JOURNAL OF ECONOMIC DEVELOPMENT
Volume 25, Number 2, December 2000

Does Trade Cause Inequality?

Avik Chakrabarti*

This paper examines the effect of international trade on intra-national distribution of income. The empirical validity of any such linkage (between trade-GDP ratio and Gini coefficient of income inequality) is tested in an instrumental variable estimation of cross-country regressions. There are three main findings from a sample of 73 countries in 1985. First, greater participation in trade significantly reduces income inequality. Second, the strong negative association between trade and inequality does *not* arise because countries that have a more egalitarian distribution of income for reasons other than trade engage in more trade. Third, growth provides a channel through which trade lowers inequality by raising both initial income and subsequent growth.

I. Introduction

In the 1980s the U.S. as well as many other OECD economies experienced an increasing "wage" inequality between "skill"-types (whether reported as declining relative wages of unskilled laborers in the U.S. or their rising unemployment in Western Europe).[1] The rising wage inequality coincided with a continued expansion of global trade.[2] This observation has generated a wide range of studies exploring the relationship between trade and wage inequality. This paper approaches a related yet distinct question: Does international trade cause inequality in the intra-national distribution of income? In other words, *but for* the opportunity to trade how different would a country's income distribution be?

In the U.S., approximately 47% of total household income goes to the richest 20% and the poorest 20% receives about 3.8%. During the 1980s, the proportion of total household income going to the richest 20% rose from 43.9% to 46.2% while that received by the poorest 20% fell from 4.2% to 3.8%.[3] Studies of other countries have also discovered a general tendency toward rising inequality. An OECD report[4] revealed that during the 1980s income inequality increased in 12 out of the 17 countries studied. The increases were particularly large in the U.K. and the U.S. while in Germany inequality declined. The ratio of the 9th to the 5th richest 10% households rose in all 12 countries except Netherlands and

* Department of Economics, College of Letters and Science, University of Wisconsin-Milwaukee, 17425 W. River Birch Dr. #208, Brookfield, WI 53045. E-mail: chakra@uwm.edu

1. See Kosters (1994).
2. See Richardson (1995).
3. Source: U.S. Bureau of Census (1992).
4. Source: OECD Employment Outlook (July 1993).

Sweden while the ratio of the 1st to the 5th poorest 10% fell in 8 of the countries.[5] The general increase in inequality has occurred at a time of increased globalization, or integration, of the world economy, with international trade growing more rapidly than world output. This makes the question addressed in this paper particularly interesting as the debate on the late 20th century globalization and inequality connection stands unresolved while some think that trade accounted for a third to a half rise in inequality in the U.S. and other OECD countries in the 1980s.

The goal of this paper is *not* to examine the causes of changes in relative wages for any particular country or group of countries over time. Instead, the empirical validity of the causal relationship between trade-GDP ratio and Gini coefficient of income inequality is tested in a cross-country regression analysis. An answer to this question may be of more interest, from the point of view of a country's welfare, than an analysis of the role of trade in the dismal real wage performance for the less skilled. It is not entirely clear that a greater wage inequality among the skilled and the unskilled, though a worrying phenomenon with important social, political as well as economic implications, lowers welfare. However, it is well known that a country's social welfare (SW) is a decreasing function of its Gini coefficient (G) of income inequality: $SW = \mu/(1+G)$ where μ is the mean income of a country's population.[6]

The three main findings of this paper are:

1. Greater participation in trade significantly reduces income inequality: on an average a percentage point increase in a country's trade-GDP ratio is expected to lower its Gini coefficient of inequality by 0.18%.
2. The strong negative association between trade and inequality does *not* arise because countries that have a more egalitarian distribution of income for reasons other than trade engage in more trade.
3. Growth provides a channel through which trade lowers inequality by raising both initial income and subsequent growth.

The rest of the paper is organized as follows. Section II provides a brief review of the literature on the relationship between international trade and inequality. Section III describes the data and estimation technique used in the empirical analysis. Section IV presents the results. Section V explores if growth provides a channel through which trade influences inequality. Section VI summarizes the conclusions of the paper.

II. The Literature

After 1973 and especially in the 1980's, the US experienced a dismal real wage performance for the less skilled, mostly due to declining productivity growth coupled with increasing wage inequality between skills. The ratio of weekly wages of the top decile to the bottom decile increased from 2.9 in 1963 to 4.4 in 1989 (Kosters (1994)). The gap between

5. For evidence on income inequality in a wider range of countries in the 1980s see Appendix I for the distribution of household income for 46 countries from all over the world.

6. See Sen (1976).

wages paid to skilled workers and wages paid to unskilled workers rose by 18 percentage points between 1973 and 1995. The same inequality trends were apparent elsewhere in the OECD in the 1980s (OECD Employment Outlook (1993)). The debate over explanations for these inequality facts started with the observation that the rising inequality coincided with expanding international trade.

The evidence is mixed. Borjas, Freeman and Katz (1992) focused exclusively on the phenomenon of increasing wage inequality in the U.S. labor market and estimated that 15% of the decline in relative wage of high school dropouts to all other workers in the U.S. was due to forces of globalization, one-third of which was due to trade. The increase in wage inequality that is attributed to international trade, in similar studies with a focus on the U.S. labor market, ranges from 5% to 30%. Technology, raising the demand for skilled workers faster than supply, has been identified as the other major factor responsible for the increasing inequality (Krugman and Lawrence (1994)). Lawrence and Slaughter (1993) dismissed any role of trade in the U.S. wage inequality based on their observation that relative prices of traded goods produced with comparatively large inputs of unskilled labor rose in the 1980s.

Several analyses,[7] based on factor content of trade, failed to detect a strong correlation between trade and inequality. Wood (1994) argued that these studies grossly underestimated the impact of trade on income distribution by making the unrealistic assumption that the labor content of goods imported by advanced countries from developing countries is identical to that of similar goods produced in the advanced countries. With necessary corrections in the measurement of unskilled labor, he estimated that trade has caused the relative demand for unskilled labor in the advanced countries to go down by 20% over three decades (1970-1990) with most of the shift taking place in the 1980s and concluded that this shift was the main cause of the inequality during the 1980s.

On a sample of 48 countries Fieleke (1994) observed no significant relationship between openness and income distribution in the 1980s. Edwards (1997) observed that ordinary least squares estimates (of a multivariate equation) from a sample of 44 countries in the 1980s indicate no significant relationship between openness and income distribution.

