Vertical Integration and Trade Policy: The Case of Sugar

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Abstract

The degree of vertical integration in the U.S. sugar industry between raw sugar processing and sugar refining cannot be explained using theories of vertical integration based on transaction costs (e.g. Williamson). We graphically decompose the economic rents accruing to each level in the marketing channel. Different strategies of several major sugar producing, processing and refining entities with regard to sugar quota policy are explored.

1. Introduction

The decade of the 1990s gave rise to several significant changes in agricultural policy in the United States. Among the most significant of these changes was the elimination of the traditional agricultural programs under the FAIR Act of 1996. However, some commodity programs escaped elimination, most notably the sugar, tobacco, and peanut programs. This paper focuses on the role of vertical integration in the U.S. sugar industry. Specifically, it decomposes graphically the economic rents accruing to each level in the marketing channel for sugar in the United States. This graphical decomposition of economic rents is then used to explain the different impacts of a change in U.S. sugar policy and the strategies of several major sugar producing, processing and refining entities to maximize rents. Some firms in the industry, such as private sugar refiners, push for freer trade while other firms support the current tight sugar import quotas.

2. Vertical Integration in the U.S. Sugar Industry

Sugar production in the United States is geographically concentrated. Sugar beet production is concentrated in the northern plains with Minnesota and North Dakota representing 45 percent of domestic sugar beet production. Florida and Louisiana produce over 85 percent of sugarcane grown. Sugarcane produced in Florida and Louisiana involves two processing operations unlike sugar beets produced in the northern plains where only a single process is involved. In Florida and Louisiana, sugarcane is delivered to a local sugar mill for processing into raw sugar. Refineries then process the raw sugar into refined white sugar in a second stage. In the northern plains no intermediate raw sugar is produced. This difference in processing gives rise to significant differences in economic structures and ownership incentives.

Differences in climate also give rise to different forms of economic organization and structures. For example, sugarcane producers in Florida are largely protected from the risk of a hard freeze while sugarcane producers in Louisiana are typically subject to a killing freeze around the December 15 of each year. As a result, sugarcane milling in Louisiana is limited to a 50 day window while the milling window in Florida may be as long as 150 days. Thus, the milling capacity per acre must be larger in Louisiana.

There are significant differences in sugarcane processing in each region. In 1989, sugarcane in Florida was milled in seven sugar mills with a daily processing capacity of 14,429 tons of sugarcane per day (Polopolous and Alvarez, 1990). In addition, roughly 80 percent of this capacity was owned by actual producers of sugar. In contrast, in the 1999 harvest period there were twenty sugar mills in Louisiana, of which half where owned by producers.

For sugar beet processing, the level of concentration is somewhat lower. Eight processors combined have 155,250 tons per day of sugar beet processing capacity (table 1). Farmers, through cooperatives, own three processors (American Crystal Sugar Company, Minn-Dak Farmers Cooperative, and Southern Minnesota Beet Sugar Cooperative). These three processors represent 31 percent of sugar beet processing capacity.

Sugarcane refiners are also highly concentrated (table 2.) Ownership of these refineries is concentrated among six companies. The total refining capacity is 24,175 short tons of raw sugar per day (table 2). Of this capacity, roughly 35 percent is owned by sugar producers. In addition, except for the new U.S. Sugar Corporation plant in Clewiston, most of the plants are at least 50 years old with three plants constructed in the 1800s. As table 3 shows, many plants were closed during the 1980s, and two plants were closed in the 1990s. This can be explained by the fact that sugar consumption dropped sharply reaching a low in 1985-86 when import quotas where set at low levels.

3. Rents in a Vertical Market

The graphical decomposition of economic rents has become a standard methodology for determining the economic impacts of agricultural policy changes. However, these applications have typically focused on economic rents within a single market (e.g. Schmitz, Schmitz and Dumas analysis of changes in economic rents for cotton producers given changes in trade policy.) The recent rise in vertical integration within agriculture requires the analysis of changes in economic rents, due to a policy change, across an entire marketing channel. Vertically integrated firms, such as sugarcane producers in Florida, may be able to trade economic rents at the farm level for

offsetting gains at the processor level due to expanded raw sugar imports. In fact, these tradeoffs could yield dramatically different policy implications.

