Prospects for Trade in the North American Steel Industry

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Abstract. *The steel industry was selected for this study because it is a major basic industry in each of the three countries and because the industry faces intense global trade competition. This paper briefly reviews the technological and operational differences between minimills and integrated mills. Also, the evolution of global steel demand is related and compared to industry structure in Canada, the United States, and Mexico. Finally, empirically estimated price and income elasticities are used to evaluate the impact of changes in export and import volumes by product line that have occurred in the United States and Canada following the US-Canada Free Trade Agreement. By reviewing the recent changes in trade patterns following the 1989 implementation of that Agreement, projections may be made about the impact of NAFTA on the steel industry in the three countries.*

Introduction

The integration of the United States, Canadian, and Mexican economies through the North American Free Trade Agreement (NAFTA) is aimed at providing growth opportunities for all three economies. However, industry in each country will be impacted differently by the opportunities and challenges of NAFTA. The reshaping of trade will have dramatic impact on the patterns of production and ultimately on employment and wages in each country.

The steel industry, which has been rapidly restructuring during the past three decades, will face significant changes under trade integration. These changes will include both shifts in production locations on an international scale and further expansion of the role of the new technology minimill producers (newer steel producing facilities using high scrap inputs and electric furnaces) into the traditional markets of the larger integrated mills.

I. Minimills and Integrated Mills

The steel industry has been dramatically restructured during the last three decades. The traditional steel industry was dominated by large integrated mills that produced a variety of steel mill products. Recently, minimills have specialized in the production of smaller quantities of steel with a narrow product line. In doing so, the minimills have created a more flexible and price responsive steel industry. The price responsive minimills provide a striking contrast to the inflexibility of the integrated mill producers, which have traditionally followed an oligopolistic pricing model. As such, the dynamics of choosing a steel supplier based on quality, lead time, and price have been altered. By changing the traditional structure of steel supply, the capacity considerations for a steel supplier have been reduced to somewhat smaller levels that favor the minimill producers (Erceg, 1989).

The minimills have two technologies that have separated them from the integrated mills. First, the minimills primarily use electric furnaces for heating steel. Although this technology was first implemented by Heroult in 1900, its rapid introduction has occurred over the past 30 years. Use of the electric furnace removes almost all of the usual preliminary steps in the steel production

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process, relying instead upon the use of scrap steel. Second, nearly all of the production is linked to continuous caster technology. Although continuous casters have been added to integrated mills, this can be costly and difficult as compared to implementation in greenfield operations. Further, the continuous caster is better suited to use of smaller billets as produced in the minimills (Scherrer, 1988). Noting that the mean age of minimills is about 6 years, compared with 22 years for the integrated mills, we can assume that the minimills typically have substantially newer technology embodied in the mill operations. This in turn leads to an enhanced ability to the minimill producers to respond to price changes facing the industry (Acs, 1988).

It has been argued that the export of technology from the United States to other countries typically follows a model of using the same mass-production methods abroad, often leading to failure in the host country. However, the steel industry is an example of where the new minimill technology has been used to produce at a low cost in a relatively unstable international environment. This contrasts with the relatively slow adoption of minimill technology by the integrated steel plants in the United States (Acs, 1988).

In the United States and Canada, the introduction of minimill technology has led to the regional production of steel away from the domination of the Great Lakes producers. This change in production location will be very important and visible in Mexico's future. The minimill will be strongly favored in Mexico as a result of the relatively low capital investment required, the possibility of locating near the regional market to lower transportation costs, and the specialization in bars and structural steel as needed for the rapidly industrializing economy (Scherrer, 1988). Mexican production, as driven by minimill facilities, will likely be dispersed more evenly across the country than is U.S. or Canadian production.

The minimills have almost pushed the integrated mills out of the U.S. and Canadian markets for wire rods, wire and wire products, structural shapes, and bars. Further, the minimill markets have generally been able to fight imported steel better than have the traditional integrated mill products (Acs, 1988). As the minimills enter the market for hot and cold rolled steel they will begin to dominate nearly all industry segments. Consequently, the majority of steel production in the next century will be controlled by the minimill producers.