III. Model, Data and Estimation

A critical problem in estimating trade's impact on income distribution is that a regression of some measure of income inequality on some measure of trade (and other variables) does not imply any causality because trade itself is endogenous. Countries that have an unequal distribution of income for reasons other than trade may choose to trade more (based on the principle of comparative advantage). For instance, a country that has a skewed distribution of income because agricultural workers are paid relatively less than industrial workers will gain from trading with (exporting agricultural products to and importing industrial products from) a country that pays its industrial workers relatively less than agricultural workers. Putting prices rather than quantities on the right hand side does not provide a solution because international prices may be endogenous as well. Even for a small

7. See Wood (1994) for an insightful review of the relevant factor-content studies.

open economy, the *but for* interpretation of the question at hand requires the assumption that trade policy could be used to hold prices constant and that need not be true. Focusing on trade policies (and/or a variety of measures of openness) rather than trade does not remove the problem either. The parameters of trade policy may be endogenous in a political economy context that becomes particularly important in any discussion of income distribution.

Another associated problem arises from the inclusion of multiple variables in a regression of income inequality on trade. Once variables other than trade (technology, age composition, natural resources, education supply, immigration, organization of the work force etc.) are included in the list of explanatory variables the *but for* interpretation of the question at hand becomes less clear. When an endogenous measure of trade enters as an explanatory variable along with other exogenous variables that could themselves affect the measure of trade then separate roles of all explanatory variables are intertwined and become difficult to interpret. For instance, a difference in technology across countries can result in a more or less equitable distribution of income within each country but the same difference can affect each country's trade. When technology is identified as a separate explanatory variable does it mean that the effect of trade is being considered under the assumption that there are no differences in technology or that the effect of technology is being considered under the assumption that there are no differences in trade? If both of these, then what can be said about the effect of trade when technology is allowed to be different?

To address these problems this paper uses an instrument for trade, based on countries' geographic characteristics (size and proximity), recently developed by Frankel and Romer (1999). While the empirical literature on gravity models of trade[8] reflect that geography is a powerful determinant of bilateral trade Frankel and Romer have shown that the same is true for countries' overall trade. For instance, the distance of New Zealand from most other countries dampens its trade and the proximity of Belgium to many of the world's most populous countries increases its trade. At the same time a country's proximity to others is not affected by its distribution of income or by other factors that can influence the distribution of income. In general, it is difficult to reason that a country's geographic characteristics can have any effect on its distribution of income other than through their impact on its trade. This makes the use of an instrumental variable based on a country's geographic characteristics (namely, size and proximity) a meaningful one in the context of estimating the effect of trade on its income distribution.

The basic idea behind the empirical analysis in this paper can be summarized using a simple two-equation model. First, the average income inequality in country i is a function of international trade and other factors:

$$G_i = \alpha + \beta T_i + \varepsilon_t . \qquad (1)$$

Here i is used to index countries, G_i is a measure of intra-country income inequality, T_i is a measure of international trade and ε_t captures other influences on its income inequality.

Second, a country's international trade is a function of its proximity to other countries

8. See Frankel (1997) and Frankel and Romer (1999).

and its size:

$$T_i = \gamma + \delta S_i + \phi P_i + \eta_i . \quad (2)$$

Here S_i measures country *i*'s size, P_i is a measure of its proximity to other countries and η_i captures other influences on its international trade.

Cross-country regressions of income inequality (measured by Gini coefficients) on international trade are estimated by Instrumental Variable (IV) method using Frankel and Romer's constructed trade-GDP ratio as an instrument. The constructed trade-GDP ratio (τ) is a series of values of trade-GDP ratio predicted by an equation that takes the form of (2). Frankel and Romer calculated this series for 150 countries in 1985 by regressing countries' actual trade-GDP ratio (T), measured by the ratio of value of trade to GDP, on their size (based on area and population) and proximity (based on distance, land-locking and border-sharing).

The residuals in the two equations, ε_i and η_i, may be correlated. For instance, a country's infrastructure or its government policies toward competition are likely to affect its international trade as well as its income distribution. But that does not pose any problem for IV estimation. The rationale behind employing Frankel and Romer's constructed trade-GDP ratio as the instrumental variable rests on three essential facts:

i) Frankel and Romer report that countries' constructed trade-GDP ratio is significantly correlated with the actual trade-GDP ratio. The magnitude of the (positive) correlation is in the order of 0.62. A regression of T on τ yields a coefficient of 0.99 with a *t*-statistic of 9.5. This means that constructed trade-GDP ratios contain sufficient information about actual trade for IV estimation.

ii) Results from Staiger and Stock (1997), Hall, Rudebusch, and Wilcox (1996), and Nelson and Startz (1990) imply that the *F*-statistic[9] is too large for any finite-sample bias of instrumental variables to be a serious problem in the IV estimation.

iii) Countries' geographic characteristics (S_i's and P_i's) are unlikely to be correlated with the residual (ε_i) in Equation (1). A country's size and proximity to other countries are not affected by its distribution of income or by other factors, such as government policies, that can affect the distribution of income. It is also difficult to imagine how a country's size and proximity to other countries can affect the factors that determine its distribution of income in any meaningful way other than through their impact on international trade.

Finally, there has always been a concern about the lack of dependable data on income distribution.[10] The World Bank has recently published a data set on income distribution (based on the work of Deininger and Squire (1996)). This presents the most comprehensive[11] data available on income distribution. This paper uses the Gini coefficients for 1985 reported

9. See Table 1.

10. See Fishlow (1996).

11. The data set consists of high-quality observations that are drawn from published household surveys based on comprehensive coverage of the population and comprehensive measures of income and expenditure.

in this data set as a measure of countries' income inequality.

In short, the empirical analysis involves instrumental variables estimation of the effect of international trade on intra-national income inequality based on a sample containing observations on trade-GDP ratios (actual and constructed) from Frankel and Romer (1999) and Gini coefficients[12] from World Development Indicators (1998), for 73 countries in 1985. The sample spans 18 low-income, 22 lower middle-income, 9 higher middle-income and 24 high-income countries.[13] The complete data set is reported along with descriptive statistics in Appendix II.

IV. Results

The results are presented in this section. Estimates from IV and OLS estimation of the log-linear version of Equation (1) are reported in Table 1. Column (1) is an OLS regression of the logarithm of Gini coefficient of inequality on a constant and the log of actual trade-GDP ratio. Column (2) reports IV estimation of the same equation treating trade-GDP ratio as endogenous and using the log of constructed trade-GDP ratio as an instrument. Figure 1 shows a scatter plot and the fitted lines: the steeper line corresponds to IV estimation and the flatter to OLS estimation.

