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**THE IMPACT OF TARIFF LIBERALISATION ON CANADIAN
EMPLOYMENT, 1987 – 1996: AN EMPIRICAL INVESTIGATION OF
SELECTED MANUFACTURING INDUSTRIES**

by Judy Hosein

**THESIS SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF SOCIAL SCIENCES**

in the Department
of
Economics

University of Ottawa
February, 1999



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ABSTRACT

This paper examines the impact of tariff liberalisation on employment for selected Canadian manufacturing industries between 1987-1996. An input-output model was constructed to estimate the changes in the level of employment arising from changes in the flow of imports and exports due to tariff liberalisation.

In addition to an input-output model, preliminary econometric testing was also conducted to capture the effects of other structural and cyclical factors that may have also affected employment during the same period. In this regard, an OLS model was constructed that examined the relationship between employment and the following variables: exchange rates, Canadian gross domestic product, US gross domestic product, and tariff rates.

The main finding of the study was that tariff liberalisation had a minimal impact on employment, but that the extent of the impact varied across industries. Moreover, the employment effects were found to be dependent on the specific production requirements of industries rather than trade sensitivity, as is commonly argued in the economic literature. It was also established that, in conjunction with tariff liberalisation, other macro-economic factors also affected the level of employment during the same period.

ACKNOWLEDGEMENTS

I wish to acknowledge Professor Mario Seccareccia, my supervisor, for his valuable comments and insight in the preparation of this thesis. Special thanks also goes to Marilyn Hosein and Thomas Allgoewer for their unending support and words of encouragement.

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1. INTRODUCTION

Tariff liberalisation in Canada began as early as 1947 when Canada became a signatory to the General Agreement on Tariff and Trade. This set the stage for further multilateral and unilateral tariff reductions over the next thirty years, with the implementation of the Kennedy Round in the early 1970s, and the Tokyo Round agreements in the early to mid 1980s. Simultaneously, Canada began entering into free trade agreements with the United States with the signing of a defence production sharing agreement in 1959, and the Canada-US auto pact in 1965. However, it wasn't until the signing of the Canada-US free trade agreement (CUSFTA) in 1988, and the North American Free Trade Agreement (NAFTA) in 1992, that labour market concerns became a key issue in the nation's trade policy.

The eighties were of particular significance because tariff liberalisation policies were adopted within a period of severe domestic recession, together with growing trends in globalisation and increased international competition. Tariff liberalisation heightened the need for structural change in Canadian manufacturing and signalled the importance of an outward-looking Canadian trade policy. The onset of the CUSFTA and the NAFTA triggered a series of debates on the impact of free trade on domestic employment in Canada.

Opponents of trade liberalisation premised their forecasts on the neo-classical economic theory of comparative advantage and the assumptions of wage equalisation. It was argued that tariff liberalisation would lead to the relocation of production to the United States and, hence, result in job losses in Canada. More specifically, since most US branch plants located in Canada in response to tariffs, the removal of these barriers would remove the incentive of US firms to remain in Canada. As such, firms would re-

locate to the US in order to benefit from specialised production and lower costs, normally associated with scale economies. Additionally, the remaining firms would adopt labour-saving technologies in order to remain competitive, which would result in further job displacement.

Moreover, it is argued that tariff liberalisation would lead to labour migration from low-wage to high-wage countries, which would ultimately have the effect of decreasing wages in high-wage countries and increasing wages in low-wage countries. Further, tariff liberalisation would also lead to the migration of capital as well, this time from high-wage to low-wage countries. Hence, the negative employment effect is further reinforced since capital migration raises the demand for labour in low-wage countries while reducing it in high-wage countries.

Alternatively, proponents of free trade argued that tariff liberalisation would have an employment-creating effect in Canada. It is argued that a major incentive for opening trade with the US was to improve job quality through increased productivity and real income. In the longer run, employment would increase through the removal of labour market imperfections. More specifically, it is argued that free trade will increase the elasticity of demand for goods by increasing consumer choice. This would lead to a decrease in wage and price mark-ups as producers face a more elastic demand curve. Lower prices will then stimulate demand and production, and consequently lead to an increase in employment.

A more general argument provided by the proponents of free trade was that tariff liberalisation would promote a more efficient allocation of resources through increased competition. This implied increased specialisation in production through the mechanism of economies of scale and increased productivity, which in turn would lead

to increased capital investment and the demand for labour. Stated differently, opening up trade would force a restructuring of domestic production, and hence the removal of labour market distortions resulting from structural unemployment. Interestingly, authors advocating this viewpoint also premised their expectation on neo-classical economic theory, but with a different set of modeling assumptions - as will be demonstrated in a later section.

The purpose of this paper is to identify how tariff liberalisation impacted employment in Canada after the signing of the CUSFTA and NAFTA. It will be argued that tariff liberalisation was both employment-creating and employment-displacing and, more importantly, that these effects were minimal in comparison with broader employment trends during the same period.

In terms of organisation, the first part of the paper will provide a critical review of the empirical literature on the employment effects of tariff liberalisation. This will be followed by an empirical investigation of tariff-related effects on employment during the 1987-1996 period. The paper adopts an input-output framework designed to measure employment changes as they related to specific tariff cuts. This was followed by a broader econometric model that was constructed to measure employment effects that may have been caused by other structural and cyclical factors in the economy. The results were then compared in order to gauge the magnitude and direction of employment effects caused by tariff liberalisation, namely: the CUSFTA and the NAFTA.

2. LITERATURE REVIEW

The ratification of the CUSFTA and NAFTA have sparked a deluge of empirical studies on the impact of tariff liberalisation on the Canadian economy. These studies – both *ex post* and *ex ante* - have attempted to investigate a variety of effects of tariff liberalisation ranging from issues such as labour adjustment costs and environmental impacts to welfare implications. This review will provide a critical summary of the empirical literature on the employment related effects of tariff liberalisation in the Canadian economy.

The empirical literature can be classified into four broad categories of research, namely: decomposition studies, trade-balance studies, computable general equilibrium models, and macro-econometric models. The earliest empirical research on the impact of tariff liberalisation on the Canadian labour market was conducted in the late 1970s. These so-called “decomposition studies” attempted to measure gains from international trade arising from tariff liberalisation through the use of accounting identities. These types of studies inferred labour market changes by decomposing changes in trade into equivalent changes in employment, productivity, and domestic demand. A key assumption of decomposition studies was that foreign imports are directly related to the level of domestic employment. Hence, by holding the ratio of imports to domestic consumption constant, employment changes resulting from tariff liberalisation can be calculated residually. That is to say, the accounting identity measured the employment levels that would have prevailed if imports had remained constant.

By the 1980s, decomposition studies were heavily criticised in favour of “trade-

balance” studies. New empirical work emerged under the rubric of the Heckscher-Ohlin factor endowment trade theory. These studies attempted to measure gains from trade liberalisation, as it pertained to employment, through the use of input-output tables and Leontief production functions. The crux of the approach involved the estimation of employment gains assumed to be associated with exports and the hypothetical number of jobs displaced as imports replaced domestic production. Labour market changes were then inferred by netting out the results of both these effects.

By the early 1980s and late 1990s, trade-balance studies were criticised on the basis of the limited explanatory power of the model. It was suggested, for example, that it was only with a system of behavioural equations that employment gains from trade can be meaningfully understood. Later empirical work on the impact of tariff liberalisation on employment emphasized the use of computable general equilibrium (CGE) models that subsequently became the standard tools in the analysis of international trade.

Initially, CGE models were based on a neo-classical framework, emphasising a static general equilibrium approach. Later, a second generation of CGEs emerged in the literature, using dynamic modeling techniques, that expanded the scope of the earlier studies by incorporating intersectoral, multi-country, and inter-temporal analyses. As a complementary development to wider ranging computable general equilibrium models, macro-econometric studies also emerged in the 1980s and 1990s. In general, the latter models were less concerned with theory, in the sense that they provided an assessment of policy based on the measurement of aggregate effects in the short run. Each of these approaches will be taken up in more detail below.

2.1 Decomposition Studies

Decomposition studies emerged from policy concerns over the costs to workers of adjusting to changes in foreign trade. It is generally argued that exogenous economic events, such as trade liberalisation, have the potential to cause significant structural adjustment in the Canadian labour market due to the rapidity of the shocks, resource immobility, and shifts in comparative advantages. In particular, employment growth is assumed to be significantly affected by import penetration. Since trade liberalisation increases import penetration, these types of shocks have the potential to create adjustment burdens to workers in import-competing industries.

Typically, this approach infers labour adjustment requirements from trade data by estimating, *ex post*, the employment levels that would have prevailed if imports or the ratio of imports to domestic consumption had remained constant. Employment displacement effects attributable to trade are obtained by decomposing the growth/decline of domestic employment into the proportion attributable to changes in domestic demand, imports, exports, and productivity.

In the empirical literature, decomposition studies examining the employment effects of tariff liberalisation have been conducted by authors such as Krueger(1979), Cable (1977), and Marsden and Anderssen(1978), to name a few. The earliest analysis using Canadian data was conducted by Robertson and Grey (1985). In their seminal article *Trade-Related Worker Adjustment Policies: The Canadian Experience*, the authors examined the employment effects of shifts in trade. Canadian program

responses were then reviewed and followed with an assessment of the adjustment process in relation to the “re-employment” of laid-off workers in “trade-sensitive” industries.

In the first part of the analysis, the authors argued that, through import competition and export growth, trade had the potential to create both “downside” adjustment difficulties, such as layoffs and plant closures, and “upside” adjustment burdens, such as skill shortages. Robertson *et al.* (1985) constructed Canadian estimates of trade-related employment effects based on a US model by Frank (1977). In terms of methodology, employment growth rates were decomposed into proportions attributable to changes in domestic demand, imports, exports and productivity. Using data from 1967-81, trade-related employment effects were estimated for 13 Canadian manufacturing industries, selected on the basis of import penetration.

The major findings of the procedure were that domestic demand and productivity factors had the strongest influence on employment during the period under study. Domestic demand was seen as being the most important source of employment change for 12 out of 13 industries, followed by productivity growth in 9 industries. The authors point out, however, that import competition should still be regarded as having a “significant” effect on employment.

Based on their estimates, Robertson *et al.* stated that “imports reduced employment by an average of 4.1% per year between 1967 and 1981” (1985, 185). In terms of absolute employment changes, increased imports and exports resulted in a net reduction in employment of approximately 200,000 workers during the same period. Industries adversely affected by trade included machinery and electrical products, among others.

Further, in comparing these results with similar studies done in the US, the authors concluded that, "... although the period examined in this study differs, comparisons with the [US] studies indicate that the average net employment loss due to net trade [exports less imports] was greater in Canada than the United States in the majority of the 13 import-competing industries" (1985, 185.)

In terms of the responsiveness of labour adjustment programs and the "re-employment profiles" of dislocated workers, Robertson *et al.* (1985) estimated that approximately 65% of laid-off workers in industries strongly affected by cyclical factors were re-hired by their former employers. However, they cautioned that import-competition had the effect of permanently displacing workers in import-competing industries, particularly in small and medium communities in Canada.

On the basis of these results, the authors observed that "programs geared to facilitating adjustment to structural change risked picking up workers temporarily laid-off because of cyclical factors" (1985, 190). They then concluded that the effectiveness of labour adjustment programs would depend on the ability of programs to discriminate between cyclical and structural dislocation.

The empirical work undertaken by Robertson *et al.* (1985) did not specifically address trade changes induced by tariff liberalisation *per se*. However, their research had the effect of motivating further empirical work in Canada on trade-related employment effects. Indeed, the authors pointed out that the findings of their study was, at best, tentative because the methodology did not account for behavioural relationships among the explanatory variables, nor the effects of intra-industry trading. Balassa expanded on this point as follows:

The expansion of trade in manufactured goods among

developed countries ... involves intra-industry rather than inter-industry specialisation. Whereas in the event of inter-industry specialisation resources move from import-competing to export industries with corresponding changes in output and employment, intra-industry specialisation involves increased exchange of ... goods as well as increased specialisation of ... intermediate products. [While] the exchange of ... goods is compatible with unchanged output levels in trading countries, ... specialising in a narrower range of commodities, may [involve altered] product composition without necessarily affecting production, volume and employment. (1967, 58)

Arguably, by omitting relationships among industries, the Robertson *et al.* (1985) study presented an incomplete assessment of the employment effects of changes in foreign trade.

