WAGE DIFFERENTIALS AND TRADE RELATIONSHIPS IN JAMAICA: APPLICATIONS OF TRUNCATED REGRESSION MODELS AND REPEATED CROSS-SECTION DATA

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Abstract

Labor and skill premiums and their relationships with trade measures are simultaneously estimated within the framework of an individual level labor supply model for Jamaica using truncated regression models. Increased imports from the US were found to reduce the return to unskilled labor, and increase the skill premium in Jamaica. Increased exports to the US had the opposite effects on returns to Jamaican skilled and unskilled labor.

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WAGE DIFFERENTIALS AND TRADE RELATIONSHIPS IN JAMAICA: APPLICATIONS OF TRUNCATED REGRESSION MODELS AND REPEATED CROSS-SECTION DATA

During the late 1980s and early 1990s the Jamaican economy experienced a period of profound change: a wider and deeper commercial opening to trade and foreign investment; the privatization of many state-owned enterprises; major tax reform; deregulation of industry; and a major restructuring of the financial sector. These reforms coincided with dramatic changes in the Jamaican labor market. During the 1989-1998 period the average real wage and employment grew by 26.8% and 6% respectively (World Bank (1999)). These changes were accompanied by a dramatic increase in wage inequality across and within education and experience groups. Workers with post-secondary education and more experience saw their wages rise rapidly while less-skilled workers experienced only slight wage growth.

In this paper we combine pooled cross-sectional household survey data with annual trade measures for the period 1990-1998 to assess the extent to which the increase in the skilled-unskilled wage gap was associated with the opening of the Jamaican economy. It is noteworthy that the most radical trade reforms over the last 2 decades have occurred in developing countries, and usually, the agricultural sector is the most significantly affected. Yet almost all the existing studies on trade-related labor adjustment tend to focus on industrial countries and their manufacturing sector (Davis and Haltiwanger, Bound and Johnson, Katz and Murphy, and Davis). Several recent studies link the rise in USA wage inequality to the increased openness of the USA economy. They argue that competition from low-wage countries has reduced the relative demand for unskilled workers and caused their wages to fall relative to those of skilled workers (Leamer (1993), (1998); Wood (1994), (1998); Feenstra and Hanson). Other studies conclude that the role of trade is small, and instead associate rising wage inequality with

technological change (Davis and Haltiwanger; Bound and Johnson; Lawrence and Slaughter; Berman, Bound and Griliches). The reasoning here is that the advent of computer technology has made skilled workers increasingly more important in the workplace, and, as such, occupation-specific, rather than industry-specific, effects better explain the growing wage dispersion.

This focus in the literature on developed countries is unfortunate. If trade is contributing to wage changes in developed countries, then we should observe opposite wage movement in developing countries. If global skill-biased technological change is the cause of relative-wage changes, then we should observe similar relative wage movements in high-wage and low-wage countries. The empirical analysis in this paper will demonstrate that, for the Jamaican experience, increases in returns to education are associated with particular tasks related to industries, and will determine the relationships between trade liberalization, wages, and the rewards to skill for different categories of workers. The paper also tests the hypothesis that trade reforms in developing countries should be accompanied by employment and wage increases due to a reallocation of output toward low-skill, labor-intensive products. Given Jamaica's proximity to the United States and its recent economic reforms, the country is an ideal candidate in which to look for such changes.

Economic Model

The simple Heckscher-Ohlin (H-O) trade model is the most commonly used in conducting analyses of the contribution of trade and other factors to wage inequality. From the model framework Stolper and Samuelson derived the factor price equalization theorem. Abrego and Whalley have shown that the simple H-O type model framework proves unsatisfactory for the task of decomposing data on wage inequality into separate trade and technology components

because of the near linearity of the production function, and the associated problems of specialization.

In order to avoid the inherent problems of the H-O type models, and given the enormous data requirements for analyzing such general equilibrium models, it is useful to consider a second approach that uses the inter-industry variation in wages to assess the relationship between increased trade liberalization and the relative return to skill. This approach has the advantage of being both empirically tractable and policy relevant. Much of the concern about heightened trade is its effect on "good jobs"--sectoral jobs that pay above average wage--an issue that requires one to deviate from models in which all similar workers receive the same return, regardless of the sector in which they are employed. Indeed such inter-industry wage premiums for comparable workers are a ubiquitous "fact of life" for both industrial and industrializing countries (Cragg and Epelbaum, Krueger and Summers).

The existence of inter-industry wage premiums may be attributable to the fact that the industry of affiliation is important per se--as in the case of compensating differentials. It may also be that industry affiliation is systematically correlated with unobserved worker attributes--as would result from a worker sorting process based on unobserved ability.[1] For this study, a broad version of the former approach is taken, treating industry premiums as compensation for particular industry characteristics.

The labor market is modeled in a partial equilibrium context and a general form of compensating differentials is assumed to explain the existence of industry-specific wages. Each firm takes the market wage as given, but pays a premium to compensate workers for loyalty, firm-specific skill acquisition, or for the disutility for higher effort, longer work weeks and

[1] Gibbons and Katz show that it may be from both, and provide a thorough discussion of the possible sources of wage premiums

unpleasant or risky working conditions associated with employment in the industry. Firms are assumed to face two distinct labor market-segments, one for unskilled workers and another for skilled workers. It is assumed that the (dis)utility arising from employment in the industry varies within the population and that workers in each market-segment can be arrayed from those who experience low to those who experience high (dis)utility from working in a given industry. Based on these supply conditions, a firm in a particular industry faces an upward sloping supply curve for labor of either type.

