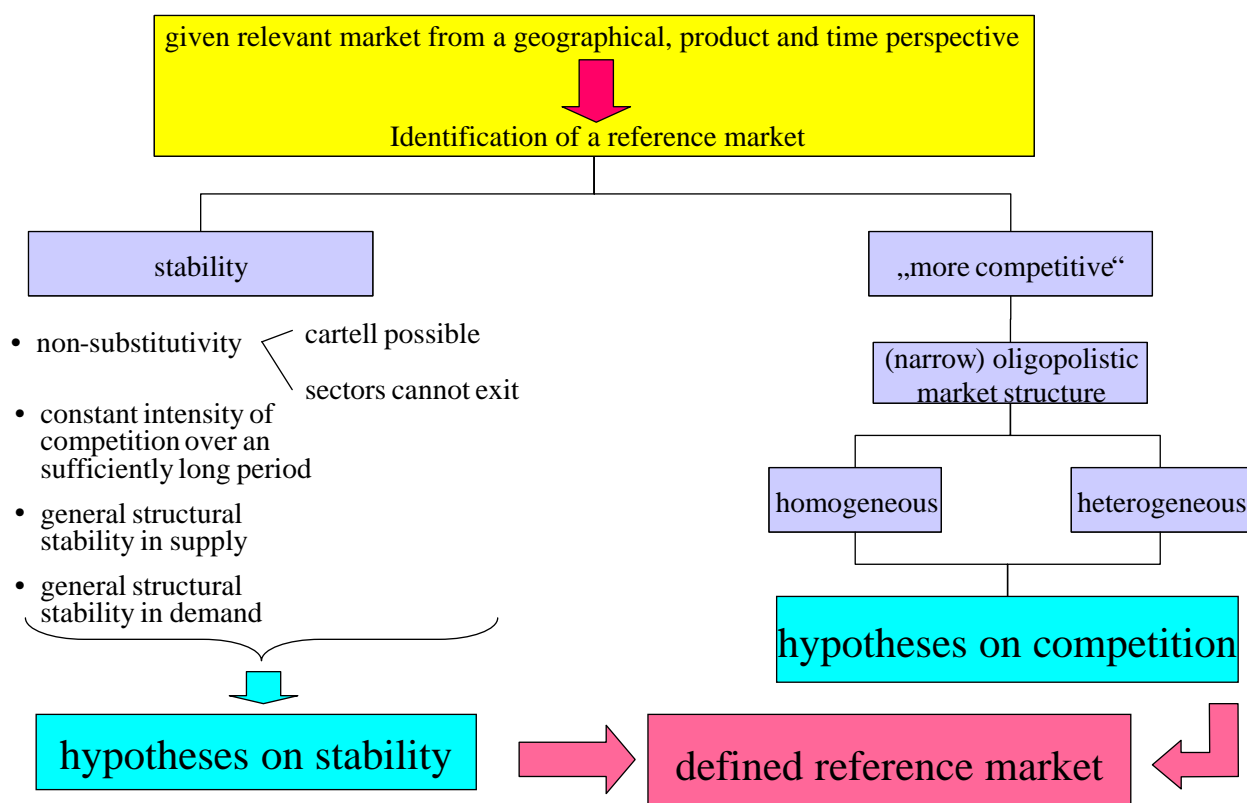
The theoretical argument behind this reasoning runs as follows: market equilibria are stable if no player has a benefit of deviating. This benefit may have a long-term and a short-term perspective. In the short run, underbidding in prices may generate additional revenues for the respective firm; in the long run, it could end in a destruction of all profits (BERTRAND competition). As a consequence, collusive arrangements become more probable – irrespective of their formal or informal level of agreement – if short term gains of price changes are low and long-term threats especially through price wars are credible. The more the number of competitors in a market grows and the more differentiated products become, the less advantageous a price decrease and the less credible retaliations will be as gains in market shares are small and only incomplete substitutes are hit. We would thus expect collusive arrangements especially in narrow markets with homogenous products but we would be unable to distinguish them from competitive regimes with very similar conduct and performance unless outright monopolistic behavior is observed. Even the existence of a formal cartel agreement could, under certain conditions, be irrelevant for the profitability of the firms. An important argument proposed by KÜHN (2001, p. 172+) may provide an important help for identifying the level of economic damage produced by a formal cartel: collusion is especially attractive, if multiple market equilibria exist and, as a consequence, players can, through proper signaling, move markets to a more profitable regime.

In terms of testable hypotheses, this implies that the increased level of competition in the reference market must be stable for a reasonable period that allows a comparison between its competitive and the allegedly non-competitive prices in the cartel period. This is a prerequisite for an accurate calcu-

lation of excess income and profit. It implies that a dynamic equilibrium exists in a reference market which is contrary to the situation of a price war with its constant underbidding.

**Figure 5:**

## From the Relevant Market to the Reference Market



As a next step, it must be shown that the comparable market is itself competitive – which is in fact only a transfer of the problem of identifying and evaluating competition regimes away from the relevant market - the proof of competitiveness of the reference market needs a subsequent reference market (BLUM 2003). As this produces an infinite regress, a theoretical benchmark must be developed. The easiest and cleanest approach would be to compare the inflicted market to a neoclassical reference model<sup>6</sup>. However, real world competition is intrinsically imperfect. Structure, conduct and performance in real world competition could be very close to collusion regimes unless they are fully monopolistic. Thus, the theory of competition only provides antitrust authorities with limited instruments to properly identify efficient collusions.

As price dynamics analyzed in part 5 need not be an unambiguous sign of a functioning level of competition<sup>7</sup>, we will add spatial price setting behavior to our analysis in part 6 and inquire into changes in competition regimes in part 7.

<sup>6</sup> In fact, the GAA always takes reference to “full and unlimited competition”.

<sup>7</sup> The scholar is caught between two arguments: on the one hand, constant prices could describe the situation of a competitive steady state; spontaneous price movements then would be the sign of a cartel playing competition. On the other hand, market-induced price dynamics could be smoothed by a cartel. This controversy is discussed by WHITNEY (1958): the WHITNEY-paradoxon is a situation in which the volatility of a market is artificial to disguise

## 4.2 Rejection of the Reference Market 2002

The East German as well as the whole German Market do not satisfy the stability conditions of a reference market for the following reasons:

1. Stability: the fall in prices in 2002 has not ended in a new equilibrium. The missing support line could be a sign of a typical price war or a simple price overshooting. No price convergence can be found throughout this year. Thus, the future development of prices should be awaited.
2. Unexplained persistence of price differentials: the stable price differential of 10 € per ton between the high-priced North and South German and the low-priced West and East German markets cannot be explained within the context of the same institutional framework, especially if the lower priced eastern market is the only one in which the participation in a quota cartel has not been disputed.
3. Unresolved identification problem: three factors could be individually wholly responsible for the rapid decline in prices: the decline in construction demand; the price war; the formerly increased price levels maintained by a functioning cartel that had ended. The GAA has not provided a model or even a logical structure that proves beyond reasonable doubt that, for the period of 2002, the price decline resulted solely from the end of the quota agreements. In fact, cement prices in Germany started to rise from the mid-1970's onwards, as Figure 1 shows. Construction volume stagnated until German Unification lead to a bubble that peaked in the mid-1990's and later burst as shown in Figure 4. Thus, tremendous drops in demand were recent phenomena in the cement industry.

## 4.3 The Situation in the Cement Industries

### 4.3.1 General Demand Conditions

Cement is a rather homogenous product in a mature market. Demand "breathes" with the market, especially with construction demand. As the input is complementary, often even limiting with respect to construction, demand elasticity with respect to price is close to zero for the total market. However, as individual suppliers compete for market shares, the higher the level of competition, the more the elasticity moves away from zero. Following the general-equilibrium approaches proposed by HARBERGER (1962) and MCLURE (1969), high firm-specific elasticities cancel out in the total because of cross-elasticities.