II. The Global and North American Steel Industries

The global steel industry, after experiencing stagnant growth in demand for nearly three decades, is beginning to grow again. Current world consumption is estimated at 611 million metric tons, but is expected to grow to 720 million tons by the year 2000, according to the International Iron and Steel Institute. Most of this increase will result from increased demand and production from mainland China (Samways, 1994). The developing countries now consume 15 percent of world steel production, up from 9 percent in 1973. Third World steel consumption grew by over 8 percent per year from 1960 until 1979, but slowed to 1.4 percent per year from 1979 until 1987, largely as a result of slow to negative economic growth in Latin America.

In a recent study, Tilton concluded that the intensity of steel use in developing countries has risen by approximately 14.4 percent per year. This growth was sufficient to counteract slower growth in demand resulting from slower growth in GDP, which stagnated during the eighties (Tilton, 1990). If economic growth accelerates in Mexico, it can be concluded that the growth in steel demand will intensify and accelerate considerably, perhaps reaching growth rates of nearly 20 percent per year during the remainder of this decade.

The restructuring of the global steel supply has been accompanied by the rapid increase in the number of international joint ventures. In 1960, U.S. and Canadian production was dominated by firms that were vertically integrated and linked through interest groups such as the Cleveland Group and the Cleveland Cliffs Company (Scheuerman, 1990). Vertical integration was a natural outgrowth of both the reduction in raw material and finished product shipping costs and the prevailing strategies of the steel producers (Burnham, 1993). The vertically integrated interest groups controlled over one-half of all U.S. and Canadian steel production and provided an effective shield against competition, particularly from foreign firms. In recent years, these interest groups have faded in power and have been replaced by international joint ventures or international ownership. Over 25 percent of all U.S.

production is now owned by foreign interests. Further, the sharing of technology has become widespread in the industry, creating a new worldwide web of linkages (Scheuerman, 1990). The increased foreign direct investment in new capital technology is likely to continue to alter trade patterns in the future. This sharing of technology has been cited as a reason for the rapid increase in labor productivity in the U.S. steel industry during recent years. Labor productivity in the U.S. steel industry rose by 4.3 percent from 1985 to 1990, compared to less than one percent for the overall business sector (Burnham, 1993).

In North America, the U.S. steel industry has been shrinking over the past three decades, although production has stabilized during the past ten years. Likewise, Canadian production has remained relatively stable over the past ten years. As Mexico has moved to privatize the steel industry and open the economy, the Mexican steel industry has moved to increase production levels. Overall, growth in the industry appears to be moderate but positive during the next decade.

The Canadian steel industry is much smaller than the U.S. steel industry, with approximately one-sixth the production capacity. On the other hand, the Canadian industry is about twice as large as the Mexican steel industry. The U.S. and Canadian industries are not only larger but both should have better access to capital, technology, and distribution than the Mexican industry. Recent production of steel in North America is summarized in Table 1.

III. The Steel Industry in Canada

The Canadian integrated steel industry is dominated by two large producers, Dofasco and Stelco. Several new minimill producers, such as Ivaco Rolling Mills, are now producing lower-value added steel mill products. Production is concentrated around the Great Lakes, with large facilities located near Hamilton, Ontario. In recent years, the Canadian steel industry has witnessed reductions of capacity as a result of foreign competition, including substantial imports from the United States.

Prior to the U.S.-Canada Free Trade Agreement more than seventy percent of all steel mill products were crossing the border free of tariffs and other non-tariff barriers. The U.S.-Canada Free Trade Agreement phases in tariff cuts immediately, over five years, or over ten years. With the U.S.-Canada Free Trade Agreement in effect for five years, trade in steel between Canada and the United States is now virtually open. The major integrated mill products, composed of carbon steel, are included in the ten year phase-out.

The Canadian industry has not grown since the passage of U.S.-Canada Free Trade Agreement. The total production of Canadian producers has actually declined in recent years, falling by nearly 2 million tons between 1989 and 1991. Although production has recovered somewhat, it still falls over one million tons per year short of its peak. One author goes as far as suggesting that rather than rework the role of steel in the U.S-Canada Free Trade Agreement, the Canadian steel producers (Dofasco, Stelco, and Algoma) should attempt to reorganize through bankruptcy proceedings. The U.S. mills now control over 16 percent of the Canadian steel market, and Canadian and United States minimills are likely to increase the competitive pressure on the remaining integrated mills in Canada (Gherson, 1993).

