INTERNATIONAL MONETARY FUND

March 2017

THE EFFECT OF TRADE ON INCOME AND INEQUALITY: A CROSS-SECTIONAL APPROACH

Approved By
Valerie Cerra

Prepared By Diego Cerdeiro and Andras Komaromi

CONTENTS

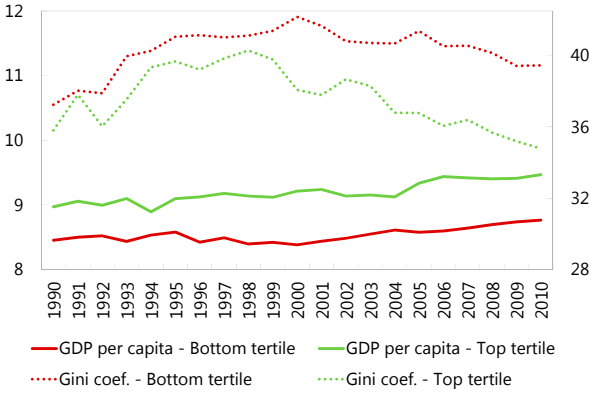
THE EFFECT OF TRADE ON INCOME AND INEQUALITY: A CROSS-SECTIONAL APPROACH[1]

This background note is a short summary of the main results in a forthcoming working paper. We use countries' exogenous geographic characteristics to construct an instrument for trade openness, and examine the cross-country relationship between trade, income and inequality.

A. Motivation and Methodology

1. There is a strong correlation between trade and income, and trade and inequality in the cross section of countries, but inferring causality is complicated due to endogeneity problems. Countries with higher trade openness (exports plus imports as a share of GDP) tend to have higher living standards and lower income inequality. The gap between more open and less open economies in terms of their GDP per capita and income Gini coefficient is persistent, and if anything it has widened in the last two decades (Figure 1). However, trade openness is arguably endogenous in these simple bivariate relationships as many variables that affect income and inequality directly may also be correlated with trade itself. For example, countries that adopt open trade policies may also pursue other market-friendly domestic policies and conduct stable fiscal and monetary policies. Since these policies are likely to affect income and inequality, trade openness is likely to be correlated with important factors that are omitted from the naïve approach.

Figure 1: Income and inequality by level of openness
(average of countries in bottom and top tertile)



2. Countries' exogenous geographic characteristics can be exploited to achieve causal identification. As the literature on the gravity model of trade demonstrates, geography is a powerful determinant of bilateral trade (e.g. Head and Mayer, 2014). A seminal paper by Frankel and Romer (1999, henceforth FR) showed that one can use this insight to construct a valid instrument for countries' overall trade openness. In particular, they estimate a gravity equation that includes only geographical variables such as bilateral distance, area, and whether the countries are landlocked, and they aggregate the fitted values to obtain the predicted trade openness of each country. The included geographic characteristics are unlikely to have important effects on countries' income except through their impact on trade. Thus, the constructed trade openness can be used to obtain

[1] Prepared by Diego Cerdeiro and Andras Komaromi. This paper was prepared as a background study for the Western Hemisphere Department's Cluster Report on Trade Integration in Latin America and the Caribbean. This paper describes research in progress by the authors and is published to elicit comments and to encourage debate. The views expressed in this paper are those of the authors and do not necessarily represent the views of the IMF, its Executive Board, or IMF management.

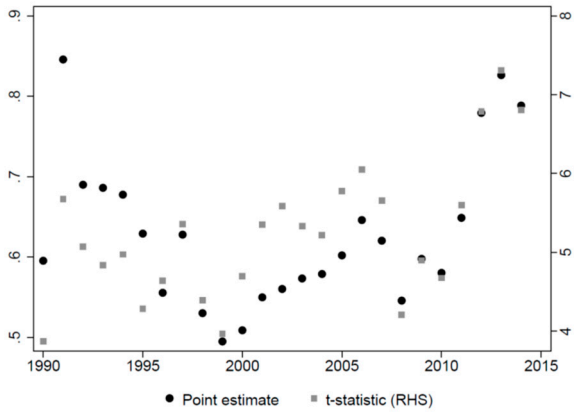
instrumental variables estimates for trade's impact on income. The authors use data from 1985, and find that a one percentage point increase in trade openness raises GDP per capita by between 2 and 3 percent.

3. Adopting the FR identification strategy, we analyze the effect of trade on income and inequality, and investigate the robustness of the results over time. We extend the work of FR in three directions: First, in addition to real income per capita, we also estimate the impact of trade openness on various measures of within country inequality. Second, instead of focusing on one cross-section of countries at a given point in time, we utilize annual data from 1990 to 2015, and check whether the estimated effects are stable qualitatively and quantitatively over time. Third, as an improvement in the econometric methodology, we employ the Poisson pseudo–maximum likelihood estimator to fit our gravity model of bilateral trade, which has a number advantages over simple OLS.[2] We also consider new robustness checks not present in the original work.

