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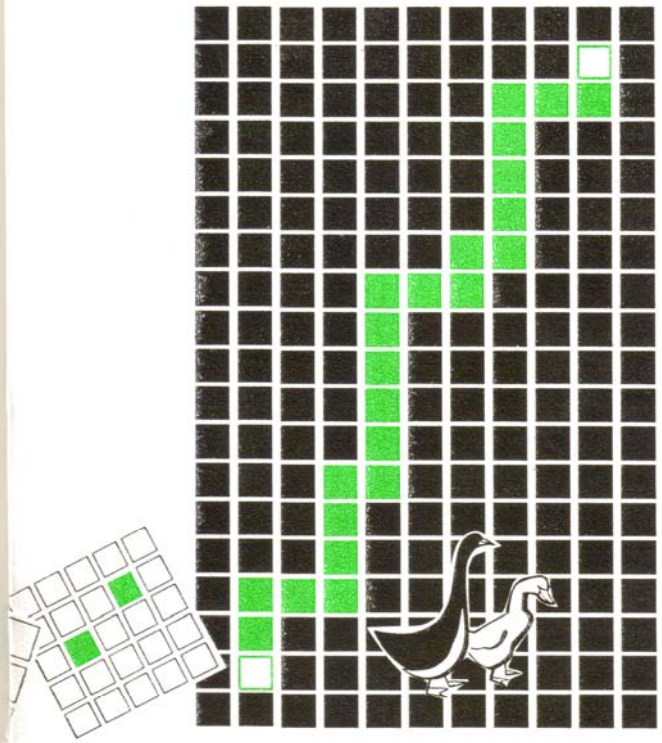

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EXPORT COMPETITIVENESS IN THE MARKET FOR WINTER VEGETABLES: WHAT CAN BE LEARNED FROM THE MEXICANS?

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INTRODUCTION

The research reported in this paper is motivated by the need to understand the determinants of export competitiveness in the market for non-traditional agricultural products. As is well known, several countries in the Caribbean Basin have embarked on, or are in the process of developing, non-traditional export strategies. The record of Caribbean countries in successfully implementing non-traditional export programs is, however, less than spectacular. Examples of failed attempts, such as the recently concluded Jamaican Agro 21 initiative[1], are all common. While the need for a diversified export strategy cannot be denied, the precise mechanisms for transforming a country's export base are, unfortunately, less than clear.

The impetus for the current diversification efforts are well documented elsewhere and will, therefore, be reiterated here only in a cursory fashion. The reasons are numerous, and include low and unstable prices for sugar and banana, the region's major traditional export crops. This price environment has created a serious shortfall in the foreign exchange earnings of many Caribbean countries and has impacted negatively on their debt repayment capability and the availability of resources to finance imports. Secondly, the development of synthetic substitutes, e.g. aspartame, has weakened export demand for cane sugar, as has nutritional trends which promote a reduction in daily caloric intake. Thirdly, uncertainty surrounding continued access to traditional export markets has also spurred the search for new products. European importers of sugar and banana have begun the process of realigning themselves into new trading blocs, calling into question preferential colonial trade relationships. It is well recognised that Caribbean countries can ill-afford to maintain their position of dependence in such a dynamic international trade environment. Economic theory would suggest

some clues to the mechanics of building a diversified export base. These would include the avoidance of implicit taxation that results from an overvalued exchange rate, the dismantling of trade barriers that shield domestic producers from international price competition, and the choice of appropriate (low cost) technologies. Theory does not, however, provide a complete explanation. As will be shown below, export success is contingent on more than getting prices right. Effective organisation, management and institutional support will be seen, in this paper, to play a pivotal role in a country's efforts at building and maintaining market share in the non-traditional export sector.

The ensuing analysis is comparative, and will focus on the winter vegetable industry in Mexico, and that which operated in Jamaica during the Agro 21 period (1982-1989). It should be pointed out at the outset that Mexico has dominated the US residual market[2] for winter vegetables over the last three decades, and therefore qualifies as an appropriate model of a successful exporter of non-traditional agricultural products. In fact, Mexico now supplies roughly 94% of all of the tomatoes, peppers and cucumbers imported into the United States, a trade which is valued at several hundred million US dollars per year.[3] Given this performance, it is logical to investigate the reasons for Mexico's success in this market, and to test the hypothesis that the major elements of their strategy can be duplicated by Caribbean Basin countries.

The analysis will be limited to the winter vegetable sector as it represents one of the most fiercely contested agricultural markets, and is one to which a considerable amount of resources was devoted during Jamaica's recent attempt at market diversification.[4] Despite the resources which Jamaica devoted to the development of this industry, the Agro 21 initiative failed to provide the diversified base of foreign exchange earnings and employment for which it was created. Over the five-year period 1984-1989, Jamaica was unable to capture more than a 3% share of the US market for vegetables (Table 1). In the process, the country lost an estimated J$77 million valued at 1982 social prices (Farrell, 1992, p.89).