In spite of the setbacks, Canadian producers are continuing to invest in the steel industry. For example, Algoma Steel has recently completed several coke-oven renovation projects and Dotasco has opened a 400 thousand tons per year galvanizing facility in Windsor, Ontario. Also, Dofasco and Co-Steel have announced the building of a $300 million, one million tons per year fiat rolled minimill under the name of Gallatin Steel. Recently, the plant produced thin-slab, fiat-rolled steel, providing an opportunity to compete with Nucor in this product line. The plant is located near Warsaw, Kentucky, south of the Ohio River. The strategic location was chosen to reduce

TABLE 1

PRODUCTION OF STEEL IN NORTH AMERICA, 1984 - 1993
MILLIONS OF TONS

YEAR	UNITED STATES	CANADA	MEXICO
1984	83.9	14.7	7.6
1985	80.1	14.6	7.4
1986	74.0	14.1	7.2
1987	80.2	14.7	7.6
1988	90.1	14.9	7.8
1989	88.8	15.5	7.9
1990	89.7	12.3	8.7
1991	79.7	13.0	8.0
1992	84.3	13.8	8.5
1993	87.2	14.4	9.2

SOURCE: CRANDALL, 1993.

transportation costs, which Gallatin believes to be as important as labor and raw material costs (Isenberg-O'Loughlin, 1995). Gallatin plans to increase capacity by an additional one million tons per year in 1997 (Samways, 1994).

IV. The Steel Industry in the United States

The demand for steel mill products has fallen rapidly since reaching a high of over 150 million tons in 1973 to current levels of approximately 90 million tons. Steel production in the United States increased 3.4 percent to 96.1 million tons in 1993, compared to 1992 production of 92.9 million tons. Capacity utilization rose to 87.4 percent from 82.2 percent during the previous year. Shipments are growing the fastest for use by steel service centers, automotive suppliers, construction companies, oil and gas equipment suppliers, and machinery and industrial tools companies (Samways, 1 994).

For most of the past three decades, the U.S. steel industry has been supportive of trade protection for the industry. Notable examples of trade protection include the 1978-1981 Trigger Price Mechanism and the 1985 to 1992 Voluntary Restraint Agreement, which covered most steel producing countries. The movement toward free trade agreements with other countries have reduced the effectiveness of trade protection in the steel industry, resulting in high import levels and strong international competition.

The downsizing of the U.S. steel industry has been accompanied by a rapid change toward minimill capacity in place of integrated mill capacity. Minimills increased capacity by almost 20 million tons between 1975 and 1989. During the same time period the integrated mills reduced capacity by over 50 million tons. By the end of this decade, it is estimated that an additional 22 million tons of minimill sheet capacity will be begin production, replacing integrated mill sheet capacity that will be closed (Szekely, 1995). Nucor, the largest of the minimill producers, has total capacity of over 8.5 million tons per year in its seven mills. Several new minimill rolling complexes are currently under construction or in planning. They include plants by Armco (Empire-Detroit), Gallatin Steel (a joint venture of Co-Steel and Dofasco of Canada), and two plants by Nucor. Additional plants are under consideration by the North Star-BHP joint venture, Acme, IPSCO, Nucor, and Steel Dynamics (Samways 1994).

Integrated mills cannot effectively compete with the minimills in steel bars, wire rods, small structural shapes, and concrete reinforcing bars (Crandall, 1993). The new minimills can add capacity for approximately $300 per ton of raw steel versus $1400 per ton of capacity for the integrated mills. The move to minimills has produced a dramatic change in the location of steel producers in the United States. Between 1973 and 1990, steel production fell by 51 million tons (42 percent) in the Rust Belt while increasing slightly in the South and Plains states. There are five basic reasons for the shift toward minimills in locations away from the traditional steel production centers. First, the use of scrap in place of iron ore has reduced the locational advantage of the Great Lakes integrated mills. Second, lower union membership has reduced labor rates. Third, the durable goods industries, especially the auto industry, have moved away from the Great Lakes region. Fourth, the use of electrical energy leads to preferred locations in states with low industrial electricity costs. Fifth, most of the remaining production in the Great Lakes region is sheet steel, an area only recently attacked by minimill producers (Crandall, 1993). Despite these rapid changes, Indiana, Ohio, and Pennsylvania continue to be the largest steel-producing states, providing over forty percent of all U.S. steel production (Espinosa, 1993).

