FTAA and North Carolina: Income Redistribution across Labor Groups

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Abstract: The specific factors model was used to determine potential adjustments due to FTAA on income redistribution among skilled labor groups in North Carolina. All wages but agriculture and manufacture labor are projected to rise. ***.*** *Returns to capital in service will increase while returns to capital in agriculture and manufacture fall.*

Introduction

Free trade increases global efficiency and aggregate income but income redistribution continues to dominate the political debate. Some productive factors stand to lose real income with free trade, at least prior to retraining and economic growth. The present paper examines the potential impact of the Free Trade Area of the Americas (FTAA) in North Carolina in a comparative static model with various skilled labor groups. Yeboah, Thompson, Malik (2002) develop a similar model for the Alabama pulp and paper industry; Thompson and Toledo (2001) examine the potential income redistribution in Bolivia with a merger between the Andean Market and Mercosur.

FTAA has the potential to impact industries and even sectors within an industry differently, similar to NAFTA. Marchant and Rupel (1993) point out that southeastern agricultural producers are particularly susceptible to swings in the production and consumption of less developed countries (LDCs) because of similar crops. While there is no doubt that FTAA will expose North Carolina firms to international competition, increasing overall efficiency and stimulating economic growth, there is concern about how trade liberalization will redistribute labor income and affect income inequality.

Methodology and Data

1. The Computable General Equilibrium Model of Production and Trade

FTAA is expected to become effective by 2005 and the potential impacts on individual economies can be examined in general equilibrium models of production and trade. The basic method is to simulate the effects of changing prices on factor prices and outputs.

Simulations are based on factor shares and industry shares across the three major aggregates of output from manufacturing, agriculture, and service sector data. Labor is disaggregated into six different skill categories and capital is assumed to be sector specific. Assumptions of the model include full employment with labor perfectly mobile across sectors and perfect competition with cost equal to price. Constant elasticity production functions and constant returns to scale are assumed. The model also assumes cost minimizing inputs.

The model generates general equilibrium elasticities of factor prices with respect to changes in output prices. Policy implications are discussed. After years of outgrowing the rest of the nation, North Carolina's economy trailed in 2003 for the third year in a row, and the pace of economic growth will slow this year. North Carolina's gross state product rose just 2.2 percent last year, compared with 3.1 percent for the nation. This year, the state's economy is expected to grow by just 1.8 percent or less, which is less than half the 4-5 percent growth forecasted for the US economy. Job growth in North Carolina is expected to increase by 31,500 in 2004, compared to 10,000 in 2003 (North Carolina Department of Commerce, 2004). A look at the potential impact of FTAA on income redistribution across labor groups may contribute to policy that would smooth the transition to expanded free trade.

Full employment of each skilled labor, capital, and energy is described by

$$v = Ax \tag{1}$$

where v is a vector of inputs, A is a matrix of cost minimizing unit inputs, and x is a vector of outputs. Factor endowments are exogenous with perfectly inelastic supplies ensuring the full employment in (1). Competitive pricing in each industry leads to the other major relationship in the model

$$p = A'w \tag{2}$$

where p is the vector of product prices and w factor prices. The North Carolina economy is assumed to be a price taker in markets for inputs and finished goods. Emphasis is upon comparative statics starting in equilibrium. Endowment changes are considered, but short or medium run adjustment process and the dynamics of growth are not. Taking the differential of (2),

$$dv = xdA + Adx \tag{3}$$

Aggregate economy wide substitution terms S_{ik} are introduced, $S_{ik} \equiv \sum_j x_j a_{ij}^h$,

where $\partial a_{ij} / \partial w_h \equiv a_{ij}^h$. This substitution term summarizes how cost minimizing firms across the economy alter their input mix in the face of changing factor prices. If S_{ik} is positive (negative), factors i and h are aggregate substitutes (complements). For every factor i, $dAx = \sum_k s_{ik} dw$, and (3) becomes

$$dv = Sdw + Adx\,. \tag{4}$$

Considering small changes, cost-minimizing behavior insures that

$$wdA' = 0. \tag{5}$$

Using (5) and taking the differential of (2),

$$dp = A'dw. \tag{6}$$

Putting (5) and (7) together into matrix form,

$$\begin{pmatrix} S & A \\ A & 0 \end{pmatrix} \begin{pmatrix} dw \\ dx \end{pmatrix} = \begin{pmatrix} dv \\ dp \end{pmatrix}. \tag{7}$$

