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AN EMPIRICAL ANALYSIS OF THE DETERMINANTS OF EARNING AND EMPLOYMENT: DOES TRADE PROTECTION MATTER?

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Empirical studies that directly analyze the effect of trade policies on earnings and employment across countries is notably absent in the international trade literature. Most of the previous work focuses on the effects of trade policy on income distribution and economic growth. This paper differs from the earlier studies in that it directly analyzes the effect of trade policies on earnings in the manufacturing and agricultural sectors, and on the unemployment rate. A theoretical model that accounts for cross-sector labor migration and urban unemployment is developed. Reduced form equations derived from the model are analyzed empirically via cross-country regression analysis. Besides trade policy, machine use in the agricultural sector, per capita land holdings, capital investments in the manufacturing sector and the adult literacy rate are the other explanatory variables incorporated in the empirical analysis.

Keywords: Tariffs, Employment, Earnings, Rural, Urban
JEL classification: F16, F14, O19

1. INTRODUCTION

In the empirical international trade literature, cross-country studies of the effects of trade policies have been limited to studying the relationship between trade policies and economic growth (refer to Edwards (1998), and Harrison (1996)) or income distribution (Bourguignon and Morrison (1990), Edwards (1997)). There is a notable lack of work examining the direct impact of trade policies on wages and employment across countries. Most studies pertaining to this issue deal exclusively with the US economy or other OECD countries (Borjas and Ramey (1994), Lawrence and Slaughter (1993), Sachs and Schatz (1994)). In this paper, the determinants of earnings and employment across countries are examined with special emphasis on trade policy.

A simple general equilibrium trade model with two sectors, agriculture and

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manufacturing, is developed with both sectors producing tradeable commodities. This model incorporates sector specific factors of production, labor migration between sectors and urban unemployment. Reduced form equations derived from the theoretical model serve as the basis for the empirical analysis. Hence, instead of using adhoc equations for estimation purpose, the ones used in this paper are motivated by theory. Since trade protection is generally prevalent in different degrees in the different sectors of the economy, the import tariff rate on manufactures relative to that of agricultural goods is taken as the measure of trade policy in order to account for changes in relative prices.[1] Agricultural land per worker and agricultural machine per worker are considered to be factors of production specific to the agricultural sector, while capital per worker in the manufacturing sector and the adult literacy rate are taken as factors of production specific to the manufacturing sector. Some of these variables are unique to this study.

The empirical results suggest that relative trade protection to manufactures did not have a significant effect on earnings of the agricultural sector, the earnings of the manufacturing sector and on the unemployment rate. The factors that had a positive and significant impact on agricultural earnings were agricultural machine use and agricultural land per worker, along with capital investment in the manufacturing sector and the adult literacy rate. Most of these variables appear to be have had a positive impact on manufacturing earnings as well. Almost all the explanatory variables had an insignificant impact on the unemployment rate.

In Section 2, a theoretical model is developed which provides reduced form equations for agricultural earnings, manufacturing earnings and the unemployment rate. Section 3 discusses the empirical work and Section 4 provides the conclusions and implications of this study.

2. THE THEORETICAL MODEL

Consider a small country with an agricultural and a manufacturing sector. Labor is mobile between the two sectors and both sectors employ factors of production that are sector specific. Both sectors produce tradable commodities. The agricultural sector is mostly rural based and we assume that this sector has a fully employed labor force. The manufacturing sector, on the other hand, is mostly based in urban areas.[2] Unemployment is assumed to exist in the urban region and is incorporated in the model via the efficiency wage mechanism (Shapiro and Stiglitz (1984), Summers (1988), Chadda *et al.* (1993)). It is assumed that manufacturing firms care about worker effort (λ_u) when

[1] Tariffs are considered to be the only measure of trade protection due to limited data on non-tariff barriers.