As a starting point for our discussion of economic rents within a marketing channel, consider the economic rents for the sugarcane industry presented in figure 1. S_F is the farm level supply curve, S_M is the supply curve of raw sugar from sugar mills, S_R is the supply curve for refined sugar and S_T is the supply curve for sugar offered to consumers. In order to derive the economic rent at each level of production above the farm supply curve, the marginal cost curve for each level must be taken through the market equilibrium quantity. The result is four profit levels associated with each level in the market channel. R_F is the economic rent accruing to the producers, R_M is the economic profit accruing to the millers, R_R is the economic rent accruing to the refinery, and R_T is the economic rent accruing to the final marketing activity.

In order to develop further the economic rent marketing channel model, the analysis presented in figure 1 is reformulated into four markets in figure 2. In the first panel of figure 2, we present the market for domestic sugarcane. The supply of raw sugar from domestic sources is the constructed by adding the marginal cost of milling to the supply of sugarcane. This market for refined sugar produced from sugarcane is presented in the second panel. This supply is the summation of the supply of raw sugar from the first panel plus the marginal cost of refining raw sugar. The third panel depicts the supply of refined sugar from sugar beets. Sugar beets typically bypass the raw sugar stage. Hence, the supply of refined sugar from sugar beets is the sum of the supply function for sugar beets plus the marginal cost of processing sugar beets into refined

sugar. The horizontal summation of refined sugar from sugarcane plus refined sugar from sugar beets yields the total supply of refined sugar in the fourth panel.

Market equilibrium is found by finding the market-clearing price in the final panel and working backwards. The price required to clear the refined sugar market is P_{RS}. Tracing this price back to the domestic sugar beet market implies a sugar beet price of P_{SB}. Similarly, the implied price for raw sugar can be found from the second panel (P_{RC}.) This implies a price of sugarcane of P_C.

To examine the implications of vertical marketing channels we introduce a fixed import of raw sugar under quota of I. (The main instrument of U.S. sugar policy is tight import quotas.) Since the world market price for sugar is significantly lower than the U.S. price, the quantity of sugar imported under quota can be depicted as a fixed quantity in the relevant price range. The imported raw sugar shifts the supply of refined sugar from sugarcane out to S_{RC}' and the supply of total refined sugar out to S_{RT}'. The increased supply results in a reduced equilibrium sugar price of P_{RS}'. Taken together, the increased supply of raw sugar from the quota and the lower price of refined sugar causes the price of raw sugar in the United States to fall to P_{RC}'. Q_{RD}' is the quantity of domestic raw sugar produced. The difference between Q_{RD}' and Q_{RC}', the total quantity of raw sugar processed in the domestic market, is the quantity of sugar imported. At the decreased price for raw sugar, a decreased quantity of sugarcane is produced.

In addition to the changes in price at each level due to a change in import quotas policy, the increased quantity imported has dramatic implications for economic rents at each level. At the farm level, sugarcane farmers lose area A. Sugar mills suffer a net loss of B-C. Similarly, sugar beet producers lose the economic rents in area F and the

sugar beet refiners lose the area D-E. Interestingly, the sugar refineries using raw sugar as an input gain J-H. Similarly, the consumers of sugar gain G.

As a starting point, consider the case where both sugarcane producers and sugar beet producers are completely integrated. It is clear that sugar beet producers will suffer a net loss in economic surplus (D+F-E). However, the implications for the sugarcane producers are less clear. It may be possible for the sector to experience of net gain if J+C-H-A is greater than zero. However, the current graphical depiction suggests that the sugarcane sector will experience a small loss. This loss will be less severe than the loss suffered by sugar beet producers. These results are consistent with the current trends toward economic integration observed among sugarcane producers.

