The Impact of Waiving Safeguard Measures on the Monopoly Producer of Cement in Jamaica

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FAIR TRADING COMMISSION[1]

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Abstract

A simple but powerful economic model is utilized to characterize the main features of the Jamaican cement Industry; and to isolate the effect of changes in import tariffs/duties on the domestic price of cement. The monopoly producer, Caribbean Cement Company Limited (CCCL), generated approximately $694 million less revenue because competitive forces, stimulated by the waiver of safeguard measures, constrained CCCL's ability to profitably increase the domestic price of cement. Price levels were estimated to be, on average, 3 percent lower than what they likely would have been had the measures not been waived.

1. Background

The objective of this paper is to quantify the impact of the Government's decision in March 2006 to waive the safeguard measures on cement. The relevant safeguard measures were recommended to be in place during the period July 2004 through June 2008. The Anti-Dumping and Subsidies Commission (ADSC, 2004,3) points out that in October 2003, CCCL submitted a request for the ADSC to provide relief from the import of Ordinary Portland Gray Cement as the imports were causing serious injury and threat to the domestic market.[2]

[1] The views expressed in this paper are those of the Fair Trading Commission and do not necessarily represent the views of either the Ministry of Industry Investment & Commerce (MIIC) or the Government of Jamaica (GOJ). Accordingly, neither the MIIC nor the GOJ are bound by the findings that are contained in this paper.

[2] Anti-Dumping and Subsidies Commission is Jamaica's trade remedy authority whose goal is to ensure equity in international trade and to prevent domestic industries from being negatively affected by imports.

In response to the request, the ADSC conducted a safeguard investigation pursuant to the Safeguards Act of 2001. The investigation concluded that the increase in the importation of cement had the effect of causing a level of injury and the threat of serious injury to the viability of the domestic industry and that safeguard measures should be imposed to protect the industry. Accordingly, in 2004, the ADSC recommended that a tariff of 25.83 percent be imposed for four years on cement originating from Argentina, China, Egypt and Russia. This was in addition to the existing CARICOM Common External Tariff (CET) regime of 15 percent. In November 2004, the Government granted approval for tariffs on cement to be raised to 40 percent (Planning Institute of Jamaica -PIOJ, 2006b). Edwards (2005, 1) reports that, due to the safeguard measures, the importation of cement by other suppliers was no longer feasible in commercial quantities. The then two main suppliers, Mainland International and Arc Systems subsequently exited the market (Meikle, 2006, 1).

In 2006, CCCL recalled a batch of cement that was later determined to be of substandard quality. Jones (2006, 14) points out that on March 2, 2006, CCCL issued the recall of a batch of 500 tonnes of cement as the cement exhibited faulty setting characteristics. A faulty quality control system was identified as the factor resulting in the production of the defective cement (Gordon, 2006, 1).

The adverse effects of the production and sale of the faulty batch were manifested in multiple ways. These included the suspension, delay and abandonment of construction projects as well as loss of jobs for persons in the construction industry (Gordon, 2006, 1; PIOJ, 2006, 14.1). Gordon reports that approximately 30,000 jobs were lost. In addition, CCCL suspended sales in March 2006 to correct the problem (CCCL Annual Report, 2006, 1). During January – March 2006, PIOJ (2006b) estimates that real GDP for the Construction and Installation sector declined by 3.6 percent; compared to a 10.5 percent growth during the corresponding period in the previous year.

On March 8, 2006 the Government, through a press briefing hosted by the Minister of Commerce, Science and Technology announced that it would be waiving, with immediate effect, the duties associated with the safeguard measures (Paulwell, 2006, 4). Then Minister Phillip Paulwell indicated that the Government took the decision after it became evident that the CCCL

would be unable to supply the volume of cement demanded by the construction Industry. Paulwell (2006, 4) stated that "…it was agreed that a policy intervention was needed that would address the needs of the construction industry and consumers in general without injuring the producer and derailing the expansion of the [domestic] cement plant…" As a result of this, the tariff was reduced from 40 percent to 15 percent. Further, in May 2006, the CARICOM Common External Tariff of 15 percent was temporarily removed (Francis, 2006, 1; PIOJ, 2006a). This was done in an effort to encourage the importation of cement by other suppliers. In addition, through the Bauxite Institute, the Government imported 64,000 tonnes of cement from Cuba (Jamaica Information Service, 2006).