The demand curve for each type of labor for a given industry is assumed to be downward sloping. It is conceived that changes in the volume of trade constitute shocks to the demand for labor. Changes in the volume of trade arise outside the industry from fundamental shocks such as endowment changes in trading partners or in the global demand for industry output. For this unskilled-labor abundant economy, it is assumed that imports substitute for skilled labor-intensive activities within the industry. Consequently, an increase in imports in the same industrial classification is viewed as a negative shock to the demand for skilled labor. Given an upward sloping supply of labor to the industry, this shock should result in a reduced premium for skilled workers. If the size of the industry is held constant, increased imports imply a shift within the domestic industry toward labor-intensive activities. It is therefore expected that increases in imports are associated with a higher premium for unskilled workers. The higher premium is necessary to attract additional workers--who have a higher disutility from industry characteristics--into the industry.

Increased industry exports are assumed to correspond to increased demand for unskilled labor, just as imports do. Exports are likely to be based on comparative advantage, and, thus, to raise the relative demand for labor-intensive inputs and processes, and lower demand for skilled

workers. Thus a larger flow of exports, like imports, should be associated with a higher premium for unskilled labor and a lower premium for skill.

This model presents a framework for thinking about the effects of trade shocks on industry-specific returns to skilled and unskilled labor. With some additional theoretical assumptions, the model framework can also be used to determine the effects by type of trading partner. Following Lovely and Richardson who developed on Ethier's model of international division of labor and Feenstra and Hanson's model of outsourcing, the country can be involved in "vertical" and "horizontal" trade with different trading partners. Vertical trade takes place between a developed country and a developing country. The former is assumed to have an abundance of human capital and thus produce goods that use this factor intensively. Trade between the two then, will likely be characterized by an exchange of skill-intensive final manufactures from the developed country, and raw materials and labor-intensive producer intermediaries from the developing country. The foregoing comparative static for the basic model will obtain for the case of vertical trade. That is, in the given framework, the distributional pattern of the effects of trade on wage premiums, will essentially be the same if either aggregate trade, or trade with developed countries, is considered--both imports and exports should be associated with higher premiums for unskilled labor, and lower premiums for skilled labor.

Horizontal trade between partners will take place where both partners are assumed to have similar endowments and are involved in similar productive activities. The goods from such activities are traded freely between the two, and factor-price equalization will obtain in equilibrium. As such, these partners together are treated as an integrated equilibrium. For a small open economy with an abundance of unskilled labor, trade with another developing country with

similar endowments can be assumed to be horizontal. Such trade will likely be in producer intermediaries and small manufactures that use the abundant factor, unskilled labor, intensively.

With these assumptions, it is conceived that within this integrated equilibrium, an increase in industry imports from one developing country to the next is a negative shock to the demand for unskilled labor in the domestic industry. Imports from developing countries are viewed as substitutes for labor-intensive inputs and processes, reducing the demand for unskilled labor in the domestic industry. This shift in the demand for unskilled labor moves the industry down the labor supply curve, reducing the premium paid to less skilled workers. If industry size is held fixed, the composition of domestic production shifts away from labor-intensive activities toward skill-intensive activities. Thus, an increase in imports from other developing countries should be associated with an increase in the premium paid to skilled labor in the domestic industry.

Conversely, industry exports to developing country partners are expected to raise the relative demand for unskilled workers and lower the demand for skilled workers within industries. Such exports should therefore be associated with higher premiums for pure labor and lower premiums for skilled workers.

A summary of the distributional pattern of the wage effects of trade, in aggregate, and by different trading partners, is presented in Table 1. In the following section this conceptual framework is used to develop methods for estimating the correlations between wage premiums and trade flows.

The magnitude of the wage premiums across industries, and hence the magnitudes of the wage correlations are, however, indeterminate. When hiring from a large pool of unskilled labor, firms may not have the incentive to pay wages in response to product changes, especially in an

environment where unionization and minimum wages are ineffective. Discussing the inter-relationships of a wage-gap model for the Jamaican case, Tidrick points out that the level of unemployment is a function of the wage structure, and wage increases in the high-wage sector alter the wage structure and also make unemployment more attractive for some workers. Agenor also supports the view that for the Jamaican economy, the overall impact of trade liberalization on employment is not certain.

Table 1: Conceptual Pattern of the Directional Effects of Positive Trade Shocks on Wage Premiums: In Aggregate, and by Trading Partner

	Total Trade		Developed Partner		Developing Partner	
	Labor Premium	Skill Premium	Labor Premium	Skill Premium	Labor Premium	Skill Premium
Industry Imports	+	-	+	-	-	+
Industry Exports	+	-	+	-	+	-

Empirical Specification

The econometric approach adopted here--first used by Lovely and Richardson--is to simultaneously estimate an industry premium to pure labor, an industry-specific return to education (skill), and the relationship of these premiums to trade flows. Earlier approaches, by contrast, first estimated the wage premiums, and then related these through a second stage to industry trade flows (Dickens and Katz, Dickens and Lang, Katz and Summers, and Gaston and Trefler).