Coinciding with these rapid shifts in technology and location, total expenditures for research and development in the U.S. mineral and metal production industries fell from $133.5 million in 1980 to $22.5 million in 1988. Only about $100 million per year is spent on R&D in the steel industry, amounting to 0.25 percent of sales (National Research Council, 1990). The amount spent on installing technology has likewise fallen.[1]

V. The Steel Industry in Mexico

In recent years, the production of steel in Mexico has been roughly split between parastatal production and private. production. In 1991, the most recent year for which data is available, parastatal production contributed 4,114 thousand tons, or approximately 52 percent of production. As more

1. An extensive listing of current expansion and modernization programs is found in Samways (1994: D-3 to D-8).

firms are privatized, the dominant share of steel production will come from private firms, including many more small minimill operations.

Further, the expected growth of the Mexican economy will increase the need for steel throughout all of the traditional consuming sectors. In particular, construction and automotive markets will grow rapidly. Several large projects, such as the construction of a highway linking Guadalajara and Mexico City and new railroads and ports, will require very large quantities of steel (Lazaroff, 1993). The NAFTA effectively provides additional access to the capital required for the expansion of Mexican steel capacity.

Mexican producers are generally assumed to be lower quality producers than those in the United States and Canada, limiting opportunities for exports to the United States. Mexico exports approximately 500 thousand tons of steel to the United States each year, holding about three percent of the U.S. import market. Additionally, access to markets has generally been served through a ground distribution system as opposed to the lower cost shipping opportunities available to U.S. and Canadian producers. Primary sites of entry for steel imports to Mexico include Matamoros with 31.1 percent of imports, Tuxpan with 19.3 percent, Veracruz with 16.0 percent, and Piedras Negras with 12.8 percent (AHMSA, March 1993).

However, some smaller Mexican steel producers are already installing specialized capacity to serve niche markets, both domestically and internationally. For example, Teknik S.A. de C.V. of Monterrey has installed new furnaces and an automated molding system to serve the specialty castings market. Clients include subsidiaries of several multinational firms, including General Electric, Nissan, General Motors, John Deere, and Caterpillar (Foundry, 1993).

Spending to upgrade and improve capacity at integrated mills is continuing and expanding following the privatization of the steel industry and the opening of markets. For example, APM of Monterrey is modernizing its hot strip and plate mill. Hylsa is installing a $300 million, 900 thousand tons per year thin slab casting/rolling mill complex in Monterrey. This upgrade will be the first to use Nippon direct current shaft furnace technology, indicating an increased willingness for Mexican steel to import technology and equipment. High production rates of up to 200 tons per hour will result from charges that include up to 45 percent scrap input, increasing the productive outlet for recycled steel in Mexico (Samways, 1994). Joint ventures will be used to market the steel from the new mill, with cooperative efforts through Sumitomo of Japan, Usinor Sacilor of France, and Thyssen AG of Germany (Huskonen, 1995). Hylsa has plans for a 480 thousand tons per year greenfield operation near Monterrey to produce rolled steel. The technology is based on several cooperative efforts between Hylsa and Nucor, the most successful of the U.S. minimill producers. The plant is projected to increase Hylsa's rolled steel production by thirty percent while drastically cutting labor and energy costs (Lazaroff, 1993).

Several minimill producers are also upgrading operations and installing capacity in Mexico. The efforts are spread geographically across the country, serving local markets and reducing transportation costs. Recent capacity upgrades include those by Aceros DM in San Luis Potosí, Compañía Siderúrgica de California in Mexicali, Deacero in Monterrey, FESZA in Zacatecas, Talleres y Aceros in Orizaba, and Siderúrgica Tultitlán in Mexico City (Samways, 1994).

VI. Estimation of Import and Export Elasticity of Demand

A quantitative assessment of the historical impact of the U.S.-Canada Free Trade Agreement on trade in steel mill products may aid in estimating the potential for increased North American steel trade following NAFTA. A recent study estimated demand elasticities for several steel mill products at a disaggregated level (Williams and Botzman, 1994). Previously, most studies of the U.S. steel industry were performed at the aggregate industry level using general equilibrium models (see, for example, Cox and Harris, 1986; Crandall, 1987). As a result, the performance of individual sectors was not previously studied, especially with regard to the impact on employment in minimill operations as compared to the traditional integrated mills.