Of course, neither sugarcane producers nor sugar beet producers are completely integrated. While sugarcane production in Florida tends to be highly integrated, sugarcane production in Louisiana is not vertically integrated. Further, relatively little of the sugar beet production in the northern plains is integrated. Figure 3 presents the scenario where some fraction of the sugarcane producers is vertically integrated. Specifically, we assume that some fraction of the sugarcane producers own sugar milling capacity and refining capacity. Modeling the marginal cost at each level as the sum of the marginal cost for integrated producers plus the marginal cost of non-integrated producers, we depict the decomposition of economic rents to integration. The economic rents to integrated producers before the quota are equal to A+B. Hence, these producers lose economic rents of B with the introduction of the import quota. Similarly, integrated producers earn rents of E+D before imports and C+D after imports. Hence, the integrated processor suffers an economic loss at the milling level of E-C with the

introduction of imports. Finally, the economic rents before the quota for integrated producers at the refining level is H+G while they increase to G+F after the quota. Thus, the change in economic rents at the refinery becomes F-H (an increase in rent.) The net economic gain to integrated sugarcane producers is then F-H-E+C-B.

It is apparent that sugarcane producers and sugar mills that are not integrated will lose economic rents with the expansion of sugar imports while sugar refineries that are integrated will benefit from further processing of imported raw sugar, but will clearly lose from lower producers prices. These results have structural implications for the industry. For example expansion of sugar imports leads to a decrease in profitability of sugar production in Louisiana for both producers and sugar mills.

4. Rent Seeking in Vertically Integrated Channels

The physical characteristics of sugar production, both sugarcane and sugar beets imply a unique relationship between producers and processing. Sugarcane is bulky and not well suited for transportation of any appreciable distance before processing. In addition, the timing of milling is critical since sugarcane starts to loose sucrose after harvest. These characteristics have historically implied that sugar milling is located close to production. Intuitively, both entities (the farmer and sugar mills) are dependent on each other's existence for their economic survival.

Following Coase, Williamson, and Grossman and Hart, these characteristics of sugarcane could lead to some degree of integration either through direct ownership or long term contracts. In this literature, vertical integration is the result of transaction costs. Specifically, Coase develops a model where acquiring a commodity through a market implies some degree of transaction costs. These transaction costs can be driven

by the cost of determining the quality of the commodity. Given the transaction costs, the buyer may decide to purchase from a supplier or internalize the market through integration. The argument for integration is that the cost of internalization is less than the transaction costs in the market.

Williamson builds on the Coase's concept by introducing informational costs. Under Williamson's scenario, transaction costs can be generated by bounded rationality coupled with the inability to specify complete contracts. Under Williamson's formulation, firms cannot anticipate all the possible risk that may arise from a business venture. Hence, they form expectations based on bounded rationality. Within this context, investors cannot write complete Arrow-Debreu contracts. Hence, any business agreement is in some sense suboptimal. This suboptimality is compounded by what Williamson refers to as impacted information, which is actually a form of the incentive incompatibility problem. Specifically, information is impacted if one agent in an economic transaction can fail to disclose relevant information, or has an incentive to missrepresent relevant information. Impacted information rules out the ability of firms to make wait and see contracts. Taken together, incomplete contracting and impacted information give rise to uncertainties about the future. However, these uncertainties need not imply transaction costs unless the market can also be characterized by a small numbers problem. Thus, bounded rationality, impacted information and small numbers combine to form the potential for increased transaction costs through monopoly pricing.