Because of its homogeneity, cement industries are hardly able to differentiate their products. In fact, differentiation emerges through geography, i.e. spatial pricing. It is an experience good and, thus, standardization plays an important role. In case of special cements, reputation plays a dominant role.

The share of cement in construction costs in general is only about 2%, but for certain construction industries, such as prefabricated components, bridges or tunnels, it is somewhat higher. These customers, often also part of an oligopolistic market, may exert strong pressure on prices.

### 4.3.2 Local Demand, Monopolistic Competition, and Geographic Pricing

Following the definition of STIGLER und SHERWIN (1985), a market is an area within which the prices of a good converge to a single value. Transportation costs may be included in case of complete price differentiation, i.e. if buyers are charged fob-prices. The transportation cost of cement would normally limit its economic distance to about 150 km. However, by means of price discrimination some customers can be charged increased prices, especially in locations close to the mill and/or sufficiently far away from competitors. Given these increased profits, suppliers could enter

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the existence of a cartel. Conversely, parallel pricing may not be the result of a cartel, as the American Tobacco case of 1946 in the US and the Wood Pulp case in Europe of 1985 suggest.



markets of competitors at reduced prices. Excessive “reverse dumping”, especially in case of price wars, would finally result in flat spatial (delivered) prices. Under normal market conditions, prices should vary in space because either market power exists or because distinctly different local market conditions allow increased price levels. For instance, ABBOTT (1994) shows that both aspects are relevant to the US cement industry.

With an increased level of concentration of industry, theory suggests that the ability to keep prices above marginal costs rises (see next section) if demand is not fully elastic with respect to prices – which gives incentives to imports, especially if navigable water access is possible and creates distinct geographic market patterns (DUMEZ, JEUNEMAÎTRE 2000). As ROSENBAUM and READING (1988) observe, these imports will limit domestic market power. The following table gives relevant transportation cost data and critical distances for means of transportation.

**Table 3:**  
**Transportation Costs in the Cement Market**

Transportation Means	Road	Rail	Sea
Loading and commissioning	ca. 3 €/t	ca. 2,5 €/t	-
Transportation	ca. 0,05 €/tkm	ca. 0,04 €/tkm	ca. 12 €/t
Unloading	-	ca. 3,5 €/t	ca. 13 €/t
Standard freight weight	25 t	1300 t	10.000 t
Sum of transport costs*	ca. 8 €/t	ca. 22 €/t	ca. 25 €/t
Critical distance (with respect to)	300 km (rail)	725 km (sea)	

Source: own calculation and D'ASPREMONT et al. 2000,

\* with respect to an average distance of 100km, 400 km and full load

Transportation costs may lead to monopolistic competition; thus, geographic price setting may become telling. Will it be non-discriminatory, which implies competition only where market areas overlap? Or will it be discriminatory, which implies competition in all places? This very much depends on geographic structures and on the gaining of experience in dealing with competitors. Because most firms' suppliers will supply from different locations, multi-market competition exerts a disciplining effect (BERNHEIM, WHINSTON 1990).

### 4.3.3 Sunk Costs

Entry costs into the cement industry – apart from imports – are high and include important irreversibilities because *clinker* production and silos are unique, as are investments in quarries and the respective environmental licenses necessary to run the business. The level of these sunk costs is important to market structure (FUDENBERG, TIROLE 1984; BLUM, MÖNIUS 1997; BLUM ET. AL. 2004). If they are too high, no market entry will occur. If entry is feasible for a (first) monopolist, he may be the only supplier able to make a profit, as additional entries will erode profits beyond sunk cost levels – and entry will be *blocked*. If they are sufficiently low, the incumbent may *accommodate* entry because blocking would be too expensive. Between these two levels, entry may be deterred by varying the price in order to just make entry unprofitable and thus *deter* the entrant. This line of argument is valid for each consecutive entry: at one point in time, a mature and stable market will be reached in which future entries are either impossible – this would suggest a wider oligopoly- or may be deterred – this would suggest a narrower oligopoly. The latter situation is the only market structure where price wars make sense! It may be oriented against local potential entrants or importers.

In order to avoid these wars, the entrant may signal friendly behavior, i.e. enter with limited capacities, which, for instance can be shown for the Norwegian case (SÖGARD 1992). To make entry easier, entrants may wait until incumbents have reached the end of their investment cycle – which will

reduce the length of the cycle as a strategic answer of incumbents and imply that „*best practice technologies*” may prevail (STIGLITZ 1987). Cement industries use the majority of their capital (incl. quarries) for at least 40 years; thus, the technology race argument does not offer any market entry explanation for opportunities.

How would these arguments change under circumstances of excess capacity?

- One argument followed above was that collusion or parallel behavior, by reducing risk, would trigger investment and produce excess capacity that allows market participants to guarantee deliveries, even in situations of very large demand. As long as total capacity installed is not way beyond any possible demand, excess capacity should not destroy the above line of arguments.
- However, if excess capacity becomes even larger than the above-mentioned maximum demand, then some oligopolists might engage in price wars in order to cleanse the market structure. This can only be a successful strategy if differences in technology or differences in financial resources make such a venture viable. But one problem in the cement industry is the ability of market participants to switch off and on certain facilities in response to changing price and demand levels. Thus, such a price war would have to prevail for a period of sufficient duration to erode the financial resources of some incumbents. Most likely, this is the sort of price war observed in the cement market in Germany in 2002.

#### 4.3.4 Process Innovation and Best Practice Technologies

This convergence of productivities will make market exit not a question of production performance but of market performance and – of utmost importance – of financial resources. Furthermore, comparable technologies will induce parallel behavior of incumbents even without cartel agreements, i.e. pooling equilibria will prevail under conditions of stable markets (MILGROM, ROBERTS 1992).

#### 4.3.5 Market Transparency and Strategic Behavior

As D’ASPREMONT, ENCAOUA und PONSSARD (2000) argue, strategic behavior may play an important role in the highly transparent cement market. Thus the choice of a proper reference market becomes a task that is hard to fulfill once a competition regime without market power is sought. The general proposition that welfare increases with a more intensive level of competition finds its limitations if sunk costs exist, because cut-throat-competition à la BERTRAND will narrow the number of suppliers and generate welfare losses (NORMAN, THISSE 1996). Thus, implicit or explicit agreements will develop, i.e. a “*tit-for tat*”<sup>8</sup> in the sense of friendly COURNOT-type quantity competition, which maintains group structure. Then, the antitrust authorities are caught between two evils. This problem was articulated by KANTZENBACH (1966) who defined an “optimal intensity of competition” in a wide oligopoly with sufficient product heterogeneity. He postulated optimal combination of innovation, financing and competition, and this idea was included, in 1973, in the German Antitrust Code (§ 5 GWB) by allowing small and medium-sized enterprises to organize alliances against large incumbents.

The transparency of the cement market also implies that signaling in search of a more advantageous equilibrium may not play a decisive role as “cheap talk” (FARRELL 1987) would not improve common knowledge<sup>9</sup>. Two arguments support this proposition:

1. market transparency is high because little private information on market conditions and technologies (i.e. price structures) exists;
2. even in cases where private information existed, decisions on market conduct are reversible given large capacities – i.e. commitments have no “sunk” credibility.

<sup>8</sup> GARICANO and GERTNER (2000), provide an excellent example for the American airline industry in 1998.

<sup>9</sup> Sometimes government produces increased market transparency in an attempt to increase competition. The result can be entirely adverse, as the case for the concrete industry of Denmark shows (ALBAEK et al., 1997).

### 4.3.6 Consequences for Competition in the Cement Industry

We do not expect low prices, i.e. prices that lead to negative profits and are below the risk-revenue line to prevail over an extended period. If momentarily low prices exist they are generally the result of price wars in an attempt to either prevent potential entrants to enter the market – in our case make imports less attractive<sup>10</sup> – or shake out some competitors – often medium-sized industries<sup>11</sup> – which may then pose a problem for antitrust policies and even for societal welfare (DEWEY 1979)<sup>12</sup>. In the case at hand, the late Nineties would relate to import competition, whereas 2002 to enforcing the reduction of capacity in an already cleansed market. This is formalized as follows in the next section.