Let i = 1,2,…, Ij index workers in industry j, and t = 1,2,…., T for the years covered by the sample. Let ln (w_{ijt}) be the natural logarithm of the hourly wage of individual i in industry j in year t, X_{ijt} be a vector of individual characteristics that affect wages (Mincer), S_{ijt} the years of schooling of individual i in industry j, T_{jt} a vector of measures of trade flow for industry j, and Z_{jt}

a vector of industry characteristics other than trade. Estimates are obtained for the following equation for the whole sample period:

$$(1) \qquad \ln(w_{ijt}) = X_{ijt}\beta_x + \sum_{j=1}^{J} D_{ij} w^*_{Lj} + \sum_{j=1}^{J} D_{ij} S_{ijt} w^*_{Sj} + T_{jt-1}\beta^*_L + T_{jt-1} S_{ijt}\beta^*_S + Z_t \rho_L + Z_t S_{ijt} \rho_S + \varepsilon_{ijt}$$

where D_{ij} is a dummy for industry j, β_x, w_{Lj}^*, w_{Sj}^* , β^*_L , β^*_S , ρ_L , and ρ_S are parameters to be estimated, and ε_{ij} is an error term assumed to be independently and identically distributed. Lovely and Richardson interpret the parameter w_{Lj}^* as the average premium paid to pure labor in industry j over the sample period. Likewise, w_{Sj}^* is interpreted as the average premium paid to skill (each year of formal education) in industry j over the period covered by the sample. The parameters β^*_L and β^*_S indicate the respective relationships between w_{Lj}^*, w_{Sj}^* and the measures of trade. The trade measures used in this analysis are trade flow indices: industry imports and exports indexed from the first year in the sample period. The parameter vectors β^*_L and β^*_S are therefore both two column vectors, the former indicating the separate effects of exports and imports on the premiums paid to pure labor in the traded goods industries, the latter determining the effects of exports and imports on the skill premiums paid in these industries. Hypotheses on the relationships between trade and wages can be tested against the estimates obtained for these parameters. Current trade volume shocks are, however, not independent of shocks to industry labor demand curves, (even with the small-country assumption made in the present case), and are therefore endogenous. Revenga highlights the importance of correcting for the endogeneity of the trade variables, pointing out that along with the usual arguments for the large-country case, correlation between trade variables and the disturbances of a wage equation could likely arise through an unobservable worldwide cost shock that can affect the price of the traded good, citing as an example, an unmeasured shock to the cost of input materials. Moreover, since any trade

shock is likely to have a delayed effect on the labor market, the lagged, predetermined values of the trade measures, T_{jt-1}, are therefore used instead.

To control for general-equilibrium factor return changes, that is, economy-wide changes in the return to labor and human capital that affect the economy as a whole but are not related to trade patterns in particular industries, a year trend, and the interaction of this variable with education, are included among the elements of Z_t. Lovely and Richardson also included a variable for industry producer price index and its interaction with skill to control for factor return changes due to changes in industry product prices. These variables were not included in this analysis because of the small-country assumption employed.

Data and Descriptive Statistics

The labor force module of the Jamaica Survey of Living Conditions (JSLC) contains annual wage and employment data for the nine-year period 1990–1998, and may be characterized as repeated cross-sectional data (as against panel data) since the sample of respondents was changed at least twice over this period. The data are statistically representative and are from household surveys that partially describe family composition, human capital acquisition, and experience in the labor market. The data also include information on individuals' occupation and the industry in which employed. The primary sources for data on trade measures and industries are from the STATIN publication, External Trade--various years, and the PIOJ publication, Economic and Social Survey of Jamaica--various years.

The sample is restricted to individuals between 14 and 65 years old who are not retired or permanently disabled, and includes workers from all industries, including those employed outside the traded goods sector. Using the Jamaica Industrial Classification (JIC) four-digit code, workers were grouped to correspond to eight single-digit sections of the Standard International

Trade Classification (SITC)--see the Appendix. The goods group SITC4--animal and vegetable oils and fats--was excluded because of too few observations. Moreover, trade figures for this section are negligible.

Starting with 17,137 observations pooled over the nine-year period 1990-1998, and after deleting for implausible observations and those with no earnings or missing information for individual controls, the sample is left with 15,003 observations.[2] The dependent variable for the wage-equation is the natural log of average hourly earnings, defined as total earned income divided by total hours worked for the reported period, deflated by the average annual Jamaica Consumer Price Index (CPI). Definitions of the control variables, together with some summary statistics are listed in Table 2.

[2] The 1992 dataset (and consequently the 1991 trade measures) was not included in the study sample because of a missing control variable.

Table 2: Definitions of Control Variables and Summary Statistics

VARIABLE	DEFINITION	MEAN[a]	STD. DEV.
Ln(wage)	Natural log of real wage per hour	1.59	1.79
Ln(hours)	Natural log of hours worked weekly	3.73	2.02
Annual Hours	Hours worked weekly*52	2159.14	390.70
SITC0-Food	= 1 if employed in S.I.T.C 0; = 0 otherwise	26.8	44.3
SITC1-Bev&Tobacco	= 1 if employed in S.I.T.C 1; = 0 otherwise	0.4	6.0
SITC2-Crude Materials	= 1 if employed in S.I.T.C 2; = 0 otherwise	0.7	8.5
SITC3-Mineral Fuels	= 1 if employed in S.I.T.C 3; = 0 otherwise	0.8	8.9
SITC5-Chemicals	= 1 if employed in S.I.T.C 5; = 0 otherwise	0.3	5.3
SITC6-Manuf. Goods	= 1 if employed in S.I.T.C 6; = 0 otherwise	1.9	13.6
SITC7-Mach&Transp	= 1 if employed in S.I.T.C 7; = 0 otherwise	0.4	0.066
SITC8-Other Manuf.	= 1 if employed in S.I.T.C 8; = 0 otherwise	4.4	20.6
Age	Worker's Age	36.48	12.43
Skill	Number of years of Formal Education	8.60	2.61
Potex	Potential Experience is age-(skill+6)	21.88	13.72
Potex-squared	Potex*Potex		
Male	= 1 if worker is male; = 0 otherwise	56.0	49.0
Married	= 1 if worker is married	41.0	49.0
HHH	=1 if worker is head of the household; = 0 otherwise	49.0	50.0
LUR	Local (Parish) Unemployment Rate	16.02	4.69
Income2	Secondary Income – Weekly (J$ deflated)	108.25	166.29
Exports	Value of exports (US$'000), by industry, by year	216534	96466
Imports	Value of imports (US$'000), by industry, by year	305731	103243
Trend	Time trend = 1 to 9 for 1990 to 1998	6.1	2.74