Grossman and Hart build on Coase and Williamson through the formulation of a relationship specific investment. Grossman and Hart consider the scenario where a car-maker purchases body parts from another firm. Such an arrangement requires the maker

of body parts to invest in an expensive die. Further, this die is useful only for the delivery of parts a specific car manufacturer for a specific class of automobiles. The investment in dies is then referred to as a relationship specific investment. This arrangement meets Williamson's conditions of bounded rationality and incomplete contracting since the parties are not able to create complete Arrow-Debreu securities since the potential sales of the car are uncertain. Further, each party to the transaction may have an incentive to misrepresent the outcome. For example, the automobile manufacturer may overstate the market potential for the particular make of car, to induce a lower price from the part maker. Given these conditions, Grossman and Hart extend Williamson to derive the conditions under which the agents will agree on long-term contracts or integrate vertically.

The construction of sugar mills can be posed within this same structure. As previously stated, the physical characteristics of sugarcane requires the construction of sugar mills in the proximity of production. Given the complexities of the sugar market, the construction of complete Arrow-Debreu contracts before the construction of the sugar mills are unlikely. In addition, once constructed such a mill would be at the mercy of producers since the producers could refuse to produce sugarcane to make the mill financially viable without concessions from the mill owner. Thus, the transaction costs associated with the construction of a sugar mill would be very high in the absence of vertical integration especially when the number of producers is small. Hence, the establishment of a sugarcane industry is conditioned on the potential for vertical integration.

The hold-up problem associated with investment specific relationships is a decreasing function of the number of producers. Returning to the car example, if more than one manufacturer uses a given die, the part maker has other potential customers and the transaction cost declines. In the case of sugarcane, as the number of producers increases, the hold-up problem associated with the establishment of sugar mills diminishes and the need for integration declines. As the number of producers increases vertical integration can be replaced with contracting, as the number of producers offsets information impactness.

In fact, these results are observed in sugarcane production. As shown earlier, large producers in Florida have tended to integrate through direct ownership. This is in contrast to Louisiana where there are relatively many small producers and little integration by direction ownership.

While the Coase, Williamson, and Grossman and Hart literature can be used to explain vertical integration between sugarcane producers and sugar mills, the recent trend toward integration between sugar mills and sugar refineries cannot be directly explained using a transaction cost model. At the present some of the producer/processor firms in Florida are integrating into sugar refining. U.S. Sugar Corp. recently constructed a sugar refinery in Clewiston Florida that can process up to 1,800 tons of raw sugar per day. Overall, Florida producers have the capacity to refine from 50 to 60 percent of the raw sugar produced in Florida.

This integration may be better explained by rent seeking behavior using the rent models in figures 2 and 3. Specifically, diversification into sugar refining may provide profits to integrated firms under expanded quotas. Thus, companies such as U.S. Sugar

Corp. may be positioning themselves to extract rents from imported raw sugar. These increased rents could be used to partially offset declining profit from domestic sugarcane and milling. This result may be particularly important if the elasticities of supply for sugarcane vary significantly between regions. The sugarcane supply in Florida is far more inelastic than sugarcane supply in Louisiana given the lack of profitable alternatives on environmentally sensitive land in Florida. The inelastic nature of the farm level supply curve increases the relative loss in economic rents at the farm level in Florida and lessens the economic loss to sugar mills. The relative change in economic rents would add additional impetus for previously integrated sugar producers to seek profits by refining sugar.

Another avenue for rent seeking in a vertical marketing channel is added by the consideration of multinationals. Flo-Sun is a large sugarcane producer in the state of Florida. As a part of its operation it controls six sugar mills. Flo-Sun also owns interests in sugarcane production and milling in the Dominican Republic. Part of Flo-Sun's sugar production is exported to the U.S. under preferential quota arrangements where the quota rents go to Flo-Sun. This structure introduces an additional economic rent due to integration to those depicted in figures 2 and 3. Specifically, Flo-Sun could gain rents from its production in the Dominican Republic if the U.S. would expand the current import quota. This additional opportunity for economic rent makes the incentives for Flo-Sun different than those for U.S. Sugar Corp. which generally favors tight import quotas.

Other explanations of expansion into sugar refining through vertical integration may involve the reinvestment of past profits from sugarcane production and raw

processing. Also under a firm growth model, these firms may have an incentive to reinvest past savings into added activities even though they are interrelated. From a risk perspective, producer investment in sugar refining is a method of risk diversification.

