Institut for Nationaløkonomi

Handelshøjskolen i København

Working paper 10-2000

TESTS OF (ABUSE OF) DOMINATION: The Danish cement industry

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6 November 2000

Tests of (abuse of) domination:

The Danish cement industry [§]

by

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Abstract: We test econometrically whether the sole Danish producer of cement holds a dominant position in the Danish market for (grey) cement. In import penetration tests, we find that its pricing and quantity decisions are independent of import price and quantity, implying that it can act to a considerable extent independently of its competitors. We also test whether it can act independently of its customers and find that its demand is inelastic with respect to its price. It thus holds a dominant position in the sense of the European Court of Justice. Having established dominance, we go on to illustrate that based on our data, it is difficult to conclude that it has abused its dominant position in the sense of the Court.

JEL codes: K21, L41, L61
Keywords: Dominant position, econometric tests, excessive pricing, cement.

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[§] We wish to thank Aalborg Portland, H.C. Johansen, Dan Knudsen and Elisabeth Møllgaard for providing us with missing data. Thanks are also due to Niels Blomgren-Hansen, Niels Haldrup, Sven Hylleberg and Stephen Martin for critical comments on earlier drafts. The responsibility for remaining errors rests with the authors alone.

1. A dominant firm?

Aalborg Portland A/S (AP in the following) — Denmark's sole producer of cement with an 85 percent share of the Danish market — was deemed guilty of abuse of its dominant position by the Danish Competition Council at its meeting on June 17, 1998. The alleged abuse consisted of charging unreasonably high prices on the Danish market. However, the Competition Council deferred its decision of an appropriate remedy to a later meeting.

At its meeting on October 28, 1998, the Council then decided that the evidence of AP's abuse was not sufficiently clear and repealed its earlier decision.

There is by now a substantial literature on the relationship between prices and concentration in the U.S. Portland cement industry. A number of studies (McBride, 1983; Koller and Weiss, 1989; Allen, 1993; Rosenbaum, 1994; Jans and Rosenbaum, 1997) report a positive, statistically significant relation between the concentration of cement producers and the price of their product. However, Newmark (1998) shows that if a measure of transportation cost (population density) is included in the regression, this positive correlation between price and concentration disappears. Thus, it is also not clear from the American studies that a large market share would lead to a high price.

A dominant position implies that the firm has power on the relevant market. The relevant market needs to be defined both in terms of geographical area and product characteristics. If for instance there is a lot of import into the area, this geographical market need not be the relevant one. Whether a given area constitutes the relevant geographical market is thus an empirical question that may be tested. Very often a large market share in a geographic area (e.g. a national market) is taken as an indicator for market dominance without further testing of the market boundaries. According to legal observers [e.g. Goyder, 1999, 324], the European Commission has a tendency to put more emphasis on market shares in establishing dominance than does the European Court of Justice. The problem with using market shares is that the definition of the relevant market becomes of crucial importance.

In this paper we test econometrically whether AP holds a dominant position in the Danish market in the sense of the European Court of Justice, and if so, whether it has abused its market power. The Court defines "dominant position" as the ability for a firm "to behave to an appreciable extent independently of its competitors and customers and ultimately of its consumers."[1] Using the most

[1] This mantra is invoked in a great many rulings by the European Court of Justice, see e.g. United Brands Company *v.* Commission (case 27/76) [1978] ECR 207; 1 CMLR 429; or Hoffmann-La Roche *v.* Commission (case 102/77) [1978] ECR 1139; 3 CMLR 217. See

sophisticated econometric methods currently available, we first test whether the firm has acted independently of its competitors who are all importers of cement. We find that AP's pricing and quantity decisions are indeed independent of import price and quantity.

We then test whether AP acts independently of its customers and consumers. The legal terminology used by EU competition lawyers does not translate immediately into economics. Economists might argue that no firm, not even the textbook monopolist, would want to act independently of its customers. We interpret the legal language as meaning that the firm faces inelastic demand allowing it to raise prices without loss of revenue. We find that the own-price elasticity of demand is close to zero, indicating that the demand is indeed inelastic.

Having thus established dominance, we finally test whether one can argue that AP has abused its market power by raising prices on the Danish market. Based on price comparisons, we find it difficult to conclude that AP has abused its dominant position in the sense of the Court.

The rest of the paper is organized as follows. Section 2 describes the industry and the data. Section 3 analyses whether AP holds a dominant position. Section 4 attempts to test whether AP has abused the dominant position while section 5 concludes the paper.

2. The industry and the data

This section describes the industry structure and the sources of supply in section 2.1, the barriers to entry and the competitors in section 2.2, the EU case against the European cement cartel in section 2.3 and the data in section 2.4.

2.1 Industry structure and supply

The Danish cement industry dates back to 1868 but really took off in 1873 when AP started using the abundant limestone of the Aalborg area.[2] In the 1960s industry consolidation had led to the existence of only five plants, four of which were owned and controlled by AP. The fifth plant was owned by a cooperative which already in the early 1960s cooperated with AP since its own capacity was insufficient to satisfy its members' demand. On June 28, 1974 it was decided that AP should take over its smaller rival on January 1, 1975. From then onwards all Danish cement production was controlled by AP.

Up until 1980 almost all import of cement was due to supply shortages: In 1973 there was both

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Goyder (1998), ch. 15 for a discussion of the concept of dominance. This definition is indicative of how the Danish Competition Act of 1997 is interpreted, see Fejø (1997a) at p. 158.

[2] See Johansen (1989) for a detailed history of the Danish cement industry.

general strikes and a problem with one of the kilns; and in 1979 another strike led to imports. However, in the 1980s there have been attempts at importing cement from Poland and East Germany. The Polish cement was imported by BC Industri Cement Aps (BC) and was sold mainly in the eastern island of Sealand, while the East German cement was imported mainly by Stub Trading (ST) and Mørch & Son (MS).

2.2 Barriers to entry and competitors [3]

Green-field entry into the Danish cement market is unlikely to happen since minimum efficient scale is large compared to the domestic market. The capacity of the newest and largest kiln is larger than total Danish consumption and other older kilns have remained in operation.[4] In addition, cement production exhibits large economies of scale in capital and labour according to McBride (1983). Due to excess capacity and cost advantages, entry by new producers is thus unlikely. AP most certainly does not have to worry about green-field entry.

A supplier of cement to Danish customers need obviously not itself be located in Denmark as recent history has shown. The possibility of imports to (and exports from) Denmark may mean that Denmark is not the "relevant geographic market." In this case, the appropriate geographic market would have to be defined and market shares calculated for this market if one would want to follow the EU Commission's tradition for equating a market share of more than 40 percent with the existence of a dominant position. However, we want to test the more interesting economic question of whether the firm is restricted in its choice of market strategy by the presence of importers. For this we do not have to define Denmark as a relevant geographic market but to test whether, for example, importers react to price changes in Denmark. If they do not, it may be the firm possess a dominant position due to barriers to entry, be they regulatory or created by the firm itself.