It is interesting to note that despite Mexico's record of dominance in the fresh winter vegetable trade, some analysts have suggested that this country will in fact be forced to retreat from this market in the face of rising labour and other input costs (see e.g. Sanderson, 1986, p.95, and Simmons and Pomareda 1975, p.478). Should this be the case, Caribbean countries may well be at the cusp of a tremendous opportunity to penetrate this lucrative market. This possibility is also investigated in the analysis which follows.

The major objectives of the paper may now be stated more precisely as:

1. To identify the major determinants of Mexico's export success in the US residual market for winter vegetables.
2. To determine the extent to which economic forces (particularly rising input costs) could force Mexico's withdrawal from the US market, and provide an opportunity for Caribbean exporters.

The paper is organised into four major sections. Following the introduction is presented a discussion of the major determinants of Mexico's export

competitiveness in the US market. The analysis presented in this section will also attempt to draw some parallels between the Mexican vegetable export system and that which operated in Jamaica over the Agro 21 period. The third section will attempt to assess the long run prospects for the entry of non-Mexican suppliers into this market. This latter assessment is conducted using a simple dynamic econometric model of the industry. The final section of the paper is brief and merely attempts to summarise the major points of the discussion, and provide a few closing observations.

THE DETERMINANTS OF MEXICO'S EXPORT SUCCESS

It is argued here that Mexico's success in penetrating the US market derives from six major factors. Some of these factors are the result of conscious planning and effective management, while several are largely *"accidents"* of geography, history and politics. Mexico's domination of the US residual market may be traced to the following:

1. Favourable transportation logistics.
2. Long term infrastructural development.
3. Development of a close network of distribution arrangements with US-based importers.
4. An efficient system of regulations to control export volume and quality.
5. A favourable macroeconomic policy environment; and
6. A number of fortuitous political events.

Favourable Transportation Logistics

The production of vegetables for export in Mexico began in the late 1800s but was severely hampered by the absence of overland transit into the US market. At that time produce was shipped around the tip of Baja, California to the Los Angeles and San Francisco markets. The completion of a rail line from Nogales, Arizona to Guasave, Sinoloa by the Southern Pacific Railroad did much to alleviate this transportation constraint, and spur increased vegetable exports. Also, a modern highway was established between Culiacan, Sinaloa and Nogales, Arizona in the mid 1950s further improving the transportation network. These events served to drive down the cost of this service to Mexican exporters and increase their price competitiveness.

In the case of Jamaica, fresh winter vegetable exports to North America involve the use of expensive air freight or more reasonably priced, but slow, sea transportation. For Agro 21 exporters the former mode proved to be not only expensive, but unreliable, as the periodic unavailability of space forced delays in the shipment of this perishable cargo. Of course, sea transportation also created problems for Jamaican exporters, as the length of voyage had serious implications for post-harvest quality control.

The economic importance of Mexico's proximity to the market and well developed transportation infrastructure is seen in Table 2 which disaggregates and compares the distribution of Mexican and Jamaican marketing costs in 1984-1986. In the case of Jamaica, transportation accounted for over 60% of the total cost

of marketing vegetables to the US, while for Mexican exporters transportation costs were roughly one-third the value of overall marketing costs.

Long Term Infrastructural Development

The Mexican industry has also benefited from a number of (non-transportation) infrastructural improvements. For example in the 1950s and 1960s the Aleman Administration embarked on a series of massive irrigation projects. Harnessing the potential of the Fuerte, Mayo and Yaqui rivers, the government was able to add some 3 million ha. of irrigated lands to the country's agricultural system. Roughly one-third of these irrigation districts were sited in the states of Sinaloa and Sonora, and tremendously increased the agricultural productivity of these regions.

In fact, Sinaloa has gone to become the country's major winter vegetable producing and exporting area. Over the 1985 to 1989 period, for example, this state accounted for roughly 74% of the nation's exports of tomatoes and over 60% of domestic production. This performance would not have been possible without the Mexican government's attention to infrastructural support.

Development of a Close Network of Distribution Arrangements

The winter vegetable industry in Mexico is highly concentrated and close-knit, both in terms of production and marketing. In terms of production, roughly 50% of the output of Sinoloa is accounted for by ten farms of between 300-1500 ha. These firms have been in the business of vegetable production since the 1950s and possess a vertically integrated structure. All production, harvest and post-harvest operations are conducted under central management, allowing to a high degree of cost control and economic efficiency.

In terms of marketing, strong grower-distributor relationships have been forged between agents located between the Culiacan shipping points and Nogales distribution centre. There are approximately 50 distributors in Nogales, Arizona and together with a few brokerage companies they constitute a powerful association known as the West Mexico Vegetable Distributors Association (WMVDA). The WMVDA was established in 1964 as an American trade association and operates in conjunction with the Food Marketing Institute and other retail organizations to market produce within the United States. The distributors of the WMVDA control the bulk of the fresh vegetable exports coming in from Mexico.

It is interesting to note that many distributors are financially integrated with Mexican growers. Buckley *et at* note that roughly 60% of the distributors in Nogales are partners with one or more Mexican producers (Buckley *et al* 1986, p.8). These partnerships account for roughly 60% of the Mexican produce entering the United States. Approximately 20% of the distribution firms are wholly owned subsidiaries of Mexican producers and account for 10% of imports. The remaining 20% of distributorships are independent firms which contract with Mexican growers for produce. These independents handle an estimated 30% of produce imports from Mexico.