In elasticity form, the model is written

$$\begin{bmatrix} \sigma & \lambda \\ \theta' & 0 \end{bmatrix} \begin{bmatrix} \hat{w} \\ \hat{x} \end{bmatrix} = \begin{bmatrix} \hat{v} \\ \hat{p} \end{bmatrix} \tag{8}$$

where σ is the 10x10 matrix of substitution elasticities, λ is the 10x3 matrix of industry shares, and θ' is 3x10 matrix of factor shares. The 13x13 matrix in (8) relates exogenous changes in factor endowments v and prices p to endogenous changes in factor prices w and outputs x given full employment and competitive pricing in the comparative statics of the general equilibrium model. The ^ represents percent changes.

2.0 Factor Shares and Industry Shares in North Carolina

The first step in building an applied specific factors model is to calculate factor shares and industry shares. Factor shares are the portions each productive factor receives from industry revenue. Industry shares are portions of each productive factor employed in each industry. Factor shares and industry shares are crucial for estimating the substitution between inputs across the economy, and then for deriving comparative static elasticities of the general equilibrium model as in Jones (1965); Takayama (1982); and Thompson (1996). Estimates of factor shares θ and industry shares λ are crucial for model specification.

Figures on each skilled labor group and factor payments for labor for the manufacturing, service and agricultural sectors are taken from the Bureau of Labor Statistics (2000). The amount of energy consumed and the corresponding expenditures by sector are from the US Department of Energy (1998). Net value added figure for the agricultural sector is from the USDA (1999) and that for the manufacturing sector is the

U.S. Census of Manufacturers/Department of Commerce (1997). Capital is treated as a residual input. For energy consumption and expenditure for the service sector, the smallest share of energy consumption in manufacturing (2 percent) is used because there is no data on energy spending in services.

Factor input is defined as the dollar value of factor *i* used in sector *j,*

$$w_{ij} \equiv w_i v_{ij}, \tag{9}$$

where w_i is the price of factor *i* and v_{ij} the quantity of factor *i* used in sector *j*. The share of factor *i* in sector *j* is then

$$\theta_{ij} \equiv w_{ij} / y_i, \tag{10}$$

where y_j is the value added by sector *j.* The data are static in nature, taken at a single point in time and nominal values for factor payments and value added are used. Index *i* runs across the three inputs capital *k*, energy *e*, and labor *l*. Value added by manufacturing sector comes from the US Census of Manufacturers (1997) and for agriculture from the US Department of Agriculture (1997). Value added in services is derived as the residual of gross state product.

Table 1 presents the total payment matrix for capital, derived as a residual, energy, and each skill group of labor:

Professionals
Managers
Clerks
Service
Agriculture
Production
Capital
Energy

Table 1. Factor Payment Matrix (Million Dollars: 1997)

	Agriculture	Service	Manufacturing	Total
Managers	42,511	20,264,026	3,545,586	23,852,123
Professionals	88,863	32,995,466	2,321,892	35,406,221
Service	83,975	28,974,167	0	29,058,142
Clerks	0	13,972,359	288,359	14,260,718
Agriculture	200,238	0	0	200,238
Production	466,738	0	16,425,400	16,892,138
Capital	3,080,305	23,201,085	131,824,630	158,106,020
Energy	1,094,232	28,754,468	7,183,300	37,032,000
Total	5,056,862	148,161,571	161,589,166	

Changing prices of agriculture, manufacturing, and service industries thus affect factorial income distribution. The total payment matrix of each skill group of labor (managers, professionals, clerks, service, agriculture, production) in each industry is used to derive factor shares and industry shares, with capital the residual input.