Other authors, such as Martin and Evans (1981), Radebaugh and Fry (1985), and Pearson and Salembier (1983) have also critiqued decomposition studies, such as the Robertson-Grey study. According to Martin *et al.*, “the accounting identities used [in decomposition studies] are arbitrary, [and that] ... no accounting identity can provide a substitute for a system of behavioural equations.... [Moreover], only such a system of behavioural equations can accurately quantify the employment effects of changes in imports”(1981, 154). The authors further suggested that decomposition studies tended to have serious omissions in the calculations, such as explicitly calculating productivity or domestic demand as “interaction terms” rather than treating them as residuals. (1981, 156)

Additionally, it is argued that decomposition studies ignore certain key factors that affected output and employment, such as differential income and expenditure propensities, changes in relative prices, and exchange rates. Furthermore, Martin *et al.*

suggested that,

Since some decomposition approach draw on the theory of index numbers, the variables in the identity may have been weighted by different factors, which may be either the base period or end period quantities, leading to an 'index-number' problem.(1981, 157)

In terms of treating each component of the identity as independent variables, Martin *et al.* explained the limitation as follows:

One might argue that productivity growth is often a function of actual or threatened import competition. In such circumstances domestic producers will tend to rationalise production facilities, investment in labour saving techniques and shed labour. Thus by stimulating productivity growth, competitiveness in the import competing sector will increase and *ex post* serve to lower import growth below what it would have been in the absence of such adjustments. The accounting formula, however, would attribute these employment losses only to the proximate cause, the rise in productivity growth, without recognising the causal influence of import competition. (1981, 158)

Pearson and Salembier (1983) agreed with Martin *et al.* (1981), and further explained that the existence of a relationship between import penetration and productivity suggested that "increased imports expand the domestic market through lower prices and can stimulate productivity improvements in domestic production"(1983, 39).

Finally, other authors, such as Grossman stated that the methodology itself was flawed because "[the procedure] is incapable of distinguishing shifts in isoquants from movements along isoquants" (1982, 2). In this regard, Grossman argued that decomposition studies ignore important effects such as factor substitution in explaining job displacement. He explained that, while the accounting identity attributes job

displacement to technological change, it does not go far enough in recognising that these types of changes may themselves have been precipitated by import competition. Like Pearson and Salembier, Grossman also criticised the calculations used in decomposition studies. He stated that,

A further difficulty with the [decomposition] approach is that it identifies the extent of import competition by the share of imports in domestic consumption. This measure is inappropriate, however, because the share variable varies not only with shifts in the foreign supply curve for imports, but also with changes in conditions of supply in the domestic industry. (1982, 2)

In terms of prescriptions, the studies suggested the use of more rigorous measurements, such as reduced form behavioural equations and econometric estimation in order to measure more accurately labour dislocation resulting from trade. Consequently, a series of trade-balance studies emerged in the literature, in the late seventies and mid-eighties that were motivated in part by attempts to test the factor proportions theory of international trade, while at the same time attempting to anticipate the effects of tariff liberalisation and increased import competition. Trade-balance studies utilised a Leontief production function within an input-output framework to estimate the impact of tariff changes on employment.

2.2. **Trade-Balance or Input-Output Studies**

Theoretically, the trade-balance approach to trade theory links trade patterns to factor endowment. The fundamental premise of the factor endowment theorem is that

international trade patterns are determined by (international) country differences in factor endowments. A country that is capital abundant will tend to specialise in capital intensive goods and, hence, will export goods that embody a relatively high level of capital per worker, while importing goods that embody relatively high levels of labour inputs. Similarly, a country that is labour abundant will specialize in labor intensive exports while importing capital intensive imports.

Opportunities for trade occurs because the prices of the capital-intensive goods are lower in a capital abundant country relative to the prices of labour-intensive goods, and the prices of labour-intensive goods are relatively lower in a labour-abundant country relative to capital-intensive ones. Since “factor requirements” for producing goods are assumed to be fixed, and demand conditions are the same, countries will have an incentive to trade because the opening up of trade relieves shortages of the less abundant factors.

According to the Stolper-Samuelson theorem, tariff liberalisation lowers the price of the relatively scarce factor whereas protection will have the opposite effect. In capital abundant countries, an opening up of trade will increase the relative price of capital-intensive goods while reducing it for labour-intensive goods. This leads to an increase in the production of capital-intensive goods and decreases the production of labour-intensive goods. Since tradable goods, such as steel, are by definition, capital-intensive, the resulting increase in the production of the capital-intensive good will raise the demand for capital by more than the decrease in demand for labour. This has the effect of reducing the real wage rate while increasing the real return to capital. Conversely, tariff restrictions would have the opposite effect of raising the domestic price of the scarce goods and, hence, raising the real wage rate while reducing the real

return to capital.

In terms of methodology, trade-balance studies typically estimate the number of jobs associated with exports and the number of jobs that would exist if imports were replaced by domestic production. Import-displacing jobs are then subtracted from export-creating jobs to obtain a net employment effect.

The most important Canadian empirical analyses using this type of approach were conducted by Cline *et al.* (1978), and Wonnacott (1986). In the book, *Trade Negotiations in the Tokyo Round: A Quantitative Assessment*, Cline *et al.* (1978) estimate the impact of multi-lateral tariff liberalisation on the major OECD countries. In particular, the authors examined the impact of tariff liberalisation on welfare, exchange rates, and employment levels on “free-trade” versus “free-rider” countries – that is to say, countries that do not reduce their own tariffs. In the study, Cline *et al.* raised the following issues:

How large are the welfare benefits that can be obtained from further liberalisation of tariffs; which types of tariff-cutting formulas under consideration in the Tokyo Round negotiations are most favourable from the stand point of overall welfare benefits, on the one hand, and of ‘balanced’ or ‘reciprocal’ outcomes on the other, [and finally] what would be the main patterns of liberalisation effects, under alternative tariff-cutting formulas, for each of the negotiating partners
(1978, 18)

In order to answer these research questions the authors developed a model based on an input-output framework that first calculates at the tariff line changes in commodity imports and exports that would result from a proposed change in tariff. The trade estimates were then multiplied by sectoral job-coefficients and price elasticities in order to derive estimates of the prospective impact of tariff liberalisation on

employment.

Utilising twelve hypothetical tariff cutting formulas, ranging from most liberalised trade to least liberalised trade, the results indicated that Canada would experience a systematic loss of jobs regardless of the tariff formula. However, Cline *et al.* further concluded that that these job losses would be relatively minimal. For example, their findings indicated that a 60% tariff cut would lead to employment losses of 42.2 thousand jobs and employment gains of 10.8 thousand jobs, or a net employment loss of 31.4 thousand jobs. With the complete elimination of tariffs, Canada would experience a net employment loss of 84.6 thousand jobs. Using these employment estimates, Cline *et al.* then further estimated the labour adjustment effects of job losses. However, the authors did not go so far as to estimate detailed results for Canada.

The most important implications of the study, according to the authors, were that under all formulas, the employment effects were very small. They estimated that, in terms of magnitude, the most liberal tariff cutting formula (other than tariff elimination), would amount to approximately 0.87% of total employment. Similarly, under the most favourable tariff cutting formula, “the net job balance between export-related and import related employment changes would amount to -0.57% of total employment” (1978, 14).

Based on these results, Cline *et al.* concluded that,

It is of interest of all countries to reduce tariff protection in order to obtain cheaper sources of supply, increase efficient utilisation of resources, and achieve efficiency gains, by allowing greater specialisation, economies of scale, and adoption of new technologies (1978, 11)

Cline *et al.* (1978) present an interesting study on the effects of tariff liberalisation on Canadian employment. This model will be further developed in a later section of the paper in order to provide more up-to-date results.

The shortcomings of the procedures used by Cline *et al.* (1978) rests mainly with the underlying assumptions of the model. A crucial set of assumptions made by Cline *et al.* (1978) was that production varied inversely with imports and that, within each industry or industry group, labour to output ratios remained constant. Also, the authors made the further assumption that world export supply elasticities are infinite.

Stein (1984), among others, have questioned these assumptions, suggesting that by ignoring the additional imports associated with lower import prices, the procedure erroneously assumed that all imports replaced domestic output. Consequently, this had the effect of biasing upwards the employment results of the model. Further, if world output supplies were not infinite, then the predicted imports would be unrealistically high.

Interestingly, Cline *et al.* (1978) critiqued the use of less than infinite export supply elasticities in an earlier general equilibrium study undertaken by Deardoff, Stern and Baum (1976). According to Cline *et al.*,

This approach would appear to bias upward the magnitudes of price change, and more seriously, employment changes resulting from liberalisation. Forced to adjust inefficiently because of fixed capital, a sector would show a relatively large price increase from increased demand. And, with typically low elasticities of substitution between labour and capital..., one would expect high percentage changes in employment to be predicted for small percentage changes in output(1978, 22)

An added shortcoming of the study conducted by Cline *et al.* (1978) is that the authors used elasticity coefficients calculated at time periods that are different from the period under study, or in relation to other countries. For instance, the study utilises Canadian elasticity estimates previously calculated by Taplin (1973) using data from 1961 to 1969. The data set used by the authors consisted of data from 1971 to 1974.

In a nutshell, Cline *et al.* (1978) examined the employment effects of free trade using an input-output model. The authors employed a trade-balance approach in their model construction, premised on the Heckscher-Ohlin comparative advantage theorem of international trade. The results of the study indicated that Canada will experience employment losses, but that these effects would be minimal.

Wonnacott (1986) undertook further empirical work using an approach similar to the Cline *et al.* (1978) study. However, unlike the former study, Wonnacott predicted that tariff liberalisation would be employment-creating in Canada.

In his article “On the Employment Effects of Free Trade with the United States”, Wonnacott (1986) assesses the sensitivity of Canadian employment to trade with the US, in the absence of a free trade agreement. The motivation of his empirical work was to add to the limited research on Canadian employment effects, as well as to assess the accuracy of the results of empirical studies, such as Cline *et al.* (1978), that associated job losses with tariff liberalisation.

It is argued that, in terms of employment, a free trade agreement would have three broad effects: it would create downward pressure on employment due to import competition, upward pressure on employment due to wider access (and increased sales) to a US market, and/or reduce the downward pressure on existing Canadian employment that would likely exist with tariffs. He criticises the “traditional Canadian

view” that free trade would lead to increased specialisation in capital-intensive resource extraction and processing and thus result in employment losses. According to the author:

The presumption of increased Canadian specialisation in resource industries is reasonable only if Canadian trade barriers are removed. US trade barriers have been a deterrent to exports of Canadian manufactured goods, and the removal of these trade barriers would allow an expansion of Canadian manufacturing for export. (Wonnacott, 1986, 258-259)

Estimates are provided using 1984 data to gain insight on the extent to which Canadian employment is directly or indirectly dependent on exports to the US.

In terms of methodology, Wonnacott (1986) uses an input-output matrix to measure the extent to which exports directly and indirectly affect the output of each Canadian industry. These estimates are then multiplied by an employment coefficient, defined as employment divided by output, to obtain the employment effect of tariff liberalization. The author describes the empirical work as essentially an “impact study” in the sense that it did not take into account other factors such as balance of payments adjustments and import demand elasticities. Further, the procedure did not take into account, income multipliers, or the response of investment to changes in output, all of which, according to the author, would have further implications for employment.

A major finding of Wonnacott’s study was that free trade was employment-creating. He estimated that in 1984 an additional 8.8 jobs were created (directly and indirectly) in the manufacturing sector for each representative \$1m basket of exports to the US. Using the results of the study, it follows that manufacturing exports amounted to approximately \$65.7m in 1984 or 753 thousand new jobs. It is interesting to note that this estimate is 9 times higher than the job loss figures estimated by Cline *et al.* (1978),

suggesting that the period of time under study in the former empirical work may have been a significant factor in the employment estimates.

The implication of these findings, according to Wonnacott was that “we risk substantial downward pressure on Canadian employment, if, in the face of increasing US protection, we follow the status quo...” (Wonnacott, 1986, 26). More specifically, it is argued that by not participating in a free trade agreement with the US, the Canadian economy would experience a negative employment effect, and that “it is only trade liberalisation that offers direct employment enhancing effects to offset negative employment effects” (1986, 261). So that, not only would tariff liberalisation create jobs, it would also act as a preventative measure in pre-empting the possibility of a worsening employment situation in Canada, if the country did not participate in bilateral free trade with the US.

In a sense, both the Cline *et al.* (1978) and Wonnacott (1986) studies predicted that tariff liberalisation would have a minimal impact on employment. Although each study predicted a contradictory set of results, they essentially conducted empirical studies that were similar in construct and based on the comparative advantage version of the Heckscher-Ohlin model.

The key assumptions of the trade-balance studies were, perfect competition, constant returns to scale and product homogeneity. These assumptions enabled these modelers to construct a relatively simple model predicting trade and employment patterns consistent with factor proportions theory. That is to say, that a country will export commodities that use relatively more of its abundant factor, and that trade barriers such as tariffs will have the ultimate effect of increasing the prices of commodities produced with the scarce factor at the expense of the abundant factor.