It turns out that AP may have benefitted both from regulatory and legal barriers to entry (see below) and from barriers created by a European market sharing agreement (see 2.3).

In 1981 AP succeeded in developing an anti-chromate-eczema process. Chromate in cement may cause an allergy that may develop into a chronic desease. By means of the process, this effect is neutralized. The compound was added to all of AP's production. In 1983 a Government order prohibited the sale after April 1, 1984 of cement that was not neutralized in this way. AP now holds a patent on the anti-chromate-eczema process in a number of countries and has managed twice to get a ban on sale of East German cement by an injunction granted according to the

[3] See Albæk, Møllgaard and Overgaard (1998, 87-92).

[4] See Johansen (1989) at p. 112.

patent.

MS, the largest importer of East German cement, contended that AP had approved the East German cement in its own laboratories in 1986 and that the patent was invalid since the process had been described in a journal as early as 1979. In a counter move, AP sued MS for damages of DKK 100 mn and approached MS's customers telling them that they might be liable too. MS's contract with the East German cement producer was abruptly discontinued in 1990 when the East German factory was acquired by a large French cement group. Today, MS has formed a joint venture with the Bouri group, a cement trading company and continues to import cement.

BC, the importer of Polish cement, initially undercut AP by about 10 percent. Following the initiation of a case before court to establish whether BC violated AP's patent, BC entered a settlement with AP in 1988: AP was to take over the yearly import of 60,000 tonnes of Polish cement; damages for the claimed patent violation would not be claimed; and AP would take over BC's Copenhagen cement silo as of January 1, 1989.

2.3 EU Commission imposes fines on European cement producers' cartel

In November 1994, the European Commission fined the European Cement Association (Cembureau), eight national cement associations and thirty-three European cement producers, among which AP, for infringement of Article 85 of the Treaty of Rome, see EU Commission (1994). Their offences were a general market-sharing agreement, transnational restrictive practices and restrictive practices relating to exports. The Commission alleged that the infringement had gone on at the latest[5] since January 14, 1983, causing the total fine (ECU 248 million) to exceed any level previously imposed under EU competition law. AP received a fine of ECU 4 million.

The Court of First Instance on March 15, 2000 decided to reduce the fines by almost EUR 140 million out of the EUR 250 million decided by the Commission. While finding that there was indeed a single agreement between the producers that was designed to ensure non-transhipment to home markets, the Court determined that the Commission had not stated its intention of adopting January 14, 1983 as the starting date for the infringement for all the firms and associations involved and therefore decided to establish the starting date for cartel participation individually for all participants. Some of the associations also claimed that the Commission had never announced its intention of fining them or did not allow them sufficient access to the investigation file. Acknowledging this, the Court decided to annull their fines.

[5]The Commission states that it had evidence that the agreement not to transhipto mome markets might have existed well before 1983.

In the case of AP, the Court reduced the fine from EUR 4,008,000 to EUR 2,349,000 because it restricted the period in which AP was found to have violated Art. 85 to a sub-period of that found by the Commission and because it annulled the verdict on damaging information exchange. AP has decided to appeal the size of the fine. The case of guilt may not be appealed.

2.4 The data

The data set has been constructed mainly from the official statistics of Statistics Denmark, especially the quarterly "Commodity statistics for manufacturing"[6] and "External trade by commodity and countries."[7] From these publications quarterly series for the quantity measured in tonnes and the value measured in DKK may be constructed for production, imports and exports of cement. The total sample runs from the first quarter of 1968 to the fourth quarter of 1998, i.e. 31 years of 4 quarterly observations making for a total of 124 observations. From 1968 through 1980, cement was only reported as one commodity. Since 1981, however, the production statistics have been split into two commodities: white cement and grey cement.[8] Since 1988, the trade statistics have been split into those two commodities as well. We have chosen to work with the aggregation of the two commodities in order to increase the number of observations. Statistics Denmark did not publish the value of the export of grey cement between 1994 and 1996. Those data have been obtained from Aalborg Portland directly.

From the aggregate data (grey and white cement lumped together), unit values may be constructed by dividing the value by the quantity. This is the price information we use in the following. Unit values are vulnerable to spurious variation if e.g. prices of grey and white cement remain constant while the quantities of white and grey cement change. This is one possible source of measurement error in our data.

Since we focus on sales in Denmark, we have constructed AP's supply for the Danish market by subtracting exports from production. This has been done both in values and in quantities, allowing us to construct a unit value that serves as a proxy for AP's price on the Danish market. As will be evident below, there is one extreme outlier in this price series in the fourth quarter of 1992. This outlier is caused by the fact that more white cement was exported in that quarter than was produced, while the price (unit value) of the export was much below the unit value of production.

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[6] To be precise, the Danish title is *Varestatistik for Industri, Serie B: Mineralske og kemiske produkter, træ og papir samt varer deraf.*

[7] *Udenrigshandelen fordel på varer og lande, Januar - marts/juni/september/december,* Statistikservice.

[8] Commodity codes 2523.21.00 and 2523.29.00 respectively.

This is possible because cement may be stored, which introduces a second possible source of measurement error in the price data. This may explain why we need to introduce lags in the econometric analysis below.

To test the seriousness of this measurement error we investigated the relationship between the different price series for the period where disaggregation was possible, i.e. 1988-1998. Table 2.1 summarizes the data by showing the average quarterly quantity, revenue and unit value by white and grey cement and by origin and use.

Table 2.1: Quarterly averages over the 1988-1998 period.

		AP's production	Export	Import	AP's dom. delivery
Quantity (thousand tons)	Total	559	255	58	304
	White	117	114	0	3
	Grey	442	141	58	301
Revenue (Mn DKK)	Total	289	91	22	198
	White	72	57	0	15
	Grey	217	34	22	183
Price (DKK/ton)	Total	517	358	375	652
	White	614	503	356	4810
	Grey	491	239	375	610

In the 1988-1998 period, AP's production consisted of 21 percent white cement and 79 percent grey cement. Almost all of the white cement was exported, so that AP's domestic delivery consisted of 99 percent grey cement and only 1 percent white cement when quantities are used. If values are used, the grey-cement content of AP's total deliveries for the Danish market was 92 percent. This indicates that the unit value of AP's domestic deliveries may be thought of as largely measuring variations in the price of grey cement. In the 1988-1998 subsample, the correlation coefficient between the production price of grey cement and the price of domestic deliveries of grey cement is 0.9474, while the correlation between the production price of all cement and that of domestic delivery of all cement only is 0.5733. This is an indication of the level of measurement error in the price variable that we use below. An alternative to the dummies introduced below to eliminate the effects of these measurement errors would thus be to replace single observations of the price variable for total cement delivered by AP to the Danish market with that of grey cement.