Table 1 Inequality and Trade

	(1)	(2)
Estimation	OLS	IV
Constant	1.75***	1.87***
	(19.07)	(16.06)
log(Trade-GDP ratio)	−0.12**	−0.18***
	(−2.15)	(−2.66)
5% Confidence Interval (log Trade-GDP Ratio)	[−0.22, −0.01]	[−0.32, −0.05]
Sample size	73	73
Adjusted R^2	0.06	0.04
Std. Error of Regression	0.113	0.114
F-statistic on excluded instrument		7.09

Notes: The dependent variable is log of Gini coefficient of inequality; *t*-statistics are in parenthesis.

** indicates that the corresponding coefficient is significant at 5% level.

*** indicates that the corresponding coefficient is significant at 1% level.

12. Two alternative measures of inequality were considered: a) the ratio of income earned by the top quartile to income earned by the bottom quartile, and b) percentage of income to the highest 20% of the population. The results are similar. The results reported in this paper are those based on the Gini coefficient of inequality since more observations are available on this measure.

13. The classification follows the World Bank's World Development Indicators (WDI), 1998.

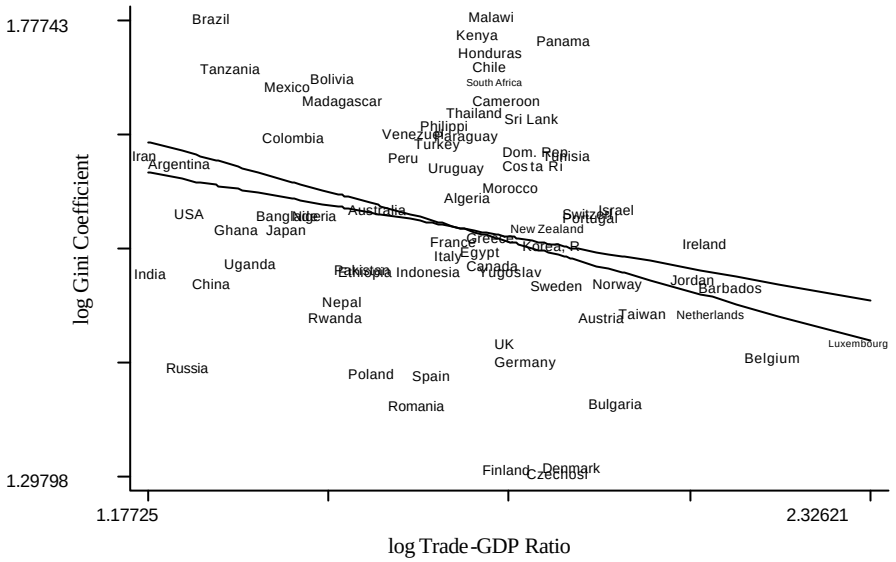


Figure 1 Inequality and Trade

The following inferences are drawn from Table 1. First, the regressions show a statistically significant inverse relationship between trade and income inequality. In other words, greater participation in trade significantly reduces income inequality. Variation in countries' trade-GDP ratio explains approximately 4% of the variation in countries' Gini-coefficients of income inequality. The point estimate (in column 2) indicates that an increase in a country's trade-GDP ratio by one percent is, on an average, expected to lower its Gini-coefficient of inequality by 0.18%. The absolute value of the true parameter is expected to range between 0.05 and 0.32 with 95% level of confidence. Second, the fact that the magnitude of the IV estimate is greater than that of the OLS estimate indicates that OLS understates the effect of trade on inequality. Under the null hypothesis that the OLS and IV estimates are equal, the difference between the two estimates divided by the standard error of the difference is asymptotically distributed as a standard normal variable. The hypothesis that the IV and OLS estimates are equal is rejected (the *t*-statistic is 1.58) at 10% level of significance. That is, the strong negative association between trade and inequality does *not* arise because countries that have a more egalitarian distribution of income for reasons other than trade engage in more trade.

The results are robust to the following alterations in model specification and information-set.

First, MacKinnon's extended J test (P_E test) is used to verify whether a linear specification provides a better fit to the data than does a log-linear specification or the other way round. The tests were inconclusive on either count (the *t*-statistic for the test of superiority of linear over log-linear specification is -0.47 and of log-linear over linear is

1.39) indicating that neither specification is superior to the other.[14] In column (1) of Table 2, I report the results from an OLS regression of the logarithm of the Gini coefficient of inequality on a constant and the logarithm of actual trade-GDP ratio. Column (2) is an IV estimation of the same equation treating the logarithm of trade-GDP ratio as endogenous and using the logarithm of constructed trade-GDP ratio as an instrument. The statistically significant inverse relationship between trade and income inequality is maintained in the linear model.[15] For ease of comparison the results reported in the rest of the paper are all based on a log-linear specification.

Table 2 Inequality and Trade (log-linear vs. linear specification)

Specification	log-linear		linear	
	(1)	(2)	(3)	(4)
Estimation	OLS	IV	OLS	IV
Constant	1.75***	1.87***	42.06***	42.32***
	(19.07)	(16.06)	(22.95)	(23.69)
log(Trade-GDP ratio)	−0.12**	−0.18***	−0.08***	−0.09***
	(−2.15)	(−2.66)	(−3.99)	(−4.58)
Sample size	73	73	73	73
Adjusted R^2	0.06	0.04	0.0794	0.0791
Std. Error of Regression	0.113	0.114	9.527	9.528

Second, Luxembourg (the observation on the extreme right of Figure 1) is detected as the single outlier. The results from dropping this observation are compared in Table 3. The IV estimate is larger but is less precisely estimated (with a standard error of 0.034) without Luxembourg in the sample than with it.

Table 3 Inequality and Trade (outlier)

Sample	all 73 countries		Luxembourg excluded	
	(1)	(2)	(3)	(4)
Estimation	OLS	IV	OLS	IV
Constant	1.75***	1.87***	1.740***	1.86***
	(19.07)	(16.06)	(17.98)	(14.76)
log(Trade-GDP ratio)	−0.12**	−0.18***	−0.11*	−0.18**
	(−2.15)	(−2.66)	(−1.88)	(−2.41)
Sample size	73	73	72	72
Adjusted R^2	0.06	0.04	0.05	0.03
Std. Error of Regression	0.113	0.114	0.114	0.115

14. For ease of comparison and interpretation the results reported in the rest of the paper are all based on a log-linear specification.

15. The results reported in this paper are based on the log-linear specification. The linear model generates qualitatively similar results. See Chakrabarti (2000).