2.3 Computable General Equilibrium Models

An alternative approach to decomposition studies and trade-balance studies in the economic literature involved the use of computable general equilibrium models (CGEs) in analysing the prospective impact of tariff liberalisation on employment. In the mid 1970s and early 1980s CGEs became the standard tools used in the economic analysis of trade patterns. These types of modeling techniques can be traced to the original work of Johansen, Shoven, and Whalley (1983) in their seminal paper, *Applied General Equilibrium Models of Taxation and International Trade*.¹

These models attempted to measure complex interactions in the economy through a system of behavioral equations. Notwithstanding, these models also reflected the views of neo-classical economic theory based on the tenets of pure competition and the Heckscher-Ohlin paradigm of comparative advantage.

It is generally argued that free trade will promote gains in terms of productivity and lower prices, and hence result in efficiency gains. Restricting trade on the other hand, not only limits market size but, by so doing, will facilitate oligopolistic competition. Typically, it is argued that the costs associated with trade restrictions “will be manifested in terms of keeping labour and capital employed in relatively less efficient uses, thus limiting their earnings opportunities in the more highly productive sectors of the economy” (Deardoff and Stern 1979, 14).

¹ National Bureau of Economic Research, 1983

The major assumptions of applied general equilibrium models were that, firstly, both goods and factor markets are perfectly competitive. This implies that domestic firms cannot influence the price of imports on world markets, nor can they “significantly raise prices above those of their competitors or offer reduced quality or service” (Harris, 1984, 5). Secondly, technology is assumed to be constant. Thirdly, “if labour is unemployed, it is assumed that wages will perfectly adjust until all labour is hired” (Stanford, 1993, 3). Fourthly, output is limited only by the availability of productive factors, so that free trade does not undermine aggregate demand, i.e. the so-called “supply constraint.” Finally, it is assumed that capital is not internationally mobile, although it is assumed to migrate within a country.

Williams (1968), Young (1957), and Boadway and Treddenick (1978) are among the earliest Canadian studies undertaking general equilibrium trade analysis. These studies focused on the impact of tariff liberalisation on production and welfare costs. The general findings of these studies were that trade liberalisation will have a positive, albeit minimal, effect on the Canadian economy.

In terms of the impact of changing trade patterns on employment, in a US study, Deardoff and Stern (1979) used a static model to conduct empirical estimates of employment using Canadian data. The authors constructed a multi-sector “Michigan” model of the world economy that included supply and demand equations and market clearing conditions for 22 “tradable” industries and 7 “non-tradable” industries for 18 countries. Hypothetical tariff and non-tariff barriers impacting country trade patterns were taken from the Tokyo Round of multilateral trade negotiations. Estimates were provided for employment, prices, exchange rates, and welfare effects.

The authors concluded that, based on various types of tariff liberalisation

scenarios, the effects on the various countries (under flexible exchange rates) would be quite small. They go on to state that:

Adjustment problems in labour markets appear to be either non-existent or negligible at the country level. And even at the more disaggregated industry level, where employment changes occasionally amount to several percent of an industry's labour force in some of the smaller countries, these adjustment problems should be slight...(Deardoff *et al.*, 1979, 119)

In the Canadian context, Deardoff *et al.* (1979) estimated that absolute changes in employment would amount to a net increase of 0.02% or 2.2 thousand workers. Specifically, employment gains (in terms of 1976 employment) were experienced in 13 out of the 22 "tradable" industries, with the largest increase occurring in paper and products industries (2.9 thousand workers), transportation equipment industries (1.9), agricultural products industries (1.9) and wood products (1.4). The largest decline in employment, according to the authors, would occur in the Canadian metal products industries, that would experience a loss of 2.6 thousand workers.

Models such as the above using a static general equilibrium approach were criticised by subsequent authors, such as Harris and Cox (1983), Cox (1992), Reynolds (1978), and Markusen *et al.* (1975). It was argued that assumptions of perfect competition, constant returns to scale, homogenous products, and so on, are not appropriate for goods-producing industries, although they admit that they may be suitable for trade in primary products. For example, Reynolds stated that,

Generally speaking, orthodox trade theories have been based upon assumptions that are contrary to the characteristics of manufactured trade ... [where the latter] seem to be better characterised by opposite assumptions [such as] ... imperfect competition, increasing returns to scale, and differentiated products. (1978, 77-78)

Firstly, it was argued that product markets were better characterised as monopolistic or oligopolistic, rather than being perfectly competitive, with firms engaging in price-setting behaviour. Further, the existence of unions precluded the assumption of perfectly competitive labour markets, and that the labour market exhibited imperfections resulting from “sticky” wages.

Secondly, the assumption of constant returns to scale was criticised on the grounds that firms face set-up costs as well as other fixed costs only at the beginning of production. Conceivably, output can be produced at constant marginal cost at a later stage of production. Thus average costs always fall in relation to output.

Finally, it is argued that most manufactured products can be better characterised as being differentiated, rather than homogenous. Reynolds, for example, stated that “it is absurd to assume that automobiles are homogenous products and that consumers always purchase the cheapest model” (1978, 79).

These criticisms lead to a second generation of computable general equilibrium models of international trade. These latter models differed from their earlier counterparts by linking industrial organisation theory with international trade theory. With respect to labour and trade issues, the general intuition underlying the later models are as follows:

Opening up trade increases consumer choice because consumers can enjoy foreign goods as well as domestic goods, and thereby substitutability between goods will be increased. Increased substitutability makes each producer face more elastic demand and decreases both the price mark-up and the wage mark-up inviting more demand and consequently production increases. The increase in production and decrease in wage mark up will increase employment (and decrease unemployment) at least in the long run. (Reynolds, 1978, 82)

In theory, gains from trade would be realised through: (i) decreasing average costs due to a larger market supported by trade, thereby allowing for the same number of products to be produced in a longer production run; (ii) pro-competitive gains due to an increase in the total number of firms, thus rendering demand more elastic, and increasing output; (iii) rationalising the number of firms and increasing competition, and hence, output and employment for surviving firms; (iv) increasing market size, which will lead to more products at the same costs, as opposed to the same products at lower costs in a restrictive regime; (iv) increasing the division of labour due to larger markets; and (v) increasing access to specialised machinery and consulting services that are prohibitively expensive to develop in a small domestic market. (Markusen 1975, 139)

The first Canadian study that developed a computable general equilibrium model in this tradition was the Generalized Equilibrium Trade Model (GET), developed by Harris and Cox (1983). In their book *Trade, Industrial Policy, and Canadian Manufacturing*, the authors argued that competitive neo-classical models are inappropriate for a small open economy such as Canada. According to the authors, "... while perfect competition is perhaps an appropriate assumption for an economy like the United States, it is not self-evident that it is justified for the Canadian economy or other small open economies."(1983, 7) This was because significant differences exist between the volume of output and, hence, costs between US and Canadian plants. Harris (1984) argued that Canadian plants tend to be more domestically oriented with lower volumes of outputs as compared with US firms. Also, Canadian plants incur higher production costs than their US counterparts because of typically higher levels of product differentiation and shorter production runs. Stated in general terms, it was

argued that the existence of structural imbalances in the Canadian economy contradicted the assumptions of perfectly competitive market conditions.

According to Harris (1984) "the objective of the CGE model was to make statements about the long-run impact of changes in policy variables on trade flows, prices, factor productivity, industry structure, and consumer welfare for the Canadian economy." (1984, 10) The methodology utilised by Harris (1984) involved estimating a bench mark equilibrium, and then performing hypothetical counter-factual experiments through the use of alternative exogenous variables. In terms of structure, the model incorporated features of a general equilibrium international trade model and features of industrial-organisation theory. Canadian firms were assumed to be price takers, and export elasticities were assumed to be less than infinite. Additionally, labour and capital were assumed to be mobile across industries and firms, where both were homogeneous and substitutable for each other. However, labour was considered to be internationally immobile.

The data consisted of 29 domestic industries and 30 commodity aggregates from the mid-1970s. Of the 29 domestic industries, twenty incorporated details of industrial structure and nine were assumed to be strictly competitive constant cost industries. Foreign and domestic goods were assumed to be close but imperfect substitutes in all demand categories (the Armington assumption), and were considered as both export goods and import-competing goods. One out of 30 commodity aggregates was assumed to be non-competing, i.e. it is not exported nor are there domestic substitutes.

In the industrial-organisation component of the model, Harris makes the following assumptions (1984, 71): constant technology among industries, fixed costs for plant set-up, product differentiation, and the presence of scale economies that were

assumed to be internal to the firm but external to the industry.

An important departure of GET from the traditional neo-classical model, according to the author was that "...changes in the absolute productive efficiency of the manufacturing sector, through some type of rationalisation, can shift the comparative advantage [from primary goods] towards manufactures." (Harris 1984, 76) This approach differs from competitive models to the extent that "traditional comparative advantage argues that the export sector should be primary ...[and that] trade liberalisation would lead to an expansion of this sector at the expense of manufactures."(*Ibid*)

Using a benchmark equilibrium, the basic trade policy simulations in the GET model involved various levels of tariff removal ranging from unilateral tariff removals to multi-lateral free trade. Based on these various simulations, the authors concluded that all types of trade policies would be employment-creating and that the effects varied depending on the level of liberalisation. More specifically, the aggregate employment estimates indicated that employment increased in manufacturing and decreased in other sectors of the economy because of rationalisation in the manufacturing sector. According to Harris (1984), this finding was counterintuitive to conventional results of tariff-related employment effects based on the Heckscher-Ohlin model, and more in line with adjustment-related trade patterns reflecting intra-industry trade.

In terms of employment changes, industries were ranked as "winners" or "losers" depending on whether employment increased or decreased by 10 percent or more. In particular, the study found that five out of 20 industries increase their employment of labour. The biggest winners were identified as: transportation

equipment, primary metals, and rubber and plastics with estimated increases in employment of 80%, 28%, and 15%, respectively. The biggest losers on the other hand were identified as, clothing, knitting mills, leather, and furniture and fixtures industries, with declining employment by 46%, 43%, and 25% respectively.

It is argued that employment losses are caused by import substitution, and that the removal of tariffs effectively “kill” industries that are typically labour-intensive. Alternatively, employment gains were attributed to unexploited scale economies, rationalisation, and longer production runs.

Overall, 9 out of 20 manufacturing industries experienced increases in employment ranging from 76% in transportation and equipment to 4% in the non-metallic mineral production. Estimates for the ‘losers’ indicate that 11 out of 20 manufacturing industries experienced declines in production ranging from 39% for furniture and fixtures to 3% for metal fabricating. Total employment in manufacturing, according to the author, would increase by 12 percent.

The author further estimated selective tariff cuts in manufacturing industries, by studying the welfare implications of cutting the domestic tariffs on industries. In terms of overall employment gains and losses, it is estimated that the removal of tariffs was employment-creating. According to estimates provided, 12 out of 20 manufacturing industries will have increased employment; with transportation equipment experiencing the largest gains by 53%, followed by primary industries at 18%, and paper and allied products at 16%. Clothing, knitting mills and leather industries reduced employment levels, by 48%, 37%, and 21% respectively.

The final step of the GET model was to estimate the long-run impact of tariff liberalisation using alternative policy simulations – namely, a wage-subsidy, a capital

subsidy, import-substitution, export promotion and unilateral industry rationalisation. However, specific employment measures were not quantified.

The implications of the GET model, was that “under free trade, Canada would have a vigorous manufacturing sector with a significant export profile” (1984: 151). Moreover, both unilateral free trade (UFT) and multilateral free trade (MFT) would be employment-creating, although more so under MFT, where

only the most labour-intensive sunset industries will lose. In this regard, it is recommended that tariff cuts should occur last since ‘export potential’ is unlikely to develop ... (1984, 122)

In general, the author states that the results clearly support the view that Canada’s best interests are served by promoting and fostering free trade by whatever means available.

Other CGE studies that have emphasised imperfect competition were Melo (1994), Brown, Deardoff and Stern (1992), and Cox (1992). In his article, ‘Some Applied General Equilibrium Estimates of the Impact of a North American Free Trade Agreement on Canada,’ Cox extended an earlier version of the (GET) model that was originally constructed by Cox and Harris (1992).² Using a general equilibrium framework, Cox argued that the implementation of NAFTA will have a negligible impact on output and employment at the industry level. However, in terms of real income, Cox predicted significant gains under the Canada-US Free Trade Agreement (CUSFTA) as opposed to the NAFTA.