Table 2.1 also shows that for both types of cement, the export price is much below the price obtained on the Danish market. The average unit value of 239 DKK/ton of grey exports is only

39 percent of the price charged to the Danish market and is 36 percent below the import price. It was this difference between the domestic price and the export price that lead the Competition Council to initially decide that AP "abuses its dominant position by charging unreasonably high sales prices on the Danish market. Corrected for the cost of transportation, Aalborg Portland A/S in 1997 sold the most important type of cement (grey cement) at a price that is more than twice as high as on the export markets." (Competition Council, 1998, our translation)

Note that the import prices (unit values) that are employed in the following include cost, insurance and freight (CIF) while the export prices are measured FOB (free on board). This means that the import price includes costs for transportation and insurance to the Danish border and since the value is measured in Danish kroner, it also includes the effect of changing exchange rates. On the other hand, export prices do not include insurance and freight and thus tend to be lower for that reason alone.

For the tests below we also need a variable that may be used to indicate the strength of demand. We constructed two variables: the number of started square meters for all buildings and the total employment in the construction industry. In both cases the source was Statistics Denmark, although we kindly received the employment figures from 1971 through 1998 from the research department of the Danish central bank. The number of started square meters turned out to have undesirable statistical as well as interpretative properties, and in the following building activity will be measured by construction employment.

3. The empirical analysis

To test whether AP holds a dominant position on the Danish market for grey cement, we perform statistical tests such as tests of price behaviour and import penetration tests (see OFT, 1999). We employ the most sophisticated econometric methods currently available for studies of non-stationary time series namely multivariate cointegration techniques, see e.g. Johansen (1995). For a brief description of these techniques see appendix B. Only the results will be given in the main text. In section 3.1, we investigate the nature of the link between AP's price on the Danish market and its competitors' prices (import prices). In section 3.2 we move on to show that the import quantity is inelastic with respect to AP's price, while section 3.3 shows that AP's demand is also inelastic. In combination these findings strongly indicate that AP holds a dominant position on the Danish market in the sence of the Court.

3.1 Analysis of price behaviour

In this section it is investigated whether the opening of the Danish cement market for import about 1981 has affected the development of the price set on the Danish market by AP.

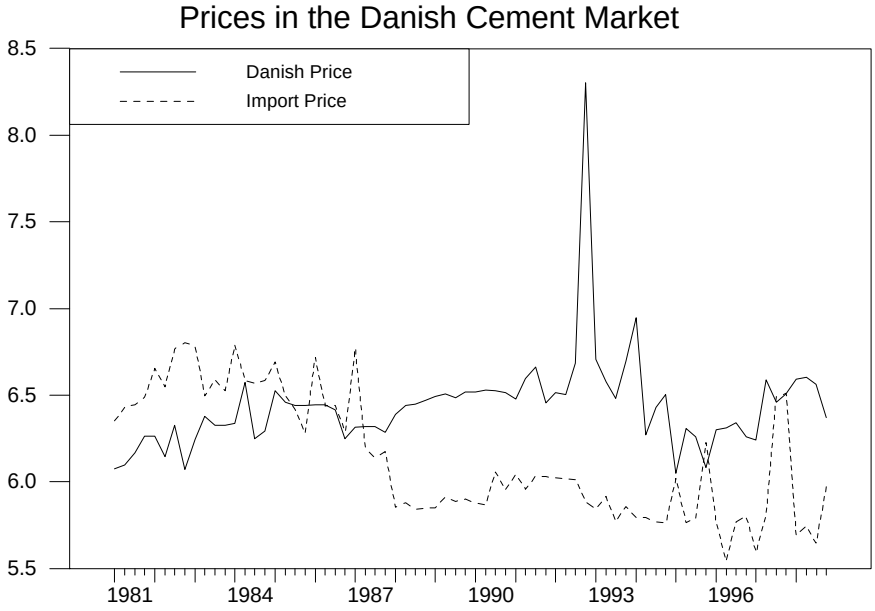
Specifically, a regression model is used to conclude that there is no evidence that the Danish price of AP has shown signs of following the development in the import price. This suggests that AP's dominant position as a price setter on the Danish cement market has not really been threatened by the allowance of imports.

The idea that price correlation may provide some indication of whether two geographic areas are in the same economic market or the degree of interdependence between sellers dates back at least to Stigler and Sherwin (1985). Prices of the same homogeneous good may differ because of transport or other transaction costs and temporary shocks to costs or demand may cause them to be out of line for a certain period of time. Today, it is well accepted that a positive and large correlation (taking account of possible lags) could indicate either that the sellers belong to the same market (and thus are highly interdependent) or that there is a common third factor (such as an input price) that causes the output prices to move together.[9] On the other hand, the absence of a correlation may be taken as a good indication that the interdependence or the common factor is not present.

In figure 3.1 below, the development in AP's domestic price and the price of imported cement are shown. It is seen that the co-movement of the two series are not too close implying that no strong correlation between the price series will be found in the statistical analysis either — although a visual inspection sometimes can be misleading. The observation of the Danish price in the 4th quarter of 1992 can be considered an outlier.

[9]The following scenario is also a possibility: If a dominant firm is more cost efficient than the importers, it might decide to always shadow the import price in order to keep the market to itself. In this case you would find almost perfect correlation between prices but also that the firm would hold a dominant position in some sense of the term (but not in the sense of the European Court of Justice). Since this scenario rules out the observation of imports taking place, and we in fact observe substantial imports, we may rule this scenario out. (In addition, we do not find any correlation!)

Figure 3.1



The visual inspection of the series also indicates slow or no mean-reversion implying that the series must be analysed as non-stationary time series. A univariate Dickey-Fuller test of the unit root hypothesis (non-stationarity) has also been applied to each of the series supporting the visual impression that the series are best analysed as non-stationary time series, see appendix A. For non-stationary time series it is posssible to analyse both possible long-run (or equilibrium) relations and short-run adjustment and dynamics amongst the series and this is most powerfully done within the framework of a multivariate time series model. In the following, a vector autoregressive (VAR) model that allows for non-stationary time series and cointegration, see e.g. Johansen (1995), is applied. More on this model is found in appendix B. Within this framework of an appropriately specified statistical model it is possible to determine the number of long-run relations. Having done so, we can test hypothesis of interest on such long-run relations among the levels of the time series and finally, an analysis of the short run dynamics or special features of the short run adjustment can be performed.

For the two price series a VAR(2) model is selected to analyse the data for the sample (estimation) period 1981, 1st quarter to 1998 4th quarter. In order to make the model conform to the statistical assumptions the analysis is done conditionally on 4 event dummies - three for the Danish price series (1992, 4th quarter; 1994, 2nd quarter; and 1997, 2nd quarter) and one for the import price (1995, 1st quarter).[10] As the series contain quarterly observations a set of centered

[10] The effects of additive outliers on tests for unit roots and cointegration may be to invalidate those tests, see Franses and Haldrup (1994). Our method remedies the invalidating

seasonal dummies are included in the information set. More on the exact definition of the dummy variables and on the results of the misspecification tests is found in the appendix C.

In order to determine whether a long run relation among the levels of the two price series exists, the Johansen Trace test is used. The results from applying the testing procedure of this test are found in table 3.1 below:

Table 3.1: Results of the Johansen Trace-test.