[2] Henceforth, manufacturing sector is used synonymously as urban sector and the agricultural sector is used synonymously as the rural sector.

making decisions, which in turn depends on the relative attractiveness of the incentives to work hard and stay on the job versus opportunities outside the firm. Incentives within the firm are reflected by the firm's wages and those outside the firm depend on the urban employment rate. The higher the urban employment rate, the greater the likelihood of getting a job if a worker loses his current job. This means that for any wage rate, worker effort increases with a fall in the employment rate.
Hence, in general terms the effort of a worker in an urban firm can be expressed as,

$$\lambda_u = \lambda_u(W_u, E)\,. \tag{1}$$

W_u is the urban wage rate and E refers to the urban employment rate as indicated below,

$$E = \frac{L_u}{N_u}\,, \tag{2}$$

where $N_u = \overline{L}_u + M$.

L_u is the employed labor force of the urban sector and N_u is the total urban labor force. $\overline{L}_u$ consists of the original inhabitants of the urban sector and M refers to the accumulated net migrants from the rural region.[3] Labor is drawn to the urban region from the rural region with the prospect of higher wages and employment. Labor migration continues until the point of equalization of the rural and urban expected wages. The expected earnings of the rural sector is the actual rural wages, while that of the urban sector is the actual wages times the probability of getting a job, which is taken to be the urban employment rate. Hence, rural and urban sectors are linked by the labor-allocation migration equation (Harris-Todaro (1970)) given below,

$$W_r = EW_u\,. \tag{3}$$

where, W_u is the urban wage rate, E is urban employment rate and W_r is the rural wage.

The urban (manufacturing) firm maximizes profit with respect to wages and the level of employment, given the employment rate of the economy as a whole (*E*). Hence, the

[3] All variables are evaluated at a particular point in time. To keep things simple the growth rate of population is not incorporated explicitly in the model. However, since all variables are evaluated at a particular time period, $\overline{L}_u$ implicitly incorporates the natural growth rate of the original urban labor force up to that time period.

profit-maximizing problem of the urban firm can be expressed as:

$$\max_{L_u, W_u} P_u X_u(L_u \lambda_u(W_u, E), \overline{K}_u) - W_u L_u - R_u \overline{K}_u \,. \tag{4}$$

Here, $L_u \lambda_u$ is labor measured in efficiency units or the effective labor input. $\overline{K}_u$ refers to the capital stock that is specific to the urban sector. R_u is the interest rate in the urban sector and P_u is price of manufactures relative to agricultural goods. The agricultural good serves as a numeraire of the system.

From Equation (4), we can derive the equilibrium wage rate and the employed labor force in the urban region as follows,

$$\square_u = \square_u\left(\overline{\square}_u + \square, \square_u, \overline{\square}_u\right), \tag{5}$$

$$\square_u = l_u\left(\overline{\square}_u + \square, \square_u, \overline{\square}_u\right), \tag{6}$$

Substituting (6) into (2) gives the employment rate of the urban sector as stated below,

$$E = e\left(\overline{\square}_u + \square, \square_u, \overline{\square}_u\right). \tag{7}$$

The lower case letters depict the equilibrium values of the variables.

Contrary to the urban region, in the rural (agricultural) sector, full employment of labor is assumed to exist. This implies that the number of people employed ($\square_r$) is equivalent to the rural labor force (N_r), which consists of the original inhabitants of the rural sector minus the net migrants from the rural to the urban region, i.e., $N_r = \square_r = \overline{\square}_r - \square$. Rural firms are assumed to be price takers and profit maximizers and rural wages adjust to ensure full employment of labor.

$$\text{Hence } \square_r = \frac{\partial X_r\left(\overline{\square}_r - \square, \overline{\square}_r\right)}{\partial \square_r} \tag{8}$$

Here, X_r is the output of the rural sector and $\overline{\square}_r$ refers to the factors of production specific to rural areas. From (8), we can derive the optimal rural wage as,

$$\square_r = \square_r(\overline{\square}_r - \square, \overline{\square}_r) \,. \tag{9}$$

By substituting Equations (5), (7), (9) into (3), we can derive the cumulative rural to

urban net migration □ explicitly as,

$$\square = m\left(\overline{\square}_u, \overline{\square}_r, \square_u, \overline{\square}_r, \overline{\square}_u\right). \tag{10}$$

In Equation (10) $\overline{\square}_u$, $\overline{\square}_r$, $\overline{\square}_r$, $\overline{\square}_u$ are given exogenously. As regards prices, given the small country assumption, $\square_u$ is just the world price of manufactures relative to agricultural goods, adjusted by the trade polices of the respective country. With tariffs imposed on both agricultural and manufacturing goods, the change in $\square_u$ ($\Delta\square_u$) as a result of these tariffs indicates the amount of protection provided to the manufacturing sector relative to that of the agricultural sector.