## 4.4 A Formal Model of Demand

If we assume that the four dominant face a market demand of size  $X(M)$  that breathes with the level of construction activity,  $M$ . Each of the oligopolists has a market share  $\alpha_i$ . There exists a “competitive edge”<sup>13</sup> of medium size enterprises and importers that offers “extra” quantities  $x_e(q)$  for market prices  $q$ . Given his costs for spatial and other types of differentiation, the supply function becomes in a fob-setting:

$$(1) \quad x_e = \frac{1}{e} \cdot (q - d) .$$

The residual demand function facing oligopolist  $i$  is (where  $f$  is an increasing function):

$$(2) \quad x_i = \alpha_i \cdot (X(M) - x_e - f(d)) .$$

The elasticity of demand with respect to prices is

$$(3) \quad \frac{\partial x_i}{\partial q} \cdot \frac{q}{x_i} = -\frac{q}{e} \cdot \frac{1}{X(M) - x_e(q) - f(d)} .$$

The model explains that

- larger markets  $X(M)$  reduce the (absolute value of the) elasticity of demand facing the individual oligopolist as volume in the denominator rises;
- if prices rise, elasticities, in absolute terms, rise simultaneously because the nominator increases and the denominator decreases (volumes of the “competitive edge” rise because it becomes more attractive to serve the market);
- more product or geographic differentiation,  $d$ , increases absolute values of elasticities because of the costs incurred volume falls (in zones were supply overlaps, demand elasticities are very flexible).

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<sup>10</sup> In fact, in a market, it is hard to distinguish whether an incumbent tries to contest the market of an importer or vice versa.

<sup>11</sup> Some medium-sized suppliers, for instance, do not have their own *clinker* production.

<sup>12</sup> See, for instance, the controversy between FOURIÉ, SMITH (1994, 1995) and LEACH (1994)

<sup>13</sup> HOLLANDER (1990) uses residual demand analysis in cartels to model how quotas originally assigned to downstream producers end up in the hand of upstream producers.

#### 4.5 A Reference Model of Competition

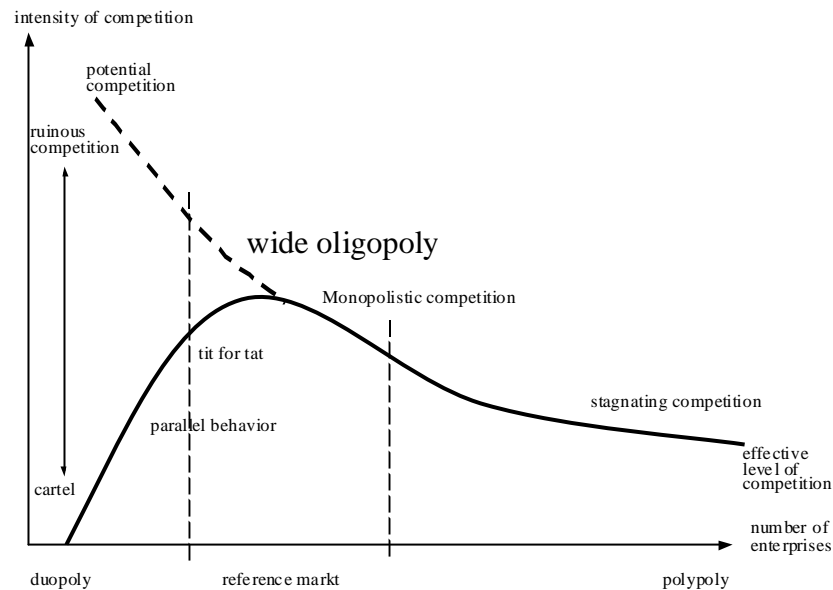
The model of polypolistic competition is entirely inappropriate for describing the true situation of the cement industry. More dynamic concepts are needed. The same applies to the concepts developed by the school of “old industrial economists” (MASON 1939; BAIN 1949, 1968; CLARK 1940, 1955, 1961) because its results are entirely ambiguous with respect to the link between market structure and market conduct, as well as between market conduct and market performance (BLUM 2004a, ch. 14). The radical prescriptions of the supply-oriented school (GILDER, 1981) and the Chicago school (BROZEN, 1975; POSNER, 1976) are of no help, as they limit government to the control of the access to resources and price agreements, not quota agreements. SCHUMPETER (1912) and DEMSETZ (1973, 1994) reverse their arguments as they suggest that an improved market performance, especially through innovation, leads to market power and thus influences industry structure – which is supported by management strategies (PORTER 1994). We thus depart from KANTZENBACH and augment his model by including elements from evolutionary competition theory and new industrial economics (BLUM 2003) with the following properties:

- Market development, especially technological development is path-dependent because of costs sunk into assets and licenses, existing technologies and demand structures; this implies that industry configuration will show strong inertia.
- Market pressure and the homogeneity of the good imply a dominance of process over product innovations, which are organized in series. Periodic price wars whose occurrence should be related to these series of innovations will shake out those suppliers which have not, in due time, reorganized their capital stock.
- Multi-market competition disciplines suppliers, as they know that they can always be hit in their most vulnerable location and market.
- Even in the absence of formal agreements, the homogeneity and the transparency of the industry will encourage a considerable level of parallel behavior and *tit for tat* responses. However, distance and associated transport costs enforce price differentiation, even discrimination. In the latter case, non-zero elasticities of demand likely exist on the company level.
- If low-priced imports exist, i.e. they are not controlled by limitations of market and access, they will play an important role in controlling prices and quantities. Local incumbents will be forced to lower prices to maintain their market or even drive out imports unless importers are treated as partners in the *tit-for-tat* regime<sup>14</sup>. We will not necessarily expect outright price wars but sizeable price turbulences.
- Extended price wars exist under situations of excess capacities far beyond possible future demand volumes. Entrants will try to drive out other entrants. The more cleansed a market is, the more time such a war will take.

Figure 6 depicts this situation. We presume a homogenous product for which differentiation only exists through geographic distance, i.e. through transportation costs. In case of the closest group structure, the duopoly, we would expect a ruinous level of competition – but this is the theoretically limiting case, as neither of the two players can be sure to win such a war for the market, given the very similar technologies. Thus, because of a very credible threat, it is more likely that the two collude and make some sort of explicit or tacit market arrangements even though the temptation to take over the whole market is high.

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<sup>14</sup> Given the fact that lowering the price in order to increase market share will result in a symmetrical behavior by the competitors, the inferior outcome of this prisoner dilemma game will encourage players to seek refuge in cooperation-sustaining strategies, i.e. to become altruistic. From an evolutionary point of view, the repeated prisoners’ dilemma game results in a *tit-for-tat* situation as a likely outcome of reciprocal altruism; see TRIVERS (1971), AXELROD, HAMILTON (1981), BINMORE (1992)

**Figure 6:****A Model of Competition in the Cement Industry**

If sufficient rents exist, market entries will occur and arrangements will become more difficult to sustain. The intensity of potential competition will thus fall and the intensity of effective competition will rise until the two intersect. In this situation of a wide oligopoly, perhaps even accompanied by a heterogeneous group structure, more stability evolves. Oscillation between two equilibria becomes more unlikely. Outright price wars will become rare unless they are triggered by special circumstances. A reference market could thus be established in the area called “*wide oligopoly*”; under certain circumstances, group structure could become – compared to market volume – narrow, the *tit-for-tat* region with its periodic instabilities which will be healed after sufficient experience building or shakeouts of competitors.