Number of relations	Trace test statistic	90 % quantile	95% quantile
0	19.59	22.95	25.47
1	4.42	10.56	12.39

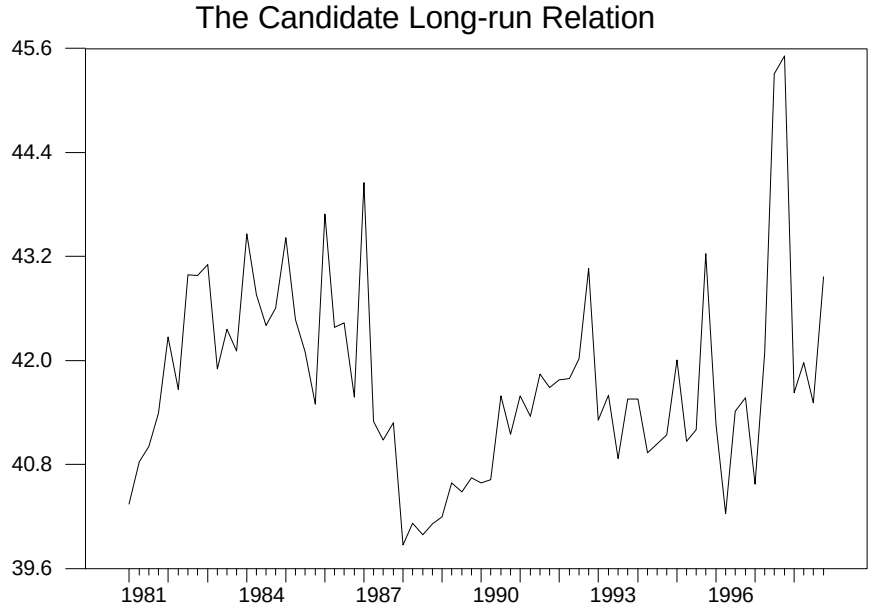
The asymptotic quantiles are from Johansen 1995, table 15.4.

As the trace statistic for the hypothesis of no long-run relations is not rejected (row one of the table) — even at the 10% level — there appears to be no long-run relation among the levels of the two price series and hence no indication that the Danish price behaviour is affected by the behaviour of the import price. On the basis of this conclusion, any further analysis of adjustment behaviour becomes meaningless.

To support the above numerical analysis a graph of the candidate long-run relation of the VAR-model is given below. Figure 3.2 clearly supports the impression of this relation being non-stationary with no evident signs of mean-reversion.

effects on those tests.

Figure 3.2



In order to complete the analysis of prices, the results of a single equation regression for the short run dependance of the Danish price on the import price has been performed. The results of the regression analysis is:

$$\text{Älpdk}_t = 0.01 + 0.02\ \text{Älpdk}_{t-1} - 0.04\ \text{Älpdk}_{t-2} - 0.03\ \text{Älpm}_t + 0.03\ \text{Ädlpm}_{t-1} + 0.09\ \text{Ädlpm}_{t-2}$$
$$(0.75) \qquad (0.23) \qquad (-0.64) \qquad (-0.44) \qquad (0.43) \qquad (1.48)$$

$$+1.61\ \text{D92-4}_t - 0.43\ \text{D94-2}_t - 0.34\ \text{D95-1}_t + 0.23\ \text{D97-2}_t$$
$$(15.59) \qquad (-4.51) \qquad (-3.65) \qquad (2.38)$$

where Ä is the first difference operator, lpdk is the log of the Danish price series and lpm the log of the import price series. Daa-b is an event dummy for bth quarter of year aa. Values in parentheses are t-values.

The choice of the number of lagged explanatory variables was inspired by the multivariate analysis and the relation can be regarded as the first equation of the system conditioned on the contemporaneous changes in the import price. Based on the individual t-values, no significant effects of the import price on the Danish price is found (only the dummy variables are significant). To enforce this conclusion, an F test of the composite hypothesis that the coefficient of the contemporaneous as well as the two lagged values of the change in the import price are zero has

been done. The F test statistic becomes 0.96 with a p-value of 0.41 such that this null cannot be rejected. Furthermore, the results of the long-run and short run analysis taken together excludes any causal (in the Granger sense) effects from import prices to the Danish price. In total, the additional analysis of the short run regression strengthens the conclusions of the long-run analysis: the Danish price is not responding to the development in the import price and the hypothesis that the price setting of AP in the Danish market has not been affected by competition from imports cannot be rejected.

3.2 The import penetration test

In this section the sensitivity of the imported quantity of cement to the Danish market with respect to prices in general and the Danish price in particular is investigated based on an import demand relation. The idea of the test is that if imports are important for AP's conduct then the imported quantity will be elastic with respect to AP's price: If AP's price increases by one percent, the volume of imports increase by more indicating that AP by this operation would not only suffer a loss of market share but also a loss of revenue. An inelastic cross price effect on the other hand is seen as an indication of no true threat from imports to the price setting of the Danish firm. Again regression methods are applied in the testing procedure and due to the non-stationarity of the price series and possibly also of the imported quantity series the use of a cointegrated VAR-model is called for. As suggested in OFT (1999), an activity variable as well as a time trend is allowed for in the levels or long-run relation. The activity variable is represented by the employment in the construction and housing sector. A trend is included to capture possible technical advances in construction. Hence the data set of section 3.1 has been extended by the import quantity series and the activity variable. The theoretical relation of interest is:

$$lqm_t = \hat{a}_0 + \hat{a}_1 lpdk_t + \hat{a}_2 lpm_t + \hat{a}_3 lact_t + \hat{a}_4 t$$

where lqm is the log of the import quantity, lpdk is the log of AP's price on the Danish market, lpm is the log of the import price, lact is the log of the activity variable and t is the time trend. In order for this relation to be an import demand relation we expect $\hat{a}_1$ to be positive (and if elastic to be larger than or equal to 1), $\hat{a}_2$ to be negative and $\hat{a}_3$ to be positive.[11]

The hypothesis of the test is that the elasticity of imports with respect to AP's price is larger than or equal to 1 i.e. that the import demand is elastic and "the local producer will have limited room to exercise market power" (OFT, 1999, p. 81). If, on the other hand, we find that $\hat{a}_1 < 1$, we may conclude that imports are for some reason not responding forcefully to increases in this price and

[11]A problem of this procedure is that of a possible simultaneity bias.

that the firm does not have to worry too much about competitors in its price setting.

A VAR(4) model turns out to provide an appropriate description of the data for the import quantity series, the two price series and the activity variable. For reports of the misspecification tests and a description of the event dummies used in the analysis, see appendix C. That the VAR model of this 4 dimensional data set needs 4 lags is explained by the strong seasonality of the activity variable. A set of centered seasonal dummies are also included as conditioning variables. Within the VAR(4) model the number of long-run relations are determined based on the Johansen Trace test. The results of this testing procedure is given in table 3.2:

Table 3.2: Results of the Johansen trace test for the import penetration model.