In September 2006, the CCCL publicly acknowledged that it was unable to produce cement in the quantity demanded by the industry as the demand exceeded its production capabilities (Meikle, 2006,1). CCCL further advised that its mills were operating at only 80 percent capacity (Meikle, 2006, 1). Thus, cement was imported by CCCL and others to satisfy the demand of the market. The level of imports during the period 2003-2007 are reported in Table 1 below

Table 1 Cement Activity in the Jamaican Market 2003-2007 (in metric tonnes)

	2003	**2004**	**2005**	**2006**	**2007**
Production	607,682	808,840	844,840	760,000	591,967
Import:					
CCCL	--	--	--	119,032	25,988
Others	173,557	21,007	9,438	187,734	49,840
Total Available[a]	781,239	829,847	854,278	1,066,766	819,795
less exports	16,058	3,501	2,762	--	
Total Supply	765,181	826,346	851,516	1,066,766	

Note: a. Total Available cement does not included opening inventory levels for the period 2003-2004.
Sources: i. Caribbean Cement Company Limited, Annual Report, 2006-2007.
ii. MIIC, 2007 Report on Cement Supplies in the Jamaican Market, 2008.

CCCL's admission of its inability to meet the demand for cement, coupled with the waiver of the safeguard measures on imported cement, opened the door for entry/ reentry of other suppliers

into the cement market. Suppliers such as Mainland International and Arc Systems Limited re-entered the cement market in 2006 (Meikle, 2006, 1).

The remainder of this paper is organized as follows. Section 2 explains the method used in this study, after which section 3 provides a detailed description of the conceptual economic model developed to capture the main economic relationships observed in the cement industry. In section 4, we verify the validity of our conceptual model to determine the extent to which it organizes observed economic data for the industry. Calculations are reported in section 5 after which concluding remarks are offered in section 6.

2. Methodology

The methodology utilised in this study, at least conceptually, involves a comparison between CCCL's actual economic position during the period March 2006 through June 2008 and its position in an unobserved (hypothetical) market in which the safeguards measures were not waived. Such a comparison ensures that our estimate of the effect of the policy intervention excludes the effect of other factors which may also have affected the economic position of CCCL during the relevant period.[3] The accuracy of the estimates produced by this study, therefore, is inexorably linked to the validity of the assumptions we have made in characterizing the main features of this hypothetical market.

Benchmarking hypothetical prices, p_1. The best strategy to identify the unobserved price data is to select an appropriate benchmark market from which we could derive a useful proxy for the price which would have prevailed if the measures were not waived. The ideal benchmark is one with similar conditions to those which existed in Jamaica during the review period, save and except for the fact that the safeguard measures were not waived. The economic model used to derive the hypothetical prices is described in Section 3.

Benchmarking hypothetical production levels, q_1. It is unlikely that the failure to impose the safeguard measure constrained the volume of cement produced by CCCL during the review

[3] For example, adverse economic conditions created by, say, the passages of hurricanes and tropical storms should be excluded from the estimate of the economic impact of the Government's intervention.

period. Documents reviewed indicate that the market demand for cement in Jamaica exceeded CCCL's productive capacity (CCCL Annual Reports, 2002-2007). In its outlook for 2006, CCCL Annual Report (2005, 14) indicated that "…demand is now exceeding the manufacturing capability of our plant and will necessitate ongoing imports until the Expansion and Modernisation program is concluded…" *The Business Observer* (18 March 2009, 11B) reports that CCCL's expansion program is scheduled for completion in the second quarter of 2009. Further, there is evidence that licenses to import cement were issued by the Government for the purpose of closing the gap between the estimated demand for cement and the forecasted production of the CCCL (MIIC, 2008,1; Paulwell, 2006,1).[4] This suggests that fluctuations in the volume of cement sold during the period were unrelated to the decision of the Government to waive the measures. Accordingly, the volume of cement (q_1) sold in the hypothetical industry is assumed to be identical to the actual volume sold (q_0). That is, during the period in which the measures were waived, CCCL would have been able so sell all the cement it was able to produce.

The economic impact of the policy intervention is estimated as the difference between profit which CCCL could have realised in a hypothetical market where the measures were not waived, π_1, and the actual profit realised in the industry when the measures were waived, π_0. In general, profit is expressed as

$$\pi = pq - c(q)$$

where,

p is the price of a unit quantity of cement

q is the volume of cement sold

c is the cost of producing *q* units of cement

Accordingly, we denote the economic impact, *d*, as:

$$d = \pi_1 - \pi_0$$

$$d = p_1q_1 - p_0q_0 - [c(q_1) - c(q_0)]$$

$$= (p_1 - p_0)q_1 - (q_0 - q_1)p_0 + [c(q_0) - c(q_1)] \qquad [1]$$

[4] Note that approval was also granted for CCCL to import cement.