## 5. A Time-Series Analysis of the East-German Cement Market

### 5.1 Identification of Market Power

As a main argument, the GAA insinuates that market power has existed over the period in question because of the cartel agreements. This allowed the cement industry to extract a higher price than the price in a fully competitive market. This argument is put to a test within the framework of an econometric model. The concept of excess revenue used by the GAA implies a downward shift of the demand function with the end of the cartel<sup>15</sup>. However, a shift in the demand curve could also be responsible for changes in competition regimes. We thus inquire into a structural break of the demand curve in terms of (i), a structural break, (ii) a change in price regimes and, (iii) functional form. Our analysis is based on the demand function established in section 4, formulae (1-3).

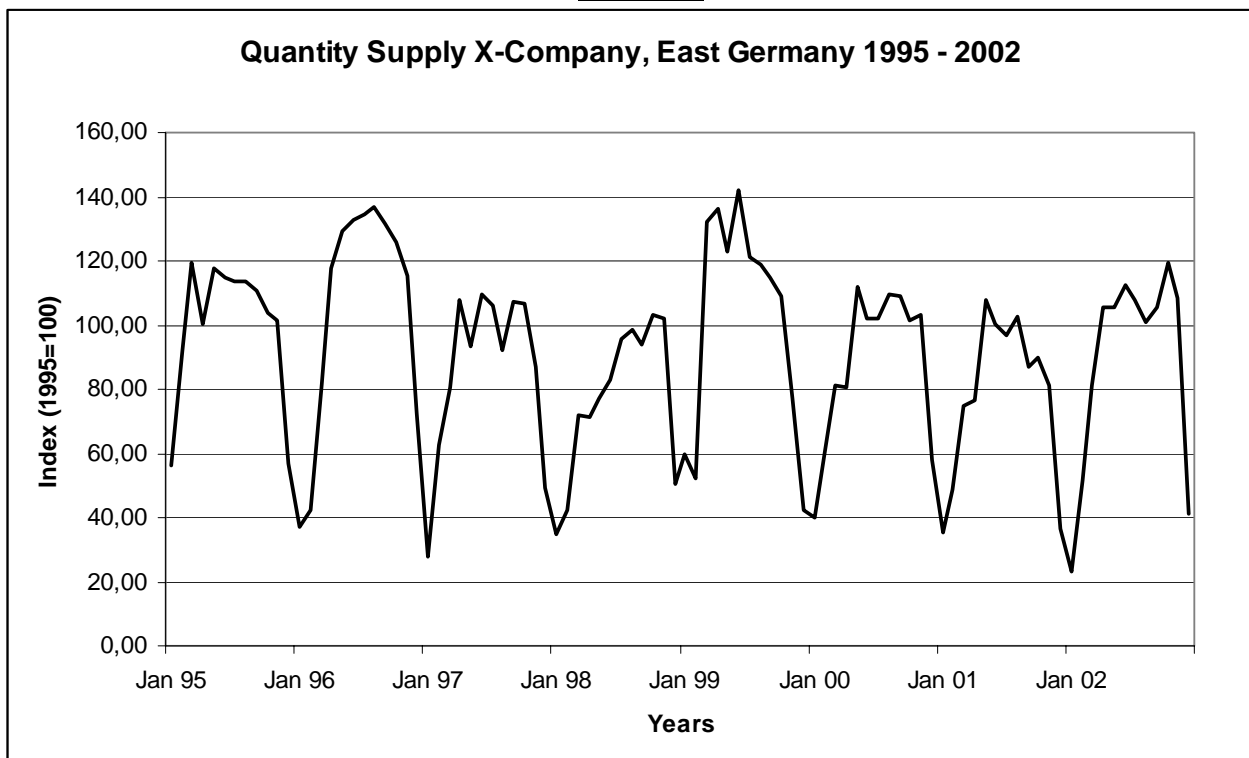
<sup>15</sup> The definition of excess revenue used by the GAA is based on the difference between prices at given quantities, i.e. a shift of the demand function. Due to the existence of additional market power, firms are assumed to extract, at given quantities, higher prices than under competition regimes. However, because of the interaction of prices and quantities, some scholars argue the difference between revenues under cartel conditions, i.e. cartel prices and cartel quantities, and those under competitive conditions should be used; this would imply a shift on the demand function; see KLUSMANN 1999; MEURER 1998; ERLINGHAGEN, ZIPPEL 1974.

## 5.2 Period Covered, Data Used and Economic Significance

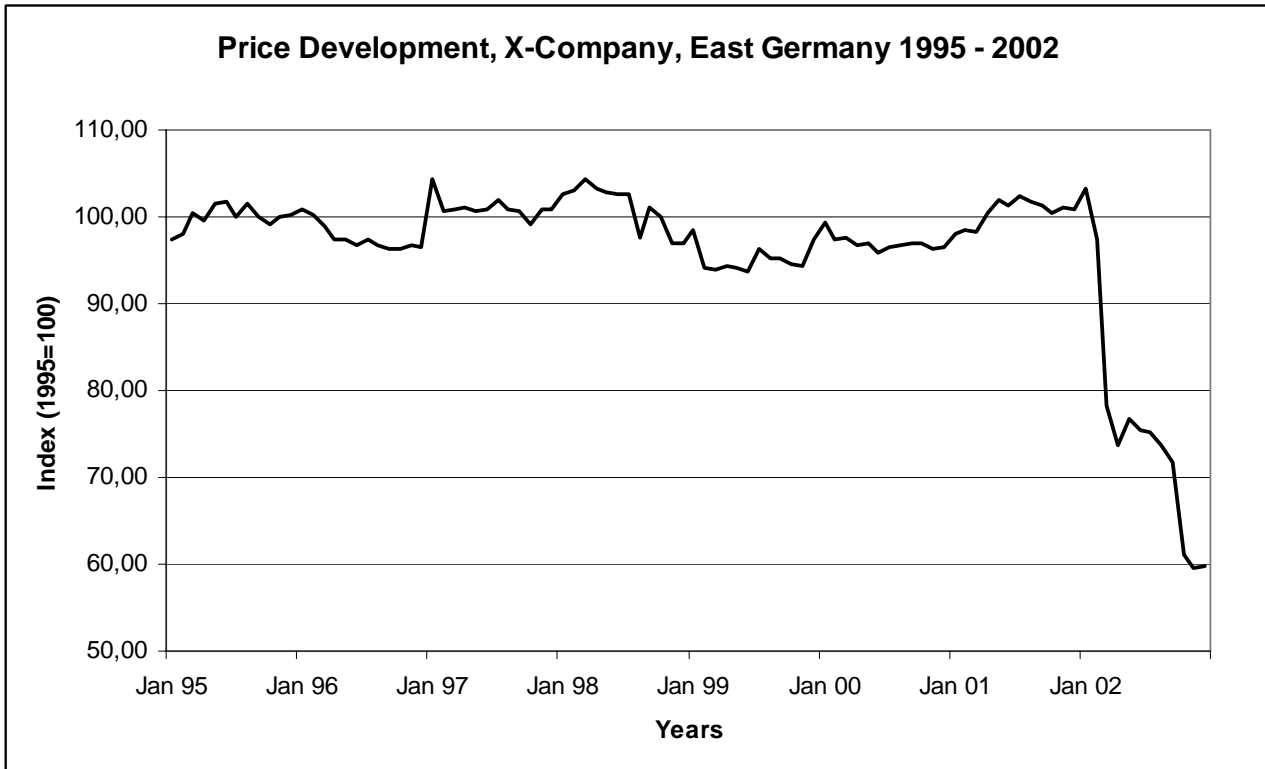
We estimate a demand model for cement for one supplier in the East German market, the X-Company. We used quantities delivered in metric tons as endogenous ( $x$ ) and, as exogenous variables, (cif-) prices ( $q$ ) in €per metric ton, the index of demand in the construction industry ( $Y$ , see Figure 4) and, as a link to the West German market, the ratio between construction demand indices in the West and in the East (WE). The data set is based on monthly data and covers the period from January 1995 to December 2002. We added monthly dummies, if necessary, to account for a seasonal structure where necessary<sup>16</sup>. We thus assume that prices, construction demand and seasonal effects are the general driving forces of demand for cement from X-Company and that certain spillovers between the Eastern and the Western markets are possible. In order to test for a structural break between December 2001 and January 2002, when the cartel broke down, we add a dummy for the 12 months of 2002 in a special regression. Figure 7 portrays the development of quantities – the endogenous; the pattern neatly follows that of construction demand in Figure 4. Figure 8 shows prices, the most interesting exogenous: we see a steep fall in 2002 of some 40 points – it exceeds that of the German average, as West German prices took a dive some months later and dropped at a slower rate. We have translated quantities and prices into indices for reasons of protecting our data source.