Cox constructed a multi-country static model of 19 industries “of which 14

² The model presented in the paper is based on a static general equilibrium framework. It focuses explicitly on the impact of NAFTA on the industrial structure and conduct of Canadian manufacturing industries. (Previously, a smaller model was used by the authors to examine the impact of the Canada-US Free Trade Agreement on the Canadian economy).

produce internationally traded goods and the remaining five produce non-traded goods". Estimates were based on three simulations: the impact of CUSFTA on the Canadian economy, the impact of NAFTA on Canada, and the absence of Canada from NAFTA.

The main assumptions of the model were: imperfect substitution between foreign and domestic commodities; fixed and mobile capital and labour between industries, with capital services being internationally mobile; and that wages are determined in a competitive labour market. Further, technology was assumed to involve constant-returns-to-scale for industries that were defined, *a priori*, as being competitive. For "non-competitive" industries, technology was assumed to be increasing returns to scale. The model was calibrated to a 1981 data set using tariff rates that were in existence in the mid to late 1980s.

The findings of the simulations varied in terms of welfare gains. The author argues that under CUSFTA, GDP and the domestic wage increased significantly due to the rationalisation of manufacturing industries. Employment estimates were presented in the second simulation. In terms of sectoral results of the NAFTA simulation, the author estimated that "there [was] virtually no impact" (1992, 114). Moreover, most manufacturing industries experienced a fall in employment, although, in terms of magnitude, it amounted to less than 1 percent. Similar results applied to industries that showed gains in employment, such as food, steel and metal products, transportation equipment, and machinery.

These results were significantly different from the earlier Cox and Harris (1992) study on tariff liberalisation. Using the same data set, Cox and Harris (1992) predicted significant gains in employment. Cox (1992) does not present employment estimates under NAFTA and suggested that the negative employment estimates refer to further

effects of CUSFTA. In the final simulation, again, employment estimates suggested declining employment in most manufacturing industries, but by negligible amounts (less than 1 percent).

Recapitulating, first generation CGE models differed from the second generation CGE models to the extent that the former adopted assumptions of perfect competition using a Heckscher-Ohlin paradigm, whereas the latter assumed imperfect competition with an industrial organization paradigm. However, both types of models tended to adopt similar computational techniques in the sense that they involved large-scale computerised simulations. The fundamental difference between the above two models and the earlier mentioned disposition and trade balance studies was that the latter two tended to adopt simplifying assumptions in the modeling, while still remaining within the neo-classical paradigm. Interestingly, the findings of all models indicated that the impact of tariff liberalisation on employment would be minimal.

2.4. Macro-econometric Studies

Macro-econometric models estimated the aggregate effects of tariff liberalisation. Francois and Shiells described macro-econometric models as “workhorse” models that “forgo the rigorous, micro-theoretic basis inherent in [CGE’s] ... in order to incorporate many traditional concerns from macroeconomics, such as the influence of fiscal and monetary policy on aggregate income, the price level, and unemployment.” (1992, 12) They go on further to state, however, that, “in principle, macro-econometric modeling has much to offer for the analysis of multisectoral structural reforms such as trade policy.” (1992, 12).

In general, macro-econometric models differed from computable general equilibrium models to the extent that (i) they were less concerned with theory, and (ii) the structural model was not estimated directly as in traditional full equilibrium Walrasian models in terms of benchmark equilibrium. Instead, the model is solved for its reduced form, where reduced form equations are estimated computationally. Further, whereas CGE models estimated long run effects, macro-econometric models were more concerned with short-term effects. The main Canadian studies assessing the impact of tariff liberalisation on Canadian manufacturing using a macro-econometric model were Deardoff and Stern (1979), Dungan and Wilson (1991), Stokes (1989), and Gaston and Trefler (1997).

The Deardoff *et al.* study is important because, as stated by the author, the objective of the work was to present a practical tool of analysis for trade policy. However, they admitted, “as compared to other models, the Michigan model may appear to be less pure theoretically, less sophisticated in its computational procedures, and less comprehensive in terms of efforts to incorporate undoubtedly important but still controversial representations of imperfect competition.” (1979, 50)

The authors criticised CGE models on the grounds that (i) the results of the studies can be misleading because they omitted interactions among and within countries and industries, and (ii) because CGE models examine welfare effects in the aggregate rather than at the industry level, and (iii) because of questionable assumptions of perfect labour markets and the use of the Armington assumption. (1979, 53)

According to Deardoff and Stern (1979), a macro-econometric model such as the Michigan model is more appropriate than other types of models mentioned above because it estimates effects with more ‘realistic’ assumptions of rigid wages, constant

returns to scale, and imperfect competition in all markets.

This version of the Michigan model consists of 22 tradable and 7 non-tradable industries in 34 countries. Each of the 34 countries included in the model had 29 industries. The model focused on micro-economic and inter-sectoral issues, using 1976 data. More specifically, the model analysed the impact of alternative trade liberalisation scenarios in the course of the Uruguay Round of Trade negotiation. The simulations measured the impact of trade liberalisation on exports, imports, employment, domestic prices, exchange rates and terms of trade.

According to the Deardoff *et al.*, the elimination of post-Tokyo round tariffs in industrialised countries would cause marginal changes in gross employment (defined as the sum of all positive sectoral employment changes for a country). The authors stated that “for Canada, the gross change in employment is 54 thousand workers, which is 0.56% of the 1976 Canadian labour force.”(1979, 25)

At the sectoral level, the authors stated that “there is evidence of sizeable net percentage increases in employment especially in leather products, non-ferrous metal, miscellaneous manufactures, and mining and quarrying (1979, 44).” The largest net percentage reductions in employment were in rubber products, footwear, glass and glass products, metal products, and transportation equipment. The authors then conclude that Canada “has a good deal to gain from freer access to world markets...[Further], it appears that Canada can reap these benefits with less strain on its domestic labour markets in the aggregate than will arise in most other countries.” (Deardoff *et al.* 1979, 44).

Other macroeconomic models, such as Stokes (1989), Dungan and Wilson (1991), and Gaston and Trefler (1997) examined the macro-economic effects of tariff

liberalisation on the Canadian economy in the short and medium term. They differed from general equilibrium models in that they examined the effects of tariff liberalization in the short term. According to Stokes,

General equilibrium models generally refer to the long run and, thus do not provide much information on the possible transition to free trade – the short-to-medium term impact ... For an economic analyst or policy maker interested in the latter information, a macroeconomic model is an essential tool. (1989, 225)

More specifically, macro-econometric models estimated the impact of tariff liberalisation on the employment/unemployment rate, government deficits, inflation, and gross output. For example, Dungan and Wilson's (1991) study examined the impact of the CUSFTA on output, prices, income, unemployment and the exchange rate, using the so-called "FOCUS" model. Stokes constructed a *Canadian Annual Model* (CAM), and utilised two different versions (consistent expectations and adaptive expectations) to estimate the effects of tariff liberalisation on GDP, consumer spending, wages, exchange rate, interest rates and the labour force. Alternatively, Gaston and Trefler (1997) estimated the impact of tariff cuts on employment and earnings using a "treatment-control approach to program evaluation" (1997, 27) in conjunction with a simple OLS regression procedure. The first method involved calculations based on "difference-in-differences" to compare specific industry groupings. The alternative OLS method estimated the effects of tariff cuts on employment and earnings by controlling for exchange rate movements, interest rate spreads, and US employment.

At the aggregate level, Stokes (1989, 235) estimated that by 1996, the CUSFTA will generate an increase of employment of 0.3% for both versions of the CAM model. Alternatively, Dungan and Wilson (1991,441) estimated that the unemployment rate

will fall by 0.3% in 1996 as a result of the CUSFTA, and by 0.2% in the year 2001. Contrastingly, Gaston and Trefler (1997, 27-30) estimated that the CUSFTA reduced employment by 14% from the first technique and by 3.4% from the second procedure, between 1988 and 1993. Estimates were not provided at the industry level of analysis for any of these models.

In all of the above-mentioned models, the results were similar to the estimates provided by decomposition studies, I-O, and CGE models - namely, that changes in employment due to tariff liberalisation would be minimal. In the next section, further estimation of the employment effects of tariff liberalization will be presented, with the objective of testing the validity of these conclusions with the use of more recent data.

3. EMPIRICAL ANALYSIS

Empirical analysis was conducted to investigate how tariff liberalisation has impacted employment in Canada during the last decade. As noted above, there is an abundance of empirical research on this topic. Further, upon closer scrutiny it becomes clear that the measurement of employment effects resulting from tariff cuts is extremely difficult to investigate in practice. On the one hand, early models such as decomposition studies and trade-balance studies were frequently criticised as being overly simplistic. On the other hand, highly complex, large-scale, computable general equilibrium models were criticised on the ground that, more often than not, the results of the various simulations were sensitive to the assumptions of the particular model. Furthermore, most studies in the economic literature utilised data ranging from the late

1970s to the early 1980s. The motivation for this paper emerged from this melting pot of ideas and equations. In particular, I propose to construct a model to measure trade-related employment effects that will avoid the pitfalls of trade-balance studies, while, at the same time, minimise the shortcomings of general equilibrium models. I am also interested in using more timely data to test the validity of the earlier findings in the literature.

At the outset, it is important to note that the empirical models constructed in this paper will be premised on international trade theory, but the actual testing of the various theorems will not be undertaken. There is an abundance of evidence in the literature that already satisfies this important component of applied research. It is generally acknowledged in the economic literature that international trade is linked to domestic employment through prices, and that variations in employment estimates in the empirical findings reflect differences in the assumption and models utilised by researchers.

The particular research questions I would like to investigate are: (i) Did the removal of tariffs have a significant impact on employment? (ii) What is the extent of the impact from a quantitative as well as a qualitative point of view? And, finally, (iii) how do tariff-related employment effects compare with the employment effects induced by structural and cyclical changes in the economy during the same period? The overall findings of the empirical analysis was that tariff liberalisation had a minimal

impact on employment between 1986 and 1997³. Also, that the impact of tariff cuts were sensitive to the production requirements of the industries examined, and not their trade orientation. Further, it will be shown that although changes in employment were associated with changes in tariff cuts, other structural and cyclical factors simultaneously influenced employment levels in the various industries examined. Finally, I will show that the effects of tariff cuts and other economic factors were not uniform across all industries and variables.

3.1 **Modeling Techniques**

The first part of the analysis consisted of constructing a trade-balance study that was intended to isolate the trade-related employment effects that were directly attributable to tariff cuts. Following that, an econometric model was then constructed to estimate the impact of other structural and cyclical variables on employment – namely, exchange rates, Canadian GDP (gross domestic product), US GDP, and a capital intensity proxy variable. The latter model was intended to serve as a counter argument to the tariffs-only employment model. It examined the impact of structural and cyclical factors on employment levels in conjunction with tariffs. In this sense, the techniques used in this paper were aimed at avoiding the pitfalls of the simplified assumptions of the trade-balance model by accounting for other factors that are normally measured through econometric estimation. In practical terms, the model does not approximate a computable general equilibrium model that can more reliably measure a host of related

3. These results do not extrapolate from other effects of prior liberalization initiatives, such as, the

effects and interactions, such as factor intensities, product differentiation, union effects, and real wages.⁴ Instead it provides a context for the interpretation of results of the trade-balance (or input-output) model. However, the results of the econometric model will be useful to the extent that it provides an up-to-date indicator of employment changes due to the tariff liberalisation in the 1987-1996 period.

3.2 Data

Quarterly import and export data from Statistics Canada's CANSIM time series were used for the years 1971 to 1997 to calculate import price elasticities (see Appendix 2). Gross national expenditure data were also taken from CANSIM. In the calculation of the employment effects attributed to import and export changes, tariff data were taken from forecasted data by Magun *et al.* in their 1987 study Open Borders: An Assessment of the Canada-US Free Trade Agreement⁵. US import tariffs on Canadian goods were used as a proxy for Canadian export taxes. Data used for the calculation of labour coefficients were taken from CANSIM matrices M7920. Econometric testing was conducted on quarterly data from CANSIM for 1986-1997 exchange rates, GDP (Canadian and US), and GDP per persons employed. Import and export penetration ratios were estimated from unpublished aggregated data at the SIC2 level from the international trade database at Statistics Canada. Shipment data was taken from

Generalized Agreement on Trade and Tariffs Rounds.

⁴ For the purposes of this model, I am more interested in the signs and significance of the coefficients in order to get a general impression of the extent to which the selected variables influenced industrial employment in the post-liberalisation period.

Manufacturing Industries of Canada, 1995 also published by Statistics Canada. Real US GDP data were not readily available for the manufacturing sector at the industry level. USGDP data were taken from CANSIM, and were deflated using a producer price index for selected Canadian industries in order to “Canadianize” the estimates. In the model the estimates represent total GDP for all manufacturing.