Number of relations	Trace test statistic	90% quantiles	95% quantiles
0	61.98	58.96	62.61
1	26.54	39.08	42.2
2	7.93	22.95	25.47
3	1.34	10.56	12.39

The asymptotic quantiles are from Johansen 1995, table 15.4.

It is often argued that a significance level of at least 10% is appropriate for this kind of test as the null hypothesis in each step in a sense is that of non-stationarity which due to standard statistical practices would make it more difficult to find the relations of economic interest that we are looking for. Hence as the test statistic of the null of no long-run relation (first row of the table) is larger than the asymptotic 10% critical value we conclude that the number of long-run relations is at least 1. This conclusion would of course have been stronger had the statistic in addition been larger than the 95% quantile. As the test statistic of the second row in the table is smaller than even the asymptotic 90% quantile, the number of long-run relations is 1. Our conclusion of one long-run relation is in addition supported by the economic interpretability of the relation, see the estimated coeffecients in (3.1) below. The presence of one long-run relation among the variables of the data set could in fact mean that one of the "new" series in the data set — either the import quantity or the activity series — is a stationary series. To exclude this possibility either univariate Dickey-fuller type tests can be run for those series or individual stationarity can be tested within the multivariate framework. In the multivariate framework the testing is done conditional on the chosen number of long-run relations and is a $\div^2$ test, see Johansen (1995). The results of the multivariate stationarity testing is that neither the import quantity nor the activity series is stationary. In the former case the test statistic becomes 29.21, in the latter 27.05 and with 3 degrees of freedom (number of series minus number of long-run relations) the asymptotic 95% quantile is 7.81. Normalizing the unrestricted long-run relation on the import quantity, we get:

$$lqm_t = 0.60\ lpdk_t - 1.60\ lpm_t + 0.54\ lact_t + 0.02\ t \qquad (3.1)$$

Notice, that the signs of the coefficients in (3.1) are in accordance with our prior expectations. In this unrestricted version the elasticity of the Danish price is well below 1 (0.60) indicating the possible presence of market power for the Danish firm. This conclusion, however, has to be confirmed by a proper statistical test. The null of the import penetration test is that the elasticity is 1 ($\hat{a}_1 = 1$). This hypothesis imposes one restiction on the relation and as suggested by Johansen & Juselius (1994) a test statistic with an asymptotic $\div^2$ distribution with one degree of freedom

can be used for this purpose. The test statistic becomes 6.82 which means that the null is clearly rejected. So the initial impression of an inelastic import demand curve is supported by the statistical test. A final test in the analysis concerns the hypothesis that it is the relative price that matters and at the same time that the import demand is elastic with respect to the relative price. This hypothesis imposes two restrictions on the coeffecients of the relation and gives a test statistic of 9.33. As the asymptotic 95% value of the $\div^2$ distribution with two degrees of freedom is 5.99 this second hypothesis is also clearly rejected. Hence the overall conclusion from the import penetration testing is that we cannot reject the hypothesis that the local producer will have room to exercise market power even in the presence of imports on the Danish cement market.

The import penetration test indicated that the *potential* for abuse of market power seems to have been present for the sample period under study. The analysis of the price behaviour further points towards an independent price setting behaviour of AP in the Dansh cement market. In sum, empirical analysis in this case provides us with quite strong evidence AP has been able "to behave to an appreciable extent independently of its competitors" in the Danish cement market in the 1980s and most of the 1990s.

3.3 Determination of the own-price elasticity of demand in the Danish cement market.

We now test whether AP has been able to behave to an appreciable extent indpendently of its customers by analysing whether demand is inelastic. In order to determine the own-price elasticity of demand in the Danish cement market we set op a system that contains the following variables: A quantity variable (qdk), the corresponding price variable (pdk - AP's price on the Danish market, also used in sections 3.1-2), the price of imported cement (pm), an activity variable ('act' - the same one as the one used in section 3.2) and a time trend (to capture changes due to changes in preferences or changes in technology)[12]. All of these variables enter the analysis in logs. With only a few lags in the system equations there is no indication of cointegration amongst these variables and hence no long-run demand relation can be discovered. This means that we are unable to report an elastic (with respect to the own-price) demand for Danish cement i.e. that we cannot reject that AP is in a dominant position. It is however possible to set up a quite well specified VAR(8) model[13] for the present set of series and the results of an analysis of that system are reported below just to reinforce the above conclusion. The number of long-run relations amongst the series is determined based on Table 3.3 below:

[12] As with such demand equation in general there is a potential danger of some simultaneity bias in the estimation results.

[13] The results of the misspecification test can be found in appendix C.3

Table 3.3: Results of the Johansen trace test for the demand model.

Number of relations	Trace test statistic	90% quantiles	95% quantiles
0	65.96	58.96	62.61
1	27	39.08	42.2
2	14.84	22.95	25.47
3	5.02	10.56	12.39

The asymptotic quantiles are from Johansen 1995, table 15.4.

Based on the figures in Table 3.3 we conclude that there is one long-run relation, the content of which is in accordance with an interpretation of a demand relation.

The long-run demand relation is:

lqdk = -0.27 lpdk + 0.33 lpm + 2.79 lact + 0.01 trend

We are unable to provide the Wald-like standard errors in the present case as no restrictions except of a normalizing one are imposed on this relation (see Hansen and Juselius (1995)). We are, however, able to add certain significance statements as we have performed additional Likelihood Ratio tests for the significance of each of the variables in the relation. The results of these LR tests are that lpdk — the own price — is in fact insignificant (p-value = 0.18). The import price is border-line insignificant (p-value=0.07). The activity variable is clearly significant (p-value = 0.00) and the trend variable is again a border-line case (p-value = 0.05). The immediate conclusion based on these results is that of an inelastic demand (with respect to own price) supporting the conclusion of a dominant position of AP as already indicated above. A final test is now run to make sure that the above conclusion is the right one. A LR-test of the hypothesis that the own-price elasticity is 1 is run. This hypothesis is rejected with a p-value of 0.00. Hence there is no support in the data for an own-price elastic demand for Danish cement and the statement that AP possesses a dominant position in the Danish cement market cannot be rejected.

4. Abuse of domination?

AP was charged with excessive pricing on the Danish market allowing it to earn supranormal profits. The question is how to establish that prices are excessive. In this section we first discuss what is needed to establish excessive pricing in the sense of the European Court of Justice, then we compare AP's domestic price with the price of importers and finally we compare AP's pricing

with that of other European exporters. In doing this we try to determine whether the European Court of Justice would have found sufficient evidence to decide that AP has abused its dominant position on the Danish market. Absent data on costs, we are not able to decide whether AP in fact abused its position: It could be that prices on all markets are excessive (because of the European non-transhipment agreement, see section 2.3) or that some exporters have higher costs and therefore wish to export only if and when they get a high price. The policy implications of these different explanations are quite diverse: If AP's prices were excessive in the Danish market as a result of Europe-wide collusion, then it is the market sharing agreement on a EU level that should be attacked. If AP's prices are moderate compared with those of less efficient rivals, then it is hard to claim that AP abuses its dominant position by excessive pricing.