B. Results

4. Countries' geographic characteristics consistently predict actual trade openness, rendering our instrument highly relevant. In line with the literature, the coefficients in our gravity models are strongly significant and geographic variables account for a major part of the variation in bilateral trade. As a result, the constructed country-level openness measure is also highly correlated with actual trade openness even after controlling for country size.[3] Figure 2 shows the point estimate and t-statistic of the first-stage regression of the IV procedure for each annual cross-section. Given that openness also has non-geographical determinants, the point estimate is less than 1 – it ranges

Figure 2. First Stage Regression: Estimated Coefficient and t-statistic of Constructed Trade Openness



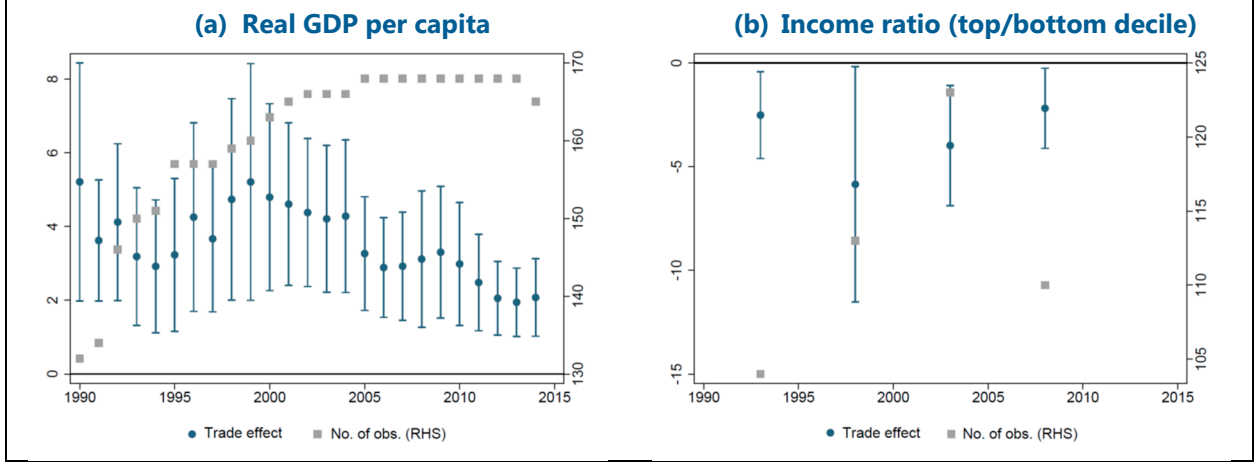
[2] The Poisson pseudo-maximum likelihood (PPML) estimator was popularized by Silva and Tenreyo (2006) in the estimation of gravity models. PPML has several desirable properties for our application: (i) it admits zero bilateral trade flows which need to be dropped for OLS due to the necessary logarithmic transformation; (ii) it remains consistent even if the error term in the original gravity relationship is heteroskedastic; and (iii) the fitted values directly yield an estimate of the *level* of bilateral trade, whereas OLS requires further to move from the estimated log-linear relationship to the predicted trade levels.

[3] Following FR, we control for country size when estimating the causal impact of international trade on income and inequality. Larger countries tend to engage in less international trade but in more within-country trade as a share of their GDP. Hence, the component of the constructed trade openness that is correlated with country size cannot be used to estimate the effect of trade. For details, see the working paper version (Cerdeiro and Komaromi, forthcoming).

between 0.5 and 0.9. Most importantly, the t-statistic shows that geography-induced openness is a sufficiently strong predictor of actual openness to serve as a reliable instrument. In particular, the usual rule of thumb that the first stage F-statistic should be greater than 10 is satisfied for every cross section.[4]

5. Our cross-country estimates for trade's impact on real income are consistently positive and significant over time. Figure 3 shows our baseline results for the effect of trade on income and inequality. According to the point estimates, a one percentage point increase in trade openness raises real income per capita by between 2 and 5 percent (Figure 3a). These estimates are overwhelmingly significant for all time periods. However, there is some time variation in the estimated effect: after hovering between 3-5 percent since the early 1990s, the coefficients fell to about 2 percent after the global financial crisis. The reasons for this decline are hard to pin down.[5]