The amount *d*, represents the economic impact as the sum of three effects: the price, quantity and cost effects. The first term, which measures the price effect, represents foregone revenues by virtue of CCCL's diminished market power, i.e. reduced price margins.[5] The diminished power is a consequence of CCCL operating in a market in which competition is more intense relative to one in which it would have operated in the hypothetical market in which the measures were not waived. The revenue loss associated with the price effect represents a direct transfer of surplus from CCCL to consumers. That is, it represents the reduction in consumer expenditure on cement sold by CCCL during the review period. The second term, the quantity effect, represents revenues from quantity adjustments made by CCCL when faced with more intense competition than it otherwise would have faced if the measures were not waived, that is if the 40.83 percent tariff was in place. These quantities are valued at the price obtained when the measures were not waived. The third term, the cost effect, represents the difference in production costs which would have been incurred for adjustments in the quantity of cement produced.

The main obstacle in quantifying the economic impact based on the expression above is the fact that calculating d requires data on (p_1, q_1) which are unobservable. Based on the above assumption that $q_1 \approx q_0$, however, the economic impact given in equation [1] is approximated by

$$d \approx (p_1 - p_0)q_0 \qquad [1']$$

[5] Economists define market power as the ability of businesses to profitable maintain price above competitive levels.

3. The Model

The cement industry in Jamaica is most appropriately characterized as one in which there is a dominant firm and a competitive fringe.[6] The main features of this market structure are described below.

i. *One dominant supplier*. There is one cement supplier that is much larger than any other firm.
ii. *Competitive fringe*. All suppliers, other than the dominant supplier, are price takers.
iii. *Market Demand*. The dominant supplier knows the market demand curve, $D(p)$ and cement from the various suppliers is perceived by consumers to be identical.
iv. *Competitive fringe's supply curve*. The dominant supplier knows the supply curve of the competitive fringe.

Equilibrium[7]

We now examine the price and quantities which would be expected to clear this market. The first basic assumption in that each supplier's only objective is to maximize its profits from operating in the market. In general, suppliers have to decide either the price or quantities of goods to supply; but they can not determine both the price and quantity. Given assumption (ii), fringe suppliers charge whatever price is being charged by the dominant supplier and select the volume of cement to import given this price. Accordingly, the dominant supplier's decision is to select a price and supply the volume of cement which the construction industry will demand at that price.

The Output Decision of the Competitive Fringe. It is easy to show that each supplier in the competitive fringe maximize its profit by selecting supply level such that the price is equal to its marginal cost of production.

The Price Decision of the Dominant Supplier. The dominant supplier correctly anticipates the units of cement which will be supplied by the fringe firms (by assumption iv.) and therefore deduces that he will be the monopoly supplier over the residual demand, that is the difference

[6] See Carlton and Perloff (2005, Chapter 4) for a useful review of this model.
[7] See the **Technical Appendix** for a more rigorous development of the equilibrium conditions in this model

between the quantity demanded by the market and the total quantity supplied by the fringe suppliers. The objective of the dominant supplier is to select a price which maximizes profits, realised from supplying this residual demand.

An important feature of this economic model is that the competitive fringe constrains the extent to which the dominant supplier can profitably increase the price, the intuition is as follows. In the absence of the competitive fringe, the monopolist could raise the price of cement by lowering its output which would also reduce the industry's output. When the fringe firms are operating in the market, industry output would not fall as much and therefore prices would not rise as much as when there was no competitive fringe (Carlton and Perloff, 2005, 113).

4. Empirical Implementation

Since this is a quantitative study, we need to identify the specific structural form of the demand and cost functions arising from the general model outlined above. A unique equilibrium will exist for the model under fairly general conditions.

4.1 Estimating Model Parameters for Market Demand

Using monthly data on prices (per metric tonne) and sales volumes (in metric tonnes) during the period 1992-2007, we use regression analysis to estimate the linear demand function. The result is reported below.[8]

$$Demand = 445{,}690 - 77\,price \qquad [2]$$

Our specification of a linear demand function appears to be appropriate as the model was found to explain approximately 70 percent of the variation in observed sales quantities. [9] The model suggests that on average, every dollar increase in the price reduces monthly industry demand by 77 tonnes.

4.2 Estimating Model Parameters for Cost Functions

[8] All regressions are estimated using *Stata* version 9. The reported results are included in the **Technical Appendix.**
[9] We also experimented with a log-linear demand function to estimate the industry demand. The log-linear function, however, explained only 67 percent of the variation.