3.3 **Industry Selection**

The criteria used for selecting industries were employee size and the size of manufacturing shipments. The procedure consisted of ranking manufacturing industries in a descending order based on shipment values and the number of employees. Separate share ratios were calculated consisting of (a) the number of employees as a proportion of total manufacturing employees, and (b) industry shipments as a share of total shipments. 1995 was selected as the base year mostly because it contained the most recent data available, but also because other empirical studies have confirmed that the structure of employment in the manufacturing sector has been stable during the last decade.⁶ Additionally, the distribution of shipments closely paralleled the distribution of employment in the manufacturing sector.

Industries were then selected on the criteria that, in the aggregate, they represented more than 50% of total manufacturing employment and manufacturing shipments (see appendix 3). The selected industries at the SIC2 level consisted of food

⁵ see Appendix I

⁶ This view was supported in a recent study conducted by Riddell and Sharpe (1998)

industries, transportation equipment industries, non-electrical machinery industries, wood industries, electrical and electronic industries, and fabricated metal industries.

Further calculations were then undertaken to determine which of these industries were “trade-sensitive”. The criteria used were based on import penetration and export orientation ratios. More specifically, import penetration was calculated as imports divided by shipments plus imports less exports. Export orientation was calculated as a ratio of exports to shipments.⁷ Industries with ratios greater than 50% were considered to be trade sensitive. Of the six industries selected, three were categorised as being trade sensitive – namely, electrical and electronic products industries, non-electrical machinery industries, and transportation equipment industries (see appendix 4).

In an U.S. study conducted by Katz and Summers (1988) that examined efficiency wages and trade performance, the authors concluded that export-oriented industries positively impacted on wages, whereas in import-competing industries, employed workers earned negative rents. Based on these findings this study explores the possibility that free trade would have a positive impact on employment in export-oriented industries, and a negative impact on employment for import-competing industries. Stated differently, tariff liberalisation would potentially lead to a decrease in the demand for labour in import-competing industries by reducing real wages. This is because cheaper imported final goods will compete in the domestic market for market shares. Also, as firms streamline in the face of increased competition, cheaper imported

⁷ A similar measure was adopted by Grey (1993).

intermediate goods will either replace domestic goods, or lead to the adoption of labor-saving technologies at the expense of domestic employment.

An alternative viewpoint would be that, even without tariff cuts, other effects, such as a devaluation of the dollar, could potentially have the effect of decreasing the demand for labour in export-oriented as well as import-competing industries. For instance, in trade-sensitive industries the industry cost structure tends to be sensitive to movements in exchange rates because of a heavy reliance on imported inputs. A depreciation of the Canadian dollar would lead to higher prices of imported inputs which cannot be passed on to consumers without a loss of market share (in perfectly competitive markets), and hence lead to lower production levels and employment. For the purposes of this paper, both effects will be examined. That is to say, the impact of tariff cuts on trade sensitive industries will be examined in conjunction with the impact of other structural and cyclical effects.

4. INPUT-OUTPUT MODEL

The first step in the model was to estimate changes in imports and exports due to tariff cuts. Since imports consist of raw materials, intermediate goods, and final products, the employment impact of changes in import prices would depend, to a large extent, on factors such as the elasticity of demand for imports, the availability of domestic substitutes, and the price of domestic goods relative to imports. As such, it

was necessary to estimate import demand elasticities from an import demand function expressed as $M_{it}/PM_{it} = f(PM_{it}/PD_{it}, E_{it})$, where,

M_{it} = import value
 i_t = industry level of aggregation for time t
 PM_{it} = import price index
 PD_{it} = domestic price index
 E_{it} = industry component of autonomous national expenditure (G+I+X)

The term M_{it}/PM_{it} represents deflated import values and PM_{it}/PD_{it} refers to relative prices. The price ratios represent substitution effects of a change in import price⁸. Although this variable is not strictly exogenous, it was used in this equation because of potential problems of multicollinearity in attempting to estimate each of the parameters separately. Taplin eloquently explains the less than strict exogenous character of price ratios as follows:

In principle, domestic prices are determined by the cost of the various inputs; often these inputs consist of imported materials. Thus, domestic prices are partly determined by import prices. At the same time, imports often act as a safety valve, dampening potential domestic price increases. (1973, 195)

Finally, gross national expenditure was included in the model as a proxy economic activity variable. Autonomous expenditure was assumed to incorporate (in the aggregate) other variables – namely, exports, government investment, and capital formation. As such, import demand is seen to be a function of all three variables. As with the relative price

⁸ This assumption was particularly relevant for industries such as machinery equipment, where producers import a significant amount of raw materials and intermediate goods.

ratios, potential problems with multicollinearity precluded the independent estimation of these parameters.

In a nutshell, the model underlines the intuition that changes in import demand are explained by changes in relative prices and income. Assumptions of the model are (a) constant elasticities, and (b) that the price of an imported good will fall by the same amount as an import tariff cut. OLS estimation was used to estimate the elasticity coefficient, using a log-linear form. Typically constant elasticities, or a log-linear model, represent the functional form of a regression that are linear in the parameters, but not necessarily in the variables. In the empirical literature, authors such as Ball (1973), Ball and Marwah (1962), Orcutt (1950), and Taplin (1973) adopted this type of model⁹.

The model was applied to six manufacturing industries that were identified *a priori* as being the largest contributors of employment in the manufacturing sector. Elasticities were calculated for each industry independently, because import price variations were dependent on the specific tariff structures of commodity groupings classified to the relevant industries. Also, since tariff cuts did not affect each industry equally, the responsiveness of demand to changes in import prices varied at the industry level.

On the export side, export supply elasticities were assumed to be infinite, i.e. that production expands at constant unit cost. The demand for Canadian goods abroad are attributable to a broad range of factors such as world prices, the exchange rate,

foreign economic conditions, and foreign elasticities of import demand for Canadian goods. As such, estimating export supply elasticities would necessitate a large-scale world trade model. However, previous empirical estimations in the economic literature have shown that changes induced by tariff liberalisation would have a minimal impact on export supply with virtually no impact on prices. Other studies adopting an assumption of infinite elasticities have included Balassa (1967), Johnson (1960), Krause (1971), Stern (1964), Kwack *et al.* (1975), Baldwin and Lewis (1977), to name a few. In general, it is argued that the impact of tariff liberalisation on export demand is sufficiently small that producers are able to meet increased demand without raising prices. Moreover, Canadian exporters are normally assumed to be price-takers because of the small size of the Canadian economy.

In the model, I have assumed export supply elasticities to be 1, following the results of empirical estimation by Goldstein and Kahn (1976). In their study of supply elasticities the authors estimated elasticities of 1.1 on average for small open economies. Other authors, such as Cline *et al.* (1978) have assumed elasticities of 5. After several levels of testing it became clear that elasticities of 1.1 or 5 had a minimal impact on employment effects.

The next step was to estimate the changes in the volume of imports and exports resulting from tariff cuts, using the elasticity coefficient and import (export) price changes. Trade changes were then calculated for each industry using the following identity:

$$\Delta M_{it} = M_{it} \times \eta_{im} \times \Delta P_{mit} \text{ where,}$$

ΔM_{it} = change in import value attributed to tariff changes weighted
by the price elasticity of demand

M_{it} = value of imports, for industry i , at time t

η_{im} = coefficient of price elasticity or price elasticity of import demand

ΔP_{mit} = tariff/1+original tariff (absolute tariff change)

The above identity was adopted from the previous empirical work of Baldwin *et al.* (1980), Salant and Vaccaria (1961), Cline *et al.* (1978), and Balassa (1967).

Effective, as opposed to nominal, tariff rates were assumed in order to compensate for the indirect tariff effects between commodities at various stages of processing. Since the effective rate measures tariffs in terms of production activity, it is generally a more precise measurement of the way in which tariff changes affect the allocation of domestic resources.

In terms of exports, a mirror image of the above identity was used to estimate changes in exports resulting from tariff cuts as follows:

$\Delta X_{it} = X_{it} \times \eta_{ix} \times \Delta P_{xit}$ where,

ΔX_{it} = change in export value for industry i at time t (\$)

X_{it} = value of exports (\$)

η_{ix} = elasticity of export supply

ΔP_{xit} = tariff/1 + original tariff (absolute tariff change)

The above equation is intended to measure the direct effects of tariff liberalisation on exports¹⁰.

¹⁰ Indirect effects can include, for example, scale economies from increased specialisation, and the infusion of new technology.

The final step was to estimate the number of jobs that were created or displaced, as a result of the estimated changes in imports and exports. Following Cline *et al.* (1978), the technique used to estimate employment effects consisted of deriving labour-coefficients, which was then multiplied by the changes in imports and exports. More specifically, the job coefficients were calculated as follows:

$$TL_s = D_1[I-A]^{-1} M_d, \text{ where}$$

TL_s = the vector of total change in employment in each sector

M_d = the vector of changes in imports (exports) in domestic prices

D_1 = the diagonal matrix of labor coefficients

A_d = input-output coefficient matrix with respect to domestically produced materials

Labour coefficients were defined as GDP per person worked, which were derived from the input-output tables of the economy. The use of input-output tables of the national economy provided a basis for expressing total labour input requirements (raw materials, intermediate and final goods) as a share of domestic output. This method assumes that for any given change in trade there is a corresponding change that takes place in domestic output. Hence, an increase in imports is assumed to cause a decrease in production by an amount equal to the increase in imports. Similarly, an increase in exports will cause a commensurate increase in production. Furthermore, for all industries the ratios of changes in employment to changes in output are assumed to be equal to the ratio of total employment to total output.¹¹ A weakness of this calculation is that it does not account for exports that are produced with imported materials. This

¹¹ Salant and Vacarria (1961) also adopted this assumption.

omission may have the effect of overestimating the level of employment generated by exports. Commenting on the use of job-coefficients, Pearson and Salembier stated that,

Job displacement estimates from increased imports should be adjusted for domestic demand growth and the normal rates of labour attrition in the industry to estimate involuntary separations ... obviously, imports can increase, causing hypothetical job displacement without actual job losses if demand for the product is growing rapidly enough. To the same extent lower-priced imports expand domestic consumption, and are not at the expense of output. (1983, 35)

Recapitulating, the input-output model first estimates import (export) demand elasticities. Next, changes in imports (exports) are calculated by adjusting for tariff rates changes and import (export) elasticities. Finally, a labour coefficient was calculated, which was subsequently multiplied by the derived import (export) changes, in order to estimate the number of jobs created or displaced by tariff changes.

4.1 **Statistical Estimation and Results using Input-Output Analysis**

As a first step, the model estimates elasticities of import and export demand, which are subsequently used to estimate net effects of changes in employment.

4.1.1 **Elasticities**

Table 1 presents the results of elasticity estimates used in the input-output model. Initial preconceptions that estimation problems would occur due to serial correlation and multicollinearity were confirmed in the base run of the model. After

some initial experimentation with omitting and/or transforming variables, the variables of the model were first differenced and the size of the sample was increased. Where possible, current data were used for the import series, although this did not always guarantee improved results. For example, the wrong sign was produced in the transportation equipment and food industries with the use of import data in current dollars.

Table 1. Import Demand Elasticities

Industry	Price Coefficient	DW	F-value
Transportation Equipment*	-0.08 (0.18)	2.3	19.7 (3.92)
Non-Electrical Machinery Industries*	-0.87 (3.21)	1.8	11.5 (3.07)
Electrical and Electronic Products*	-1.92 (1.06)	2.0	10.1 (3.23)
Fabricated Metal Industries	-0.65 (0.81)	1.7	2.98 (2.44)
Food Industries	-0.35 (2.29)	2.1	2.6 (2.35)
Wood Industries	-0.33 (1.58)	2.0	7.1 (3.23)

Note: The coefficient represents the percentage change in imports and export demand attributed to a percent change in import prices.

*refers to import sensitive industries.

The parentheses represent t-statistics in absolute values for the price coefficients, and critical F-values

One-tailed significance testing was performed on all variables because the price coefficients were expected to be negative and the income coefficients were expected to be positive. As shown in Table 1, the overall fit of the estimated equations was

significant at five percent for wood industries, machinery industries, and transportation equipment industries and electrical and electronics products industries, and at ten percent for food industries and fabricated metal industries.

The price variable performed as expected in terms of signs and levels of significance. The results did not significantly vary for trade-sensitive industries as compared with industries not considered to be trade-sensitive. This would suggest that either imports from the US consisted of intermediate or semi-processed goods or that domestic substitutes were not available for final goods.