[a] The means for all dummy variables are the percentages of the sample for which the variable equals one. The means for Income2 and the trade variables are computed from the proportions of the sample for which these variables are positive – 7.66% and 42.84%, respectively.

Estimation and Results

The sample used for this study is based solely on observations on employed individuals. The sample is thus truncated, and the truncation criterion is that the dependent variable–-wage earnings-–was positive. As is well known (Amemiya), maximum likelihood procedures are necessary to obtain consistent parameter estimates in this case, often referred to as truncated regression models.

Notwithstanding the primary focus of this study, the use of labor force surveys enables more information to be gleaned from the data. The estimation technique applied in this paper also takes into account the simultaneous nature of the wage-hour relationship. Considering only a wage equation would obscure the process by which earnings are generated; they result from a choice of hours of work made by the individual, together with the hourly wage that he commands in the market. When investigating the relationship between personal attributes and productivity, we are particularly interested in the wage per unit of time that the individual commands in the market--his marginal product. This relationship would be partly hidden if we look only at his hourly wage. Furthermore, from an econometric standpoint, the variance of the error term in earnings, the product of hours of work and a wage rate, is larger than that of a wage equation. Thus the accuracy with which we can estimate the effect of personal attributes should be greater if we break the relationship into its component parts. For the JSLC surveys, earnings were reported annually, monthly, or weekly, so that if we consider hourly wage, we must also consider hours worked.

Heckman's model of labor supply explicitly considered the wage-hour relationship. The model is applied to derive a common set of parameters which underlie the functions determining the probability that an individual works, his hours of work, his observed wage rate, and his

asking wage or shadow price of time. As such, the model relaxes the assumption of no labor-leisure choice made in the H-O type model outlined above. The model relies on two behavioral schedules: the function determining the wage an individual faces in the market--the offered wage, and the function determining the value an individual places on his time--the asking wage. If the individual works, his hours of work adjust to equate these wages if he has freedom to set his working hours. If the individual does not work, no offered wage matches his asking wage. By estimating both wage schedules, the estimated parameters can be used to determine the probability that an individual works, his actual work hours given that he works, the potential market wage rates facing unemployed individuals, and the implicit value of time for unemployed individuals.

The two wage functions of Heckman's model are outlined as follows:

(2) $\ln W_i = X_{1i}\delta_1 + \varepsilon_{1i}$ and

(3) $\ln W_i^* = h_i\beta_1 + X_{2i}\delta_2 + \varepsilon_{2i}$

where in equation (3), W^* is the reservation wage of the individual and h is his hours of work, and X_2 includes variables such as asset income and individual characteristics. Equation (2) is the offered wage function, and is the standard human capital earnings function (Mincer). The shadow price function expresses the demand for leisure, or, the marginal value of time, and can be derived in the usual manner as for conventional demand relations for goods.

If an individual is free to adjust his working hours, an employed individual will have W = W* as an equilibrium condition. If the individual does not work, (and hours of work cannot be negative), then W* ≥ W. Since the offered wage is assumed to be independent of hours worked, and the asking wage is assumed to increase with hours worked, a necessary condition for equilibrium to occur is that at zero hours of work, offered wage exceeds asking wage.

Heckman established that for the reservation wage equation (3), if *ln(W) > ln(W*)* at *h*=0, then

(4) $$X_{1i}\delta_i - X_{2i}\delta_2 > \varepsilon_{2i} - \varepsilon_{1i},$$

and hours of work will adjust so that $W = W^*$, the particular adjustment depending in part on the magnitude of the discrepancy $\varepsilon_2 - \varepsilon_1$. Given that condition (4) holds for individual *i*, then the reduced form equations for observed wages and hours become

(5) $$\ln W_i = X_{1i}\delta_1 + \varepsilon_{1i}$$

(6) $$h_i = \frac{1}{\beta_1}(X_{1i}\delta_1 - X_{2i}\delta_2) + \frac{\varepsilon_{1i} - \varepsilon_{2i}}{\beta_1}.$$

Equations (5) and (6) are therefore conditional on the inequality (4), and since the same variables appear in all three equations, the means and variances of the distributions of (5) and (6) depend on the values of the exogenous variables for a particular observation. Heckman pointed out that it is therefore not possible to obtain unbiased or consistent estimates using OLS since the regressors are correlated with the disturbances and showed that this model could yield asymptotically unbiased, consistent and efficient parameter estimates by applying maximum likelihood techniques.