Apart from the handling of produce, US distributors also perform other services for Mexican growers such as the provision of market intelligence,

supervision of growing and packing operations as well as the provision of US farm inputs. In fact, Andrew, DeBoon and McPherson (1975) have estimated that 75% of the capital needs of Mexican vegetable exporters were supplied from US sources in the mid 1970s. This association with US importers has also meant that Mexican growers have had ready access to US production technologies, and have not lagged behind their rivals in Florida.

This close network of relationships within the marketing channel has been of tremendous value to Mexican exporters as they compete with growers in Florida for market share. As Bredahl *et al* note, since 1969 there have been several attempts to pre-empt increases in Mexico's share of the US market (Bredahl ef a/1983, p.14). In the early 1970s, for example, the Florida Tomato Committee (FTC) attempted to introduce differential size restrictions in the tomato market, a move which would have excluded a large percentage of Mexican produce from entering the United States. The new regulations were, however, resisted not only by the Mexican exporters but also by the WMVDA and the Consumers Union (a US consumer advocacy group). The proposed legislation was eventually defeated. The case clearly signalled the extent to which the Mexicans had become entrenched in this market.

The absence of any formal relationship between Jamaican producers and the middlemen who control distribution should be noted at this point. Channel members had no pecuniary interests in Jamaican exports and hence no incentive to ensure timely and efficient passage through the system. Jamaica did not represent the only (or even an important) source of supply. Also, once shipped from Kingston, Jamaica exporters had no representation in the US market and effectively lost control of their investment. In fact, an examination of the company records of a failed Agro 21 exporter indicated that in several instances the quality of Jamaican produce was found to be below the standards of the US market, and had to be disposed of at the grower's expense. This type of situation prompted Buckley to conclude after a careful comparative study of the Jamaican marketing operations:

"The lack of adequate representation of Jamaican interest in the market place has left Jamaican growers vulnerable to US markets during the previous season. In 1985/86, the Jamaican farms received lower prices on the average than Florida producers marketing in Pompano, Florida. This emphasises the importance of developing an efficient marketing and promotion system that ensures Jamaican produce is shipped and received in a timely manner, is in good marketable condition, and that a fair price is obtained." (Buckley 1986, p.ii.)

The Mexican System of Market Regulation

There are two principal agencies responsible for the regulation of Mexican vegetable exports. The first is the Confederacion de Asociaciones de Agricultores del Estado de Sinaloa (CADDES) which is an association of vegetable growers in Sinaloa. The second major organization is the Confederacion Nacional de Productores de Hortalizas (CNPH) which is an umbrella organization representing state and local producer organizations. In 1982 CNPH represented some 226 local

associations with a combined membership of 16,000 (Bredahl *et al* 1983, p.42).

The above two organizations exert a powerful influence on Mexico's production and export of winter vegetables. This influence is exerted at several points in the production and marketing system beginning with the submission of recommendations to the federal government regarding the area to be planted to vegetables on federally irrigated lands. Export production quotas are also established and these are presented to state organizations which in turn solicit applications from individual producers in their state. Bredahl *et al* note that these applications often exceed the allotted area and a final decision must be negotiated (Bredahl *et al* 1983, p.43). In order to enforce the final decision on acreage allocation, CADDES and CNPH are also involved in determining the availability of irrigation water for crop production in the various areas. Sanderson notes that the Comite de Usuarios meets with officials in Mexico's federally irrigated districts to determine water usage in the area (Sanderson 1986, p.76). CADDES and CNPH members are well represented on these councils.

The allocation of water among the various crops is dependent on the relative priority assigned to each in the country's national agricultural policy. Top priority is officially given to sugar cane with winter vegetables being assigned the lowest rank after food crops. In fact, there has never been a shortage of water for vegetable production in Sinoloa, a fact which perhaps underscores the strength of CADDES and CNPH as political lobby groups. In Sonora, vegetable producers have had to turn to wheat, sorghum and other crops due to a shortage of water for vegetable production in that state.

In addition to the above, CADDES controls the quantity and quality of vegetable exports to the United States. Changes are made in response to prices prevailing in the US market. During periods of depressed prices quality standards are raised in order to restrict supplies. In the case of tomatoes, CADDES may also restrict the export of smaller sizes or more mature produce. In each case the intent is to exert upward pressure on producer prices. It is also well known that CADDES monitors prices in Nogales on an hourly basis in order to ensure that local producers receive current market value for their shipments. Such monitoring also assists CADDES in providing timely assessments of the general cost effectiveness of continued exports in any period. The system of production and quality control exercised by CADDES is voluntary, and is designed to pre-empt the imposition of import quotas by the US government (Bradahl et al 1983, p.43).

The above system contrasts sharply with the organization of the Jamaican winter vegetable thrust where there was no established mechanism for generating intelligence on market conditions, and no coordinated system at the national or parish level for controlling the quality of produce reaching the export market.