Table 2 presents the related factor shares, the share of each factor in the revenue of each sector. Summing down a column in Table 1 gives total sector revenue. For instance, total revenue of service is \$148 billion and the capital share is \$23.2/\$148 = 15.7 percent. Capital has the largest factor share in each sector except energy in the service sector. The high share of energy in the service sector (19.4 percent) may probably due to the inclusion of transportation in service. The largest labor shares go to professionals workers in the service sector, service workers in that sector, and managers in services.

Table 2. Factor Shares, θ_{ij}

	Agriculture	Service	Total Mfg.
Managers	0.0084	0.1368	0.0219
Professionals	0.0176	0.2227	0.0144
Service	0.0166	0.1956	0.0000
Clerks	0.0000	0.0943	0.0018
Agriculture	0.0396	0.0000	0.0000
Production	0.0923	0.0000	0.1016
Capital	0.6091	0.1566	0.8158
Energy	0.2164	0.1941	0.0445

Industry shares are in Table 3. Summing across rows in Table 1 gives total factor incomes. Assuming perfect labor mobility, the wage of each labor is the same across sectors, and the share of each factor employed in each sector, the industry shares, can be derived. For instance, the total income of professionals is $35 billion and $33/$35 = 93% of professionals work in services. Very large shares of professionals, managers, and service workers are in the service sector, and production workers in manufacturing. Agriculture workers are virtually sector specific.

Table 3. Industry Shares, λ_{ij}

	Agriculture	Service	Manufact.
Managers	0.0018	0.8496	0.1486
Professionals	0.0025	0.9319	0.0656
Service	0.0029	0.9971	0
Clerks	0	0.9798	0.0202
Agriculture	1.0000	0	0
Production	0.0276	0	0.9724
Capital	0.0195	0.1467	0.8338
Energy	0.0295	0.7765	0.1940

3. A Specific Factors Model of Production for North Carolina

Factor shares and industry shares are used to derive the aggregate substitution elasticities in Table 4. Substitution elasticities describe the adjustment in cost minimizing inputs to factor price changes as developed by Jones (1965) and Takayama (1982). Following Allen (1938), the cross price elasticity between the input of factor *i* and the payment to factor *k* in sector *j* can be written as

$$E_{ij}^{k} = \hat{a}_{ij} / \hat{w}_{k} = \theta_{kj} S_{ij}^{k} \quad (11)$$

where ^ represents and percentage change in a variable and S_{ij}^{k} is the Allen partial elasticity of substitution. With Cobb-Douglas production, $S_{ij}^{k} = 1$. Homogeneity implies $\sum_k E_{ij}^{k} = 0$, and the own price elasticity E_{ij}^{i} is the negative of the sum of cross price elasticities. The cross price elasticity is a weighted Allen elasticity and with Cobb-Douglas production it equals the factor share. Aggregate substitution elasticities for the economy are the weighted average of the cross price elasticities for each sector. Elasticities are summed across industries to arrive at aggregate substitution elasticities, as described by Thompson (1994):

$$\sigma_{ik} \equiv \hat{a} / \hat{w}_{k} = \sum_{j} \lambda_{ij} E_{ij}^{k} = \sum_{j} \lambda_{ij} \theta_{kj} S_{ij}^{k} \quad (12)$$