Third, there may be a concern that systematic differences among countries at varying levels of development are driving the results. That is, it could be that the IV estimate of the impact of trade arises because countries in certain income-groups have systematically lower constructed trade-GDP ratio given their levels of development and that they also have systematically unequal distribution of income. If this were true, then the results could be driven not by trade but by other features of those income-groups. To address this concern, the regressions are re-estimated using a dummy variable for each income-group.

Table 4 Inequality and Trade
(income-groups: low & lower middle-income and high & higher middle-income)

Specification	without dummy variables		with dummy variables	
	(1)	(2)	(3)	(4)
Estimation	OLS	IV	OLS	IV
log(Trade-GDP ratio)	−0.12**	−0.18***	−0.08	−0.16**
	(−2.15)	(−2.66)	(−1.49)	(−2.30)
Constant	1.75***	1.87***		
	(19.07)	(16.06)		
D1 = 1 for low & lower middle-income countries			1.72***	1.85***
= 0 otherwise			(18.84)	(16.03)
D2 = 1 for high & higher middle-income countries			1.66***	1.81***
= 0 otherwise			(16.61)	(14.27)
Sample size	73	73	73	73
Adjusted R^2	0.06	0.04	0.995	0.999
Std. Error of Regression	0.113	0.114	0.110	0.112

In Table 4 the estimates are presented with two dummy variables: one for high and higher middle-income and the other for low and lower middle-income countries. While the OLS estimate loses its significance, the magnitude of the IV estimate drops only marginally maintaining the statistically significant inverse relationship between trade and income inequality throughout.[16] Thus there is no evidence that systematic differences among income-groups are important in the results.

Fourth, a concern about the (economic) quality (although the statistical properties[17] are impressive) of the instrument, may stem from the observation that income is an important determinant of trade. The instrument employed here was constructed by Frankel and Romer (1999), on the basis of a "pure geography" approach using a country's geographic characteristics, namely, size and proximity. The regressions are re-estimated with an alternative instrument

16. Similar results are obtained when a) three dummy variables (for high-income, middle-income and low-income countries) are introduced and b) the measure of openness is interacted with the dummy variables for income groups. See Chakrabarti (2000).

17. See Section III.

that was constructed, by Frankel and Romer (1996), on the basis of a "factor accumulation" approach using information on physical and human capital accumulation and population growth (as determinants of income) in addition to size and proximity. The results are compared in Table 5. The IV estimate is larger but is less precisely estimated (with a standard error of 0.079) with the instrument based on factor accumulation.

Table 5 Inequality and Trade (choice of instrument)

Choice of Instrument	None	Pure Geography	Factor Accumulation
	(1)	(2)	(3)
Estimation	OLS	IV	IV
Constant	1.75***	1.87***	2.14***
	(19.07)	(16.06)	(16.04)
log(Trade-GDP ratio)	−0.12**	−0.18***	−0.35***
	(−2.15)	(−2.66)	(−4.38)
Sample size	73	73	73
Adjusted R^2	0.06	0.04	0.03
Std. Error of Regression	0.113	0.114	0.126

Fifth, as a general check of potential data problems, I use the Penn World Table's summary assessments of the quality of countries' data to exclude the countries with the poorest data from the sample. Specifically, only countries that are assigned a grade better than "D" on the basis of the quality of data are included. The results are presented in columns (3) and (4) of Table 6. The change in sample size and composition affects the estimates only marginally. An alternative sample is also considered from which major oil-producing countries are excluded because the bulk of their recorded growth comes from extraction of existing resources, not value added. The results are presented in columns (5) and (6) of Table 7. While the OLS estimate loses its significance the IV estimate remains significantly negative.

Table 6 Inequality and Trade (data quality)

Sample	all 73 countries		'D'-graded countries excluded		oil-producing countries excluded	
	(1)	(2)	(3)	(4)	(5)	(6)
Estimation	OLS	IV	OLS	IV	OLS	IV
Constant	1.75***	1.87***	1.81***	1.93***	1.72***	1.86***
	(19.07)	(16.06)	(18.94)	(16.25)	(16.29)	(13.58)
log(Trade-GDP ratio)	−0.12**	−0.18***	−0.14**	−0.21**	−0.09	−0.18**
	(−2.15)	(−2.66)	(−2.53)	(−2.99)	(−1.54)	(−2.22)
Sample size	73	73	64	64	69	69
Adjusted R^2	0.06	0.04	0.08	0.07	0.05	0.03
Std. Error of Regression	0.113	0.114	6.42	8.95	9.78	9.87

Finally, I turn to the possibility that the estimated coefficient of the log of trade-GDP

ratio can be sensitive to the inclusion of additional explanatory variables.[18] The additional explanatory variables (*Z*-variables) considered are age composition (Z_1), education supply (Z_2), and relative demand for skilled workers (Z_3). An Extreme Bound Analysis (EBA) is used to test the fragility of the estimated coefficient.[19] The EBA involves alterations in the subset of *Z*-variables to find the widest range of coefficient estimates on the variable of interest (trade-GDP ratio). The *extreme upper bound* (EUB) is defined by the group of *Z*-variables that produces the maximum value in terms of the estimated coefficient of the trade-GDP ratio plus two standard deviations. The *extreme lower bound* (ELB) is defined by the group of *Z*-variables that produces the minimum value in terms of the estimated coefficient of the trade-GDP ratio minus two standard deviations. The fraction of population aged 40-64 is used as a proxy for the labor in peak earning years to capture the effect of age composition on inequality. The fraction of population aged 25 and up having complete secondary or higher education is used as measure of education supply. Services production as a proportion of GDP is used as an indicator of the relative demand for skilled workers.[20] The results are presented in Table 7. The estimates maintain a statistically significant inverse relationship between trade and income inequality.

The results consistently reflect a statistically significant inverse relationship between trade and income inequality and are thus distinct from those reported in related literature.[21] The neutral evidences of Fieleke (1994) and Edwards (1997) may be attributed to the endogenous nature of the trade variable included in their regressions. Wood's (1994) finding, while distinct from other factor content studies, can be subjected to the criticism that he assumes that advanced countries use the same technology as the developing countries to produce all of the goods that are shipped from the developing countries to the advanced countries.[22]

18. It may be noted that the argument behind using Frankel and Romer's instrument based on geographic characteristics implies that there is *a priori* no strong reason to expect additional independent determinants to be correlated with the instrument.