We can solve for the change in the price of manufactures relative to agricultural goods as:

$$\Delta\square_u = \eta_u = \frac{t_m - t_a}{1 + t_a}. \tag{11}$$

t_m is the tariff rate imposed on manufactured goods and t_a is the tariff rate on agricultural products. A value of $\eta_u > 0,$ implies that the manufacturing sector is protected relative to the agricultural sector, and $\eta_u < 0,$ implies that the manufacturing sector is being taxed relative to the agricultural sector.

By substituting (11) into (10) and then into (5), (7) and (9) we get, $\square_r$, $\square_u$, and E as functions of all the exogenous variables of the model as depicted below. The hypothesized direction of change derived from comparative statics is stated in the equations.[4]

$$\square_r = \square_r\left(\underbrace{\overline{\square}_u - \square\,(.\eta_u, \overline{\square}_u, \overline{\square}_r.)}_{\substack{+\\-}}, \overline{\square}_r\right) \tag{12}$$

$$W_u = w_u\left(\underbrace{\overline{L_u} + M(.\eta_u, \overline{K}_u, \overline{K}_r.)}_{\substack{+\\-}}, \underbrace{P_u(\eta_u)}_{+}, \overline{K}_u\right) \tag{13}$$

[4] These results are available from the author upon request.

$$E = e\left(\underbrace{\overline{L_u} + M(.\eta_u, \overline{K}_u, \overline{K_r}.)}_{+ \quad + \quad - \quad - \quad +}, \underbrace{P_u(\eta_u)}_{+}, \overline{K}_u \right). \tag{14}$$

Increased relative protection to manufactures affects rural (agricultural) wages indirectly through its effect on labor migration. Higher relative protection to manufactures is expected to stimulate greater rural to urban labor migration, increasing agricultural earnings. Urban (manufacturing) wages and the urban employment rate, on the other hand, are affected from two angles; direct positive effect through change in prices and indirect negative effect due to increased migration from rural areas. The final outcome depends on the relative strength of the two effects.[5] Similarly, sector specific factors of production have a direct effect on earnings and employment and an indirect effect through labor migration. Increase in capital specific to rural areas directly increases rural earnings, on the one hand, and has an indirect negative effect by reducing the outflow of migrant labor to the urban region. This latter effect stimulates urban earnings and employment, resulting in an indirect positive effect of factors specific to the rural region on the urban region. Similarly, factors specific to urban region directly raise urban earnings and employment and also have an indirect negative effect by stimulating increased migration from the rural areas. This latter effect now has a positive effect on rural earnings. Again the final outcome depends on which of the two effects are stronger.

In the next section, Equations (12), (13) and (14) are analyzed empirically using a cross-country data set.

3. EMPIRICAL ANALYSIS

The main purpose of the empirical analysis is to examine the determinants of the difference of earnings and employment across countries, using Equations (12), (13) and (14) as the basic framework for the estimation procedure. Hence, the equations used in the empirical study are consistent with the theoretical model.