For our purpose, the most interesting economic result of the price variable would be a unit elasticity with respect to demand, as this would imply that any change in price is entirely compensated by an opposite change in quantities, thus making any additional or excess revenue impossible. Furthermore, we will test whether changes in demand were price-induced or induced by overall construction demand – or both. This is important as this may provide insights into changes in market power, which should have fallen if an effective cartel had fallen apart.

**Figure 7:**



<sup>16</sup> As an alternative, we could have added an extended BOX-JENKINS-type autocorrelation structure. We refrained from it because of the loss of observations.

**Figure 8:**

### 5.3 Statistical Properties of the Data and Estimation Techniques

#### 5.3.1 Stationarity of Time Series

Given the price-setting behavior of the cement industry, i.e. the strong stickiness for reasons of oligopolistic interaction unless price wars occur, autocorrelative structures are very likely. Thus, we first tested the stationarity of all time series (taken to the log as we use a multiplicative COBB-DOUGLAS-type demand function) using the ADF-test. Only in the case of the variable relating western and eastern construction demand, we discovered a borderline case of non-stationarity for which rejection at the 1 % level was not possible. Thus, we also employed the PERRON test which clearly suggested stationarity. The sharp price decline shown in Figure 8 suggests that, at least from the end of 2002 onwards, the price series is no longer stationary. However, the test for the total series of 96 observations clearly rejected the hypothesis of stationarity; a separate analysis of the last 12 months is not meaningful.

#### 5.3.2 Estimation Techniques

We used the EVIEWS program package and least squares with ARMA-terms for our initial models based on a multiplicative form (i.e. all quantitative data was taken to the log). The underlying assumption of an isoelastic demand function, however, is open to challenges and by definition does not allow us to inquire into any changes of elasticities over time if they exist. Thus, we tested the functional form of the equation using the TRIO program package, which allows BOX-COX-transformations for quantitative variables. The function estimated thus was

$$(4) \quad x_t = c \cdot q_t^a \cdot Y_t^b \cdot WE_t^e \cdot e^{\sum_{i=1}^I f^i \cdot d_t^i} \cdot e^{\mu_t}, \quad t = 1, 2, \dots, 96$$

where  $x_t$  is the quantity of cement consumed in period  $t$  at prices  $q_t$  at a given level of industry demand,  $Y_t$ .  $WE_t$  captures the ratio between western and eastern demand levels in order to account for

indirect market effects, i.e. exports out of or imports into the East German market area, and  $d_i^i$  structural dummies,  $i=1,2,\dots,I$ . A BOX-JENKINS autocorrelation term was added:

$$(5) \quad \mu_t = \rho \cdot \mu_{t-1} + v_t, \quad t = 2,3,\dots,96,$$

where  $v_t$  is white noise and  $\rho$  the correlation coefficient..

As a separate econometric analysis of only 12 months – the period assumed by the GAA to have been cartel free - would be hardly significant, we tested changes within the sample.

## 5.4 Results of Estimations

### 5.4.1 Representation of Results

The results of our estimations are represented in columns. Each column contains the elasticity of demand with respect to the variable given in the line; t-statistics (against the probability of the coefficient being zero) are given in round parentheses; furthermore, if a variable transformation was applied, the transformation coefficient  $\lambda$  is given in angular parentheses. If  $\lambda=0$ , this corresponds to a multiplicative, a  $\lambda=1$  a linear and a  $\lambda=2$  a squared transformation. We omit the constant for reasons of protecting our data. All models are estimated as “January models”, i.e. if all months had to be included with dummies, the constant would represent the January. Models (1) to (5) are all multiplicative; functional forms are tested in models (7) and (8). Asterisks are used to show levels of statistical significance.

### 5.4.2 Results and Statistical Interpretation

Table 4 contains the results of the estimations.

- (1) Model (1) gives a first simple model of demand elasticities. It already contains the main elements of the more elaborate functions (2) to (6). Elasticity with respect to prices is  $-0.82$ , with respect to construction demand  $1.65$ , and with respect to the ratio between West and East construction demand of  $1.16$ . Nearly 90% of total variance is explained. We see that prices are flexible with respect to quantities and that production “breathes” over-proportionately with construction demand in the East. It is interesting that the ratio between construction demand in the West and East nearly has unit elasticity. This implies that the larger Western market influences production in the East. As deliveries between the Western and the Eastern markets are low (see following chapter), we assume that this is an expectation variable – the market of West Germany is by far larger.
- (2) Model (2) adds four seasonal dummies; dummies for all other months were statistically insignificant. Furthermore, an autocorrelation term is included. These statistically significant additions improved the model but do not fundamentally change the structure of the model. The East-West-ratio becomes more important, i.e. the link to the markets of the West.
- (3) Model (3) tests the structural break between 2001 and 2002 attributable to the end of the quota agreement. The dummy is statistically insignificant. The same holds if the price variable is split up into two periods, one for 1995 – 2001 and the other for the year 2002, in model (4). The elasticities are nearly identical. This suggests that no structural break had occurred. If the two methods are combined in model (5), this allows the function to shift and to choose elasticity for each of the sub-periods separately. A shift occurs and the elasticity for the price of 1995-2001 changes in the direction given by the demand model: it assumed that a fall in prices reduce (the absolute value of the) elasticity, we clearly see from Figure 7 that falling prices crowded out imports and other suppliers, so that the fall in market volume did not affect X-company. However the shift is statistically insignificant and the equation does not im-



prove significantly in log-likelihood (+0.9 points). Part of this change in slope may relate to aspects of functional form, which is discussed below<sup>17</sup>.

**Table 4:**  
**Results of Estimations, X-Company in East Germany, 1995 - 2002**

Variable	Models						
	(1)	(2)	(3)	(4)	(5)	(6)	(6)
Quantity ( $x$ )						[0,0599]	[0,1012**]
Price ( $q$ )	-0.8227** (3.780)	-0.7412** (3.586)	-0.7302** (3.152)			-0.7333** (2.722) [0.0599]	-0.6212** (2.467) [-0.4456*]
Price ( $q_{2001}$ )				-0.7301** (3.286)	-1.6843** (2.606)		
Price ( $q_{2002}$ )				-0.7261** (3.121)	-0.6217** (2.741)		
Construction ( $Y_E$ )	1.6514** (18.53)	1.8195** (24.44)	1.8220** (23.56)	1.8225** (23.62)	1.7865** (23.04)	1.7911** (25.16) [0.0599]	1.5999** (22.84) [-0.4456*]
West-East ( $Y_W/Y_E$ )	1.1589** (3.808)	1.6184** (4.882)	1.6056** (4.654)	1.6020** (4.647)	1.7778** (5.650)	1.5685** (4.768) [0.0599]	1.4678** (4.798) [-0.4456*]
<i>Cartel 2002</i>			0.0121 (0.112)		-4.2026 (1.594)		
<i>February</i>		0.2484** (5.875)	0.2491** (5.820)	0.24892** (5.830)	0.2053** (5.090)	0.2099** (5.890)	0.1987** (5.397)
<i>March</i>		0.0934** (2.428)	0.0935** (2.418)	0.0936** (2.420)	0.0888** (2.339)	0.0858** (3.159)	0.0714** (2.783)
<i>May</i>		0.0686** (2.078)	0.0686** (2.065)	0.0686** (2.065)	0.0715** (2.127)	0.0659** (2.095)	0.0603** (2.115)
<i>August</i>		0.1724** (3.696)	0.1712** (3.605)	0.1709** (3.597)	0.1671** (3.860)	0.1542** (2.794)	0.1486** (2.668)
$\rho$ (AR-1)	0.5792** (6.023)	0.6791** (8.139)	0.6810** (8.089)	0.6813** (8.1067)	0.5819** (6.046)	0.6816** (6.970)	0.6813** (7.284)
$R^2_{adjusted}$	0.8854	0.9268	0.9260	0.9260	0.9265	0.9262	0.9306

\*\* : results significant at the 5% level; \* : results significant at the 10% level.