For a sub-sample truncated for individuals with positive earnings, the log-likelihood function for *n* observations for the Heckman model can be written as

(7) $$L = \ln L = \frac{n}{2}\ln D - \frac{1}{2}\sum_{i=1}^{n}\left[(V_{1i}V_{2i})\,\Omega^{-1}(V_{1i}V_{2i})'\right] - \sum_{i=1}^{n}\ln\Phi\left[\frac{X_{1i}\,\delta_1 - X_{2i}\,\delta_2}{\sqrt{\sigma_1^2 + \sigma_2^2 - 2\sigma_{12}}}\right]$$

where *D* is the determinant of Ω^{-1}. For this log-likelihood function, the errors are defined as

$V_{1i} = \ln W_i - X_{1i}\,\delta_1$, and

$V_{2i} = h_i - (X_{1i}\,\delta_1 - X_{2i}\,\delta_2) / \beta_1$.

This log-likelihood function is maximized to obtain estimates for the structural model parameters β_1, δ_1, δ_2, σ_{11}, σ_{22}, and also σ_{12}, the covariance between ε_1 and ε_2. The function is first maximized with respect to β_1, δ_1, δ_2, w^{11}, w^{22}, and w^{12}, the last three being elements of Ω^1. Estimates of σ_{11}, σ_{22}, and σ_{12} are then solved for from the w^{ij} values and β_1, relying on the invariance theorem. Following this procedure yields consistent, asymptotically unbiased, and efficient parameter estimates that are asymptotically normally distributed (Hausman and Wise, Heckman, Amemiya).

The usual rules for identification of the parameters also apply to this model. In the present case, identification is assured since the shadow wage equation would not include the individual's labor market experience or the local unemployment rate. Industry dummies and trade measures are also excluded from the shadow wage equation. Secondary income, a proxy used for the individual's net assets or wealth, enters the shadow wage equation but not the wage-equation. Moreover, hours of work are excluded from the offered-wage equation.

Maximum likelihood estimates for the base model without trade variables are included in Table 3. The model was then re-estimated in turn with measures for total trade, trade with the USA, and trade with Trinidad and Tobago.

Estimates for the wage equation (1) obtained by OLS and single-equation maximum likelihood (truncated regression) reveal that many of the maximum likelihood estimates are larger than the corresponding OLS estimates[3] giving an indication of the bias of the least squares estimates. In particular, the maximum likelihood estimate of the coefficient on education is approximately 50% larger than the corresponding least squares estimate, a finding similar to that obtained by Hausman and Wise. This implies, as was argued in the previous section, that taking

[3] These results are obtainable from the authors.

explicit account of the truncation leads to parameter estimates that are larger than the biased least squares estimates.

The sign of the estimated covariance between the offered wage and the shadow wage in the Heckman model is positive, and thus theoretically consistent, based on the assumption that omitted variables such as ability, quality of schooling, and taste factors will have a positive effect on the wage rate as well as on the number of hours worked or a shadow wage. The ratio of this estimate to its standard error is 8.58 and is therefore significantly different from zero at better than the one percent level. This provides strong evidence that the model is indeed simultaneous. Almost all the coefficients are significant, of the expected sign, and are of reasonable magnitudes, not dissimilar from findings of other studies done for Jamaica--see for e.g., Scott.

Table 3 also displays the fixed-effect estimates of the industry-specific labor and skill premiums obtained from the base regression. A Wald test that this set of parameters is jointly equal to zero is strongly rejected given the statistic value of 5479.4, in comparison to the tabled value for the $\chi^2_{.005}(16)$ of 34.3. The test provides strong evidence that wage differences in Jamaica can be explained by inter-industry labor and skill premiums. Figure 1 depicts the fixed-effect estimates of the industry-specific premiums attached to different amounts of education. Only two industries have rising skill premiums-–beverages and tobacco and chemicals–-while one industry–-machinery and transport equipment–-has a profile that is essentially flat. Most of the SITC groups show premiums that decline as the years of formal education of the employee increase. This declining premium could reflect a variety of factors, including lower industry-specific (dis)utility experienced by more highly skilled workers, greater locational mobility of more highly educated workers, or greater intersectoral mobility of educated workers.

Table 3: Maximum Likelihood Estimates for Control Variables

VARIABLE	Offered-Wage Equation Estimates (Standard Errors)	Asking-Wage Equation Estimates (Standard Errors)
Age ≤ 35	-.025	-.145
	(.011)**	(.034)**
Age ≥ 45	.028	.096
	(.012)**	(.037)**
Experience	.026	
	(.001)**	
Experience-squared.	$-.382\times10^{-3}$	
	$(.165\times10^{-4})$**	
Skill	.108	.037
	(.003)**	(.007)**
Male	.257	-.945
	(.006)**	(.067)**
Married	.113	-.131
	(.006)**	(.030)**
Head of Household	.055	-.215
	(.006)**	(.032)**
Local Unemployment Rate	-.009	
	$(.574\times10^{-3})$**	
SITC0	-.379	
	(.021)**	
SITC1	-.328	
	(.215)	
SITC2	1.006	
	(.126)**	
SITC3	.434	
	(.115)**	
SITC5	-.096	
	(.177)	
SITC6	.104	
	(.095)	
SITC7	.205	
	(.146)	
SITC8	.449	
	(.058)**	
SITC0*Skill	-.012	
	(.002)**	
SITC1*Skill	.047	
	(.021)**	
SITC2*Skill	-.057	
	(.013)**	
SITC3*Skill	-.012	
	(.011)	
SITC5*Skill	.011	
	(.020)	
SITC6*Skill	-.005	
	(.009)	
SITC7*Skill	-.007	
	(.020)	
SITC8*Skill	-.054	
	(.006)**	
Second Income		-.002
		$(.235\times10^{-3})$**
Annual Hours		.0075
		$(.430\times10^{-3})$**
Trend	.059	-.148
	(.003)**	(.012)**
Trend*Skill	-.001	
	$(.378\times10^{-3})$**	
Constant	-.240	-13.725
	(.035)**	(.782)**
$\sigma_1 = .488$	$\sigma_{12} = .102$	$\sigma_2 = 1.990$