3.1. Description of Variables, Data and Methodology

In estimating Equations (12), (13) and (14), effort was made to include all countries for which relevant data was available. The countries used in the analysis and the

[5] Using Cobb-Douglas production functions we can show that the price effect outweighs the migration effect. These results are available upon request.

descriptive statistics are provided in the Appendix. Due to lack of data on agricultural wages (w_r) in most countries, the value added per worker in the agricultural sector is used as a measure of agricultural earnings. Average hourly earnings in the manufacturing sector, average annual manufacturing wage and value added per worker in the manufacturing sector are all used to measure manufacturing earnings (w_r). The unemployment rate of the country is used as a measure of the urban unemployment rate. Factors specific to the urban region $(\overline{K}_u)$ were measured by capital employed in the manufacturing industry (per worker) and the by adult literacy rate (as a measure of human capital), while arable land (per worker) and agricultural machines (per worker) represented factors specific to the agricultural sector $(\overline{K}_r)$. Both the simple average and weighted average tariff rates for the agricultural and manufacturing sectors were used to estimate the measure of relative protection (η_u). Some of these variables are unique to this study.

The data for value added per person, annual manufacturing wages, unemployment rate, agricultural machine use, arable agricultural land, the adult literacy rate and average tariff rates were obtained from *the World Development Indicators* (World Bank (2002)). The data on all variables from this source are for the years 1996-1999, and the data for the latest available year is used. Hourly manufacturing wages was from *Import Trade Administration* (1999). Here, the data available was for the years 1997-1999 and the data for the latest available year was used. Data on manufacturing capital were from *Manufacturing Worldwide* (Gale Research (2000)). The data from this source was available for the years 1991-95 and the latest available year was used. The descriptive statistics are reported in Table 6 in the Appendix.

In order to facilitate these estimations, simple linear specifications have been used. All equations are estimated via the Ordinary Least Squares (OLS) method of estimation, with the results corrected for heteroskedasticity using the White (1980) correction procedure. The results from the econometric estimates are given in the next section.

3.2. Econometric Results

The regression results are provided in Tables 1-5. In all tables, the first and third columns use simple average tariff data while the second and last columns use weighted average tariff data. Due to lack of data on capital investment in the manufacturing sector (per worker) for some countries, the analysis was conducted with and without this variable. The first two columns in all tables relate to a larger sample of countries, excluding capital investment in manufacturing. This variable is included for the smaller sample of countries depicted in columns 3 and 4 in all tables. The number of countries included is indicated in the last row in each table.

The regression results for the agricultural sector are in Table 1. The first two columns use simple average tariff. These results indicate that arable land (per worker), agricultural machine use (per worker), capital employed in the manufacturing sector (per

worker) and the adult literacy rate had a positive and significant impact on agricultural earnings. In terms of the theoretical model discussed in Section 2, these results imply that arable land and agricultural machines directly raise agricultural earnings, while capital investment in the industrial sector expand employment opportunities in the urban region, stimulating rural to urban labor migration. Relative trade protection to the manufacturing sector (η_u) had an insignificant effect on agricultural earnings. Given the fact that majority of the population live in rural areas of developing countries, these results reinforce the importance of modernizing the agricultural sectors and expanding employment opportunities in the urban areas of developing countries.

Table 1. Determinants of Agricultural Earnings

	AGVA	AGVA	AGVA	AGVA
Constant	–10498**	–11179**	–10868**	–12993**
Agricultural land per labor force	126.48*	130.02*	118.37*	122.58**
Agricultural machines per 1000 Workers	13.142**	12.858**	10.514**	10.153**
Capital in manufacturing per worker			1.292**	1.327**
LIT	193.05**	192.85**	151.35**	161.01**
η_u (simple)	242.04		294.64	
η_u (weighted)		186.54		300.50
R^2	.541	.540	.616	.614
Breusch-Pagen Chi-Squared	85.988**	77.813**	34.167**	32.971**
Number of observations	78	78	54	54

Note: AGVA = value added per agricultural labor force.

Tables 2, 3 and 4 provide the results for the determinants of earnings in the manufacturing sector. Table 2 uses value added per worker in the manufacturing sector as a measure of manufacturing earnings while Tables 3 and 4 use annual manufacturing wage and hourly manufacturing wage respectively. Arable land per worker, capital investment in the manufacturing sector and the adult literacy rate are found to have a positive effect on urban income. The effect of relative trade protection to manufactures on manufacturing earnings was again insignificant. These results are consistent across all measures of manufacturing earnings. In terms of our theoretical model (specifically Equation (13)), these results suggest that increased adult literary and capital investments in manufactures had a direct positive impact on the earnings of this sector, while increased arable land holdings among agricultural labor force reduced migration from rural areas reducing the dampening effect on urban earnings.