Table 4. Cobb-Douglas Substitution Elasticities, σ_{ik}

	ŵMgr	**ŵProf**	**ŵSer**	**ŵClrk**	**ŵAgr**	**ŵProd**	**ŵE**	**ŵA**	**ŵS**	**ŵM**
âMgr	-1.3697	0.1914	0.1662	0.0804	0.0001	0.0153	0.1719	0.0007	0.7165	0.0274
âProf	0.1289	-1.3896	0.1823	0.0880	0.0001	0.0069	0.1843	0.0010	0.7860	0.0121
âSer	0.1364	0.2221	-1.4892	0.0940	0.0001	0.0003	0.1941	0.0011	0.8410	0.0000
âClrk	0.1344	0.2185	0.1916	-1.5677	0.0000	0.0021	0.1910	0.0000	0.8264	0.0037
âAgr	0.0084	0.0176	0.0166	0.0000	-0.7421	0.0923	0.2164	0.3909	0.0000	0.0000
âProd	0.0216	0.0145	0.0005	0.0017	0.0011	-0.2784	0.0492	0.0108	0.0000	0.1791
âE	0.1107	0.1762	0.1523	0.0736	0.0012	0.0224	-1.2386	0.0115	0.6549	0.0357
âA	0.0084	0.0176	0.0166	0.0000	0.0396	0.0923	0.2164	-0.3909	0.0000	0.0000
âS	0.1368	0.2227	0.1956	0.0943	0.0000	0.0000	0.1941	0.0000	-0.8434	0.0000
âM	0.0219	0.0144	0.0000	0.0018	0.0000	0.1016	0.0445	0.0000	0.0000	-0.1842

Constant elasticity of substitution (CES) production would scale these elasticities. With CES of 0.5, for instance, elasticities would be half as large. The largest own substitution elasticity is for clerks. There is generally less substitution for capital.

The present focus is on price changes due to FTAA. Comparative static elasticities $\hat{w}/\hat{p}$ and $\hat{x}/\hat{p}$ are found by inverting (8). The $\hat{w}/\hat{p}$ matrix describes how out prices affect factor prices and the $\hat{x}/\hat{p}$ matrix describes the local surface of production possibilities in which each output should be positively related to its own price while some other output declines given constant endowments

Table 5. Elasticities of Factor Prices with Respect to Output Prices

	^pA	**^pS**	**^pM**
^wMgr	-0.005	0.984	0.021
^wProf	-0.004	1.008	-0.004
^wSer	-0.004	1.024	-0.021
^wClrk	-0.006	1.021	-0.015
^wAgr	1.524	-0.368	-0.157
^wProd	0.077	-0.101	1.025
^eE	0.019	0.947	0.034
^rA	1.524	-0.368	-0.157
^rS	-0.006	1.026	-0.020
^rM	-0.010	-0.085	1.096

4. Comparative Static Elasticities in the North Carolina Specific Factors Model

Table 5 reports the $\hat{w}/\hat{p}$ elasticity matrix. Every 1% increase in agricultural prices would raise agricultural wages by 1.52%, and the return to capital in agriculture by also 1.52%. Higher agricultural prices increase agricultural output and draws labor from other sectors. Movements of from other sectors to agriculture lower the return to capital in those sectors. Every 1% increase in the price of manufactures would raise the wages of managers by 0.02% while the production wages would rise 1.02% and the return to manufacturing capital rises 1.10%. In services, professional wages and capital returns are most closely tied to price. Some factors benefit and others lose with any price change, and the effects are uneven. Price changes affect returns to specific capital more than shared labor.

Thompson and Toledo (2000) prove that the comparative static effects of price changes on factor prices are the same for all CES production functions. The degree of substitution, if constant along isoquants, has no effect on the general equilibrium elasticities of factor prices with respect to prices in competitive models of production. Comparative static elasticities in Table 5 extend to all CES production functions regardless of the degree of substitution.

Table 6 shows price elasticities of outputs along the production frontier, with a higher price raising output in a sector as it draws labor away from other sectors. The largest own output effect occurs in agriculture, where every 1% price increase raises output 0.52%. All effects are inelastic with the smallest own effect in service.