The cost function was not empirically estimated as we do not have data on actual costs. To overcome this problem, we assumed values of the parameters so that the level of profits predicted by the model would be, on average, close to the operating profit of the dominant supplier over the relevant period, as reported in its published annual reports.

The price data observed during period March 2006 through December 2007 were then utilized to gauge the potency of our conceptual model to organize the empirical data. To do this, we calculate the correlation coefficient ρ between the prices predicted by our model with those observed during the period. The correlation coefficient allows us to measure the strength and direction of the linear relationship between the prices predicted by our model and the actual prices. The correlation coefficient between predicted prices, $p^*(\tau)$ and actual prices is $\rho = +0.86$. This indicates that there is a strong positive relationship between the prices predicted by our model and the actual prices and that approximately 74 percent of the variation in observed prices is explained by variations in the predicted prices. To derive the exact form of the linear relationship, we then estimate the following equation.

$$\textit{observed}\ \text{price} = z_0 + z_1\, \textit{predi}\text{cted price} \qquad [3]$$

Parameter estimates of $z_0 = 0$ and $z_1 = 1$ would suggest that our predicted prices coincided with the actual prices. The results are presented below.

$$\textit{observed}\ \text{price} = -40{,}069 + 9\, \textit{predi}\text{cted price} \qquad [4]$$

Although the results reveal that the parameter estimates $\hat{z}_0 = -40{,}069$ and $\hat{z}_1 = 9$ differ significantly from their ideal levels, the model is still useful since, as mentioned above, it explains approximately 74 percent of the variation in actual prices. Accordingly, to estimate the effect of trade barriers (τ) on equilibrium prices, we use the following function:

$$P(\tau) = -40{,}069 + 9\, p^*(\tau) \qquad [5]$$

where,

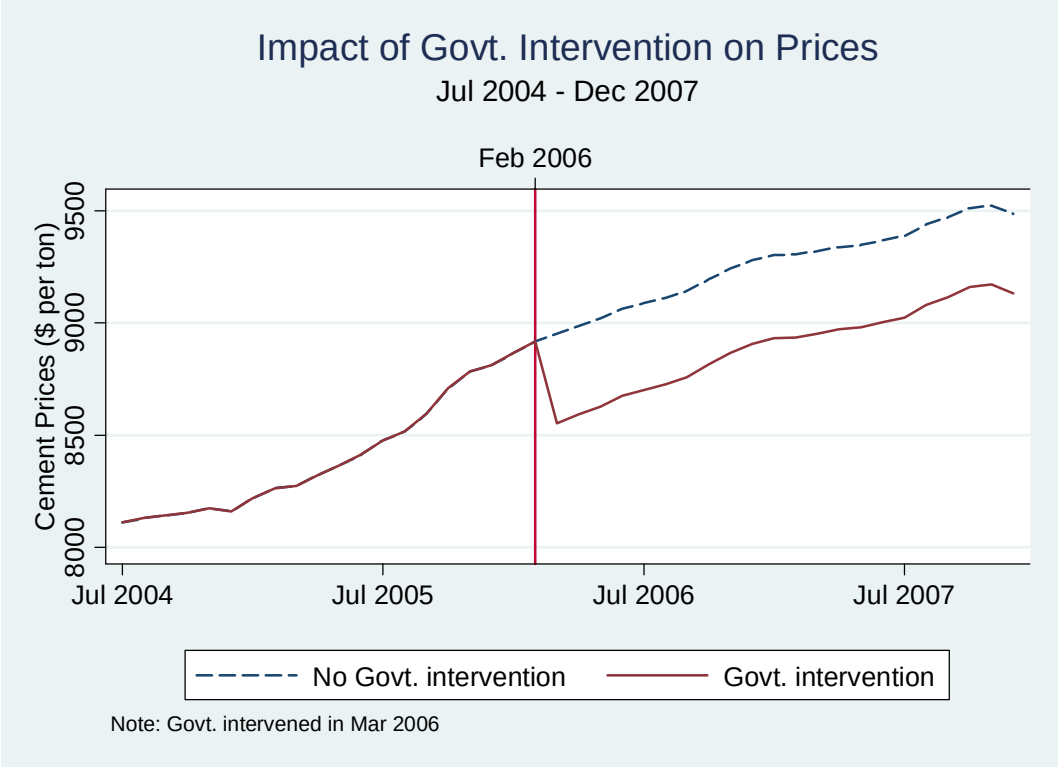
$p^*(\tau)$ is the price predicted by our economic model