Table 2. Determinants of Manufacturing Earnings: Measured as Value Added per Manufacturing Labor Force

	MFGVA	MFGVA	MFGVA	MFGVA
Constant	–14343**	–13401**	–19815**	–25491**
Agricultural land per labor force	248.82*	263.08*	257.43**	268.79**
Agricultural machines per 1000 workers	10.309	9.905	6.369	5.438
Capital in manufacturing per worker			1.886**	1.94**
LIT	450.41**	417.11**	409.5**	446.21**
η_u (simple)	741.17		619.55	
η_u (weighted)		273.76		694.11
R^2	.253	.242	.559	.558
Breusch-Pagen Chi-Squared	14.597**	10.826**	25.538**	22.693**
Number of observations	72	72	57	57

Notes: MFGVA = value added per manufacturing labor force. * (**) indicates significance at 10% (5%) level.

Table 3. Determinants of Manufacturing Earnings: Measured as Annual Manufacturing Wages

	MFGW	MFGW	MFGW	MFGW
Constant	–5520.9**	–5882.2**	–10550**	–11380**
Agricultural land per labor force	118.06*	119.28*	113.45**	116.86**
Agricultural machines per 1000 workers	8.062	7.942	6.015	5.860
Capital in manufacturing per worker			0.428	0.448*
LIT	131.74**	133.41**	184.97**	185.93**
η_u (simple)	76.039		179.35	
η_u (weighted)		83.669		145.77
R^2	.456	.456	.506	.503
Breusch-Pagen Chi-Squared	127.87**	124.95**	55.68**	51.83**
Number of observations	77	77	57	57

Note: MFGW = average annual wage per worker in the manufacturing sector.

Table 4. Determinants of Manufacturing Wage: Hourly Wage Rate per Worker

	MFGWH	MFGWH	MFGWH	MFGWH
Constant	–6.867**	–7.789**	–4.678**	–6.676
Agricultural land per labor force	0.047	0.048	0.053**	0.053**
Agricultural machines per 1000 workers	0.003	0.003	0.002	0.002
Capital in manufacturing per worker			0.0005**	0.0005**
LIT	0.114**	0.121**	0.069**	0.089**
η_u (simple)	0.082		0.052	
η_u (weighted)		0.101		0.126
R^2	0.400	0.400	.514	.517
Breusch-Pagen Chi-Squared	71.64**	68.20**	23.21**	24.10**
Number of observations	65	65	47	47

Notes: MFGWH = average hourly wage per worker in the manufacturing sector. * (**) indicates significance at 10% (5%) level.

Table 5 provides the results for the unemployment rate. Almost all variables had an insignificant or inconsistent impact on the unemployment rate. Judging from the value of the R^2 we may conclude that the explanatory variables incorporated in our study did not account for a significant part of the variation in the unemployment rate across countries.

Table 5. Determinants of Unemployment

	UNEMP	UNEMP	UNEMP	UNEMP
Constant	23.817**	27.025**	9.994**	15.369**
Agricultural land per labor force	.007	.005	–.0007	–.001
Agricultural machines per 1000 workers	–0.0007	.0002	–.001	–.0003
Capital in manufacturing per worker			–.0001	–.0002
LIT	–0.160	–0.189**	.005	–.050
η_u (simple)	0.160		–.083	
η_u (weighted)		–0.656**		–.478
R^2	0.11	0.188	.032	.0914
Breusch-Pagen Chi-Squared	37.07**	50.28**	8.872**	29.842**
Number of observations	77	77	54	54

Note: * (**) indicates significance at 10% (5%) level.