19. The logic of the EBA runs as follows. Suppose a regression involves a set of variables that are always kept in the equation (the free variables) and some others that the researcher feels comfortable experimenting with (the doubtful variables). Normally, this experimentation is limited to a small subset of the possible models that could have been estimated. Instead a meaningful analysis should consider a whole range of models in each of which the free variables and any one linear combination of the doubtful variables are included. If it turns out that inferences about issues of interest are essentially the same, in the sense that the estimates fall within a reasonable range, for all choices of the linear combinations of the doubtful variables, then there need be no debate. If, on the other hand, the range turns out to be too wide then it must be admitted that the inferences are too fragile to be useful. The intuition for considering all linear combinations of the doubtful variables is that this represents all (linear) constraints that can be imposed, the most familiar constraint obviously being the exclusion of a variable by setting its coefficient to zero. See Leamer (1985, 1983) and Chakrabarti (1999, 1998) for a thorough discussion on EBA.

20. The data is extracted from the WDI, 1998.

21. See Section II.

22. See Golub (1994). He identified sizeable and persistent gaps even between the advanced countries in both labor

Table 7 Inequality and Trade (EBA)

Estimate		β	SE	# of countries	Adj. R-sq.	*Z*-variables
OLS	MAX	-0.17^{**}	0.051	58	0.24	$\log Z_2$
	BASE	-0.12^{**}	0.046	73	0.06	
	MIN	-0.10^{**}	0.043	54	0.27	$\log Z_1$, $\log Z_2$, $\log Z_3$
IV	MAX	-0.21^{***}	0.061	58	0.11	$\log Z_2$
	BASE	-0.18^{***}	0.057	73	0.04	
	MIN	-0.13^{***}	0.054	54	0.17	$\log Z_1$, $\log Z_2$, $\log Z_3$

Notes: The base β is the coefficient of log(trade-GDP ratio). The MAX refers to the estimated β from the regression yielding the EUB and the MIN refers to the estimated β from the regression yielding the ELB, identified from the set of regressions run by permuting the subset of *Z*-variables.

In some sense the observations of Lawrence and Slaughter (1993), despite their exclusive focus on the phenomenon of increasing wage-inequality in the U.S. labor market and dismissal of any role of trade in it, can be interpreted to be consistent with my results. They observed that relative prices of traded goods produced with comparatively large inputs of unskilled labor rose in the 1980s. Conventional wisdom (Stolper-Samuelson theorem) suggests that if trade is to be held responsible for a relatively high reward to skilled labor one should have observed, instead, a decline in the relative prices of goods with relatively large content of unskilled labor. Therefore, if anything, trade must have, through a movement in relative prices, had a dampening effect on wage inequality in the U.S. during the 1980s.

V. Trade, Growth, and Inequality

Having observed that international trade reduces inequality it is important to examine *how* it does so. To shed some light on this issue let us turn to a long-established empirical regularity (due originally to Nicholas Kaldor and Simon Kuznets): there is a tendency for income inequality to worsen at early stages of growth and then improve at later stages. A common interpretation of this phenomenon is that income redistribution is a "superior good" that societies choose to purchase more of, even though at some cost to aggregate income, as they grow rich enough to be able to afford to do so. A large number of empirical studies have repeatedly confirmed a trade-off between growth and inequality.[23] At the same time from Adam Smith's discussion of specialization and the extent of the market, to the debates about import substitution versus export-led growth, to recent works on increasing returns and endogenous technological progress economists have argued that countries gain from trade. Frankel and Romer (1999) have convincingly demonstrated that trade has a quantitatively large, significant and robust positive effect on per-capita income.

One distinct possibility is then that trade lowers inequality by raising income. If growth enters into the analytical framework in this fashion then, in addition to Equations (1)

and total factor productivity by industry indicating significant technological differences across countries.

23. For recent works in the area see Deininger and Squire (1998), Perotti (1996), Clarke (1995), and Persson and Tabellini (1994).

and (2), the model will include an equation that expresses income of a country can as a function of international trade and other factors:

$$Y_i = \eta + \theta T_i + \omega_t . \quad (3)$$

Here Y_i is income per person in country i and ω_t captures other influences on its income. Data on income per person, measured by real GDP per worker at 1985 international prices (dollars), is extracted from Penn World Table, Mark 5.6. The hypothesis that growth provides a channel through which trade lowers inequality, is evaluated in the following steps.

First, the log-linear version of Equation (3) is estimated by IV method, using the constructed trade-GDP ratios as instruments, to obtain the vector of predicted per-capita income ($\widehat{\log Y}$) that measures the component of per-capita income explained by trade. Then $\log G_i$ is regressed on $\widehat{\log Y}$.

Table 8 Trade, Income, and Inequality

Instrument	(1) Pure Geography	(2) Factor Accumulation
Constant	2.45***	1.89***
	(5.91)	(12.20)
$\widehat{\log Y}$	−0.22**	−0.08**
	(−2.15)	(−2.15)
5% Confidence Interval ($\widehat{\log Y}$)	[−0.43, −0.02]	[−0.16, −0.01]
Sample size	73	73
Adjusted R^2	0.06	0.06
Std. Error of Regression	0.113	0.113

Note: The dependent variable is log of Gini coefficient of inequality.

Table 8 reports the results: column (1) describes the regression of $\log G_i$ on $\widehat{\log Y}$ corresponding to the "pure geography" based instrument and column (2) describes the same regression corresponding to the "factor accumulation" based instrument. In either case the coefficient of $\widehat{\log Y}$ is significantly negative reflecting that an important mechanism through which trade lowers inequality is by raising income.

Second, following Frankel and Romer (1999), per-capita income is decomposed into two components (initial income and subsequent growth):

$$\log(Y_i)_{1985} = \log(Y_i)_{1960} + [\log(Y_i)_{1985} - \log(Y_i)_{1960}] . \quad (4)$$

Here the log of output per worker in 1985 ($\log(Y_i)_{1985}$) is expressed as the sum of its value at the beginning of the sample ($\log(Y_i)_{1960}$) and the change over the sample period ($\Delta \log Y_i = [\log(Y_i)_{1985} - \log(Y_i)_{1960}]$). Each component of income is regressed on trade-shares,

using the constructed trade-GDP ratios as instruments, to obtain vectors of predicted initial income ($\log(\hat{Y})_{1960}$) and of subsequent growth ($\Delta\hat{\log}Y$). These vectors measure the respective components of initial income and of subsequent growth explained by trade. Then log G_i is regressed on each of these components.