5. Analysis

In the previous section, we constructed a function $P(\tau)$ that has as one of its arguments, the level trade barriers/duties levied on imported cement. This allows us to assess the likely impact of various level of this parameter on the observed prices. The records show that prior to the safeguard measures, imported cement attracted only CET duties of 15 percent. In July 2004, the ADSC recommended that safeguard measures in the form of an additional tariff of 25.83 percent be imposed for a period of four years.[10] With effect from March 2006, the Government waived the safeguard measures. To isolate the effect of the Government's policy intervention, we need to compare the domestic price of cement when the safeguard measures were waived, that is when duties were 15 percent, with prices in (the hypothetical market) in which the measures were not waived, that is if the duties remained 40 percent. Using the economic model described in the previous section, we generate the market-clearing prices under the two alternative policies: waive safeguard and impose safeguard. The results are displayed below in Figure 1. Prices under 'Govt. intervention' represent the model's predicted prices with the policy intervention while 'No Govt. intervention' shows the predicted prices in a benchmark hypothetical market in which the Government does not intervene.

[10] See ADSC (2004).

Figure 1 Predicted Price with Intervention and without Intervention



It is seen that price under alternative regimes display identical upward trends prior to March 2006. Following the intervention in March 2006, however, our model predicts a discrete fall in prices, after which prices resumed the upward trend. The important observation to make here is that although prices are rising in the post intervention period, they are not as high as what they could have been in the absence of the intervention.

Accordingly, the economic impact as determined by equation [1'] is calculated as

$$d = \left[P(\tau = 40\%) - P(\tau = 15\%)\right]q_0 \qquad [6]$$

where q_0 is the actual quantity of cement supplied by CCCL during the relevant period.

Table 2 below shows the economic impact of intervention on CCCL's revenues, prices and market power during the period March 2006 through June 2008. Panel A in Table 2 shows that the CCCL sold approximately [✂] tonnes of cement up to December 2007 and revenue from these sales is estimated to be $553.85 million lower than what they would have been had the safeguard measures not been waived. It is also observed that this reduction in revenue was due to

the fact that prices per tonne were, on average, $373 lower compared to what they would have been had the measures not been waived. Alternatively expressed, we estimate that if the measures were not waived, prices would have been approximately 3.32% higher than those observed during the period. The inability to charge higher prices is a direct consequence of competition from imported cement.

Table 2 Economic Impact of Intervention

Month	Quantity Supplied (in metric tonnes) [A]	Price difference (in $) [B]	Foregone Revenues (in $million) [C=A× B] [C]	Market power (%) [D=(B ÷ Actual Price)×100]
Panel A				
2006				
Jan	---	---	---	---
Feb	---	---	---	---
Mar	✂	✂	18.18	✂
Apr	✂	✂	29.02	✂
May	✂	✂	27.61	✂
Jun	✂	✂	33.65	✂
Jul	✂	✂	28.67	✂
Aug	✂	✂	25.61	✂
Sep	✂	✂	28.33	✂
Oct	✂	✂	24.96	✂
Nov	✂	✂	23.84	✂
Dec	✂	✂	21.56	✂
2007				
Jan	✂	✂	26.90	✂
Feb	✂	✂	25.37	✂
Mar	✂	✂	25.35	✂
Apr	✂	✂	22.14	✂
May	✂	✂	24.91	✂
Jun	✂	✂	25.34	✂
Jul	✂	✂	24.49	✂
Aug	✂	✂	19.97	✂
Sep	✂	✂	21.37	✂
Oct	✂	✂	26.27	✂
Nov	✂	✂	26.30	✂
Dec	✂	✂	23.97	✂
Panel B				
2008				
Jan	✂	✂	23.30	
Feb	✂	✂	24.99	
Mar	✂	✂	21.94	
Apr	✂	✂	24.36	
May	✂	✂	22.99	
Jun	✂	✂	21.73	

Our objective is to estimate the economic impact on CCCL of the policy intervention for the period up to the June 2008. The data we have, however, allow us to estimate prices up to December 2007 only. To estimate the economic impact of the policy during the first half of 2008, therefore, we use the price difference as at December 2007 and the actual quantities of cement supplied by CCCL during January-June 2008.[11] The results are reported in Panel B. The data show that CCCL sold [✂] tonnes of cement during the six-month period. Accordingly, it is estimated that CCCL realised approximately $139.31 million less in revenue relative to what they would have realised in the absence of Government's intervention.