The price variable was insignificant at the 5% level for four out of six industries. Of these, electrical and electronic products industries and transportation industries were considered to be trade-sensitive. The electrical and electronic products industry import mainly semi-processed components (intermediate products) from the U.S., for the fabrication of commodities such as electronic data processing equipment, computers, and electronic components and parts. These results confirmed the expectation that changes in relative price did not significantly affect demand and that import demand was price inelastic.

In the transportation industries, the major outputs consist of passenger automobiles, trailers, ships, and aircraft and aircraft assemblies. Transportation industries are generally characterised as being Canadian-owned subsidiaries of larger US multinational corporations. Hence, the production structure of the industry is highly integrated with counterparts in the US. This implies trading patterns that are consistent

with intra-industry and intra-firm trading, which may account for the above result. An alternative explanation would be that the period under investigation covers the years 1986-1997, which is well after the Canada-U.S. auto pact of 1965 that involved a single sector free trade agreement covering automotive products.

In industries that were deemed trade-insensitive, the relative price variable was not significant at the 5% level for wood industries and fabricated metal industries. The wood industries manufacture commodities such as shingles and shakes, veneer and plywoods, wooden boxes, and wooden buildings. Imports accounted for approximately 13.7% of domestic demand in 1995. Hence, a tariff cut in this industry is less likely to have a significant impact on the demand for imports. However, since this industry has a export-orientation (64.7%), the reduction of export taxes will likely impact the industry in terms of production and employment.

Similarly, price elasticity of import demand was found to be insignificant in the fabricated metal products industries. The primary outputs of this industry consist of custom fabricated metal products, hardware, tool and cutlery products, and ornamental and architectural metal products. Fabricated metal products industries face a moderate amount of import competition (32.5%) and are characterised by a relatively limited degree of export orientation (26.9%). Hence a plausible explanation of the relative prices being statistically insignificant, in terms of import demand, would be the largely domestic orientation of the industry. Also, since this industry has a high value added

component (48.8% of total shipments), tariff cuts in inputs and outputs are less likely to have a serious impact on import demand in terms of effective rates of protection.

The expenditure variable served as a proxy for income. It was found to be significant for all industries, except food industries, and had the correct signs. That is to say, the results confirmed the expectation that income is positively related to the demand for imports. In terms of food industries, an alternative explanation may lie in the availability of domestic substitutes, and the low levels of import penetration (15.7%).

Calculated price elasticities ranged from -0.08 to -1.92 . Compared with other studies, these results were lower than estimates provided by Brown, Deardoff and Stern in their study, 'A North American Free Trade Agreement: Analytical Issues and a Computational Assessment' (1992). Brown *et al.* used a computational general equilibrium model where the authors calculated demand elasticities for Canada ranging from -2.7 to -2.9 . Cline *et al.* (1978) also provide similar estimates from their 1979 study, *Trade Negotiations in the Tokyo Round*. In examining the welfare benefits of alternative tariff cutting formulas, the authors estimated elasticities ranging from -0.76 to -2.14 , using an input-output approach. It is worth noting that comparisons with other studies are limited to the extent that differences exist in terms of models used and data periods. For example, Cline *et al.* (1978) uses data from 1971-1974, whereas the time period used in this study ranged from 1986 to 1997 for most elasticity calculations. Also, in calculating demand elasticities, the authors used U.S. data and

made the assumption that US elasticities were identical to Canadian elasticities. The rationale given was that the structure of demand was similar in both countries.

4.1.2 Employment

Table 2 shows the estimates for employment changes adjusted for import demand elasticities and tariff changes. The table presents calculations based on the 1987-1996 time period. To derive the number of jobs, total import values were divided by the values for GDP per person. The table shows that in five out of the six industries the impact on manufacturing employment ranged from 8% to 0.1%. Industries experiencing the most significant employment effects due to changes in import tariffs were electrical and electronics products industries and fabricated metal industries.

Table 2. Employment Gains and Losses Resulting from Import Changes

Industry	Jobs Gains/Losses (number of jobs)	% of total manufacturing employment (final goods only)
Transportation Equipment*	128	0.1
Non-Electrical Machinery Industries*	166	0.2
Electrical and Electronic Products*	6,692	8.0
Fabricated Metal Industries	793	0.6
Food Industries	270	0.2
Wood Industries	16	0.0

* trade sensitive industries

On the export side, job gains and losses resulting from tariff cuts were calculated using the same methodology and time period as imports, with the exception that export elasticities were arbitrarily assumed to be 1. The results are presented in Table 3 below.

Table 3. Employment Changes Resulting from Export Changes

Industry	Job Gains/Losses (number of jobs)	% of total manufacturing employment
Transportation Equipment*	640	0.4
Non-Electrical Machinery Industries*	136	0.2
Electrical and Electronic Products*	830	1.0
Fabricated Metal Industries	363	0.3
Food Industries	610	0.4
Wood Industries	222	0.2

* represents trade-sensitive industries

As shown in Table 3, the largest changes in manufacturing employment occurred in industries that were classified as being trade sensitive. It is also interesting to note that employment in electrical and electronic products industries experienced the largest impact on employment due to changes in exports, and the largest impact in terms of imports. This result suggests that the demand for employment may have more relevance to the cost structure of the industry than the tariff cuts themselves.

In terms of net job effects, the model assumed that increases in exports are job creating, whereas increases in imports were job displacing. Hence, to determine the net changes in employment, jobs created from increases in exports were subtracted from jobs displaced from increases in imports. The results indicated net job losses in three out of six industries. Table 4 shows the net effects by industry.

Table 4. Net Job Gains/Losses resulting from Tariff-Related Trade Changes

Industry (SIC2)	Net Gains/Losses (number of jobs)	% of manufacturing employment	% of total industry employment**
Transportation Equipment	512	0.3	0.2
Non-Electrical Machinery Industries*	(30)	-0.1	-0.0
Electrical and Electronic Products*	(5,862)	-7.0	-1.7
Fabricated Metal Industries	(431)	-0.4	-0.1
Food Industries	340	0.2	0.1
Wood Industries	204	0.2	0.1

* trade sensitive industries

** represents total labour inputs in the production of raw materials, intermediate goods, and final goods

As a percentage of manufacturing employment, the results ranged from 0.3% to -7%. Further calculations in terms of total industry employment indicate that, as a percentage change in total industry employment, the net losses represented a fraction of a percentage of employment losses for most of the selected industries. Furthermore, as compared with other cyclical trends in the economy, changes in employment due to tariff reductions appear to be negligible. For instance, in a recent study conducted by

Riddell and Sharpe (1998), the authors estimated Canada's unemployment rate at 9.5% on average, between 1986 and 1996. The highest loss in employment due to tariff liberalisation was calculated at 7% for total manufacturing employment and 1.7% for total industry employment.

5. **ECONOMETRIC MODEL**

An econometric model was constructed to test the responsiveness of employment to factors other than tariff cuts during the 1987-1996 period. A tariff variable was also included in the model for the purpose of significance testing. These results were then used as a framework for interpreting the previously estimated tariff-related employment effects. The latter model, it will be recalled, extrapolated total direct employment effects from related changes in exports and imports as a result of tariff cuts. The construction of the econometric model draws on the previously mentioned empirical studies that utilized various versions of computable general equilibrium and a macro-econometric models in order to estimate the impact of tariff liberalization on the Canadian economy

The variables used in the alternative employment model consisted of employment (number of workers), exchange rates (Canadian dollars per unit of US dollar), output (gross domestic expenditure), tariff rates (expressed as a percentage), and a labour coefficient (GDP per persons at work). In log-linear form, the base model was defined as follows: $\Delta L_i = b_1 \Delta \ln ER_t + b_2 \Delta \ln Q_{Cit} + b_3 \Delta \ln Q_{US_t} + b_4 \ln CO_{it} + u_t$

where,

- L_{it} = employment (number of jobs)
- ER = exchange rates
- Q_{Cit} = Canadian real GDP (billions of dollars)
- US_t = US real GDP (billions of dollars)
- CO_{it} = labour coefficient (dollars)

Logarithmic transformations were undertaken for most variables to reduce the trend in variance.

5.1 Variables

The exchange rate variable was included in the model to investigate the extent to which labour changes are attributable to changes in exchange rates. Evidence from other studies have indicated that variations in exchange rates can have a direct impact on employment.¹² More specifically, movements in exchange rates, such as a devaluation of a country's currency, can impact on employment (through increased output) because it lowers the foreign price of Canadian goods and hence increases the demand for Canadian exports abroad. It is expected that employment will increase in response to production increases in meeting increased foreign demand.

On the import side, the effects of devaluation on domestic production and employment depends on the stage of processing of the imported good. If the imports involve inputs, the devaluation is likely to have the effect of raising production costs. Under conditions of perfect competition this leads to subsequent decreases in domestic production and employment. If the imported goods are final commodities for resale in the domestic market, and domestic substitutes are available, consumers may substitute away from higher priced imports towards domestic substitutes. This will bid up the

¹² See for example, Krueger(1979); Ravenga(1992); Deardoff, Stern and Greene (1975), and Grossman (1982)

price in the domestic market and stimulate production. Further, the extent of these effects may vary across industries depending on the trade orientation.

Output variables were included in the regression to capture the cyclical factors affecting employment in the domestic economy. Canadian GDP was used as a proxy for domestic demand conditions. An increase in output is likely to have a positive effect on employment, whereas a decrease in output will likely have a negative impact on employment. In this regard, the data set included two recessionary periods: from 1981-82, and again from 1991-92. U.S. Gross Domestic Product (GDP) was used as a proxy for world market conditions. During the period under investigation, more than 80% of Canadian trade occurred with the United States. An increase in external demand is expected to increase employment.

In terms of structural effects, an input-output coefficient (defined as GDP per persons at work) was included in the model as an indicator of process innovation (or capital infusion.) This technique was adopted to prevent issues of multicollinearity with capital formation and domestic output. The intuition behind the inclusion of the input-output variable is that the demand for labour is affected by exogenous changes to capital. According to the Specific Factors Model of Comparative Advantage¹³, if an industry or country has a comparative advantage in the production of goods that are capital-intensive, an exogenous change, such as the implementation of the North American Free Trade Agreement, would have the effect of increasing real incomes of

¹³ Jones (1971), Samuelson (1971), Mayer (1974), and Mussa (1974)

capital¹⁴ through the international price mechanism. Assuming that labour is sector specific¹⁵ and capital is mobile, capital accumulation will occur at the expense of labour. In this sense, an increase in GDP per persons employed – the capital proxy - is expected to decrease employment. The model investigates the extent to which an increase in capital investment can explain changes in employment.¹⁶ Structural changes occurring in the Canadian manufacturing sector during the period under investigation have included restructuring, downsizing, and streamlining as a result of globalisation.

5.2 OLS Estimation Criteria

The use of time-series data in the model implied the presence of serial correlation. To detect serial correlation, the residuals of each industry were plotted against a time element to detect any patterns in the data. As an additional step, Durbin-Watson tests were conducted. Both these tests detected serial correlation, which was subsequently corrected through the use of a first difference model. Correlation coefficient tests were run on all the exogenous variables to test for the presence of multicollinearity. When collinearity was detected, for example between the Canadian GDP (gross domestic product) variable and the US GDP, one of the variables were omitted, or both variables were redefined - for example Canadian-U.S. GDP were

¹⁴ According to the theory, a country will export a commodity that makes intensive use of its relatively abundant factor. Capital is assumed to be more abundant than labour for Canada.

¹⁵ This assumes the need the new labour skills as labour changes industry.

¹⁶ The model does not go so far as to measure 'substitution' effect as Canadian firms adopt labour-saving technologies. For the purposes of this paper this variable will serve only as a proxy.

estimated as a ratio (instead of being estimated independently). The results are presented in Appendix 5.

5.3 OLS Results

The evidence from OLS regression indicated varying levels of significance for the variables in the base model. The main objective of the model was to investigate what types of structural (supply side) and cyclical (demand side) variables would have also affected employment during the same period. This was accomplished by observing the signs of the estimates in the multivariate regression model. The reader should note that the magnitude of the coefficients was not crucial for these tests. To estimate precise parameters, further testing will be required using a larger scale model – which is beyond the scope of this analysis.

Firstly, to determine the significance of each exogenous variable in the model, partial tests were conducted (see Appendix 6). The OLS results indicate that Canadian GDP, Capital Effects, Tariff Rates and relative output affected changes in employment during the 1987-1996 period. The exchange rate variable was not a significant factor in employment trends during the period. Further, the impact of the variables varied depending on the industry. For example, in transportation industries, output and tariff changes affected employment, whereas in food industries employment was associated with domestic output, the injection of capital, and the changes in tariff rates (or, rather, tariff cuts). F-testing confirmed the significance of the overall equations. The results of the OLS model are presented below.