The Macroeconomic Policy Environment

The export of winter vegetables from Mexico has also benefitted from a wide range of government subsidies. The Mexican winter vegetable industry is heavily subsidised although the need for fiscal restraint has forced a re-thinking of

the government's support program in recent years. In the past, irrigation, water, energy, chemical fertilizers, labour and credit have all been supplied to Mexican growers at less than market price.

In the case of fertilizer and energy, the Mexican government has used a number of policy instruments in its attempts to control the prices of these input. The government, for example, operates a national fertilizer production company, FERTIMEX, which is a key component of the country's national self-sufficiency plan. By maintaining acceptable levels of domestic production, the Mexican government has attempted to control fertilizer prices. Indirect subsidization of this input is provided by the government's intervention in the price of energy which goes into fertilizer production. PEMEX which governs the national petroleum pricing system provides fuels and fertilizer feedstock from natural gas at prices below market value. Large primary producers of export crops and agribusiness firms in the irrigated districts are the principal beneficiaries of this policy.

Irrigation water is also subsidized by the Mexican government. Water is supplied to producers in the federally irrigated districts at prices below market value. This policy is consistent with the country's federal water law. Since the creation of the national water system in 1926, the Mexican government has been reluctant to impose cost effectiveness on the federal irrigation districts. Irrigation district officials collect only nominal user fees which are sufficient to cover the basic costs of maintaining the irrigation infrastructure (Sanderson 1986, p.82).

In terms of finance, Mexican producers also benefit from controlled credit programs which have tended to favour producers operating in the federally irrigated districts. FIRA and BAN RURAL are the principal financing agencies. FIRA offers short and medium term loans at graduated interest rates, while BANRURAL offers a more general credit program.

Apart from the above areas of support, Mexican vegetable producers also benefit from the country's low wage cost structure. The abundant supply of cheap Mexican labour is a well known feature of that country's competitive advantage. The minimum daily wage rate paid to Mexican workers is a fraction of that paid to Florida workers. For example, in 1983 the Mexican daily minimum wage was US$3.53, while the average earnings for Florida based workers was US$31.64 per day (roughly 900% higher). Sanderson notes as well that as low as the Mexican minimum wage may be, rural workers rarely receive the full minimum wage (Saunderson 1986, p.79). Enforcement of the country's minimum wage legislation is quite lax in the rural areas, and faced with rising rates of unemployment, the labour force has grown increasingly more desperate and willing to accept work at any price.

The generous regime of input subsidies provided to Mexican exporters had no parallel under the Jamaican Agro 21 program. In fact, available evidence suggests that the Jamaican dollar was severely over-valued during the operation of the initiative, and effectively levied a punitive 38% tax on the industry (Farrell 1992, p.92). Also, while there were some attempts to waive import and consumption duties in the initial stages of the program, fiscal constraints forced the government to withdraw these incentives before they could have any real effect.

Fortuitous Political Events

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The structure and performance of the Mexican industry has also been shaped by events over which the Mexican government exercised little control. The first such event was the termination of the US Bracero program in 1964. This program permitted the large scale use of immigrant labour in the United States. Termination of the program served to drive up US input costs in vegetable production and resulted in the spontaneous flight of capital to Mexico. This was the beginning of the close relationship between Mexican producers and the business firms in Nogales, Arizona now called the WMVDA. The importance of this association in the Mexican export program was discussed in an earlier sub-section.

The second political event which was important in Mexico's development as a major vegetable exporter to the United States was the embargo on trade with Cuba after the 1959 revolution. Prior to that period Cuba was a significant player in the US market for fresh vegetables. But by 1962 Cuba has been completely ousted as a major supplier. This event created the void Mexican producers needed to expand their exports.

LONG RUN PROSPECTS FOR THE ENTRY OF NON-MEXICAN EXPORTERS

The analysis presented in the first part of this paper suggests that several factors are at work to maintain Mexico's leadership position in the US market. The issue of importance to Jamaica (and other Caribbean countries) is the extent to which changes in economic conditions could force Mexico to withdraw from this market and, therefore, provide a window of opportunity for non-Mexican suppliers. As noted earlier, some analysts have claimed that Mexico's recurrent balance of payments deficits would eventually force the government to abandon its generous regime of subsidies, which would cause input prices to rise to their equilibrium levels, and drive down export supply. These analysts have also pointed to increased union activity in the agricultural labour market, and the increasingly vocal calls for increases in the minimum wage. Is it reasonable to conclude, therefore, that these economic pressures will eventually force Mexico to exit the market?

The second part of this paper will address this issue using a simple dynamic model of the US industry. In this analysis supply and demand conditions in the US are explicitly modelled as is Mexican export supply. Given that Mexican export supply is explicitly included, this approach allows for the computation of dynamic multipliers which can trace and quantify the impact (if any) that rising input costs would have on Mexican exports.

Structure of the Model

The model is estimated for fresh tomatoes which represent the bulk of the vegetables produced and consumed in the United States.[5] The model consists of three behaviourial equations and three identities. As noted above, the behaviourial equations describe supply and demand conditions in the US market as well as the export supply response of Mexican exporters. The first of the three identities relate the acreage response of Florida producers to the corresponding level of output. The second identity aggregates Florida production and

production from other US states to arrive at total US output. The final identity describes equilibrium quantity flows in the market.