In sum: In this section we restrict our analysis to the easier question of whether AP's prices fall within the "normal commercial range" in order to analyse whether the European Court of Justice would have found price comparisons, the only available data, to reveal abuse of domination.

4.1 Excessive prices

In the *United Brands* case[14] the Commission compared prices for green bananas intended for the Irish market with those intended for the Danish market and found that the latter price was 2.38 times the former. The Commission concluded on the basis of this that prices on the Danish market were abusive. The European Court of Justice refused to accept this argument and indicated that it felt that the basis for using the Irish price as a reference price had not been sufficiently investigated. In particular, it could be that the Irish prices were loss-making.

In table 2.1 we showed that the Danish price of grey cement was in fact 2.5 times the export price of grey cement on average for the 1988-1998 period. This however is insufficient to establish abuse of dominance.

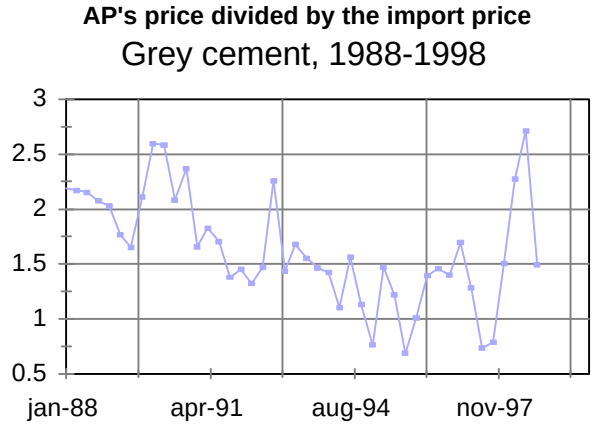
In the *United Brands* case the Court stated that a detailed cost analysis was a necessary prerequisite for establishing that a price was excessive, thus constituting abuse of a dominant position. The next step would be to compare the prices charged with those charged by competitors for the same product. Excessive prices would be established if prices were outside the "normal commercial range." In the *United Brands* case, the Court found that the price difference between United Brand's Chiquita brand and that of its main competitors was only seven percent. This was insufficient to establish dominance.

[14] See footnote 1 above for a reference to the case and e.g. Fejø (1997b, 103-5) and Goyder (1998) for a discussion.

4.2 AP's domestic price compared with the import price

Our data set does not permit us to do a detailed cost analysis thus showing that the margin between prices and costs is outside the normal range. However we may compare the prices of AP with the prices of its competitors (the importers). Table 2.1 shows that in the 1988-1998 period, AP's price is on average 63 percent above the import price. Figure 4.1 below shows the price of AP's domestic price of grey cement relative to the import price from 1988 through 1998. During this period, AP's price has varied from 33 percent below the import price to 171 percent above it. Although AP's price has been higher on average, there have been periods in 1995 and 1997 where AP's domestic price was below the import price. AP's price was persistently more than 50 percent above the import price in the period from 1988-1991 and during 1998. However, AP might argue that its product is really different from imported grey cement since it has added the anti-chromate eczema compound mentioned in section 2.1. The price of the imported grey cement would go up, if this compound were added to the imported grey cement.

Figure 4.1



4.3 AP's pricing compared with other European exporters

Another price comparison with AP's competitors can be constructed using unit values calculated on the basis of Eurostat's *Internal and External Trade of the EU*.[15] This is done for a number of countries in table 4.1. The entries show the unit value of the export of grey cement from the country to the (rest of) the EU in 1997 and 1998. For Denmark we have attempted to construct a comparable domestic price using the relation between this price and the price of exports in our

[15] Available from Eurostat on CD-Rom.

data base.

Table 4.1 shows that AP's export price is relatively low. Only Greek — and in 1998, Swedish — producers charge a lower export price when selling in the EU. The average export price from EU countries is 32-36 percent higher than the similar Danish price. On the other hand, AP's *domestic* price is below the *export* prices of the U.K. and Finland, making it difficult to conclude that the Danish prices are unreasonable when compared with prices of identical goods. This does not mean that AP's domestic price is not excessive: It could be that the UK and Finnish export prices are also excessive especially when the European cement producers' cartel discussed in section 2.2 is kept in mind. It does mean, however, that the task of establishing abuse is much more complicated since it would likely have to account for the pricing system of all the overlapping European cement markets.

Table 4.1: Unit values in exports (expeditions) of grey cement to the EU

ECU per ton	1997	1998
France	54.03	59.07
Belgium and Luxembourg	59.36	56.62
Netherlands	60.77	66.90
Germany	65.06	65.03
Austria	66.04	67.21
United Kingdom	81.14	81.60
Ireland	55.23	61.01
Italy	46.93	76.61
Greece	30.95	33.32
Spain	43.47	39.14
Sweden	48.58	15.96
Finland	115.38	88.31
Norway	48.52	72.37
Poland	41.23	44.47
EU	51.68	51.10
Denmark	37.92	38.59
AP's domestic price*)	71.29	86.82
*) Calculated by multiplying the Eurostat number with the relation between domestic price and exports from our data base (1.88 in 1997 and 2.25 in 1998).		

5. Conclusion

We have established that Aalborg Portland holds a dominating position on the Danish market in the sense of the European Court of Justice. We did this through an analysis of AP's pricing behaviour and by an import penetration test thus demonstrating that the company has the power on this market to act independently of its competitors. Furthermore, we established that AP's domestic demand is inelastic allowing it to behave to an appreciable extent independently of its customers and ultimately of its consumers.

Holding a dominant position is not in and of itself prohibited. It is the abuse of this position that is banned. In order to establish abuse by excessive pricing, it is not enough to show that prices are high in a given market. The competition authority must also show that the price-cost margin falls outside the normal commercial range and that the price cannot be considered reasonable in comparison with prices of identical goods. Our analysis fails to show that the prices are unreasonable: We find prices of identical goods that are both below and above AP's prices. This indicates that their prices fall within the normal commercial range. Given the presumption that a company is innocent until proven guilty, we conclude that based on our data AP has not abused its dominant position and the Competition Council was right in acquitting it in 1998.

Our analysis also leads us to question the wisdom of a competition policy regime that includes as a definition of abuse the charging of excessive prices to consumers. Abuse may be more sensibly defined in terms of conduct toward rivals, e.g. the attempt to reduce actual or potential competition, thus increasing the profit-maximizing price that could (non-cooperatively) be set. Since it is not illegal to possess the dominant position nor to price non-cooperatively, it follows that it cannot in an internally consistent way be illegal to non-cooperatively set a monopoly price. Competition policy should aim at regulating competition, not prices. Thus barriers to entry should be the target.