Table 6. Elasticities of Output with Respect to Output Prices

	^pA	^pS	^pM
^xA	0.5244	-0.3676	-0.1568
^xS	-0.0058	0.0262	-0.0203
^xM	-0.5360	0.4199	0.1161

5. Projected Adjustments with FTAA

Literature on impact of NAFTA on the US agricultural, service, and manufacturing sectors (Marchant and Rupel, 1993; USDA/ERS 1998a; Boyd, Krutilla, and McKinney, 1993; Wall, 2000; Weintraub et al., 1991; Hanson, 1994)) indicate the agricultural sector will suffer under NAFTA, especially in the Southeast but export of service goods to Mexico will increase. They however, differ on manufacture. Some claim export of automobile and petrochemical to Mexico would increase while that of other manufactured goods will fall. Based on the literature, we assume the prices of agricultural, textile and apparel manufacturing goods will fall; prices of manufacturing goods would stay the same while service goods would rise. The effect of changing prices on factor prices depends on the interplay of factor intensity and substitution as output adjust. Sensitivity analysis is discussed.

Projected price changes are multiplied by the matrix of factor price elasticities in Table 5 to find the vector of price adjustments in Table 8. Wages fall with FTAA with the exception of agriculture and production wages, which fall with lower relative price of agriculture manufactures. Service capital modestly benefits with a 0.05% increase in its return. Capital returns fall 0.09% in agriculture and .06% in manufacture with the falling prices in those sectors.

Table 8. Factor Prices and Outputs Adjustments (5%)

	Projected Price Change		Factor Price Adjustments		Output Adjustments
		wMgr	0.0484		
		wProf	0.0508		
		wSer	0.0524		
		wClrk	0.0521		
		wAgr	-0.0868		
		wProd	-0.0601		
		eE	0.0447		
A	-5%	**rA**	-0.0868	**xA**	-0.0368
S	5%	**rS**	0.0526	**xS**	0.0026
M	-5%	**rM**	-0.0585	**xM**	0.0420

The effects of FTAA on outputs are found by multiplying the output elasticities in Table 6 by the projected vector of price changes. Output declines by .04% in agricultural, while service and manufacturing output increase .03% and .04%.

Regarding sensitivity, factor price changes are proportional to the vector of price changes. For instance, if out prices change only half as much factor price changes would be half as large as in Table 8. Further, factor price adjustments are identical with any degree of CES production and output adjustments are scaled accordingly. For instance, CES = 0.5 implies output adjustments half as large as in Table 8.

6. Conclusion and Policy Recommendations

Potential adjustments due to FTAA can be broken down into factor income redistribution using applied models of production and trade. The specific factors model provides some insight into the potential income redistribution in North Carolina as a result of FTAA. The main lesson is that input markets adjust as the economy moves along its production frontier toward a new production pattern caused by changing prices. North Carolina agriculture and manufacture are projected to suffer falling prices and import competition, while service is projected to enjoy higher prices and expanded export opportunity.

Predicted output adjustments in the present model are very modest but projected factor price changes are quite large. Wages of all but agricultural and manufacturing labor are projected to rise with FTAA, with the return to capital in service projected to increase. Returns to capital in agriculture and manufacture are predicted to fall considerably.

With falling output in agriculture, an increase in the number of displaced workers could occur as more agricultural workers move from rural to metropolitan areas. Metropolitan unemployment could rise temporarily, deepening the economic crisis. The problem of underemployment should also be considered a potential short run cost of FTAA, as a larger informal sector would offer low pay and few benefits. Economic policy might be designed to provide farmers with alternative incomes and markets. Incomes to agricultural firms could be raised by assisting farmers to form new generation cooperatives that will export high value added products both regionally and globally.

Also, increase in investment in a competitive and more efficient North Carolinian economy could result in higher income in the long run for every factor of production. The present results are not an indictment of FTAA but might be used to recognize that various sectors and factors of production stand to lose with FTAA, at least short of investment, retraining, and relocation. Policies designed to anticipate the effects of income redistribution in the United States should be considered to minimize potential losses that could result in public outcry. If such measures are taken, the political struggle to establish FTAA might be easier allowing the long term benefits of free trade to become apparent. These tangible results certainly exceed temporary losses, but political response can be anticipated during FTAA adjustment.

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