The complete structural model is presented in Exhibit I. It is observed that the acreage planted to tomatoes by Florida producers is hypothesized to be determined by the average Florida producer price of tomatoes and the producer price of other vegetables. The producer price of other vegetables is calculated as a Divisia index of the average Florida producer prices of carrots, celery, lettuce and onions. Acreage planted is also hypothesized to be determined by the costs of harvesting and growing the crop. As with the producer price of other vegetables these costs are expected to be negatively correlated with the dependent variable. The producer price of tomatoes is of course expected to be positively correlated with the acreage devoted to tomato production.

Acreage response is also assumed to be influenced by the acreage planted in the previous period as well as by the occurrence of freeze conditions in Florida. Freeze conditions during the winter vegetable season have from time to time constrained the ability of producers to respond to consumer demand. This inability, has resulted in a sharp escalation in retail prices and windfall profits for exporters. In the present model freeze conditions are represented by a dummy variable which equals 1 in years of severe freeze conditions and 0 otherwise. A positive sign is expected for the variable representing lagged acreage planted as well as for the freeze dummy.

As noted above, the acreage response equation is translated into quantity supplied by an identity. In this identity it is of course assumed that acreage planted will approximate closely acreage harvested. In fact, over the period covered by the data, acreage harvested averaged 97% of the total acreage planted. The use of acreage planted as a proxy for acreage harvested is, therefore, not likely to introduce serious errors into the analysis. It should also be recognized that Florida's production, and the production of the other US states, are summed to arrive at total US production (see Exhibit 1, equation 3).

The demand side of the model is represented by equation 4. Quantity consumed is assumed to be determined by the retail price of tomatoes and the retail price of other vegetables (in this case onions and lettuce). Again the price of other vegetables is represented by a Divisia index of average prices. Assuming weak separability, consumption of tomatoes is also hypothesized to be influenced by the total expenditure on vegetables as opposed to personal disposable income. It should be recognized that personal disposable income is not used here, as it would be necessary to include the prices of all other commodities available for purchase by the consumer. A negative association is of course expected between quantity consumed and the own price variable. The sign on the variable representing the price of other vegetables would be dependent on whether these commodities are substitutes or complements in consumption. Expenditure is expected to be positively correlated with consumption.

As will be noted from Exhibit 1 demand is also expected to be determined by the quantity consumed in the previous period. It is therefore

assumed that habit formation plays an important part in determining consumption in the current period. A positive sign is expected for this variable. Equation 5 of the model describes the export supply response of Mexican producers. Exports are hypothesized to be determined by, *inter alia,* the average price received by Mexican tomato producers. This price is actually an adjusted US retail price calculated as follows:

$$P,Mex = (P_tUS - f)\ x$$

Where: $p,^{Mex}$ = Mexican producer price of tomatoes

$P,^{us}$ = US retail price of tomatoes t = MFN tariff rate

US exchange rate

Mexican exports are also assumed to be determined by the producer price of other crops which could in fact be produced by Mexican tomato farmers. This price is represented by an index of prices received by Mexican producers for crops sold on the domestic market.

The supply of Mexican tomato exports is also assumed to be dependent on the wage rate paid to Mexican farm workers. As is well known, labour costs are a major component of vegetable cost of production in Mexico, and so this variable is expected to be strongly (negatively) related with export supply. Similarly, the cost of fertilizers is also expected to be a major determinant of Mexican export supply response. This variable is represented by an index of fertilizer prices, and as with the wage rate, is expected to be negatively associated with the volume of exports.

Finally, it is hypothesized that the supply of Mexican tomato exports in any year would be determined by Florida production in the previous period. As noted in an earlier section CADDES controls the volume of exports and continuously monitors market conditions in the US. It is expected that increased Florida production in one year would force a significant drop in farmgate and retail prices, and precipitate an increase in the quantity of foreign and domestic tomatoes consumed. In response to increased US demand, CADDES is expected to increase exports to the US markets in the subsequent period. A positive sign is therefore expected for the export variable in the Mexican export supply relationship.

An identity describing equilibrium quantity flows in the market (equation 6) completes the specification of the model. It is therefore assumed that the market for tomatoes clears and that the interaction of supply and demand yields a unique equilibrium price.

Functional Form and Estimation Method

In order to circumvent the theoretical inconsistency inherent in most linear specifications of demand and supply schedules, all price and expenditure variables in the above model were normalized (see Coyle 1989, p.263-268 for a discussion of the theoretical problems). In the case of the Florida supply function, the per unit growing cost was chosen as numeraire. The US demand function, on the other hand, was normalized on the retail price of other

vegetables, while the price of fertilizer was selected as numeraire of the export supply function. The above choices were arbitrary.

The normalized functions were expressed in logs and estimated as a complete system using 2SLS. In the case of the export supply schedule, all prices were deflated by the index of prices received by Mexican farmers. This was done prior to normalization. Given the rapid rate of inflation in that country over the sample period (1970-1989) it was considered important to estimate this relationship in real terms.