6. Conclusion

We utilized a simple but powerful model to characterize the main features of the Jamaican cement Industry and successfully isolated the effects of changes in trade barriers on the domestic price of cement. Accordingly, it is estimated that as a direct result of the Government waiving the safeguard measures in March 2006, the CCCL realised approximately $694.27 million less in sales revenues than it otherwise would have realised. The analysis shows that reduced sales revenue is attributable entirely to the competitive pressures exerted by commercial importers which discouraged CCCL from increasing prices by approximately 3% higher than observed prices. As such, consumers benefited from the policy in the sense that their expenditure on cement purchased from the CCCL was $694.27 million lower than what it otherwise would have been.

[11] We utilized the price difference as at December 2007 and not the average price difference due to the fact that price difference trended downwards during the period March 2006 through December 2007. See Table 2 for details.

References

Anti-Dumping and Subsidies Commission .2004. Statement of Reasons (Final Determination of the Commission), http://www.jadsc.gov.jm/adsc.nsf/f821ed001c6676e85256e270009449e/59d7ed755237b56105256edd00667122(accessed January 22, 2009).

Baltagi, Badi . 1999. *Econometrics: 2e*. New York: Springer.

Caribbean Cement Company Limited, *Annual Report 2002-2007*.

Carlton, Dennis and Jeffrey Perloff .2005. *Modern Industrial Organization: 4e*. New York: Pearson Addison Wesley.

Edwards, Al. 2005. The Caribbean is experiencing a shortage of cement- Carib Cement Company. *Jamaica Observer*, 18 November. http://www.jamaicaobserver.com/magazines/Business/html/20051117T190000-0500_92683_OBS__THE_CARIBBEAN_IS_EXPERIENCING_A_SHORTAGE_OF_CEMENT___CARIB_CEMENT_COMPANY.asp (accessed January 22, 2009).

Francis, Petrina. 2006. Prime Minister of Jamaica warns cement traders- Consumers should benefit from any price reduction. *Jamaica Gleaner*, 22 May. http://www.jamaica-gleaner.com/gleaner/20060522/lead/lead1.html (accessed February 3, 2009).

Gordon, Susan. 2006. Cement crisis cost 30, 000 jobs. *Jamaica Gleaner*, 19 May. http://www.jamaica- gleaner.com/gleaner/20060519 /business/business1.html (accessed January 22, 2009).

Jamaica Information Service. 2006. Government Importing Cement to Meet Shortage in Supplies. http://www.jis.gov.jm/development/ html/20060411t1100000500_8539_jis_gov_t_importing_cement_to_meet_shortage_in_supplies.asp(accessed January 30, 2009).

Jones, Peter. 2006. *The Dialectics of Jamaican Economic Thought: The Postmodernists Vs.Modernists*. SSRN database. http://papers.ssrn.com/sol3/papers. cfm?abstract _id=911281 (accessed January 23, 2008)

Ministry of Industry, Investment and Commerce. 2008. 2007 Report on Cement Supplies in the Jamaican Market.

Ministry of Industry, Investment and Commerce.2007. 2006 Summary Report on Cement Supplies in the Jamaican Market.

Meikle, Ashford. 2006. Carib Cement warns of two year shortfall. *Jamaica Gleaner*, 22 September.http://www.jamaica-gleaner.com/gleaner/efg/22-Sept-06/local news /local2.htm (accessed January 30, 2009).

Paulwell, Phillip.2006. Press Briefing, PCJ Building, Kingston, 8 March.

Planning Institute of Jamaica (PIOJ). 2006a. *Economic and Social Survey Jamaica*. Jamaica: Jamaica Printing Services Ltd.

Planning Institute of Jamaica (PIOJ). 2006b. *Economic Update and Outlook,* Volume 10, No. 4. Jamaica: Jamaica Printing Services Ltd.

The Business Observer .2009. Carib Cement's profit Jump on Improved Efficiencies, March 18: 11B.

U.S. Geological Survey .2008. Cement statistics, in Kelly, T.D., and Matos, G.R., comps., Historical statistics for mineral and material commodities in the United

States: U.S. Geological Survey Data Series 140. 2005/140/(accessed March 19, 2009).

Technical Appendix

Data Sources

The quantitative estimates derived in this study relied on data supplied by:

- Bank of Jamaica (BoJ);
- Caribbean Cement Company Limited (CCCL);
- Ministry of Industry, Investment and Commerce (MIIC);
- Statistical Institute of Jamaica (STATIN); and
- U.S. Geological Survey.

Data Description

The statistical relationships estimated in this study utilized monthly data covering the period January 1992 through December 2008.