Table 9 Trade, Components of Income, and Inequality

Instrument	(1) Pure Geog.	(2) Factor Acc.	(3) Pure Geog.	(4) Factor Acc.
Constant	2.73***	1.99***	1.81***	1.69***
	(5.78)	(11.56)	(18.11)	(31.54)
$\log(\hat{Y})_{1960}$	−0.32**	−0.11**		
	(−2.46)	(−2.46)		
$\Delta\hat{\log}Y$			−0.86**	−0.45**
			(−2.46)	(−2.46)
Sample size	70	70	70	70
Adjusted R^2	0.08	0.08	0.08	0.08
Std. Error of Regression	0.109	0.109	0.109	0.109

Notes: The dependent variable is log of Gini coefficient of inequality.

The sample size is smaller because decomposition was not possible for Bulgaria, Poland and Soviet Union due to lack of data on Real GDP in 1960 (at 1985 International Prices) for these countries.

Table 9 reports the results: columns (1) and (2) describe the regression of log G_i on $\log(\hat{Y})_{1960}$ and columns (3) and (4) describe the regression of log G_i on $\Delta\hat{\log}Y$, corresponding to the "pure geography" and "factor accumulation" based instruments respectively. The significantly negative coefficients of $\log(\hat{Y})_{1960}$ and $\Delta\hat{\log}Y$ indicate that trade lowers inequality by raising both initial income and subsequent growth.

Finally, a distinct question is posed: does growth have a role in lowering inequality that is independent of international trade?

Table 10 Trade, Growth, and Inequality

Specification	(1)	(2)	(3)
Constant	1.92***	2.03***	2.16***
	(15.72)	(14.97)	(13.97)
log(Per-capita Income)	−0.09***	−0.05	−0.01
	(−2.97)	(−1.51)	(−0.32)
log(Trade-GDP ratio)		−0.15**	−0.33***
		(−2.08)	(−3.58)
Sample size	73	73	73
Adjusted R^2	0.09	0.09	0.09
Std. Error of Regression	0.110	0.111	0.125

Notes: The dependent variable is log of Gini coefficient of inequality.

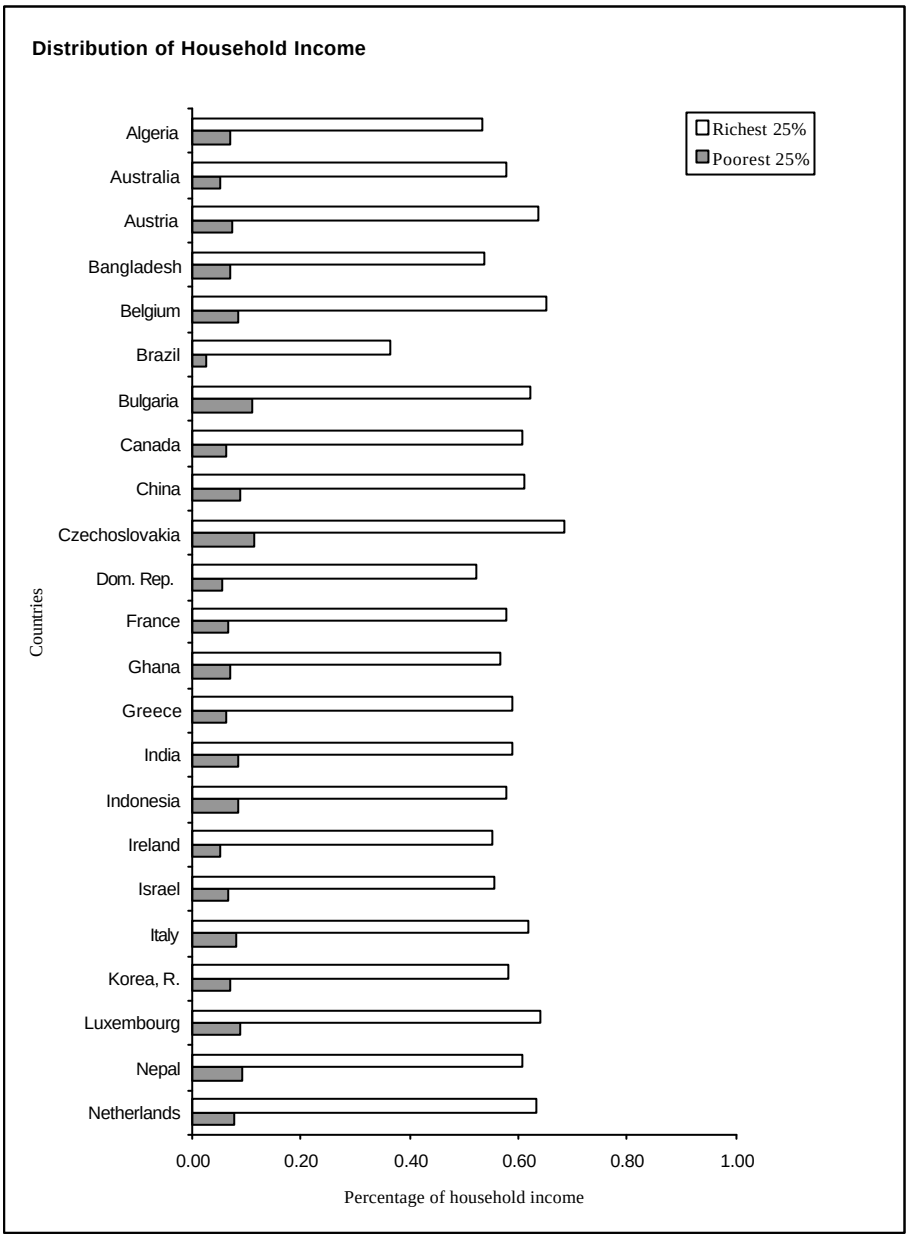
Table 10 reports the results. Column (1) describes the regression of log G_i on the log of per-capita income. Columns (2) and (3) describe regressions of log G_i on the log of per-capita income as well as log of trade-GDP ratio using instruments based on "pure geography" and "factor accumulation" respectively. The coefficient of log of per-capita income is negative and highly significant in the first regression but loses its significance when log of trade-GDP ratio is added as an explanatory variable. This provides evidence that growth does not have a role in lowering inequality that is independent of trade. In other words, the growth-inequality trade-off is driven by the dampening effect that international trade has on inequality.