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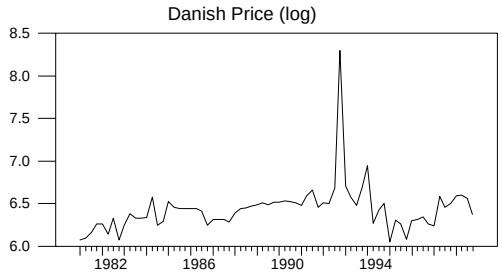
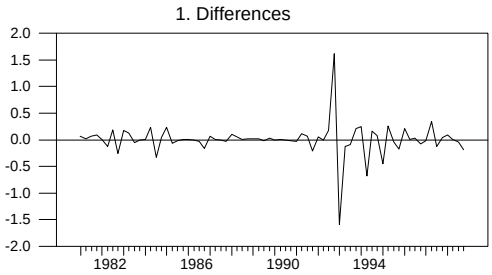
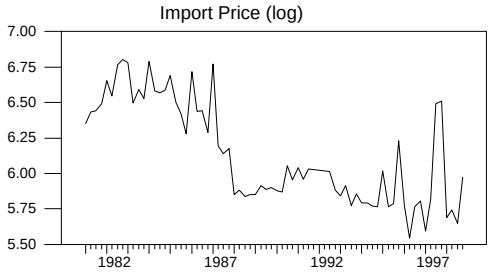
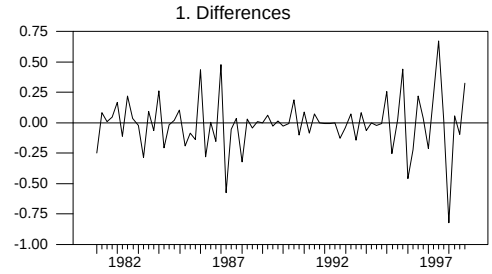
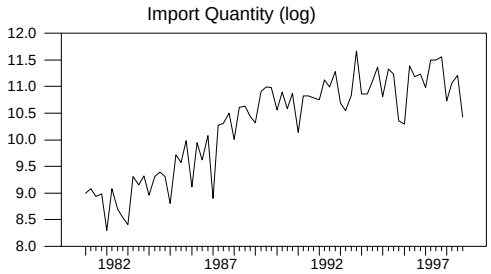
Appendix A: Graphs of the Data.

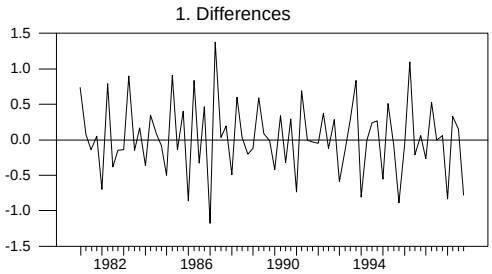


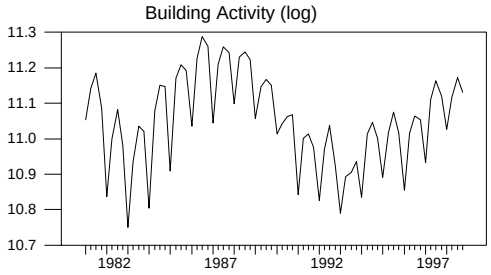


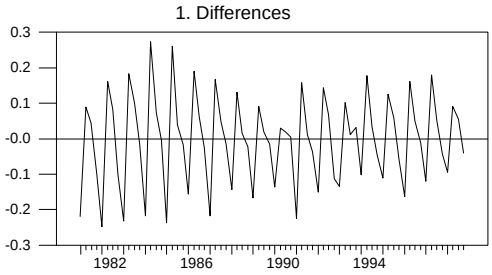


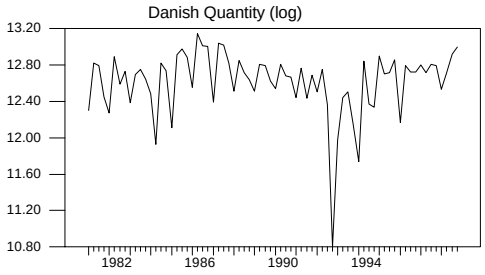


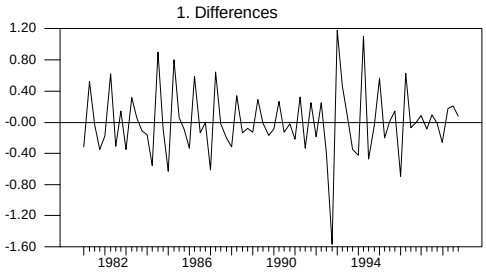












A.1 Univariate Unit root tests.

The univariate Dickey-Fuller tests are based on a regression of the change in the series of interest on the lagged level of the series, some lagged differences and maybe also some deterministic components. In the regressions, the results of which is reproduced below, the explanatory variables included are chosen such that each equation look as much like the corresponding one in the multivariate system as possible:

$$\Delta z_t = \alpha_0 + \gamma z_{t-1} + \alpha_1 \Delta z_{t-1} + \text{some dummies}; \qquad t=1,....,T$$

where z is either the Danish price series or the import price series. In both cases a set of centered seasonal dummies is included and for the Danish price series the event dummies from the multivariate analysis are also included. The null hypothesis to be tested is: $\gamma=0$ - i.e. the null of non-stationarity. The test statistic is the usual t-statistic only it does not follow a t-distribution under the null but rather what is known as the Dickey-Fuller distribution the critical values of which have been simulated and can be found in various text books on econometrics.

Table A.1: Results of the Dickey-Fuller type unit root tests.

Series	DF-statistic	Conclusion
Danish price	-2.16	Non-stationary
Import price	-2	Non-stationary

With approximately 100 observations the 5% critical value of the test statistic is: -2.89 (the null of non-stationarity is rejected when the test statistic is smaller than the critical value of the table); while the 10% critical value is: -2.58 (see e.g. Enders (1995), p. 223).

An assumption of the unit root test is that the residuals in the unit root regression are uncorrelated. Based on the Ljung-Box tests the residuals of the import price equation fulfills that assumption while it is rejected for the Danish price equation at standard significance levels. Adding a few more lags to the latter equation does not solve this problem so maybe a model with a MA-structure for the residuals will be better in this case. The absolute value of the tau-statistic does, however, only change marginally when additional lags are added to the equation and as the conclusion that each series are individually non-stationary is consistent with the results obtained in the multivariate analaysis we will not pursue this minor problem further.

Appendix B: The multivariate statistical model.

A vector autoregressive model (VAR) of order k can be expressed as:

$$\text{VAR(k):} \quad Z_t = Đ_1 Z_{t-1} + Đ_2 Z_{t-2} + \ldots + Đ_k Z_{t-k} + \mu + \varphi D_t + å_t, \qquad t=1,\ 2,\ldots,\ T$$

i.e. in a VAR(k) model the p time series of interest (contained in the vector Z_t) are explained by k lagged values of the time series themselves a constant term and maybe in addition some dummy variables, D_t, in order to make the residuals, $å_t$, multivariate normally distributed with mean zero and some covariance matrix $Ù_p$. The Đ- and φ-matrices as well as the μ-vector contain the parameters of the model.