- (4) Models (6) and (7) test the functional form of the model because the RAMSEY reset test on model (4) weekly suggested non-linearities and the price elasticity showed signs of become more inelastic over time. In fact, the multiplicative model is supported in model (5) against model (2) as the log-likelihood only changes by 0.1 points. However, if we separate the transformation of the endogenous from all exogenous variables, the log-likelihood shows a statistically significant improvement. The Box-Cox-transformation coefficients of the endogenous is close to zero and the transformation coefficient of the three quantitative exogenous is close to -0.5, which implies a inverse square-root function – but this coefficient is only significantly different from zero at the 10% level. We further added variables as in functions (3), (4) and (5) against function (2) in order to identify a structural break from 2001 to 2002; this, again, did not produce statistically significant results<sup>18</sup>.

<sup>17</sup> The estimation suggests that, at least with respect to the last 12 months, the reservation price of cement did not change much with construction demand; however, if construction demand falls, the demand function (with respect to price) seems to turn in clockwise direction; see Figure 12.

<sup>18</sup> Log-likelihoods increased by 0.9 points once the cartel-dummy was added to model (6); splitting up the price variable led to an increase of 0.9 points with respect model (6). The adding the cartel dummy led to a gain of 0.1 points with respect to the model with split prices.

The formal analysis thus supports our view that a clear-cut structural break did not occur from 2001 to 2002. If we accept the marginal evidence found as important for further analytical inquiries, we again are trapped: The downwards shift of the demand function would suggest that market power fell once the cartel came to an end; however, the difference in demand elasticities with respect to price implies an increase in market power from January 2002 onwards.

Given these rather ambiguous results, we maintained the multiplicative model (2). We used different methods to further test the stability of our results:

- We estimated model (2) without the AR(1) term and analyzed the residual for stationarity to identify whether a co-integration approach is needed. The residual was clearly found to be stationary.
- As we are very much interested in the possibility of a structural break, we used the CHOW break-point test on observation 84, which is December 2001. The result was negative. However, the CHOW forecast test for the year 2002 suggested a structural break, and in the 1995 – 2001 estimation, the elasticity with respect to prices (absolutely) rose – a result already known from model (6). But this test is not very powerful given estimation over a period of only 12 months with three degrees of freedom. Thus, we remained with the methodology used in models (3) and (4). In these cases, the log-likelihood ratio test did not suggest any improvements<sup>19</sup>.
- Because of the autoregressive structure, we tested a NERLOVE-type specification, i.e. lagged the endogenous, the quantity, by one period. This allowed us to distinguish between long-term and short-term elasticities. However, a test for missing lagged endogenous did not show significance.

## 5.5 Economic Interpretation

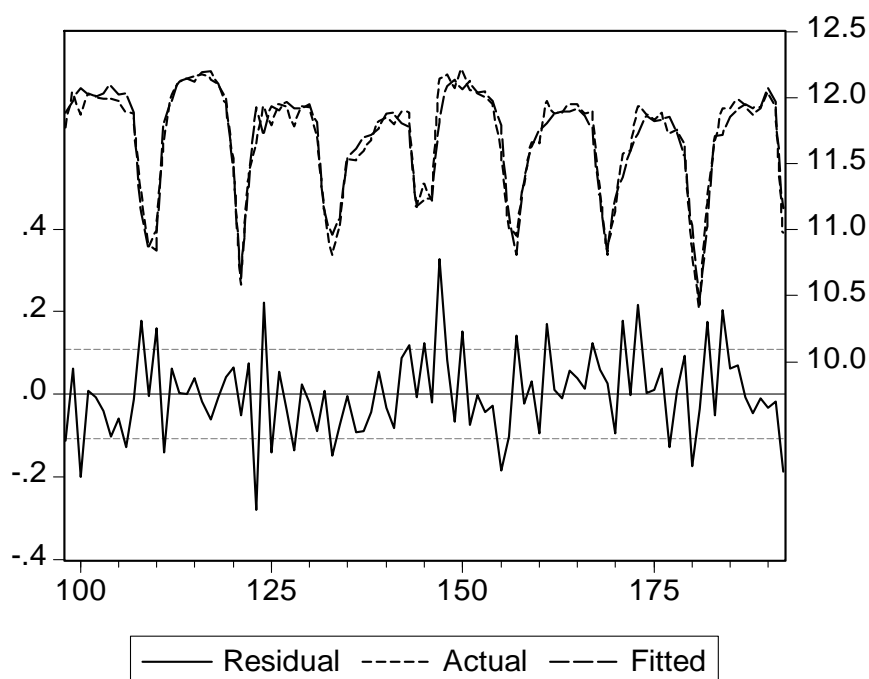
We conclude that demand elasticities with respect to prices are close to unity; for sure, quantities react with prices on the firm level. An elasticity of  $-0.7$  implies that price strategies are meaningful – price increases lead to a slightly below-proportionate loss in volumes and thus to a small increase in income. Changes in competition regimes cannot be traced either as a structural break, a shift in price elasticities or a change of the isoelastic exogenous. Furthermore, demand “breathes” with construction demand, and this also includes demand from German regions in the West. Finally, no sign of a structural break at the end of 2001 can be found.

Figure 9 gives the plots of actual, fitted and residual values of model (2). We clearly see that the critical period of 2002 does not show any peculiarities. Our inability to capture a structural break implies that no change in market power can be traced over the period included, i.e. a persistence of the “transmission” between quantities, prices and industry performance even in periods of sharp price dives. Thus, we conclude that the price reductions due to of excess capacities and the slump in industry demand better explain the situation of 2002 than the dissolving of the cartel. Generally speaking, this time-series model is driven by construction demand, seasonality and, path dependency.

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<sup>19</sup> In fact, the log-likelihood ratios were 0.007 for models (3) against (2) and 0.014 for models (4) against (2). As the forecast test estimates the sub-samples separately, it has less statistical power than the approach used here, i.e. testing within the sample a structural break, splitting up a variable or enquiring into changes of functional form away from the isoelastic model.

**Figure 9:**  
**Error Term Analysis of Model (2)<sup>20</sup>**



## 6. Excess Income and Profit

### 6.1 The Legal Formulae

The legal formulae of excess income and excess profit are based on the real quantities exchanged on the market (restricted by the cartel) and compare (supposedly lower) hypothetical prices and (supposedly higher) cartel prices. This approach assumes that, because of market power, firms are able to extract higher prices than under “normal” conditions, i.e. the demand function under cartel conditions dominates the competitive demand function<sup>21</sup>. Furthermore, cost savings due to the existence of the cartel, such as reduced marketing efforts, must be accounted for, but alternative strategic options under competitive circumstances that would have reduced cost are not allowed to be included. The usual approach to quantify excess income would be by calculating deadweight loss, the LERNER Index (LERNER, 1934) or a combination of the two that also accounts for the cost structure (UTTON, 2003, p. 59 ff.). However, as elasticities of demand with respect to price were – in absolute terms – below unity in the time series, this is not possible. Classic monopoly or oligopoly theory assumes that allocations lie in the elastic region. In our case, elasticities in the time-series model are below unity<sup>22</sup>.

<sup>20</sup> As the data set also includes other production units, X-Company data range from 97 to 192.