Table 6. The Impact of Structural and Demand Variables on Employment

Industry N=42	Capital Proxy	USGDP	Exchange Rate	Canadian/US GDP	Canadian GDP	Tariff Rates
Transportation Equipment*	-187,215 (2.15)	...	73,309 (1.06)	11,924 (1.95)	...	-28,540 (4.06)
Non-Electrical Machinery Industries*	-217,881 (1.29)	...	-15,939 (0.66)	412,024 (10.53)	...	-2,590 (1.9)
Electrical and Electronic Products*	-22,914 (1.29)	8,349 (0.07)	...	...	...	11,156 (2.9)
Fabricated Metal Industries	-417,956 (9.2)	...	-24,372 (0.36)	412,024 (1.053)	...	-4,563 (1.0)
Food Industries	-772,992 (8.7)	-62,778 (0.17)	...	...	...	55,725 (2.35)
Wood Industries	-109,381 (2.15)	-55,464 (.75)	99,038 (.58)	...	...	36,670 (1.56)

Note: the brackets report the t-statistics

* trade sensitive Industries

... omitted variables due to problems with multicollinearity

The results of the parameters may be biased due to omissions of other factors, such as multiplier effects.

In terms of the estimated variables, the input-output coefficient (which served as a proxy for capital) had a significant effect on employment in all industries except electrical and electronic products industries and non-electrical machinery industries. In the Canadian manufacturing sector, in particular, it has generally been argued that in recent years economic activity has been buttressed by international trade within the context of falling domestic demand and wage suppression. The evidence presented in

the above table provides support for this hypothesis. Intuitively, since increases in GDP per persons at work negatively impacted employment, it is likely that increases in GDP per worker resulted from increases in capital inputs. Further research will be needed to confirm whether an infusion of capital can be equated with the adoption of labour-saving technologies in the remaining industries, or as a result of new entrants. For the purposes of this paper it is sufficient to note that changes in employment were also affected by the capital input proxy, which was earlier defined as being a structural variable.

U.S. gross domestic product (US GDP) was used as a proxy for cyclical effects in the world economy, that is, external demand conditions. The empirical analysis indicated that USGDP did not have a significant effect on employment in the industries tested. This effect was further confirmed by the partial coefficients presented in the appendix. An alternative explanation may be that domestic employment is more likely to be affected by external demand conditions in the longer term.

Canadian GDP served as a proxy for domestic output. This variable was omitted from the regression for all industries because the results of earlier testing detected the presence of multicollinearity between this variable and the labour productivity variable. However, the results from the ratio of Canadian GDP to US GDP variable confirmed that these cyclical (demand) effects were associated with changes in

employment, particularly for non-electrical machinery industries and transportation equipment industries.¹⁷

In terms of exchange rates, the results indicated that a significant relationship did not exist between movements in the exchange rate and changes in employment for all industries tested. This result was not consistent with the findings of a study conducted by Ravenga (1992). In the paper, *Exporting Jobs? The Impact of Import Competition on Employment and Wages in US Manufacturing*, the author investigated the impact of import prices on employment using an instrumental variable estimation procedure. The study concluded that exchange rates had a significant impact on employment and wages. It was estimated, for example, that between 1980 and 1985, exchange rate “misalignments” reduced employment by 4.5 to 7.5% in U.S. manufacturing. However, differences in the results may have been related to differences in time periods and modelling techniques.

Finally, the results of the estimation of the tariff variable confirmed that tariffs affected employment during the period under investigation, particularly in the transportation equipment industries, electrical and electronic products industries, and food industries. Since only two of these industries were deemed to be trade sensitive, this would further suggest that the effect of tariff changes on employment was not sensitive to the trade orientation of industries. Moreover, the effects themselves varied depending on the industry.

16 A weakness of this hypothesis is that employment will be unchanged if the growth rates between Canada and US remains identical. However, this occurrence was not present in the data.

Summing up, the findings indicate that GDP per person worked was strongly associated with employment in four out of the six industries. Also, demand conditions (the relative output variable) affected employment in at least two out of six manufacturing industries, namely: non-electrical machinery industries and transportation equipment industries. It is also evident that there was a significant relationship between tariff rates and employment in three out of six manufacturing industries. These findings suggest that, in addition to tariff liberalisation, employment changes were associated with structural and cyclical effects occurring in the economy during the 1987-1996 period.

6. OLS VERSUS INPUT-OUTPUT ESTIMATES

Evidence from the OLS technique indicated that tariff liberalization had a diverse impact on employment. More specifically, the results showed that tariff liberalization negatively impacted employment in at least two out of the six industries examined, and positively impacted employment for another two industries. For the remaining industries, changes in tariff rates were found to be insignificant. Furthermore, the OLS results pointed to additional factors that may have also affected employment during the same period. Contrastingly, estimates from the input-output model showed a negative impact on employment on three out of six industries. However, both models also estimated a minimal employment effect resulting from decreased tariff rates.

A plausible explanation for the conflicting results may be due to specification error in the input-output model, in terms of the number of jobs attributed to changes in exports and imports. That is to say, the model does not differentiate employment by import (export) activity. By assumption, the same labour coefficient was used to estimate jobs created/displaced due to changes in imports and exports. This ignores the possibility of differences in labour requirements, in the domestic production of goods that may have otherwise been imported more cheaply. Further, the input-output model assumes that all imports displace domestic production, and hence, discounts the efficiency aspects of imported intermediate goods (or technology) for which domestic substitutes are not available. In this instance, the model interpreted changes in imports

as employment displacing.

At the industry level of estimation, evidence from the OLS testing supported the results of the input-output estimates for transportation industries. In the former, a decrease in tariff rates were found to be positively associated with employment, and in the latter model, declining tariff rates were estimated as having a positive impact on employment. Additionally, the OLS results indicated that other factors, such as relative output and capital injections, were also associated with changes in employment levels during the same period.

In the non-electrical machinery industries, changes in employment were positively associated with relative output. Also, tariff changes were a (positive) significant factor in employment change in the OLS results for this industry. In comparison, the results of the input-output estimation showed a negative impact on employment due to tariff liberalisation.

Insignificant results for the tariff variable were present in the estimates for fabricated metal industries and wood industries. However, the capital proxy (structural) variable was found to be significantly related to employment for both industries. More specifically, the capital proxy variable negatively affected employment for both these industries. In terms of the tariff variable, it is likely that the addition of other variables in the OLS model may have had the effect of swamping the already minimal effects of tariff cuts.

In the electrical and electronic products industries, the tariff rate emerged as the only significant variable in explaining employment changes in the OLS estimation. This result confirms the relationship between employment and tariff rates assumed by the input-output model. Moreover, the direction of the impact also agrees with the

(negative) results estimated by the input-output model.

Lastly, the results of OLS estimation for the food industries indicate that employment was significantly affected by GDP per person employed (capital proxy variable) as well as the tariff variable between 1987 and 1996. More specifically, the results show that capital increases and tariff decreases were job displacing. These results conflicted with the positive employment effects previously calculated in the input-output model. However, the results also imply that while tariff changes influenced employment during the period under study, other economic factors also had an effect on employment.

In the final analysis, the results of both the input-output model and the OLS model can be viewed as being relevant. On the one hand, the input-output model suggests that tariff liberalisation was employment-displacing for some industries. On the other hand, the OLS estimates suggest that although tariff changes influenced employment in 4 out of the 6 industries examined, additional economic factors also affected employment levels during the same period.

The OLS results supported the negative effects on employment of a decrease in tariffs for certain industries. That is to say, even though the results of Table 6 show a positive sign, the raw data indicated a steady decline in the tariff rates. Implicitly, the results can then be interpreted as a corresponding negative effect on employment in at least 2 out of the 4 industries. However, a specification weakness in the input-output model became apparent when tariff changes were estimated to have an opposing effect on employment in two industries that were earlier identified as being insignificant (in terms of the impact of tariff changes on employment) by the OLS procedure. Finally, the trade orientation of industries did not appear to be a significant factor in the

estimates presented, neither for the OLS nor the input-output model. Conceivably, changes in the employment levels are related more to changes in the specific production requirements of industries, than to tariff cuts.

Based on these findings, it is likely that the impact of tariff liberalisation on employment is minimal because of the indirect and lagged nature of these effects. Furthermore, since the selected structural and cyclical variables were found to be associated with employment trends during the period under investigation, it is more likely that the impact of these latter factors on employment would be larger than tariff impacts. This conclusion was supported by the empirical evidence presented earlier in the thesis.

7. CONCLUSION

The proposition that tariff liberalization can affect domestic employment has long been accepted as a general condition of tariff liberalization. Conceivably, free trade among developed economies can be mutually beneficial since not all nations are equally endowed in terms of resources. What is new, however, is the notion that tariff liberalization can be mutually beneficial even when conducted between developed and developing economies, and between developed economies of significantly different sizes.

In this sense, the ratification of the CUSFTA and the NAFTA marked a new direction in the practice of international trading. In the academic community, these events also sparked a preponderance of empirical studies aimed at examining the implications of these new liaisons. This work has added to this body of literature, particularly in regards to trade-related employment effects.

This objective of this study was to assess the employment-related effects of tariff liberalization on the Canadian economy during the 1987-1996 period. Through the use of an input-output paradigm supported by some preliminary econometric testing, it quickly became evident that, in fact, tariff liberalization had only a minimal impact on employment for the period under study. These results were further supported by studies in the empirical literature that also estimated a minimal employment effect.

The main conclusions of the study are, firstly, that tariff liberalization had a negative employment effect for some industries. In three out of the six industries investigated, namely: non-electrical machinery, electrical and electronic products, fabricated metal products industries, the reduction of tariffs led to an employment loss

of approximately 6.3 thousand jobs. This represented a 0.5% loss in manufacturing employment, and a negligible loss in terms of total employment. Secondly, the results indicated that tariff effects were not related to the trade orientation of the pre-selected industries. The second largest trade-related impact on employment was experienced by fabricated metal industries, which were defined as not being trade sensitive; whereas, non-electrical machinery industries experienced a negative employment effect, and the industry was considered to be trade sensitive.

Finally, an important finding of the study was that employment levels were affected by tariff cuts in addition to other structural and cyclical factors occurring in the economy during the 1987-1996 period. In terms of the magnitude of the impact, however, the results were not conclusive. The results did confirm, however, that the effects varied depending on the industry.

A major implication of these findings is that tariff cuts minimally affected total employment across all industries. This was confirmed by the empirical testing conducted in this paper, as well as in the findings by researchers in the empirical literature. Furthermore, it became apparent that, while sophisticated modeling techniques such as computable general equilibrium models were useful, they did not necessarily improve the results previously identified by simpler models, for example trade-balance (or input-output) studies, as was also confirmed by this analysis.

In terms of future work, the next step would be the estimation of reliable parameters for the structural and cyclical variables mentioned above with additional variables or improved data. For instance, the addition of well-defined variables such as capital stock or investment data, rather than an implicit capital effect proxy, as was assumed in this model. Other variables that may prove useful in the OLS estimation

could be data on product innovation, or variables measuring technical progress.

Conceivably, measuring technical progress would have a stronger association with changes in trade-related employment effects, rather than the determination of these effects residually through the use of factor content estimations, and assumptions based on input substitution. Further, the results of the model could be improved with more detailed data, such as USGDP at the industry level, rather than in the aggregate. However, these important improvements go well beyond the scope of the current work. Furthermore, it is expected that the use of -additional data and variables will in fact confirm these findings, albeit, with a more efficient estimation of the existing parameters.