Data Sources

The complete data set used in the estimation of the model is briefly described in this sub-section. Data on total production and the number of hectares planted to tomatoes in Florida were obtained from the Florida Agricultural Statistics Service publication *Vegetable Summary,* 1988-1989. This publication also contained relevant data on the number of hectares harvested and average yields. Data on growing and harvesting costs are for South-West Florida and were obtained from the Department of Agricultural Economics, University of Florida. The years of severe freeze conditions were also obtained from this latter source. Total US production of tomatoes was obtained from the USDA publications, Vegetable and *Specialities Situation and Outlook Yearbook,* 1990.

The above USDA publication also contained data on per capita tomato consumption as well as the retail price of tomatoes and other vegetables. Producer price data were obtained from the above USDA publication, and these data also allowed for the calculation of a time series vegetable expenditures.

Data on Mexican vegetable exports were obtained from the Foreign Agriculture Service (FAS) of the USDA. These data were unpublished. Information on the Mexican minimum agricultural wage was obtained from Buckley *et al,* 1986 (see p.51), while fertilizer prices were acquired from the FAO *Production Yearbook,* 1989. The above unpublished FAS data also allowed for the determination of the rest of the world supply of tomatoes to the US. The volume of US tomato exports was calculated as a residual. MFN tariff data were obtained via personal communication with officials at the US International Trade Commission in Washington.

Empirical Results

This subsection discusses the results of the econometric estimation of the model presented in Exhibit 1. There were several problems associated with the estimation of the above model. Firstly, the error terms of the demand function were observed to be serially correlated as evidenced by the calculation of the Durbin Watson h statistic.[6] In terms of the acreage response function it was also observed that inclusion of the producer price of other vegetables and the lagged acreage planted variable yielded poor results.

The model was re-estimated with the above two variables omitted from the specification and the problem of serial correlation corrected. It should be noted that because equation 4 contains a lagged dependent variable as a regressor, the usual Yule Walker and maximum likelihood approaches to autocorrelation correction cannot be directly applied (SAS Institute 1988).

Instead an instrumental variable method was used in which the lagged dependent variable was predicted using the other regressors and their lags. The predicted value of the lagged dependent variable was then used as a regressor in equation 4 (see Johnston 1984, p.321 for a brief discussion).

The results of the revised model are presented in Exhibit 2. All variables in the model have the expected sign and most are significant at conventional levels. It should be noted that because the equations are expressed in log form the parameters are also the elasticities and these are seen to be reasonable both in terms of sign and magnitude. The elasticity estimates are also observed to be reasonably consistent with those contained in other studies (see for example Hammig and Mittlehammer 1982, p.140-145).

Impact Assessment

As noted above, the primary focus of this section is to assess the impact of changes in Mexican input costs on the volume of tomatoes exported to the US. It has been argued that changes in export supply will, *ceteris paribus,* result in an increased demand for non-Mexican supplies and improved potential for smaller exporters, such as Jamaica, to re-enter the market.

Tables 3, 4 and 5 summarize dynamic interim and total multipliers for the system of equations. The first interim multiplier is termed the impact multiplier and it shows the immediate effect of changes in each exogenous variable on the values of the model's endogenous variables. The total multiplier measures the *long run* change in the endogenous variable occasioned by a one unit change in the exogenous variable.

In the case of US supply all impact and interim multipliers are zero (Table 3) indicating little dynamic response of this equation to exogenous shocks.[7] In the long run, however, acreage planted will be moderately affected by changes in output and input prices as well as by freeze conditions. The same is also true of the demand function where, except for expenditure, the exogenous variables appear to have a limited short run and long run impact.

More importantly we observe (Table 5) that Mexican export supply response is influenced, in the short run, by predominantly US supply conditions. US prices, production costs and weather conditions are observed to have an immediate, albeit small impact on Mexican exports. Mexican input costs, i.e. wage rates have no immediate effect although in the long run the influence of Mexican supply side factors is seen to become more important. In fact, increases in the minimum wage rate are observed to be the most important factor (after the intercept) operating to depress export supply. The long run dynamic multiplier is -0.60. This value, which is less than one, suggests that even in the long run export supply will respond less than proportionally to labour cost increases.

The above finding is interesting as it clearly shows that the potential for Mexico's withdrawal from the market in the face of rising input (i.e. wage) costs is limited. It should also be noted that the multiplier estimate of -0.6 is consistent with that of a much earlier study by Simmons and Pomareda (1975, p.478). The authors of this study employed a linear programming model of vegetable production in Sinaloa and concluded as follows:

> *"It was found that, given present technologies an increase of 10% in the minimum daily wage would decrease exports by 9% for tomatoes ... Given present Mexican government policies of rapidly increasing the minimum farm wage, substantial decreases in vegetable exports can be expected (other factors such as Florida production assumed constant)."* (Simmons & Pomareda, 1975, p.476)

The authors go on to argue that it would not be long before Mexico is eliminated as a major supplier of fresh winter vegetables. These results, it would be noted, were reported in 1975. Contrary to the findings of the above researchers, Mexican exporters have, of course, continued to consolidate their position in the US market. When cast in a simple dynamic framework it was discovered that any impact of increased wage cost on Mexican exports will be experienced only in the long run. Changes on the US supply side, e.g. an increase in the cost of production of Florida-based exporters, could also impact on Mexican exports in the near term. However, such shocks are also likely to be small.