<sup>21</sup> See for a definition of excess income and profit: DANNECKER, BIERMANN (2001), Rz. 337; KLUSMANN, WIEDEMANN (1999), MEURER (1998), ERLINGHAGEN, ZIPPEL (1974). In fact, this formula is a rather close translation of what we describe with the term of “change in competition regime”.

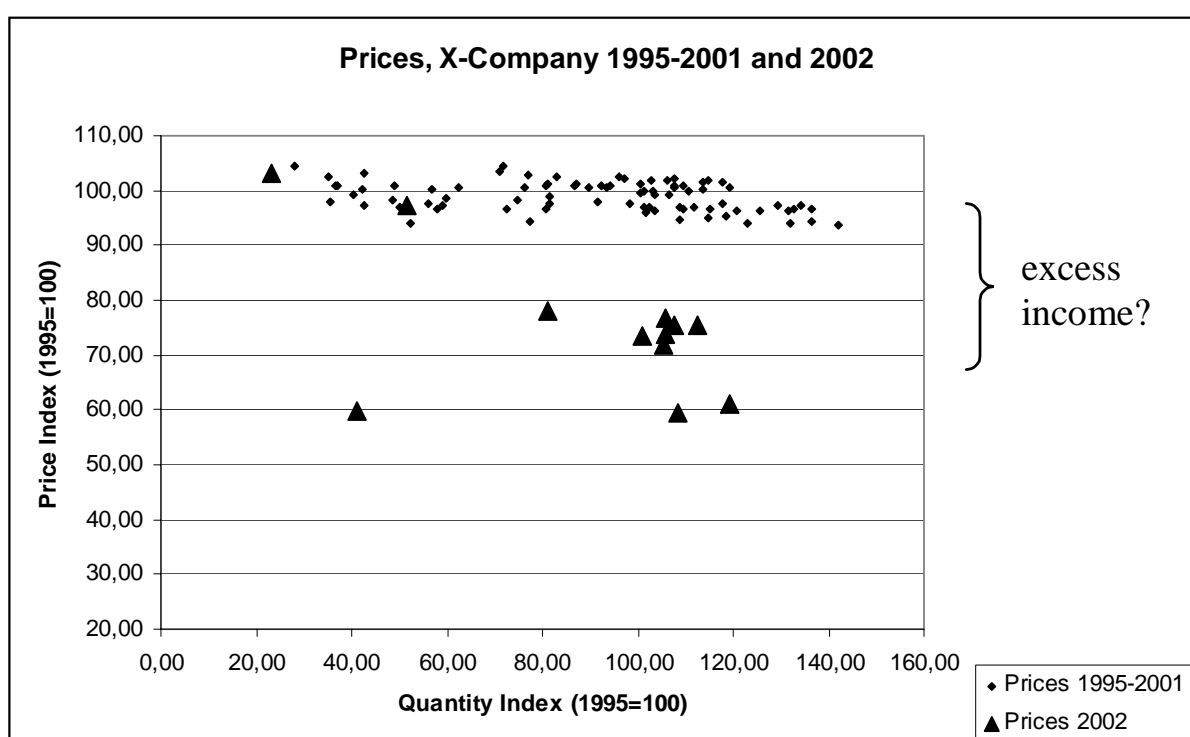
<sup>22</sup> Elasticities above unity (in absolute terms) can be derived from a spatial model of cement demand (values range between -3.5 and -2.0, depending on model specification); see BLUM 2004b.

## 6.2 Fundamental Theoretical Considerations

Let us briefly summarize our main arguments on the competition structure:

1. Because of sunk costs, sustainable price systems that allow rents without market entry are possible.
2. Price differentiation is possible, in fact strong price discrimination can be observed because of transportation costs, which allow the delineation of individual markets (see 6.1).
3. If a quota agreement is effective – which we had trouble to show as structural breaks were both non-existent in the time-series and the regional cross-section analysis of cement demand – then we would assume that prices are higher for given quantities than under conditions of competition. This is exactly what the excess income formula supposes. This implies that, at given prices, increased quantities will be observed if a quota agreement has been effective<sup>23</sup>. This is the argument of the GAA and can be represented as follows in the price-quantity-diagram of X-Company in Figure 10.

**Figure 10:**



What would happen if the reduced level of demand, as given above, is explained (or even under-explained) by general economic development? This would imply that the “split”, in fact, did not exist, were only the consequence of different external conditions. Thus, only through a multivariate analysis can the question of whether this split exists be resolved. As the demand function estimated in the fifth chapter for the eight years from 1995 to 2002 includes, following the argument of the GAA, seven years of quota agreement (1995-2001) and one year of full competition (2002), it should be dominated by the cartel period and, thus, estimate a demand function that is “too high”. In fact, this is exactly what the “cartel dummy” tried to capture, namely a decreased level of demand in 2002 – which we were not able to identify on a statistically significant level. Figures 11 and 12 identify reduced and excess revenues.

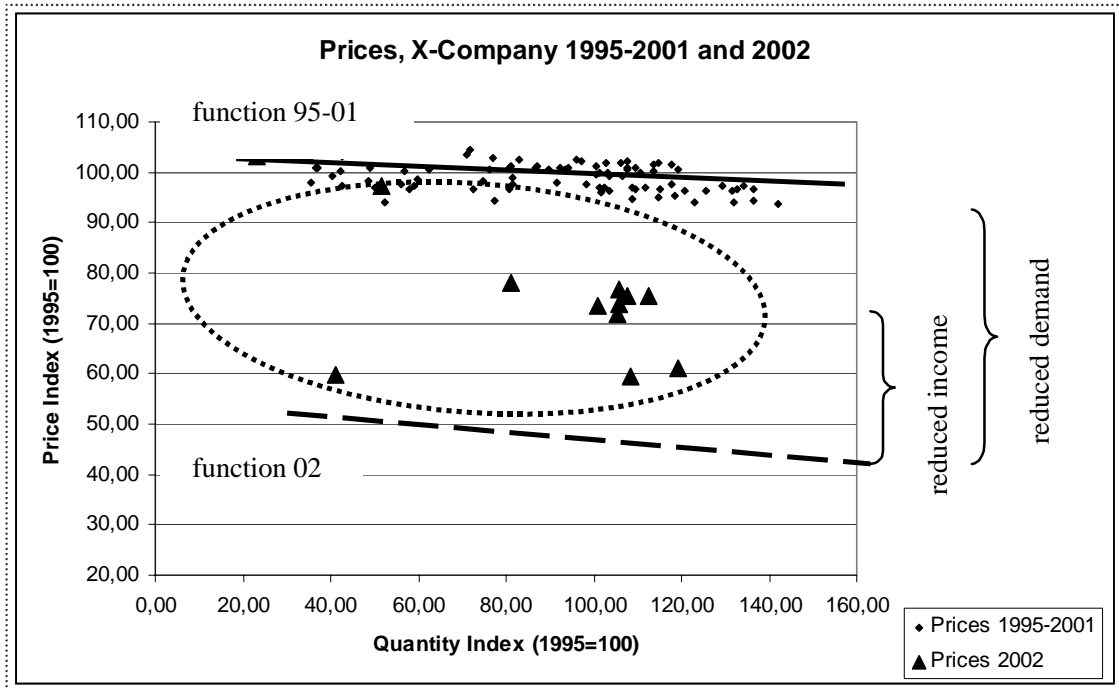
<sup>23</sup> This is the complement of the argument that, through market power, firms were able to charge increased prices for given quantities.