The Williams and Botzman multiple linear regression model used as a dependent variable quarterly export or import volume, respectively, measured in tons. The iron and steel product groups covered are those with major trade volumes and relatively homogeneous price structures. These entail steel mill products in the ag-

gregate and ten sub-categories covering scrap, plates, bars, sheets, and structural shapes. The model used three variables as independent variables: the domestic price, the import price adjusted for exchange rate and the tariff level, and the U.S. industrial production index (IPI) as a measure of overall economic activity. Each variable was modeled in logarithmic form to provide the best fit and direct estimation of demand elasticities. The logarithmic model is:

$$Q_i = \alpha_0 P_f^{\alpha_1} P_d^{\alpha_2} IPI^{\alpha_3}$$

where

Q_i = import or export volume of steel by product

P_f = import or export price (including tariff, adjusted for exchange rate)

P_d = domestic price

IPI = U.S. Industrial Production Index (base year 1977)

The study concluded that the foreign country price (i.e., the price of imported steel products) and the level of industrial production were key determinants of cross-border trade in steel mill products. Using demand elasticities and the changes in tariff rates resulting from the U.S.-Canada Free Trade Agreement, estimates were provided of the changes in the volumes of steel mill product exports and imports between Canada and the United States.

VII. Exports and Imports of Steel in North America

1. Aggregate Trade in-Steel Mill Products

The United States exported slightly over 1.4 million tons of steel mill products to Canada in 1992, roughly the same volume as U.S. exports to Mexico for the same year. Major exports included cold and hot rolled sheets, ingots and billets, steel plates, and structural shapes. Canada exports to the United States in 1992 totaled over 4.2 million tons. Leading product groups included hot and cold rolled sheets, galvanized sheets, wire rods, steel plates, hot rolled bars, and various types of pipe. Canada share of the apparent U.S. supply has risen to 4.5 percent from previous levels of about 3 percent. Canada provided 24.8 percent of U.S. total imports of steel mill products in 1992 (AISI, 1993).

Mexico imported over 1.4 million tons of steel mill products from the United States in 1992. The largest volumes were in hot and cold rolled sheets, steel plates, ingots and billets, structural shapes, and hot rolled bars. By contrast, the United States imported 424 thousand tons of steel mill products from Mexico during 1992. The largest volumes were for ingots and billets, various galvanized sheets, line pipe, and standard pipe. Mexico supplied less than 3 percent of U.S. imports of steel mill products, and less than 0.5 percent of the U.S. apparent supply in 1992 (AISI, 1993). In general, the United States is exporting higher value-added steel mill products to Mexico than it receives in return.

2. Iron and Steel Scrap

The health of the minimills is highly dependent on a reliable supply of iron and steel scrap. As there has been no tariff on iron and scrap imports in recent years, changes in this product classification are more indicative of changes in the exchange rate, transportation costs, and demand levels. In effect, much of the market for iron and steel scrap has and will continue to be bilateral between the United States and Canada. Since 1989, the United States has routinely obtained in excess of 90 percent of all imported scrap from Canada, with Mexico holding a relatively small share. In the first half of 1994, however, Mexico gained nearly one-quarter of the U.S. scrap market with a seven-fold increase in the export of steel scrap to the U.S. over the previous year. It remains to be seen if these increases will be sustained over a longer time period. Although the United States exports much of its scrap to countries other than Canada and Mexico, it consistently has a trade surplus in scrap with both countries. Total exports of scrap rose from about 1.1 million tons in 1989 to nearly 1.6 million tons in 1993.

The role of scrap will become increasingly important to the development of the Mexican steel industry as additional minimill production is added. With approximately 18 percent of current Mexican steel production, the minimills are poised to gain a significant share of the rapidly expanding Mexican steel market. Interestingly, a recent study indicated that the overall health of the Mexican steel industry and the type of Mexican production, either electric furnace or basic oxygen furnace, were significant predictors of Mexican demand for steel scrap. The U.S. price of shredded steel scrap was not significant in the model (Truett, 1994).

3. Cold Rolled Sheets

Cold rolled sheets are a high-value added primary product of the integrated mills, although minimills are beginning to produce cold rolled sheets. The import price elasticity from Canada to the United States is -2.971. This indicates that changes in the tariff rate from 4.5 percent in 1989 to 2.5 percent in 1993 should have resulted in a relatively modest 5.9 percent increase in imports of cold rolled sheets, all other things equal. However, two other variables also impact the change in the estimated level of cold rolled sheet imports. First, the average exchange rate changed from 1.1842 Canadian dollars per U.S. dollar in 1989 to 1.2902 Canadian dollars per U.S. dollar in 1993. This approximately 9 percent change in the price of Canadian products would then predict a change of approximately 26.7 percent in the U.S. imports of cold rolled sheets, all other things equal. Second, the U.S. Industrial Production Index (IPI) rose from 108.1 in 1989 to 110.9 in 1993. Multiplied by the elasticity of imports with respect to the IPI, 4.749, it provides an estimate of an increase of 12.3 percent of imports as a result of increased economic activity and production. Summing the three possible causes of imports indicates a roughly 27.2 percent increase in the level of cold rolled sheet imports.