SUMMARY AND CONCLUSIONS

This paper has sought to achieve two specific objectives. The first was to identify the major determinants of Mexico's export competitiveness in the US market for winter vegetables. The second was to determine the extent to which economic forces would force a withdrawal of Mexico from the US market and create an opportunity for the re-entry of Caribbean exporters.

It was found that Mexico's domination of the US residual market stems from a complex set of factors, some of which were the direct result of long-range government planning, and some which were largely *'accidents'* of geography, history and politics. Given the nature of these factors it is unlikely that there is potential for rote duplication of the Mexican strategy.

It was also found that economic forces in the domestic Mexican economy, particularly rising wage costs, are also not likely to force a withdrawal of this country from the market segment they have controlled for decades. This result, obtained using a simple dynamic model of the industry does not lend support to the claims of some analysts the Mexican will soon be priced out of the market. The logical inference that the escalation in Mexican input cost would present a window of opportunity for other TWCs is also moot.

To be successful in the market for winter vegetables potential exporter would need to focus on the smaller speciality markets where the Mexicans have been less aggressive. This must be done, of course, in conjunction with the provision of adequate institutional and management support, and on-going efforts to correct macro-prices. As the Jamaican Agro 21 program has shown, to do less will be to guarantee failure.

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NOTES

'The Agro 21 initiative was an experiment in the production and export of non-traditional crops mounted by the Seaga Administration in October in 1982. The program was designed to move the country away from its reliance on sugar by encouraging the reallocation of private sector resources into 19 targeted non-traditional crop sub-sectors. The program failed to realise its objectives, however, and was formally disbanded by the Manley government after the 1989 elections (see Farrell 1992, p.229-251 for a more complete discussion). [2] *The term residual market refers to that share of the North American market which is not controlled by producers in Florida and other US states.* [3]*It should be noted that Florida and California are the major winter vegetable producing states. During the winter months, production from these areas is*

not, however, sufficient to satisfy demand, and this creates a window of opportunity for export-ready Third World Countries (TWCs). Also, the need for imports is often compounded by periodic freezing conditions in the above states which can further expand import demand.

'See Brehdahl et al 1982, p. 14-30 and Bredahl, Schmitz and Hillman 1987, p.5-10, for a discussion of the trade wars waged between producers in Mexico and Florida.

[5]/f should be noted that tomatoes comprised only 3% of the total volume of Jamaican exports over the 1984-1988 period. Cucumber, pumpkin and sweet peppers were the most important crops. However, a lack of US data for these commodities precluded their consideration in this analysis. [6] The demand function contains a lagged endogenous variable as a regressor and so the Durbin Watson d statistic is not valid (Pindyck and Rubinfeld 1981, p. 194).

' Unlike the other behavioral equations of the model the acreage planted function does not exhibit a lagged structure.

TABLE 1. U.S. Imports of Fresh Vegetables, and Mexican and Jamaican Market Shares, 1984-1989

Commodity	Volume (mt) and Market Shares				
	1984/5	1985/6	1986/7	1987/8	1988/9
Cucumber:	176,967	182,331	190,983	213,905	192,548
Mexico Share	92%	94%	96%	98%	94%
Jamaica Share	1%	2%	1%	-	
Peppers:	107,144	106,930	112,774	128,831	133,077
Mexico Share	91%	89%	90%	92%	93%
Jamaica Share	1%	3%	3%	-	
Tomatoes:	374,337	422,200	441,321	376,081	365,849
Mexico Share	98%	97%	98%	98%	98%
Jamaica Share	.			-	
Other Vegetables:	271,433	273,551	350,675	371,742	412,662
Mexico Share	67%	41%	51%	55%"	56%
Jamaica Share	2%	2%	2%	2%	1%

Source: USDA Foreign Agricultural Trade of the United States, Various issues.

- Less than 1%.

TABLE 2. Matrix of Interim and Total Multipliers for

Acreage Planted

Exogenous Variable	INTERIM 1	2	3	4	5	6	7	8	9	10	Total
In (P," / GcO	0	0	0	0	0	0	0	0	0	0	0.474
In (He, / GcJ	0	0	0	0	0	0	0	0	0	0	-0.027
Freeze,	0	0	0	0	0	0	0	0	0	0	0.098
InOVPo',)	0	0	0	0	0	0	0	0	0	0	0
InCX./Po',)	0	0	0	0	0	0	0	0	0	0	0
ln(P,^{M}-/F,)	0	0	0	0	0	0	0	0	0	0	0
ln(fy/F.)	0	0	0	0	0	0	0	0	0	0	0
Intercept	0	0	0	0	0	0	0	0	0	0	7.021

TABLE 3. Percentage Distribution of Jamaican and Mexican Marketing Costs for Cucumber and Peppers, 1984-5 and 1985-6

	Percentage of Marketing Costs (%)					
	Jamaica			Mexico		
	Transportation	Duties	Selling	Transportation	Duties	Selling
Cucumbers	62	14	24	35	32	32
Peppers	61	15	23	26	26	39

Source: Calculated from Buckley 1986.

Note: Percentages may not add to 100 due to rounding.