VI. Conclusion

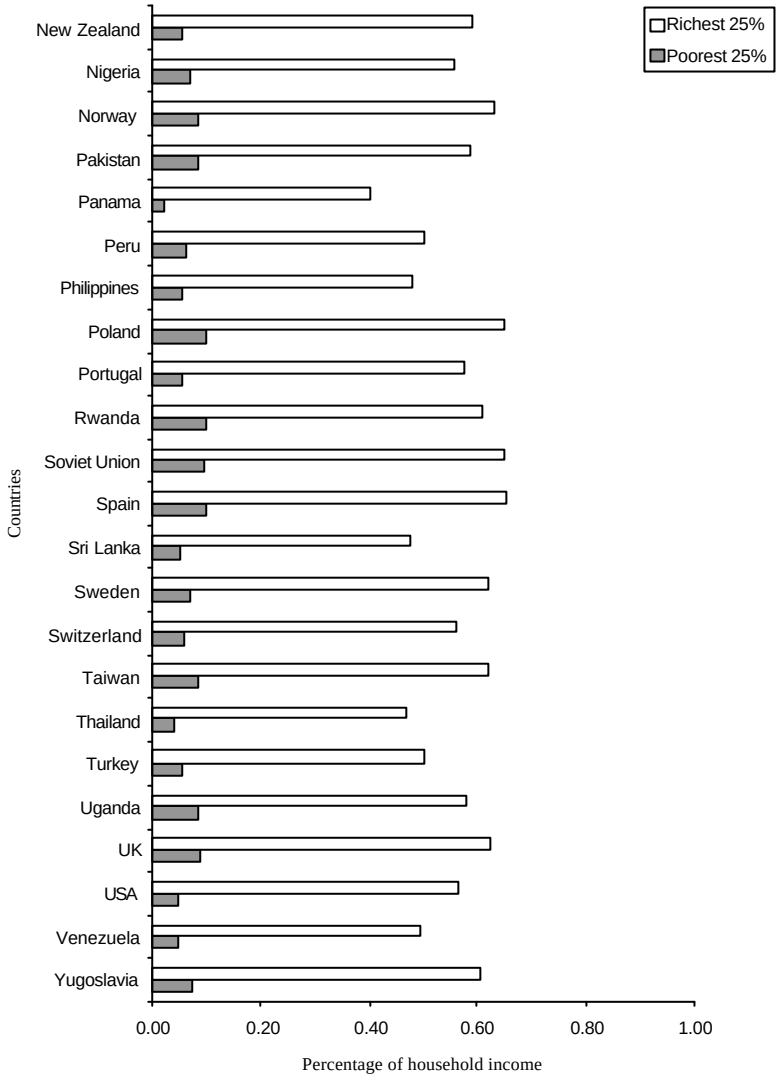
In this paper I have investigated the effect of international trade on intra-national distribution of income. During the 1980s the distribution of income had become less equal than ever in a large number of countries all over the world. At the same time international trade had intensified. The merit of international trade has been hotly debated in this light. Conclusive evidence has not yet emerged in a form that can enable one to take a strong position on either side of the debate. Empirical analyses of the link between trade and income distribution become particularly challenging because of the endogenous nature of trade. This problem has been addressed in this paper by estimating the relationship between countries' Gini coefficient of inequality and trade-GDP ratio using instruments based on countries' geographic characteristics (size and proximity) and factor accumulation (physical and human capital accumulation and population growth). The results from a sample of 73 countries in 1985 indicate a robust and statistically significant inverse relationship between trade and income inequality. Greater participation in international trade reduces inequality in the intra-national distribution of income. The strong negative association between trade and inequality can *not* be attributed to the possibility that countries with a more egalitarian distribution of income for reasons other than trade engage in more trade. Finally, growth provides a channel through which trade lowers inequality by raising both initial income and subsequent growth.

Appendix I

Distribution of Household Income in the 1980s



Distribution of Household Income: *Continued*



Source: World Development Indicators (1998).

Appendix II : Data and Descriptive Statistics

Data

Country	Gini Coefficient	Actual Trade-GDP Ratio	Constructed Trade-GDP Ratio (Pure Geography)	Constructed Trade-GDP Ratio (Factor Accumulation)
Algeria	38.73	49.66	13.97	12.51
Argentina	42.00	17.10	5.60	5.97
Australia	37.58	35.28	4.07	5.14
Austria	28.94	81.27	36.64	56.95
Bangladesh	37.00	25.78	10.31	8.55
Barbados	31.10	130.30	56.10	38.63
Belgium	26.22	151.34	52.46	77.66
Bolivia	51.57	30.27	8.06	7.79
Brazil	59.54	19.34	3.03	3.31
Bulgaria	23.42	85.99	31.12	45.96
Cameroon	49.00	57.67	15.79	6.50
Canada	32.81	54.48	4.97	8.05
Chile	53.20	53.85	7.25	7.70
China	31.40	19.44	2.30	4.49
Colombia	44.70	26.33	7.54	7.43
Costa Rica	41.80	63.19	23.37	15.07
Czechoslovakia	19.86	69.45	21.07	39.58
Denmark	20.10	72.99	30.89	56.68
Dom. Rep.	43.29	64.24	22.37	13.75
Egypt	34.00	51.97	11.75	10.32
Ethiopia	32.42	34.13	8.44	3.41
Finland	20.00	57.50	21.64	41.09
France	34.91	47.17	15.26	28.94
Germany	26.00	61.52	18.47	34.46
Ghana	35.90	21.29	18.87	8.87
Greece	35.19	53.97	27.01	38.98
Honduras	54.94	54.15	27.58	10.56
India	32.22	15.04	3.29	4.68
Indonesia	32.40	42.66	4.47	5.01
Iran	42.90	15.20	10.06	10.96
Ireland	34.60	118.84	33.85	54.49
Israel	37.71	85.80	54.17	41.99
Italy	33.58	46.06	13.97	26.92
Japan	35.90	25.54	5.47	14.41
Jordan	31.70	113.50	68.18	39.46
Kenya	57.30	51.69	12.48	5.94
Korea, R.	34.54	67.86	14.36	28.18
Luxembourg	27.13	211.94	281.29	235.01
Madagascar	48.90	30.99	9.9	3.56

Data (Continued)