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APPENDIX 1

A1.1 Import Tariff Level Schedule by Industry, 1987-1998, Base Rates (%)

	Transportation Equipment	Non- Electrical Machinery	Electrical and Electronic Products	Fabricated Metals	Food Industries	Wood Products
1987	2.3	4.7	6.1	6.8	4.2	2.7
1989	1.9	3.2	5.2	5.9	3.7	2.4
1990	1.7	2.5	4.4	5.1	3.3	2.1
1991	1.5	1.8	3.5	4.3	2.9	1.7
1992	1.2	1.1	2.7	3.5	2.4	1.4
1993	1.0	0.3	1.9	2.6	2.0	1.1
1994	0.8	0.3	1.5	2.1	1.6	0.9
1995	0.6	0.2	1.1	1.6	1.2	0.7
1996	0.4	0.1	0.7	1.1	0.8	0.4
1997	0.2	0.1	0.4	0.5	0.4	0.2
1998	0.0	0.0	0.0	0.0	0.0	0.0

A1.2 Export Tariff Schedule* by Industry, 1987-1998, Base Rates (%)

	Transportation Equipment	Non- Electrical Machinery	Electrical and Electronic Products	Fabricated Metals	Food Industries	Wood Products
1987	0.5	2.5	3.7	3.2	3.5	1.4
1989	0.4	1.8	3.1	2.6	3.2	1.2
1990	0.3	1.4	2.5	2.2	2.8	0.9
1991	0.3	1.0	1.9	1.9	2.5	0.6
1992	0.2	0.5	1.3	1.5	2.1	0.4
1993	0.1	0.1	0.7	1.1	1.8	0.1
1994	0.1	0.1	0.6	0.9	1.4	0.1
1995	0.0	0.1	0.4	0.7	1.1	0.1
1996	0.0	0.1	0.3	0.4	0.7	0.0
1997	0.0	0.0	0.1	0.2	0.4	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0

* US import tariffs on Canadian exports was used as a proxy for Canadian export taxes

APPENDIX 2
CANSIM Time Series for Input-Output Model

Variable	Matrix Number	Databank Number
Industrial Product Price Indexes	M2008	D694006, D694100, D694106, D694121, D694089, D694055
Import Price Indexes	M935	B1551, B1558, B1556, B1557
	M3620	D750121-123, D8750106, D750091-96
Import Volumes	M935	B1564, B1571, B1569, B1570
	M3651	D397897, D397896, D397880, D397870, D397865
Gross Domestic Product	M4672	I36108, I36112, I36123, I36124, I36121, I36116

APPENDIX 3
Employment as a Share of Total Manufacturing Employment

INDUSTRY – SIC2 Level, SIC 80 STANDARD INDUSTRIAL CLASSIFICATION	Share of Total Manufacturing(%)
Transportation Equipment Industries	14.2
Food Industries	11
Fabricated Metal Industries	9.48
Wood Industries	7.8
Electrical and Electronic Products Industries	6.5
Paper Industries	6.2
Printing and Publishing Industries	5.5
Primary Metal Industries	5.3
Clothing Industries	5.2
Non-Electrical Machinery Industries*	5.2
Other Industries	3.8
Chemical Industries	3.7
Plastic Industries	3.5
Non-Metallic Metal Products Industries	2.6
Textile Products Industries	1.8
Rubber Industries	1.5
Primary Textile Industries	1.2
Beverage Industries	1
Leather Industries	.8
Refined Petroleum Industries	.5
Tobacco Industries	.2

Note: Non-Electrical Machinery was substituted for Paper Industries due to data availability

APPENDIX 4
Import Penetration and Export Orientation by Industry

INDUSTRY – SIC 2, 1980 Standard Industrial Classification, 1995	Import ⁺ Penetration (%)	Export Orientation (%)
Electric and Electronic Industries*	77.9	64.2
Other Industries	76.0	56.6
Non-Electrical Machinery Industries*	74.0	57.9
Leather Industries	67.6	23.1
Primary Textiles	53.3	39.6
Primary Metals	50.0	71.3
Transportation Equipment Industries**	48.3	52.1
Chemical Industries	45.4	36.3
Furniture and Fixtures Industries	39.1	61.7
Textile Products Industries	39.1	19.2
Clothing Industries	37.3	22.1
Rubber Industries	34.0	31.1
Plastic Industries	33.8	29.2
Fabricated Metal Industries	32.5	26.9
Non-Metallic Minerals Industries	31.8	27.2
Paper Industries	26.0	65.2
Printing and Publishing Industries	17.3	7.7
Food Industries	15.7	16.4
Wood Industries	13.7	64.7
Petroleum Industries	12.1	29.7
Food Industries	15.7	16.4
Beverage Industries	11.7	13.4
Tobacco Industries	2.5	5.3
All Manufacturing	43.1	43.9

*trade sensitive industries

**defined as a trade sensitive industry because export penetration and import orientation averaged out to be greater than 50%

* import penetration may be overestimated because the data includes imported goods that are not normally manufactured in Canada, for example, printing presses or dyeing machines

APPENDIX 5
Partial Coefficients as a Test for Multicollinearity

A5.1 Transportation Equipment Industries

r_{12}, r_{13}, r_{22} etc	Exchange Rate	Canadian GDP	US GDP	Labor Productivity	Tariff Rate	Canadian GDP/US GDP
Exchange Rate	1	...	$r^2 = 0.00$ $t = 0.15$	...	$r^2 = 0.00$ $t = 0.3$	$r^2 = 0.02$ $t = 0.88$
Canadian GDP	$r^2 = 0.00$ $t = 0.41$	...	$r^2 = 0.05$ $t = 2.67$	$r^2 = 0.03$ $t = 1.09$	$r^2 = .06$ $t = 1.63$	...
USGDP	...	...	...	...	$r^2 = 0.00$ $t = 0.46$	...
Labour Productivity	$r^2 = 0.74$ $t = 10.6$	...	$r^2 = 0.00$ $t = -0.423$	...	$r^2 = .05$ $t = 1.48$	$r^2 = 0.03$ $t = 1.12$
Tariff Data	...	...	...	...	...	$r^2 = 0.26$ $t = -1.02$
Can GDP/USGDP	...	...	...	...	...	1

... omitted run due to a priori expectations and to prevent duplication

A5.2 Electrical and Electronic Products Industries

	Exchange Rate	Canadian GDP	US GDP	Labour Productivity	Tariff Rate	Canadian GDP/US GDP
Exchange Rate	1	...	...	...	$r^2 = 0.03$ $t = -1.11$	$r^2 = 0.01$ $t = 0.74$
Canadian GDP	$r^2 = 0.01$ $t = 0.73$	1	$r^2 = 0.01$ $t = -0.58$	...	$r^2 = 0.03$ $t = -1.11$	...
USGDP	$r^2 = 0.00$ $t = -0.23$	...	1	...	$r^2 = 0.26$ $t = -1.04$	...
Labour Productivity	$r^2 = 0.29$ $t = 1.09$	$r^2 = 0.91$ $t = 19.85$	$r^2 = 0.01$ $t = -0.59$	1	$r^2 = 0.00$ $t = 0.35$	$r^2 = 0.9$ $t = 19.12$
Tariff Data	...	...	...	...	1	$r^2 = 0.26$ $t = -1.02$
Can GDP/USGDP	...	...	...	...	$r^2 = 0.25$ $t = 1.04$	1

... omitted run due to a priori expectations and to prevent duplication

A5.3 Non-Electrical Machinery Industries

	Exchange Rate	Canadian GDP	US GDP	Labour Productivity	Tariff Rate	Canadian GDP/US GDP
Exchange Rate	1	...	$r^2 = 0.00$ $t = 0.02$	...	$r^2 = 0.00$ $t = -0.06$	$r^2 = 0.02$ $t = 0.8$
Canadian GDP	$r^2 = 0.02$ $t = 0.78$	1	$R^2 = 0.04$ $t = 1.23$	...	$r^2 = 0.01$ $t = -0.58$	...
USGDP	...	...	1	...	$r^2 = 0.00$ $t = -0.58$	...
Labour Productivity	$r^2 = 0.44$ $t = 0.87$	$r^2 = 0.72$ $t = 10.02$	$r^2 = 0.07$ $t = 1.7$	1	$r^2 = .01$ $t = -0.6$	$r^2 = 0.69$ $t = 9.39$
Tariff Data	...	...	...	...	1	$r^2 = 0.01$ $t = -0.55$
Can GDP/USGDP	...	...	...	...	...	1

... omitted run due to a priori expectations and to prevent duplication

A5.4 Fabricated Metal Industries

	Exchange Rate	Canadian GDP	US GDP	Labour Productivity	Tariff Rate	Canadian GDP/US GDP
Exchange Rate	1	$r^2 = 0.00$ $t =$	$r^2 = 0.00$ $t =$	...	$r^2 = 0.03$ $t =$	$r^2 = 0.00$ $t =$
Canadian GDP	...	1	$r^2 = 0.01$ $t = -0.58$	...	$r^2 = 0.03$ $t = -1.11$	...
USGDP	...	$r^2 = 0.00$ $t =$	1	...	$r^2 = 0.19$ $t = -$	...
Labour Productivity	$r^2 = 0.01$ $t = 0.71$	$r^2 = 0.4$ $t = 5.14$	$r^2 = 0.13$ $t = -0.71$	1	$r^2 = 0.00$ $t = -0.26$	$r^2 = 0.39$ $t = 5.1$
Tariff Data	...	...	...	...	1	$r^2 = 0.26$ $t = -1.02$
Can GDP/USGDP	...	...	...	...	$r^2 = 0.19$ $t = 3.1$	1

... omitted run due to a priori expectations and to prevent duplication

A5.5 Wood Industries

	Exchange Rate	Canadian GDP	US GDP	Labour Productivity	Tariff Rate	Canadian GDP/US GDP
Exchange Rate	1	...	$R^2 = 0.00$ $t = 0.15$	...	$R^2 = 0.00$ $t = 0.3$	$R^2 = 0.02$ $t = 0.88$
Canadian GDP	$r^2 = 0.00$ $t = 0.41$	...	$r^2 = 0.05$ $t = 2.67$	$r^2 = 0.03$ $t = 1.09$	$r^2 = 0.06$ $t = 1.63$	...
USGDP	...	...	...	...	$r^2 = 0.00$ $t = 0.46$	...
Labour Productivity	$r^2 = 0.74$ $t = 10.6$	...	$r^2 = 0.00$ $t = -0.423$	...	$r^2 = .05$ $t = 1.48$	$r^2 = 0.03$ $t = 1.12$
Tariff Data	...	...	...	...	...	$r^2 = 0.26$ $t = -1.02$
Can GDP/USGDP	...	...	...	...	...	1

... omitted run due to a priori expectations and to prevent duplication

A5.6 Food Industries

	Exchange Rate	Canadian GDP	US GDP	Labour Productivity	Tariff Rate	Canadian GDP/US GDP
Exchange Rate	1	$r^2=0.04$ $t = 1.22$	$r^2 = 0.05$ $t = -1.38$	$r^2 = 0.5$ $t = 1.52$	$r^2 = 0.05$ $t = -1.42$	...
Canadian GDP	...	1	...	...	$r^2 = 0.00$ $t = -0.18$	...
USGDP	...	$r^2 = 0.03$ $t = -1.18$	1	...	$r^2 = 0.07$ $t = 1.71$	...
Labour Productivity	...	$r^2 = 0.36$ $t = 4.66$	$r^2 = 0.04$ $t = -1.26$	1	$r^2 = 0.21$ $t = -3.29$	...
Tariff Data	1	...
Can GDP/USGDP	1

... omitted run due to a priori expectations and to prevent duplication

APPENDIX 6

Tests for Signs of Coefficients and Significance of Regressors by Industry

Y on X_1, X_2, etc N=42	Exchange Rate	Canadian GDP	US GDP	Capital Effects	Tariff Rate	Canadian GDP/US GDP**
Transportation Equipment	...	$r^2 = 0.12$ $t = 2.31$	$r^2 = 0.04$ $t = 1.23$	$r^2 = 0.07$ $t = -1.65$	$r^2 = 0.36$ $t = -4.7$	$r^2 = 0.08$ $t = 1.84$
Electric and Electronic Products	$r^2 = 0.03$ $t = -1.15$	$r^2 = 0.02$ $t = 0.089$	$r^2 = 0.01$ $t = 0.03$	$r^2 = 0.03$ $t = -1.08$	$r^2 = 0.08$ $t = 1.91$	$r^2 = 0.02$ $t = 0.88$
Non-Electrical Machinery	$r^2 = 0.00$ $t = -0.36$	$r^2 = 0.06$ $t = 1.57$	$r^2 = 0.00$ $t = -0.04$	$r^2 = .99$ $t = -0.21$	$r^2 = 0.00$ $t = -0.3$	$r^2 = 2.06$ $t = 1.6$
Fabricated Metals	$r^2 = 0.02$ $t = -0.91$	$r^2 = 0.39$ $t = 5.07$	$r^2 = 0.00$ $t = 0.15$	$r^2 = 0.05$ $t = -0.38$	$r^2 = 0.25$ $t = 3.7$	$r^2 = 0.33$ $t = 4.46$
Wood	$r^2 = 0.00$ $t = -0.16$	$r^2 = 0.28$ $t = 3.96$	$r^2 = 0.00$ $t = -0.15$	$r^2 = 0.15$ $t = -2.66$	$r^2 = 0.19$ $t = 3.88$	...
Food	$r^2 = 0.00$ $t = -0.16$	$r^2 = 0.28$ $t = 3.96$	$r^2 = 0.00$ $t = -0.15$	$r^2 = 0.15$ $t = -2.66$	$r^2 = .19$ $t = 3.09$	...

** relative output