* Statistically significant at the .10 level
** Statistically significant at the .05 level

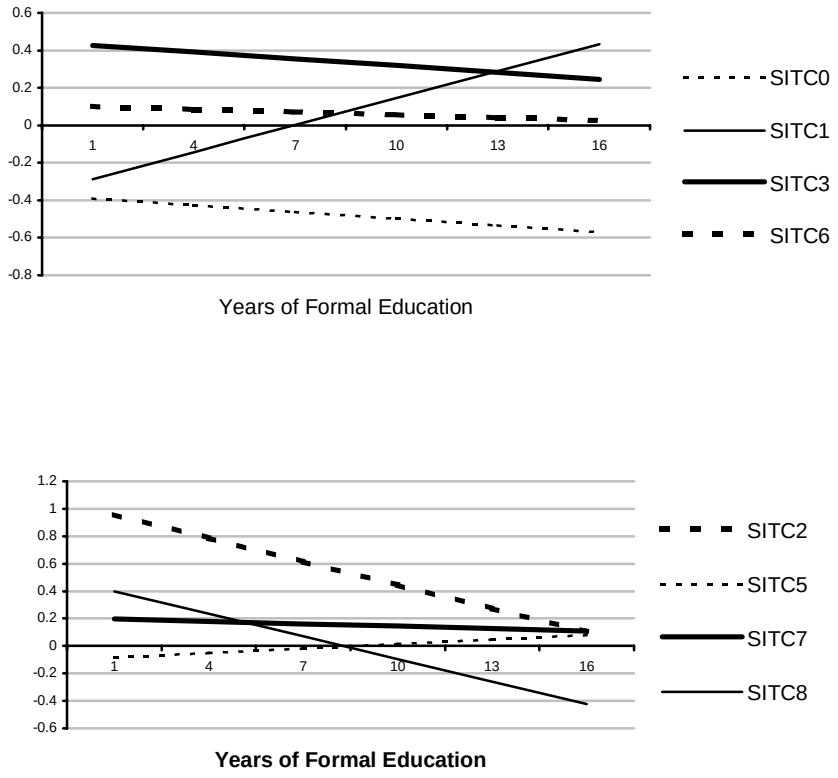

Figure 1: Industry-Specific Wage Premiums by Education Level
(Deviation from Employment-Weighted Average Log Real Wage)

Together, these results for labor and skill premiums suggest that different labor market conditions for skilled and unskilled workers, are an important part of the explanation of industry wage premiums in Jamaica. The existence of industry wage premiums, therefore, may be less a phenomenon of particular industry structure and more a reflection of the local, industry-specific nature of the labor market facing the less skilled.

The main interest is how these wage and skill premiums correlate with measures of trade for Jamaica, both as an aggregate, and disaggregated by different trading partners, represented here by the USA as a developed country (vertical) trading partner, and Trinidad and Tobago as a

developing country (horizontal) partner. Table 4 records the estimates and standard errors of the coefficients on the trade variables in the wage equations.

The sign of the coefficient on a trade measure is interpreted as the sign of the correlation between that trade flow and the return to pure labor (given by the industry-specific intercepts). Similarly, the sign of the coefficient on the interaction between education and a trade measure is interpreted as the sign of the correlation between that trade flow and the return to each year of education for a worker in a specific industry.

Much of the recent literature asserts that skilled and unskilled workers in an industry experience the same industry wage premiums. For comparison purposes, the correlation between such standard premiums (that is, excluding the industry-education interactions) and the measures of trade were also estimated. The results appearing in the first column of Table 4 show that increased imports have a strong positive correlation with Jamaican wage premiums while exports show no significant relationship. Distinguishing skilled workers from those less skilled provides some insight into these results. The second column in Table 4, under the heading "Total Trade", suggests that increased trade, and the direction of trade, have opposing effects on the return to pure labor and the return to skill. It can be seen that the positive effect of increasing imports on the standard premiums is strongly driven by higher premiums for pure labor, while skilled workers experience a lower return--a 10% increase in aggregate imports is estimated to shift industry-specific labor premiums upward by 3% of the average wage, while decreasing the industry-specific rate of return on education by .24%. The opposite effect is suggested for increased export trade--increased exports lead to lower premiums for less skilled workers, and higher premiums for workers with more skill--but these export coefficients are not statistically significant.

Further insight is provided when trade is disaggregated into type of trading partner. For trade with the USA, the distributional pattern is reversed compared to that for aggregate trade. Increased export trade with the USA is associated with higher industry premiums for less skilled workers in the traded goods sectors in Jamaica, and lower premiums for skilled workers. Conversely, higher import penetration from USA goods is associated with lower premiums for the less skilled, but is positively related to wage premiums for skilled workers.