Country	Gini Coefficient	Actual Trade-GDP Ratio	Constructed Trade-GDP Ratio (Pure Geography)	Constructed Trade-GDP Ratio (Factor Accumulation)
Malawi	59.90	54.09	12.67	3.83
Mexico	50.58	25.74	4.52	5.55
Morocco	39.70	58.50	12.71	9.95
Nepal	30.06	31.29	13.26	9.23
Netherlands	29.10	118.76	35.84	63.30
New Zealand	35.82	65.25	8.19	9.98
Nigeria	37.02	28.53	8.68	5.22
Norway	31.39	86.00	23.54	41.23
Pakistan	32.44	34.00	8.04	6.54
Panama	56.47	70.96	23.56	18.17
Paraguay	45.10	49.58	10.43	7.80
Peru	42.76	39.42	7.03	7.56
Philippines	46.08	45.84	8.84	14.64
Poland	25.27	35.07	13.84	28.80
Portugal	36.80	77.95	18.78	27.32
Romania	23.38	41.62	18.80	32.10
Rwanda	28.90	30.65	26.20	4.67
South Africa	51.00	55.43	8.90	4.76
Soviet Union	25.62	18.28	3.68	7.71
Spain	25.19	43.51	12.38	21.43
Sri Lanka	46.70	62.93	13.94	15.08
Sweden	31.24	69.02	18.22	32.41
Switzerland	37.37	77.69	32.57	48.85
Taiwan	29.20	94.62	17.92	27.19
Tanzania	53.00	21.03	10.97	2.84
Thailand	47.40	51.20	9.45	9.44
Tunisia	43.00	71.33	23.83	20.64
Turkey	44.09	44.40	11.26	15.37
Uganda	33.00	22.54	12.97	3.76
UK	27.10	56.87	13.47	22.54
Uruguay	41.72	47.86	17.07	15.52
USA	37.26	18.01	2.56	5.22
Venezuela	45.17	40.76	8.94	7.82
Yugoslavia	32.40	57.88	25.82	42.93

Notes: Gini Coefficient = Gini coefficient of income inequality in 1985 (World Development Indicators (1998)); Actual Trade-GDP Ratio = Ratio of imports plus exports to GDP, 1985 (Penn World Table, Mark 5.6, Series: OPEN). Constructed Trade-GDP Ratio (Pure Geography) = Aggregate fitted values of bilateral trade equation with geographic variables (Frankel and Romer (1999)). Constructed Trade-GDP Ratio (Factor Accumulation) = Aggregate fitted values of bilateral trade equation with geographic variables, physical and human capital accumulation, and population growth (Frankel and Romer (1996)).

Descriptive Statistics

	Gini Coefficient	Actual Trade-GDP Ratio	Constructed Trade-GDP Ratio (Pure Geography)	Constructed Trade-GDP Ratio (Factor Accumulation)
Mean	37.48	55.64	20.77	22.85
Standard Deviation	9.86	33.71	33.57	30.58
Maximum	59.90	211.94	281.29	235.01
Minimum	19.86	15.04	2.30	2.84

References

Chakrabarti, A. (1998), "The Distribution of FDI and the Excluded Economies," Working Paper No. 397, Research Seminar in International Economics, The University of Michigan, Ann Arbor.

_____ (1999), ""Foreign Direct Investment & Host Country Interaction," Occasional Paper No. 69, Export Import Bank of India.

_____ (2000), "Do Nations That Trade More Have A More Unequal Distribution of Income?" *mimeo*, University of Wisconsin-Milwaukee.

Clarke, G.R. (1995), "More Evidence on Income Distribution and Growth," *Journal of Development Economics*, 47(2), 403-27.

Deininger, K., and L. Squire (1996), "A New Data Set Measuring Income Inequality," *World Bank Economic Review*, 10, 565-91.

_____ (1998), "New Ways of Looking at Old Issues: Inequality and Growth," *Journal of Development Economics*, December, 57(2), 259-87.

Edwards, S. (1997), "Trade Policy, Growth, Income Distribution," *American Economic Review*, May, 87(2), 205-10.

Fieleke, N.S. (1994), "Is Global Competition Making the Poor Even Poorer?" *New England Economic Review*, November.

Fishlow, A. (1996), "Inequality, Poverty and Growth: Where Do We Stand?" in *Annual Bank Conference on Development Economics*, eds. by M. Bruno and B. Pleskovic, Washington D.C., 25-39.

Frankel, J.A. (1997), *Regional Trading Blocs in the World Trading System*, Washington D.C.: Institute of International Economics.

Frankel, J.A., and D. Romer (1996), "Trade and Growth: An Empirical Investigation," National Bureau of Economic Research (Cambridge, M.A.) Working Paper No. 5476.

_____ (1999), "Does Trade Cause Growth?" *American Economic Review*, 89(3), 379-99.

Golub, S.S. (1994), "Comparative Advantage, Exchange Rates, and Sectoral Trade Balances of Major Industrial Countries," *IMF Staff Papers*, 41(2), June, 286-313.

Hall, A.R., G.D. Rudebusch, and D.W. Wilcox (1996), "Judging Instrument Relevance in Instrumental Variables Estimation," *International Economic Review*, 37(2), May, 283-98.

_____ (1996), "Trade and Growth: An Empirical Investigation," National Bureau of Economic Research (Cambridge, M.A.) Working Paper No. 5476, March.

Kosters, M.H. (1994), "An Overview of Changing Wage Patterns in the Labor Market," in *Trade and Wages: Leveling Wages Down?*, eds. by Bhagwati and M.H. Kosters, AEI Press, Washington D.C., 1-35.

Leamer, E. (1983), "Let's Take the Con Out of Econometrics," *American Economic Review*, 73.

_____ (1985), "Sensitivity Analyses Would Help," *American Economic Review*, 75.

Nelson, C.R., and R. Startz (1990), "Some Further Results on the Exact Small Sample Properties of the Instrumental Variable Estimator," *Econometrica*, 58(4), 967-76.

Perotti, R. (1996), "Growth, Income Distribution and Democracy," *Journal of Economic Growth*, 1(2), 149-87.

Persson, T., and G. Tabellini (1994), "Is Inequality Harmful for Growth," *American Economic Review*, 84(3), 600-21.

Richardson, J.D. (1995), "Income Inequality and Trade: How to Think, What to Conclude," *Journal of Economic Perspectives*, 9, 33-55.

Sen, A.K. (1976), "Poverty: An Ordinal Approach to Measurement," *Econometrica*, 44(2), 219-31.

Staiger, D., and J.H. Stock (1997), "Instrumental Variables Regression with Weak Instruments," *Econometrica*, 65(3), 557-86.

Williamson, J.G. (1998), "Policy Backlash: Can the Past Inform the Present?" in *Growth, Inequality and Globalization: Theory, History and Policy*, eds. by P. Aghion, and J.G. Williamson, Cambridge University Press, New York, 169-93.

Wood, A. (1994), *North-South Trade, Employment and Inequality: Changing Fortunes in a Skill-Driven World*, Oxford University Press, New York.