### 6.3 Excess Income

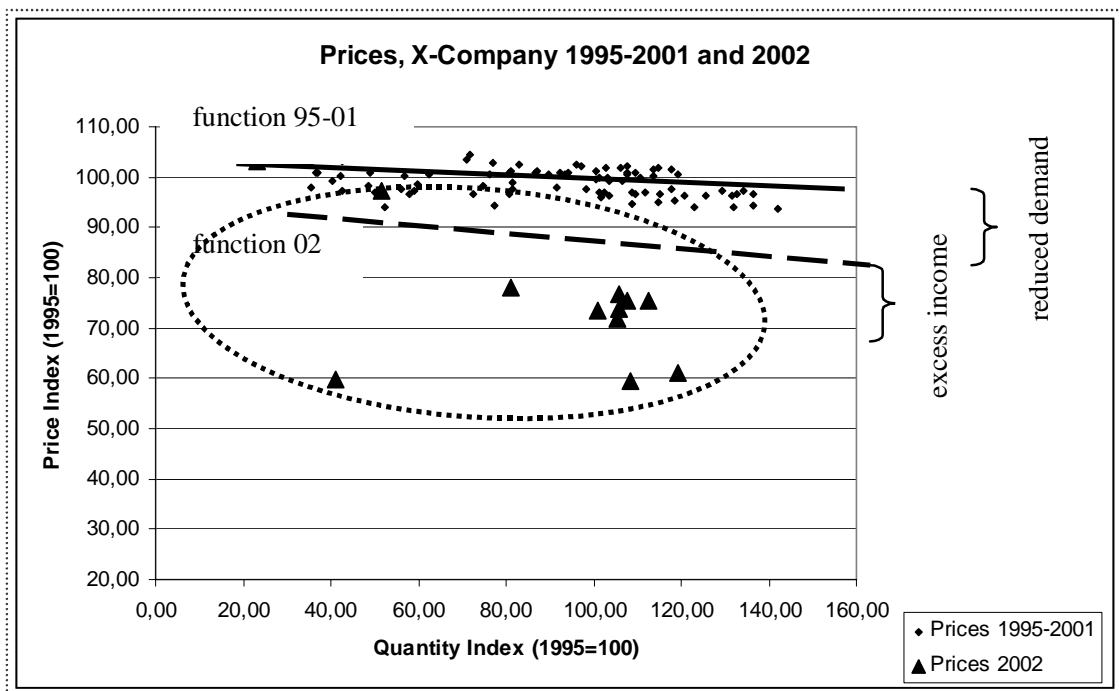
#### 6.3.1 Ex-Post Forecast

This approach uses the elasticities computed in Model (2) of Table 4, the changes in the three strategic exogenous variables, prices, construction index, and the West-East Ratio, and compares the quantity change defined through the model. It then compares it to the true volume change. In doing so, we use the results in a deterministic way, i.e. imply that they are “true”, because we do not account for confidence intervals. Table 5 contains the necessary data and results.

**Figure 11:**



**Figure 12:**



The first group of data gives the index values of 2001, the second group of 2002 and the third group the changes. The fourth group contains the three elasticities, which are combined with their respective variables. We compute an explained change in volume of 0.08. The true quantity change, however, is 0.134 – which leaves 0.054 as unexplained rest. This implies, however, that the model under-explains reality, which suggests a *reduced*, and not an excess income<sup>24</sup>.

**Table 5:**

<b>Computation of Excess Income (I)</b>	
Position	Value
Price Index Level 2001 (1995=100)	100,54
Quantity Index Level 2001 (1995=100)	78,20
Construction Industry Index 2001 (1995=100)	67,08
West-East Index Ratio 2001	117,96
Price Index Level 2002 (1995=100)	75,50
Quantity Index Level 2002 (1995=100)	88,65
Construction Industry Index 2002 (1995=100)	58,63
West-East Index Ratio 2002	127,05
Price Change	-0,249
Quantity Change	0,134
Construction Industry Index Change	-0,126
West-East-Ratio	0,077
Elasticity of Demand with Respect to Prices	-0,741
Elasticity of Demand with Respect to Industry	1,820
Elasticity of Demand with Respect to West-East	1,618
Explained Change of Quantity	0,080
Not Explained Change of Quantity	0,054

### 6.3.2 Analysis of Residuals

We compute the sum of residuals over the last 12 months of the sample, i.e. 2002, which should be negative, as we suspect that in this last year, in case of an excess income, actual values should lie below fitted values. As the function was estimated in a logarithmic form, this implies:

$$(7) \quad x_t = \hat{x}_t \cdot e^{\mu_t}, \quad t = 1, 2, \dots, 96,$$

where  $x$  is the real value of cement demand and  $\hat{x}$  the estimated (fitted) value. The effect,  $\delta$ , of the residual with respect to a reference situation is

$$(8) \quad \hat{x} - x = x \cdot e^{\mu} - x = (e^{\mu} - 1) \cdot x = \delta.$$

In Table 6, we have included the residuals of 2002. We see that the sum is positive, which implies that over these 12 months actual values are above fitted values. This gives further evidence of reduced income, which amounts to about 1 % per year.

<sup>24</sup> Even if we push the elasticities to their limit of the 95% confidence interval, the reduced income will not vanish – but of course become very small.

**Table 6:**

<b>Computation of Excess Income (II)</b>	
Months	Residuals
1 / 2002	-0,036
2 / 2002	0,175
3 / 2002	-0,051
4 / 2002	0,203
5 / 2002	0,063
6 / 2002	0,070
7 / 2002	-0,009
8 / 2002	-0,046
9 / 2002	-0,011
10 / 2002	-0,033
11 / 2002	-0,019
12 / 2002	-0,188
Sum of Residuals	0,1174
Average Sum of Residuals	0,0098
Index 2001 (1995=100)	113,37
Additional Index Points from Residuals	-1,11

In addition, we have plotted net prices over distance. Again we see an enormous variation over distance. If we take gross prices or take gross prices only until the year 2001, the general structure of Figure 9 remains unchanged. This shows us that X-Company actively uses price discrimination, for instance in order to meet import competition.

#### **6.4 Excess Profit**

There is little evidence of excess profits if excess income cannot be found. It would imply that savings in certain cost categories, especially in marketing, etc., have been made. However, this would imply that the quota cartel showed a reasonable level of effectiveness. This is exactly what is cast into doubt through our econometric analysis, which did not reveal any significant change in the demand function. Following our argument, we see 2002 as a shake-out period which still follows the general quantity-activity-price mechanisms. In fact, our model traces the fall in prices back to the attempt to keep production at sustainable levels by sacrificing prices in a period of very low construction activity. This happens, in fact, at the expense of less competitive suppliers.

Excess profit can emerge under situations of constant revenues under two additional conditions:

1. If reduced or increased volumes lead to falling unit costs depending on the technology used. The firm would then try to approach and then stick to its optimal production point under the situation of an efficient cartel. Given the de-facto variation of production over time in order to breathe with the market and rather constant price, X-company was never able to achieve such a goal.
2. Excess profit could be hidden in artificial costs, i.e. slack. But given the low price level compared to other regions, it is more likely that X-company has less slack than competitors outside this market.

## **7. What Do We Learn?**

The GAA of Germany has fined the defendants €661 million because of alleged excess revenues in all four markets of Germany. Its arguments rest on two central propositions:

- the existence of a credible comparative market period;
- a break in competition regime from increased market power until 2001 to decreased market power from 2002 onwards, which allowed excess revenues (relative to normal revenues) to be maintained in the first period.

In our analysis, we first showed that 2002 is an inappropriate comparative market period for the cement industry, as it lacks a minimum level of stability – in particular its prices do not converge. We then proceeded and described a hypothetical competition structure. By using a time-series econometric model, we showed that a break in competition regime could not be identified. This implies that market power did not change from 2001 to 2002 – which it would have if a functioning cartel had existed before. Given the small evidence of excess profits, we even identified conditions for a reduced income, given the market structure of the “cartel period”. We saw evidence that the price dive of 2002 relates more to depressed market conditions and to the will to shake out excess capacity in the industry. However, driving out capacity in an already cleansed market could take some time. This implies – and here we fall back to the comparative market period – that more than a year might be needed for such a restructuring of the market which then, once prices have converged, may be structurally too different to serve as a comparative market. Our analysis further points to the potentials of pursuing a “quantitative antitrust policy” in order to augment the rigorosity of legal decisions.

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