4. Conclusions

Vertical integration of sugar producing entities through the marketing channel has significant implications for rent seeking in the sugar industry. Current U.S. sugar policy with tight import quotas favors farmers and sugar millers. Raw sugar mill owners would loose economic rents under free trade scenarios because they are not able to process imported raw sugar. This is also true for beet refiners. However, integration into sugar refining requires that the economic losses from freer trade must be compared with the increased economic rents at the refined level since refiners can benefit from increased raw sugar imports. This can only be the case for sugar cane since beet processors cannot compete in the processing of additional imports of raw sugar. This paper examines these interactions focusing on geographic differences among producer groups, different integration strategies in Florida, and the role of multinationals.

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Table 1. 1999 Beet Sugar Processors in the United States

Company	Capacity (daily capacity in tons of beets)	Location[a]
Amalgamated Sugar Company	37,000	Ogden, UT
American Crystal Sugar Company	30,400	Moorhead, MN
Holly Sugar Corporation	22,100	Sugar Land, TX
Michigan Sugar Company	15,750	Saginaw, MI
Minn-Dak Farmers Cooperative	7,500	Wahpeton, ND
Monitor Sugar Company	8,000	Bay City, MI
Southern Minnesota Beet Sugar Cooperative	10,000	Renville, MN
Western Sugar Company	24,500	Scottsbluff, NE
Total	155,250	

[a]Location refers to the location of the corporate office.

Table 2. Cane Sugar Refining Companies (1898-1998)

Company	Refinery Location	Capacity[a]	Year Built
California & Hawaiian Sugar Co.[b]	Crockett	3,400	1898
830 Loring Avenue Crockett, California 94525 [510 787-2121]			
Florida Crystals Refinery*	South Bay	925	1978
PO Box 86 South Bay, Florida 33493 [407 996-9072]			
Imperial Sugar Company[b]	Clewiston, FL	850	1889
PO Box 9	Gramercy, LA	2,150	
Sugar Land, Texas 77487	Port Wentworth, GA	3,100	
[281 491-9181]	Sugar Land	1,950	
Refined Sugars, Inc.[b**]	Yonkers	2,000	1938
One Federal Street Yonkers, New York 10702 [914 963-2400]			
Tate & Lyle North American Sugars Inc.[b]	Baltimore	3,000	1922
1114 Avenue of the Americas	Brooklyn	2,000	1865
24th Floor	Chalmette, LA	3,000	1908
New York, New York 10036 [201 896-6066]			
U.S. Sugar Corporation	Clewiston	1,800	1998
PO Drawer 1207 Clewiston, Florida 33440 [941 983-8121]			
Total Capacity (tons of raw sugar per day)	24,175		
Percentage owned by producers	33.6%		

[a] - 24-hour melting capacity, short tons, raw value

[b] - Member of United States Cane Sugar Refiners' Association

* - Owned by Fanjul Family

** - Purchased by the Fanjul Family and others in the late 1990s

Table 3. Cane Sugar Refining Industry Profile: 1999

Refinery Location	Company	Capacity[a]	
Aiea, Hawaii	C & H	142	Closed 12/96
Baltimore, Maryland	Domino (Tate & Lyle)	3,000	
Belle Glade, Florida	Florida Sugar	390	Closed 3/86
Boston, Massachusetts	Amstar (Domino)	1,000	Closed 3/88
Boston, Massachusetts	Revere	1,200	Closed 5/84
Brooklyn, New York	Domino (Tate & Lyle)	2,000	
Brooklyn, New York	Revere	1,120	Closed 3/85
Chalmette, Louisiana	Domino (Tate & Lyle)	3,000	
Chicago, Illinois	Revere	850	Closed 5/84
Clewiston, Florida	Everglades	850	
Clewiston, Florida	U.S. Sugar	1,800[b]	
Crockett, California	C&H	3,400	
Gramercy, Louisiana	Colonial	2,150	
Mathews, Louisiana	Louisiana Sugarcane	600	Closed 9/85
Philadelphia, Pennsylvania	Amstar (Domino)	2,100	Closed 10/82
Philadelphia, Pennsylvania	National	2,100	Closed 9/81
Port Wentworth, Georgia	Savannah	3,100	
Reserve, Louisiana	Godchaux Henderson	1,900	Closed 1/85
St. Louis, Missouri	Industrial	300	Closed 3/87
South Bay, Florida	Florida Crystals	925	
Sugar Land, Texas	Imperial Sugar	1,950	
Supreme, Louisiana	Supreme Sugar	850	Closed 10/95
Yonkers, New York	Refined Sugars	2,000	
	Total Operating Capacity	23, 175	