Domestic price data (p_0) were constructed from information supplied by the Caribbean Cement Company Limited (CCCL). We obtained monthly price data on the three packages of cement they supply in Jamaica: the Bag (42.5 kg); Jumbo Bag (1.5 tonnes); and Bulk OPC (1 tonne) packages. This study used a weighted index of these prices (p_0); with the weights being the volume of the respective packages. The data covers the period January 1992 through December 2008.

Quantities data (q_0) were constructed from information supplied by the Caribbean Cement Company Limited (CCCL) and the MICC. The CCCL supplied data on total monthly quantities (volume) of cement sold during the period January 1992 through December 2008. The MIIC provided data on the volume of cement approved to be imported during the period 2006 through 2008.

World price data (w_0) was constructed from annual price of cement sold in the US market. We used simple (linear) interpolation technique to convert the series to monthly data. The data covers the period 1992 through 2007 and was from the U.S. Geological Survey (2008).

Exchange rate data ($JMD/$USD) were obtained from the BoJ website. We used the exchange rate on the last day of each month covering the period January 1992 through December 2008. http://boj.org.jm/

Consumer Price Index data were obtained from STATIN. We obtain monthly data covering the period January 1992 through December 2008. http://www.statinja.com/

Model Description

The cement industry is most appropriately characterized as one in which there is a dominant firm and a competitive fringe.[12] The main features of this market structure are described below.

i. *One dominant supplier*. There is one cement supplier that is much larger than any other firm.
ii. *Competitive fringe*. All suppliers, other than the dominant supplier, are price takers.
iii. *Market Demand*. The dominant supplier knows the market demand curve, $D(p)$ and cement from the various suppliers is perceived by consumers to be identical.
iv. *Competitive fringe's supply curve*. The dominant supplier knows the supply curve of the competitive fringe, $S(p)$.

Equilibrium

We now examine the price and quantities (p^*, q^*) which would be expected to clear this market. Fringe suppliers import all the cement they supply to the local market. The objective of each fringe supplier is to maximize its profits, π_f. The profit for each fringe supplier is given as follows:

$$\pi_f = p \cdot q_f - c(q_f, \tau)$$

where,

p is price of one unit (metric tonne) cement set by the dominant supplier,

q_f is the quantity of cement supplied to the market,

τ is the level of trade tariffs/duties imposed on imported cement

[12] See Carlton and Perloff (2005, Chapter 4) for a useful review of this model.

c is the total cost of supplying q_f unit quantities of cement, given τ.

The Output Decision of the Competitive Fringe. It is easy to show that each supplier in the competitive fringe maximize its profit by selecting supply level q_f^* such that the price is equal to its marginal cost of production, *MC*. That is, in equilibrium

$$p^* = MC(q_f^*, \tau)$$

The Price Decision of the Dominant Supplier. The dominant supplier correctly anticipates the units of cement which will be supplied by the fringe firms (by assumption iv.) and therefore deduces that he will be the monopoly supplier over the residual demand, that is the difference between the quantity demanded by the market and the total quantity supplied by the fringe suppliers. The objective of the dominant supplier is to select a price p which maximizes profits π_d, realised from supplying this residual demand, $q_d(p) \equiv D(p) - S(p)$. That is, the dominant supplier's objective is to maximise

$$\pi_d = p \cdot q_d(p) - c(q_d(p))$$

where,

q_d is the market segment which would not be served by the competitive fringe

c is the total cost of supplying, and is a function of q_d only.

Note that the production cost of the dominant supplier is assumed to be independent of trade barriers, τ.

It is easy to show that the condition for profit maximization is given by

$$q_d(p^*) + p^* \cdot q_d'(p^*) = MC(q_d(p^*)) \cdot q_d'(p^*)$$

Empirical Implementation

Since this is an empirical study, we need to identify the specific structural form of the demand and cost functions arising from the general model outlined above. A unique equilibrium will exist for the model under fairly general conditions. Namely, sufficient

conditions for a unique equilibrium are (i) the market demand $D(p)$ is a decreasing concave function of prices and (ii) the cost function of each firm is an increasing convex function of prices.

Demand

It is assumed that market demand is a linear function of price. That is,

$$D(p) = a - bp \qquad \text{[A1]}$$

where a and b are parameters (constants)

Costs

It is further assumed that production cost for the fringe suppliers is given by

$$c(q_f, \tau) = \tfrac{1}{\alpha}\left[F + w(1+\tau)q_f + w(1+\tau)q_f^2\right]$$

where,

F is the fixed cost of production

w is the price of cement sold on the world market.