Table 4: Selected Coefficients (Standard Errors) of Real Log Wage on Trade Measures from the Simultaneous Equations Model[a]

	Std. Premium (Standard Errors)	Total Trade		USA Trade		Trinidad Trade	
		Labor Premium (Standard Errors)	Skill Premium (Standard Errors)	Labor Premium (Standard Errors)	Skill Premium (Standard Errors)	Labor Premium (Standard Errors)	Skill Premium (Standard Errors)
Industry Imports	.084 (.030)**	.300 (.066)**	-.024 (.008)**	-.245 (.066)**	.022 (.007)**	-.028 (.011)**	.003 (.001)**
Industry Exports	-.030 (.037)	-.041 (.085)	.008 (.010)	.323 (.050)**	-.025 (.005)**	-.044 (.072)	$.19\times10^{-3}$ (.007)

* Statistically significant at the .10 level
** Statistically significant at the .05 level
[a] Column entries are from separate regressions that include individual controls, industry dummies and their interaction with education, a time trend and its interaction with education.

Trade with less developed countries, as represented by trade with Trinidad, shows a different distributional pattern from that of trade with the USA. As with the USA, increased import penetration from Trinidadian goods into Jamaica is associated with lower wage premiums for the less skilled and higher premiums for skilled workers in Jamaica. The magnitudes are however much smaller–-for any of the eight industries, a 10% increase in imports from the USA will lead to a downward shift in the wage premium paid by that industry by approximately 2.5% of the average wage, and an increase in that industry's specific rate of return on education by about .22%, while a similar increase in imports from Trinidad will shift the industry's wage premium schedule downward by only .3%, and increase the industry-specific rate of return on

education by .03%. Increased export intensity to Trinidad shows no statistically significant impact on wages, but the signs obtained on the estimates suggests lower premiums for the less skilled and higher premiums for the more skilled--which is the reverse effect for exports to the USA.

Using the estimates of w_L^*, w_S^*, β_L^* and β_S^* for Jamaican trade with the USA, real hourly wages earned by two different employees in each of the eight industries, under different trade scenarios, are presented in Table 5. The two employees are representative of the typical individual in the sample but differ by two standard deviations around the mean years of formal education for the sample, i.e., one is assumed to have 6 years of formal education, the other, 11.2 years. The table shows that over the period 1989-1997, increased imports lowered the real wages earned by both skilled and unskilled employees in the traded goods sectors in Jamaica, with unskilled workers losing more, thus increasing the wage gap between the skilled and the unskilled. The analysis also shows that increased exports had the desirable effects of increasing real wages for both the skilled and the unskilled and at the same time reducing the wage gap. The wage changes are also greater in absolute value for the analyzed change in exports than for the same percentage change in imports. Noting that import levels for most of the eight industries were higher than export levels in 1989, the analysis suggests exports affect wages positively and by a larger margin than the negative change that would be brought about by imports of a similar dollar value.

Table 5: Analysis of the Effects of Trade Changes on the Wages of the Typical Unskilled and Skilled Employee

	1989 Trade Level			50% Increase in Imports			50% Increase in Exports		
	UW[a]	SW	WG	UW	SW	WG	UW	SW	WG
Average Wage[b]	3.56	5.82	1.63						
SITC Sections									
0. Food	2.03	3.33	1.64	1.92	3.33	1.73	2.22	3.40	1.53
1. Beverages & Tobacco	3.58	6.91	1.93	3.39	6.91	2.04	3.91	7.06	1.81
2. Crude Materials excluding Fuel	7.44	8.45	1.13	7.03	8.45	1.20	8.12	8.63	1.06
3. Mineral Fuels, Lubricants, etc.	5.15	7.78	1.51	4.87	7.78	1.60	5.62	7.95	1.42
5. Chemicals	2.36	5.27	2.23	2.23	5.27	2.36	2.58	5.38	2.09
6. Manufactured Goods classed by Materials	3.70	6.02	1.63	3.49	6.02	1.73	4.03	6.15	1.53
7. Machinery and Transport Equipment	4.07	6.56	1.61	3.84	6.56	1.71	4.44	6.70	1.51
8. Misc. Manufactured Articles	3.97	4.75	1.20	3.75	4.75	1.27	4.33	4.85	1.12

a: UW = unskilled wage; J$/hour(C.P.I. deflated) earned by the typical worker with 6 years of formal education
SW = skilled wage; J$/hour (C.P.I. deflated) earned by the typical worker with 11.2 years of formal education
WG = wage gap; SW÷UW

b: The average wage in the non-traded goods and services sectors.

The wage premiums paid in the food sector (SITC0) are of particular interest. As depicted in Figure 1 above, the results suggest that employees in agricultural industries face wages that are less than two-thirds of the average wage across the economy, and that premiums decline with their educational level. The implication, as brought out in Table 5, is that more-educated workers in the food sector earn less than less-educated workers in the other traded-goods sectors. Table 5 also suggests that trade in general has minimal effect on the wages earned in this sector; an employee with high school education earning $3.33 per hour will see his wage unchanged if agricultural imports were to increase by 50%, and would see only a seven cent per hour pay increase if agricultural exports were to increase by 50%. These results are consistent with the standard problem in agriculture vis-à-vis economic development, i.e., the low wages are indicative of the excess supply of labor in the agricultural sector that needs to be shifted out to the non-farm sectors. The results also point to the low productivity in the agricultural sector, and with the end of preferential marketing for the two main agricultural exports--sugar and bananas--will come even more depressed wages and greater unemployment in the sector. To the extent that a country's standard of living depends on the income of the people, together with the fact that over one quarter of the Jamaican workforce is employed in agriculture, the importance of the sector cannot be overstated.