However, this was not the case. The actual levels of U.S. cold rolled sheet imports from Canada between 1989 and 1993 was a decrease from 2823 thousand kilograms to 1094 thousand kilograms, a drop of approximately 60 percent. Clearly, a factor other than tariff cuts, exchange rate, or industrial production is changing rapidly during this time. The change is originating outside the model, that is, the change is coming from third country imports and high capacity utilization inside the U.S. steel industry. In 1989, Canada supplied more than 20 percent of all cold rolled sheet imports into the United States. By 1993, that level had dropped to 1.20 percent. Mexico, which did not export cold rolled sheet to the United States in 1989, exported more than 36 million kilograms to the United States in 1993. Mexico supplied over 29 percent of the imports of cold rolled sheets into the United States in 1993. At the same time, Mexico consistently consumes over 90 percent of U.S. exports of cold rolled sheets. The United States has been a moderately positive net exporter of cold rolled sheets to Mexico in recent years.

The Williams and Botzman model predicts that as tariffs fall roughly equal increases in the market share of exports and imports of cold rolled sheets will result. Also, increasing economic activity levels will increase the trade volume in this category. This has not generally been the case. Canada's exports of cold rolled sheets have roughly halved over the past five years, and levels of U.S. exports of cold rolled sheets to Canada have been erratic. The United States has gone from a net importer of 318 thousand kilograms in 1989 to nearly 80 million kilograms by 1993. Clearly, the export picture for U.S. cold rolled sheets is not bright in the near future. On the other hand, the domestic consumption of sheets is at a level which will sustain production and profitability in the industry. In this area, the Williams and Botzman model performs poorly, failing to foresee the continued erosion of the position of U.S. firms as a net exporter. The use of a general equilibrium model or inclusion of capacity utilization as an independent variable in the linear regression model is likely to produce better results in this sector.

4. Hot Rolled Sheets

U.S. hot rolled sheet imports from Canada and Mexico are dwarfed by imports from third countries. Canada has risen from 7.2 percent of the U.S. import market in 1989 to nearly 16 percent in 1993. Mexico had less than 3 percent of the U.S. import of hot rolled sheet market in 1993, up from extremely low levels in previous years.

However, Canada and Mexico are becoming the primary, if not sole, destination for exports of U.S. hot rolled sheets. Canada consumed 0.7 percent of U.S. hot sheet exports in 1989, but now consumes 44 percent. Mexico consumed 0.5 percent of U.S. hot sheet exports in 1989, and now consumes nearly 56 percent. In only five years Canada and Mexico went from consuming less than 1.3 percent of U.S. hot sheet exports to nearly 99 percent. However, this change is not entirely encouraging for the United States. Although the volume of hot rolled sheet exports to Canada has nearly tripled and the Mexican consumption is up nearly six-fold, the other markets for U. S. hot rolled sheets have collapsed. Total exports have fallen from almost 725 million kilograms, in 1989 to about 34 thousand kilograms in 1993. Again, this may be partially a temporary change resulting from strong domestic demand.

5. Galvanized Steel

The removal of tariffs appears to have encouraged increased trade of galvanized steel between the United Stales and Canada. Galvanized steel imports from Canada have risen from 12.2 percent of U.S. imports in 1989 to over 35 percent by 1993. At the same time, the U.S. exports of galvanized sheets now go almost entirely to Canada, rising form 11.3 percent of U.S. exports in 1989 to 92.3 percent in 1993. Net imports of galvanized steel from Canada have increased from approximately 89 thousand kilograms in 1989 to over 165 thousand kilograms in 1993.

The Williams and Botzman model predicted that trade volume for galvanized sheets would rise following the U.S.-Canada Free Trade Agreement. Indeed, both export and import volumes of galvanized sheets have roughly tripled from 1989 to 1993. For galvanized sheets, it appears that both sides have gained in trade volume. The Williams and Botzman model performs relatively well in this category.