$\alpha > 0$ is a parameter controlling the efficiency of the production technology

Similarly the cost function of the dominant firm is given as

$$c(q_f, \tau) = \tfrac{1}{\beta}\left[F + rq_f + rq_f^2\right]$$

where,

F is the fixed cost of production

$r, \beta > 0$ are parameters controlling the efficiency of the production technology

Based on the above specification for the cost and demand functions, in equilibrium the number of units which will be supplied by each fringe supplier is given as

$$q_f^* = \tfrac{\alpha}{w}p - 1$$

Further, the price set by the dominant supplier is given as

$$p^*(\tau) = \frac{(a+1)\left[1 + \frac{r}{\beta}\left(b + \frac{\alpha}{w(1+\tau)}\right)\right] + \frac{r}{\beta}\left(b + \frac{\alpha}{w(1+\tau)}\right)}{\left(b + \frac{\alpha}{w(1+\tau)}\right)\left[2 + \frac{r}{\beta}\left(b + \frac{\alpha}{w(1+\tau)}\right)\right]} \qquad \text{[A2]}$$

In what follows, we confront actual data collected with our theoretical model outlined above.

Estimating Model Parameters for Market Demand

Using monthly data on prices (per metric tonne) and sales volumes (in metric tonnes) during the period 1992-2007, we use regression analysis to estimate the linear function. The result is reported in Table A1 below.[13]

Table A1 2SLS Parameter Estimates for the Industry Demand Curve

Variable	Parameter Estimate	Standard Error
Constant	445,690.1	(23,660.75)*
Cement price	-77.31239	(4.692448)*
Adjusted r^2=69.74%		

*parameter estimate significant at the 1% level

Using the reported results, the industry demand curve is given as

$$Demand = 445{,}690 - 77\,price$$

This implies that $a = 445{,}690$ and $b = 77$ in equation [A1] above. [14] Further, our specification of a linear demand function appears to be appropriate as the model was found to explain approximately 70 percent of the variation in observed sales quantities. The model suggests that on average, every dollar increase in the price of cement reduces monthly quantities demanded by 77 tonnes.

Estimating Model Parameters for Cost Functions

The cost function was not empirically estimated as we do not have data on actual costs. To overcome this problem, we assumed values of the parameters so that the level of

[13] All regressions are estimated using *Stata* version 9.

[14] In estimating the demand function, we utilized the 2SLS method to overcome the simultaneity bias inherent in demand estimation. See Baltagi (1999) for more details on resolving this problem. For the first stage of the regression, we regress the domestic price of cement against the price of cement on the world market (presumably this is a cost shifter).

profits predicted by the model would be, on average, close to the operating profit of the dominant supplier over the relevant period, as reported in its published annual reports. At this stage, based on the various assumptions, we have the information required to calculate the equilibrium price identified in equation [A2] above.

The price data observed during period March 2006 through December 2007 were then utilized to gauge the potency of our conceptual model to organize the empirical data. To do this, we calculate the correlation coefficient ρ between the prices predicted by our model (equation [A2]) with those observed during the period. The correlation coefficient allows us to measure the strength and direction of the linear relationship between the prices predicted by our model and the actual prices. The correlation coefficient between $p^*(\tau)$ and actual prices is $\rho = +0.86$. This indicates that there is a strong positive relationship between the prices predicted by our model and the actual prices. This suggests that approximately 74% of the variation in observed prices is explained by variations in the predicted prices. That is we estimate the following equation.

$$\textit{observed}\ \text{price} = z_0 + z_1\, \textit{predi}\text{cted price}$$

Parameter estimates of $z_0 = 0$ and $z_1 = 1$ would suggest that our predicted prices coincided with the actual prices. The results are presented in Table A2 below.

Table A2 OLS Parameter Estimates for Predicting Actual Prices

Variable	**Parameter Estimate**	**Standard Error**
Constant	-40,069.86	(1945.269)*
Predicted price	9.295166	(0.3949977)*

Adjusted r^2=74.42%

*parameter estimate significant at the 1% level

The results suggest that the actual price and the price predicted by our model are governed by the following linear relationship.

$$observed \text{ price} = -40{,}069 + 9.29\, predicted \text{ price}$$

Although the results reveal that the parameter estimates $\hat{z}_0 = -40{,}069$ and $\hat{z}_1 = 9.29$ differ significantly from their ideal levels, the model is still useful as the model explains 74% of the variation in actual prices. Accordingly, to estimate the effect of trade barriers (τ) on equilibrium prices, we use the following function:

$$P(\tau) = -40{,}069 + 9.29\, p^*(\tau)$$

where,

$p^*(\tau)$ is defined in equation [A2] above.