Summary and Conclusions

The main purpose of this paper has been to empirically determine the impact that liberalization of trade has had on the wages of skilled and unskilled workers in Jamaica, and to test these results against the hypotheses of the formal trade models. The importance of the study is linked to the growing debate on issues surrounding globalization and income distribution. Advocates for freer trade have long argued that increasing global engagement has positive

overall effects on the incomes and growth of the countries involved. Recently, however, voices have emerged that argue that the benefits of globalization are not evenly distributed, and that there are even groups that lose in the process.

From the perspective of a small developing country, trade models have posited that such a country will have a comparative advantage if they export the good that uses the abundant factor of production intensively, and consequently, the returns to this factor will increase more relative to that for the scarce factor. The usual assumption under such models is that small developing countries have an abundance of unskilled labor relative to skilled labor, and this assumption was incorporated into the present study. The analytical model also extends the framework to distinguish between Jamaican trade with developed country partners--vertical trade--and trade with other developing countries--horizontal trade.

A model that incorporates industry-specific wage premiums was estimated using simultaneous-equations truncated regression procedures. The model was estimated in turn for aggregate Jamaican trade with the rest of the world (ROW), Jamaican trade with developed country partners as represented by trade with the USA, and Jamaican trade with other developing countries as represented by trade with Trinidad and Tobago.

One of the main findings suggested by the results is that the direction of Jamaican trade, and with whom Jamaica trades, seems to matter for Jamaican wage inequality. The results for trade with the ROW suggest that exports in aggregate have no discernible impact on the wages earned by individuals employed in the traded goods sectors. Aggregate imports on the other hand, were found to shift industry-specific wage schedules upward while reducing the returns paid to skill in the traded goods industries. A reverse effect was found, however, for imports from the USA--a downward shift in industry-specific wage schedules and increased returns to

years of investment in formal education. The opposing effect was found for exports to the USA. The results suggest that increased exports to developed country partners, as represented by trade with the USA, are associated with an upward shift in industry-specific wage schedules and a lower premium paid to the skill component in each industry in the traded goods sector. Another important finding is that industry-specific wage premiums are more responsive to increases in exports than for a similar percentage increase in imports. Together these results for trade with the USA indicate that for two workers in an industry who differ only in years of formal education, increased imports will increase the wage inequality between them, with a larger portion of the resultant inequality being borne by the loss in wages for the less skilled worker. Conversely, the indication is that increased exports to developed countries will narrow the inequality of earned income between the two workers, with the magnitudes of the effects resulting in increased wages for both workers as the upward shift in the industry-specific wage schedule more than offsets the resultant lower premium paid to the skill component.

The results for Jamaican trade with Trinidad and Tobago, representative of trade with other developing countries, suggest that increased imports from Trinidad result in a similar effect as for imports from the USA, but the magnitude is considerably smaller, and minimal. No discernible effect on wages was detected for increased exports to Trinidad and Tobago.

These results are interpreted in accordance with the analytical models that assume differences in the types of trade that Jamaica conducts with developed- and developing-country trading partners and differences in the types of labor markets faced by less-skilled and more-skilled workers. With some exceptions, the empirical results are largely consistent with the conceptual pattern of the directional effects of trade shocks on wage premiums. Exceptions include the indiscernible effects of exports in aggregate, and exports to developing-country

partners. Two conclusions may be drawn from this result. One is that, over the period considered, even with much liberalization of trade policies, and while exports to the USA show some impact, Jamaican exports have not grown in sufficient quantities, in total, to significantly impact the wages of workers. The second is that, Jamaican horizontal exports--exports to developing-country partners--have grown less than vertical exports, thus dampening the impact for exports in total. The other departure from the expected results is the relationship between wage premiums and imports from developed-country partners. The reverse effect reflected by the results may be attributed to the composition of imports from the USA--a large part of Jamaica's import bill from the USA is for food, fuel, and miscellaneous manufactured articles. These are, arguably, not skill-intensive products, counter to the assumption given for Jamaican vertical imports, hence the departure of signs of the estimated effects from those of the conceptual directional effects.

The results also support a view of labor markets in Jamaica that is to some extent industry-specific, generating different industry-specific components to wages and returns to education. The results show pronounced differences in the size of these industry wage premiums across industries and between workers, and thus, pronounced differences in the way trade affects them. In particular, it was found that industry wage premiums for less educated workers are much larger than for more educated workers.

The results, in sum, suggest that for a developing country such as Jamaica, both what is traded, and with whom, impacts on Jamaican wage inequality. The relationships, however, are complex, and this study provides only a basic interpretation of these matters, but more importantly, extends a framework from which further investigation into these issues may be pursued.

APPENDIX

ALLOCATION OF JAMAICA INDUSTRIAL CLASSIFICATION (JIC) CATEGORIES TO THE STANDARD INTERNATIONAL TRADE CLASSIFICATION (SITC) SECTORS.

SITC 1-Digit Sector to which allocated	JIC Categories
0 – Food	0xxx+2111+2112+2113+212x+213x+214x
1 – Beverages and Tobacco	215x+216x
2 – Crude Materials	1xxx
3 – Mineral Fuels, Lubricants etc.	26xx
5 – Chemicals	25xx+272x
6 – Manufactured Goods	221x+222x+224x+231x+241x+242x+271x +28xx+30xx+31xx+32xx
7 – Machinery & Transport Equip	331x+332x+334x+335x+336x+3370+3371+3372 +34xx+35xx+36xx+37xx+38xx+39xx
8 – Miscellaneous Manufactures	223x+225x+232x+233x+290x+3373+3381+3382 +3383+3384+3385+3386

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