6. Steel Bars and Shapes

The production of steel bars and shapes is now largely the domain of minimill producers The export of light shaped bars from Mexico to the United States, for example, has increased from 4 thousand kilograms in 1989 to over 4.7 million kilograms in 1993. Mexico held about 0.01 percent of the U.S. import market for light shaped bars in 1989, but holds over 16 percent today. Interestingly, this increase has come at the expense of countries outside of the NAFTA participants, as Canada today has roughly the same level of light bar exports to the United States as in 1989.

In recent years the production of bars and structural shapes has been largely the domain of the minimills. The shift toward exports to Canada from the U.S. minimills has indeed been dramatic. For example, in 1989 the United States exports of cold rolled bars were directed almost entirely to Canada and Mexico. Canada imported approximately 44 percent of U.S. cold rolled bar exports and Mexico imported nearly 51 percent of cold rolled bar exports. By 1993, Canada consumed over 95 percent of U.S. cold rolled bars exports. Canada's volume of imports has risen from 432 thousand kilograms in 1989 to over 13.6 million kilograms in 1993. Mexico's imports of cold roiled bars during the same period rose from 502 thousand kilograms to 671 thousand kilograms.

The Williams and Botzman model predicts that U.S. next exports of bar products will rise under the U.S.-Canada Free Trade Agreement. For cold bars, the U.S. has gone from a net importer to net exporter during the 1989 to 1993 period. In the light bar market, the net export deficit has fallen slightly from the high of over 48 thousand kilograms in 1989. In concrete reinforcing bars, the volume of trade has more than doubled, with the United States holding a net export surplus of over 55 thousand tons in 1993. The Williams and Botzman model appears to perform reasonably well for minimill products.

The market for structural shape imports into the United States is dominated by Canada, with over a 90 percent share. Mexico plays only a small role in this market, with less than a 2 percent share in most years. The U.S. consistently imports more structural shapes from Canada than it exports, with a deficit ranging from between 40 thousand and 80 thousand kilograms during the past five years. Mexico has recently become a net importer of structural shapes from the United State.

VIII. Prospects for the future

Several trends and conclusions can be drawn from a review of the historical trade patterns between Mexico, Canada, and the United States; study of the shifting between traditional integrated mill production and minimill production; and quantitative assessment of the impact of the U.S.-Canada Free Trade Agreement and inferences about the impact of the NAFTA.

First, Canada and the United States have a long history of trade in steel mill products, especially around the Great Lakes region. The trade diversion effect of lower tariffs as a result of the U.S.-Canada Free Trade Agreement will continue to increase the level of this trade in place of imports from third countries. This appears to be quite important in explaining the recent trade in cold rolled bars, galvanized steel, sheet steel, and iron and steel scrap.

Second, Mexico's export and import of steel mill products has a large potential for increase, especially if the economy grows rapidly as a result of the opening of the economy and NAFTA. As shipping and rail transport become more efficient in Mexico, more steel will enter through ports than by truck. Also, the large number of minimill producers will be able to provide quality products

for local markets and for export. We can conclude that even without NAFTA the level of steel trade between Mexico and the United States was destined to climb rapidly. With NAFTA, the steel trade is likely to rise very rapidly. Mexico may become a strong competitor in minimill products over the next decade.

Third, the lowering of tariff and non-tariff barriers between the three countries will increase the competitiveness of all three nations vis-a-vis third country producers, such as Brasil and Japan. As such, each industry will benefit in some segments from NAFTA. The additional ability of Mexican producers to acquire modern technology and joint venture capital from the United States and Canada will add to the speed of development of the Mexican steel industry, particularly for products from minimills.

Finally, the impact of the U.S.-Canada Free Trade Agreement has demonstrated quantitative support of increased trade between the two nations. For some product groups, such as cold rolled sheets, the market is now driven by global production and demand. As such, use of a single equation linear regression model does not appear to be a good predictor of future demand and trade patterns. For other product groups, such as galvanized steel and bars, the market is driven by regional needs, supporting the use of a single equation linear regression model. Overall, the U.S.-Canada Free Trade Agreement does provide increased opportunities for trade between the two nations. The North American Free Trade Agreement appears to provide additional opportunities for growth in demand and trade, especially as the economy appears to provide additional opportunities for growth in demand and trade, as the economy of Mexico reaches maturity. ◆

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