In addition to the multivariate aspect of the analysis we want to use a model that allows us to treat the time series properties of the data in a proper way. Based on graphs of the log-transformed data and various unit root tests, see appendix A, there are indications of non-stationarity in the data. For practical purposes non-stationarity means that the means, the variances and the covariances of the time series are not constant over the sample period. To use OLS on the levels of such non-stationary data is a bad idea as such regressions will be affected by e.g. autocorrelation problems that are known to invalidate the standard statistical inference procedures. Fortunately, the VAR model when respecified properly is able to handle non-stationary time series (see Johansen (1995)). As non-stationary time series often can be made stationary by taking first differences (such series are often referred to as I(1) series) the proper transformation of the VAR is done by subtracting Z_{t-1} from both sides of (1) and rearranging terms:

$$ÄZ_t = ĐZ_{t-1} + Ã_1 ÄZ_{t-1} + \ldots + Ã_{k-1} ÄZ_{t-k+1} + \mu + \varphi D_t + å_t$$

(2) is also known as a vector error correction model (VECM). The matrices of coefficients in the VECM form of the model are uniquely derived from the parameters of the VAR-form. It can be shown that for I(1) series the matrix Đ in (2) will have reduced rank, $Đ = áâ^T$; where á and â are (p x r) matrices and superscript 'T' means the transpose of the preceding matrix. Disregarding the deterministic terms, in long-run equilibrium situations all 'changes-in-variables' will equal zero and therefore $â^T Z_t$ must be zero as well. This is why $â^T Z_t$ can be interpreted as deviations from long-run equilibria which may allow for interesting economic interpretations of the regression results. Note that for r>1 there are information on more than one long-run equilibrium relation in the data set. The short-run behaviour of the variables is affected both by lagged differences of the series but also by last periods disequilibrium error. The á-vector indicates how fast the variables will change as a result of a disequilibrium hence is interpretable as a set of speed-of-adjustment coefficients. A thorough description of estimation and inference procedures for this

model is beyond the scope of this paper. The interested reader is referred to Johansen (1995). It suffices to say that we have procedures available to test for the number of long-run relations (the cointegration rank), to test restrictions on the coefficients of the long-run relations and in case of more than one long-run relation to tests for a different set of restrictions on each of the long-run relations. Restrictions on the short run parameters of the model can also be tested.

Appendix C.1: Results of the misspecification tests for the price behaviour analysis.

Multivariate tests for autocorrelation in the residuals of the model. The null is that there is no autocorrelation.

Test	Statistic	p-value
Ljung-Box test based on 18 lags:	77.65	0.12
Lagrange multiplier test, order 1:	4.57	0.33
Lagrange multiplier test, order 4:	5.47	0.24

Multivariate test for normality. The null is that of normality.

Test	Statistic	p-value
Hansen-Doornik test	7.77	0.10

Univariate tests for ARCH and normality.

We test for 2th order ARCH. The null is that of no ARCH. The test-statistic is asymptotically Chi-square distributed with 2 degrees of freedom (the critical 5% value is 5.99).
Normality is tested based on the Jarque-Bera test. The null is that of normality. The test-statistic is asymptotically Chi-square distributed with 2 degrees of freedom (the critical 5% value is 5.99).

Series	Test-statistic, ARCH	Test-statistic, normality
Danish price	9.59	2.36
Import price	6.83	5.40

Based on the above statistics the VAR model with 2 lags gives a very acceptable description of the data set. The only point of worry is the significance of the univariate ARCH(2) tests at the standard 5% level. Using a significance level of 1%, however, will almost make the statistics insignificant and therefore we are quite satisfied with the present form of the unrestricted model.

It is at this stage worth mentioning that the nice results with respect to normality of the residuals are partly due to the inclusion of 4 event-dummies in the D-matrix. The dating of these dummies are mentioned in the main text and they are primarily present to cope with a few outliers in the data set. Each of these dummies consists of zeros except for the period of the outlier. In the outlier period the dummy is 1 while it is defined to be -1 in the following period. Such a construction ensures that the dummy variables do affect neither the linear trends in the levels of the variables nor the asymptotic distribution of the cointegration rank tests.

C.2: Results of the misspecification tests for the import penetration analysis.

Multivariate tests for autocorrelation in the residuals of the model. The null is that there is no autocorrelation.

Test	Statistic	p-value
Ljung-Box test based on 18 lags:	253.91	0.08
Lagrange multiplier test, order 1:	15.33	0.50
Lagrange multiplier test, order 4:	18.36	0.30

Multivariate test for normality. The null is that of normality.

Test	Statistic	p-value
Hansen-Doornik test	11.04	0.20

Univariate tests for ARCH and normality.

We test for 4th order ARCH. The null is that of no ARCH. The test-statistic is asymptotically Chi-square distributed with 4 degrees of freedom (the critical 5% value is 9.49).

Normality is tested based on the Jarque-Bera test. The null is that of normality. The test-statistic is asymptotically Chi-square distributed with 2 degrees of freedom (the critical 5% value is 5.99).

Series	Test-statistic, ARCH	Test-statistic, normality
Danish price	9.59	2.36
Import price	6.83	5.40
Import quantity	13.44	3.80
Building activity	1.98	2.40

Based on the above statistics the VAR model with 4 lags give a very acceptable description of the data set. The only point of worry is the significance of the univariate ARCH(4) test of the residuals from the import quantity equation at the standard 5% level. Using a significance level of 1%, however, will almost make the statistics insignificant and therefore we are quite satisfied with the present form of the unrestricted model.

It is at this stage worth mentioning that the nice results with respect to normality of the residuals are partly due to the inclusion of 5 event-dummies in the D-matrix. 4 of them are the dummies used in the price behaviour analysis while the fifth is an event dummy for the building activity series. The fifth dummy is also an event dummy and is designed to capture the special behaviour of the building activity in the 1st quarter of 1985.

C.3: Results of the misspecification tests for own-price elasticiy of demand analysis.

Multivariate tests for autocorrelation in the residuals of the model. The null is that there is no autocorrelation.

Test	Statistic	p-value
Ljung-Box test based on 18 lags:	262.19	0.00
Lagrange multiplier test, order 1:	8.41	0.94
Lagrange multiplier test, order 4:	27.90	0.03

Multivariate test for normality. The null is that of normality.

Test	Statistic	p-value
Hansen-Doornik test	11.37	0.18

Univariate tests for ARCH and normality.

We test for 8th order ARCH. The null is that of no ARCH. The test-statistic is asymptotically Chi-square distributed with 8 degrees of freedom (the critical 5% value is 15.51).

Normality is tested based on the Jarque-Bera test. The null is that of normality. The test-

statistic is asymptotically Chi-square distributed with 2 degrees of freedom (the critical 5% value is 5.99).

Series	Test-statistic, ARCH	Test-statistic, normality
Danish price	9.14	4.61
Import price	7.82	4.81
Import quantity	12.35	0.05
Building activity	4.58	1.81

Based on the above statistics the VAR model with 8 lags give a quite acceptable description of the data set.There is a small problem with some of the tests for multivariate autocorrelation but these indications are not too serious and in the light of the fact that this analysis serves as a sensitivity analysis we will not pursue this discussion futher.