4. IMPLICATIONS OF RESULTS AND CONCLUSIONS

In this paper, a simple theoretical model provides reduced form equations for earnings and employment that are estimated empirically using cross-country regression analysis. Supporters of trade protectionist polices generally claim that trade liberalization generates reduced income and increased unemployment. The empirical results of this paper counter this argument. We find that relative trade protection to manufactures did not have a significant impact on earnings of the agricultural sector, manufacturing earnings and on unemployment rate. Instead, increased use of agricultural machines and arable agricultural land per worker, along with increased employment opportunities in the urban sector, demonstrated by increased capital investment in the manufacturing sector, seem to be instrumental in raising agricultural earnings. Increased capital investment in the urban region had a significant positive impact on industrial earnings and the unemployment rate as well. A higher adult literacy rate also appears to have a positive impact on manufacturing and agricultural earnings. Hence, augmentation of the basic factors of production rather than trade restrictive measures appears to be the major determinants of earnings.

The results suggest that in developing countries, many of which are characterized by a dualistic economic setup, governments should try to expend their resources in modernizing the agricultural sector, increasing arable land holding per worker, and formulate policies that encourage capital investments in urban regions and increase the literacy rate. Analyzing these results from a different angle brings into question the supposed gains that are to accrue to developing countries by their increased participation in the international trade regime. Since tariffs do not seem to play a significant role in determining earnings and employment, will their reduction have a positive effect?

APPENDIX

Countries included in the empirical study:

Algeria, Argentina, Australia, Austria Bangladesh, Belarus, Belgium, Bolivia, Brazil, Canada, Chile, China, Columbia, Costa Rica, Cote d' Ivori, Denmark, Dominican Republic, Ecuador, Egypt, El Salvador, Finland, France, Germany, Greece, Guatemala, Honduras, Hungary, India, Indonesia, Ireland, Italy, Jamaica, Japan, Korean Republic, Latvia, Lithuania, Malawi, Malaysia, Malta, Mauritius, Mexico, Moldova, Morocco, Mozambique, Nepal, Netherlands, New Zealand, Nicaragua, Nigeria, Norway, Oman, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Portugal, Romania, Saudi Arabia, Singapore, Slovania, South Africa, Spain, Sri Lanka, Sweden, Switzerland, Taiwan, Tanzania, Thailand, Trinidad and Tobago, Tunisia, Turkey, Ukraine, United Kingdom, United States, Uganda, Uruguay, Venezuela, Vietnam, Zambia, Zimbabwe

Table 6. Descriptive Statistics

Variables	Mean	Minimum	Maximum	Std. Deviation	# of obs.
Average annual agricultural value added per worker (source WB year)	$10467	$136	$52810	14837	78
Average annual manufacturing value added per worker (source: WB)	$29320	$1042	$139400	27353	73
Average annual manufacturing wage per worker (source: WB)	$9454	$346	$38420	10943	78
Average hourly manufacturing wage per worker (source: ITA)	$5.059	$0.1600	$24.54	5.739	65
Agricultural machines per 1000 workers (source: WB)	334.10	0.145	4190	628.58	83
Arable land per worker in hectares (source: WB)	8.07	.024	111.7	17.746	83
Simple average manufacturing tariff rate (source: WB)	10.65	0	46.90	7.909	83
Simple average agricultural tariff rate (source: WB)	13.918	0	42.70	8.646	84
Weighted average manufacturing tariff rate (source: WB)	9.839	0	44.40	7.909	83
Weighted average agricultural tariff rate (source: WB)	9.476	0	32.40	7.766	83
η_u (simple)	–2.756	–20.45	5.314	4.185	84
η_u (weighted)	0.487	–13.22	14.42	4.185	84
Adult literacy rate (percentage) (source: WB)	86.36	40.00	100.0	16.63	84
Annual capital investment in manufacturing per worker (source: MFG)	$5287.1	$97.00	$32580	5603.6	58
Unemployment rate	10.22	1.6	50.00	8.35	78

Notes: WB = World Bank (2002) (Data for all variables is between (1996-1999 (latest available)). ITA = Import Trade Administration (1999) (Data is for the years 1997-1999 (latest available)). MFG = Gale Research (2000) (Data is for the years 1991-1995 (latest available)).

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