[a] - 24-hour melting capacity, short tons, raw value, as reported by USDA.

[b] - As reported by Sugar Journal

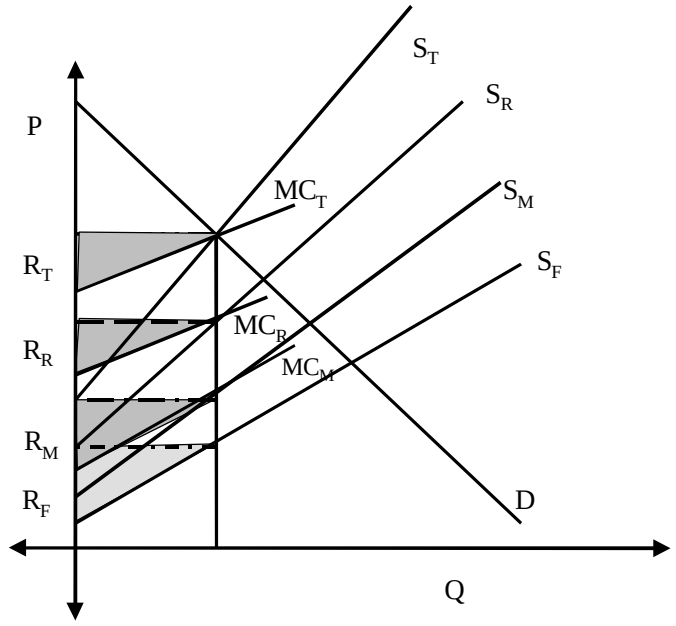

Figure 1. Decomposition of Economic Rents in a Vertical Market