TABLE 4.

Matrix of Interim and Total Multipliers

for Quantity Demanded

Exogenous Variable	INTERIM										
	1	2	3	4	5	6	7	8	9	10	Total
In (P,^{p} / GcJ	0	0	0	0	0	0	0	0	0	0	0
ln(Hc,/GcJ	0	0	0	0	0	0	0	0	0	0	0
Freeze,	0	0	0	0	0	0	0	0	0	0	0
In (F, / Po^{r}.)	-0.278	.0.165	-0.098	-0.058	-0.035	-0.021	-0.012	-0.007	-0.004	-0.003	-1.154
In (X, / Po',)	0.654	0.388	0.231	0.137	0.081	0.048	0.028	0.017	0.010	0.005	2.714
In(P,*^{l}™*1*F,)	0	0	0	0	0	0	0	0	0	0	0
In (W, / F,)	0	0	0	0	0	0	0	0	0	0	0
Intercept	1.579	0.937	0.556	0.330	0.196	0.116	0.069	0.041	0.024	0.014	6.549

TABLE 5.
Matrix of Interim and Total Multipliers for

Mexican Export Supply

	INTERIM										
Exogenous Variable	1	2	3	4	5	6	7	8	9	10	Total
In (P,^{F} / GcJ	0.311	0	0	0	0	0	0	0	0	0	0.311
In (He, / Gc.)	-0.017	0	0	0	0	0	0	0	0	0	-0.017
Freeze,	0.065	0	0	0	0	0	0	0	0	0	0.065
In (F, / Po^{r}.)	0	0	0	0	0	0	0	0	0	0	0
In (X, / Prf,)	0	0	0	0	0	0	0	0	0	0	0
InCP.^/FJ	0	0	0	0	0	0	0	0	0	0	0.457
In (W, / FO	0	0	0	0	0	0	0	0	0	0	-0.60
Intercept	4.61	0	0	0	0	0	0	0	0	0	4.41

EXHIBIT 1.
Structure of the Econometric Model

Florida Production:

$$AP_t = f(P_{t-1}^{F}, Po_{t-1}^{F}, Gc_t, He_t, AP_{t-1}, Freeze) \quad \ldots 1$$

$$Qs_t = AP_t \times Y \quad (\text{Assume } AH_t = AP_t) \quad \ldots 2$$

U.S. Production:

$$Qs_t^{US} = Qs_t + Qs_t^{OUS}$$

U.S. Demand:

$$Qd_t = f(P_t^{r}, Po_t', X_t, Qd_{t-1})$$

Mexican Export Supply:

$$ES_t = f(P_{t-1}^{*}, Po_{t-1}^{*}, W_t, F_t, AP_{t-1}) \quad \ldots 5$$

Market Equilibrium:

$$Qs_t^{ROW} = Qd_t - (Qs_t^{1} + ESO) \quad \ldots 6$$

Where:

AP_t = Acreage planted in Year t	AP_{t-1} = Acreage planted in Year t-1
P_{t-1}^{F} = Average producer price of tomatoes	Po_{t-1}^{F} = Average producer price of other vegetables
Gc_t = Per unit growing cost	He_t = Per unit harvesting cost
Freeze = Dummy variable representing freeze conditions	Qs_t = Quantity of tomatoes produced in Florida
7 = Average Florida tomato yield	Qs_t^{US} = Total U.S. tomato production
Qs_t^{OUS} = Total tomato production of the other U.S. states	Qd_t = Quantity of tomatoes consumed in the U.S.
P_t' = Average retail price	Po_t' = Average retail price of other vegetables
X_t = Expenditure on vegetables	ES_t = Mexican exports of tomatoes
pMa_t = Mexican producer price of tomatoes	PC_t = Mexican producer price of other crops
W_t = Mexican minimum agricultural wage rate	F_t = Index of Mexican fertilizer prices
Qs_t^{ROW} = Rest of the world tomato supply	

EXHIBIT 2. Parameter Estimates of the Base Model

$$\ln AP_t = \underset{(10.23)}{7.0209} + \underset{(3.86)}{0.474} \ln \frac{P_{t,F}}{Gc_t} - \underset{(-0.26)}{0.027} \ln \frac{He_t}{Gc_t} + \underset{(2.10)}{0.098}\ Freeze_t$$

$DW = 1.61 \qquad R^2 = 0.73$

$$\ln Qd_t = \underset{(1.57)}{2.66} - \underset{(-2.59)}{0.469} \ln \frac{P_{t,r}}{Po_{t,r}} + \underset{(2.73)}{1.103} \ln \frac{X_t}{Po_{t}^{r}} + \underset{(3.15)}{0.594} \ln$$

$R^2 = 0.97$

$$\ln ES_t = \underset{(0.062)}{-0.20} + \underset{(2.78)}{0.457} \ln \frac{P_{t}^{M''}}{F_t} - \underset{(-3.46)}{0.60} \ln \frac{W_t}{F_t} + \underset{(2.03)}{0.66} \ln AP_{t-1}, (-$$

$R^2 = 0.62 \qquad DW = 2.31$

Note: - denotes variables expressed in real terms.

Note: t values are in parentheses.