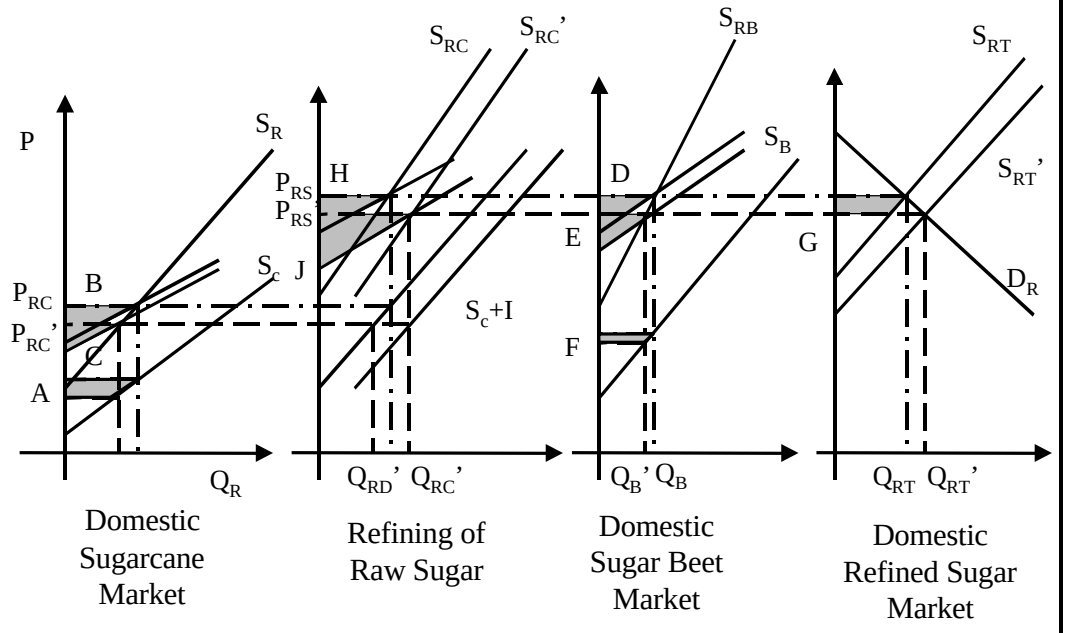

Figure 2. Decomposition of Rents with Import Quota

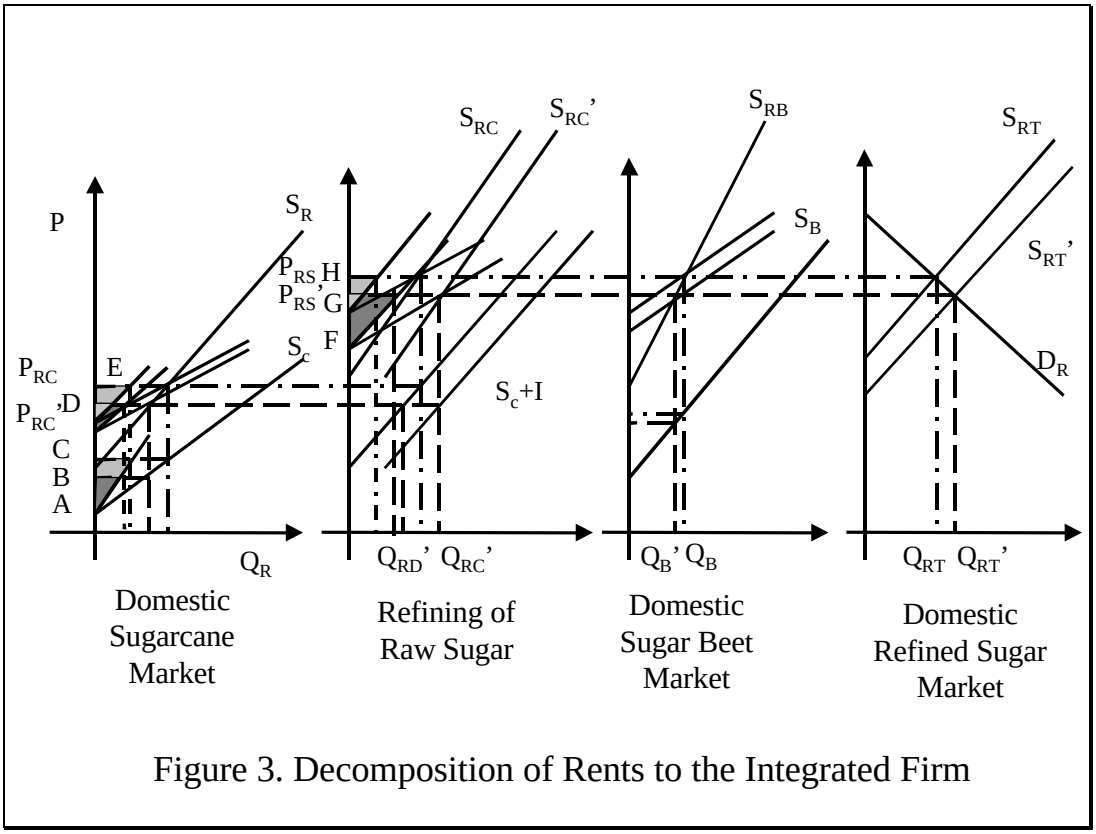

Figure 3. Decomposition of Rents to the Integrated Firm