Figure 3. Effect of Trade Openness on Real Income and Inequality

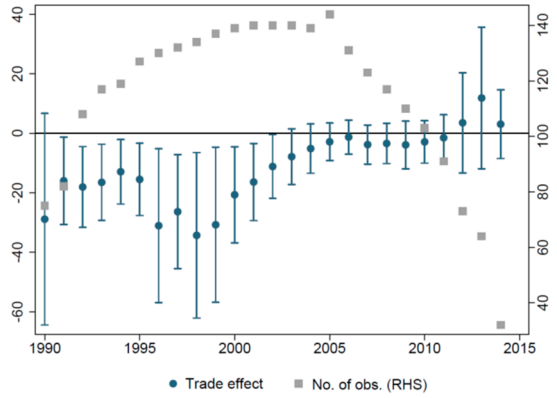


[4] The F-statistic can be readily obtained as the square of the t-statistic presented in Figure 2.

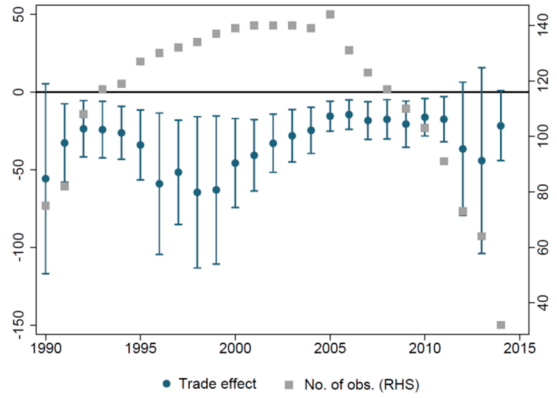
[5] One should be cautious in interpreting changes in the estimated coefficients for two reasons. First, most of the confidence bands include most of the other point estimates, so generally the differences are not statistically significant. Second, the figures also show that the sample of countries changes over time because of data availability constraints. The working paper version discusses possible explanations for the change in the estimated coefficients in both the income and inequality regressions, including changes in the country sample.

Figure 3. Effect of Trade Openness on Real Income and Inequality (Concluded)

(c) Market Gini coefficient



(d) Net Gini coefficient



Notes: Results from IV estimation of the regression: $Y_i = a + bT_i + c_1 \ln N_i + c_2 \ln A_i + u_i$, where T_i is trade openness, and N_i and A_i are population and area. The figures show the estimated b coefficient on trade openness (dots) and the 95 percent confidence intervals (spikes). The number of countries in the sample is shown on the right axis (squares). Trade openness enters the regressions in decimal form. The dependent variables (Y_i) in the four panels, respectively: log real GDP per capita (PPP-adjusted), log ratio of the average income of the top and bottom deciles in the population, and the market and net Gini coefficients on a 0-100 scale. The real incomes by decile are from the World Panel Income Distribution database (Lakner and Milanovic, 2016) and the Gini coefficients come from the Standardized World Income Inequality database (Solt, 2016).

6. The evidence suggests that, if anything, trade tends to reduce overall income inequality. Panel (b) shows trade's impact on the top-to-bottom income ratio for the available vintages of data. Point estimates suggest that one-percentage-point higher openness causes the income of the top decile to decrease by about 4 percent relative to the income of the bottom decile of the income distribution. This estimated effect is significant across all vintages. Panels (c) and (d) show the estimated effect of trade openness on the market and net Gini coefficients, respectively. Again, almost all of the point estimates suggest an inequality-reducing effect of trade. Moreover, for a number of years the estimates are significant, especially for the net Gini coefficient. The insignificant results and the few positive estimates all emerge for the more recent time period simultaneously with a dramatic drop in the number of countries in the sample. Overall, the estimated impact of trade on the Gini coefficient is fairly large, considering that these inequality indicators tend to move quite slowly over time.

7. Our results are qualitatively unaffected under various robustness checks. The methodology requires bilateral trade data for a large number of countries to construct the instrument. Since this is only available for goods, in our baseline regressions we calculate openness using only merchandise trade. However, we confirmed that the instrument is also relevant for trade openness including services, and that our results remain broadly unchanged both qualitatively and quantitatively. Another concern about our geography-based identification strategy is that systematic differences among parts of the world may drive the results. To address this issue, we follow Hall and Jones (1999) and include countries' distance from the equator as a control variable. This variable may reflect the impact of climate, or it may be a proxy for omitted country characteristics that are correlated with latitude. With this approach, the estimated effects are smaller, but the qualitative message is the same: trade improves living standards and there is no statistical evidence for any

negative effect on aggregate income inequality. Finally, we demonstrate that our results are mostly driven by non-European, and hence less developed countries.

C. Conclusion

8. Despite aggregate benefits, policies need to address the short and medium term adjustment. Given that the results are based on cross-country data, they should be interpreted as the long-run estimated effect of trade on real income and overall inequality. Thus, the estimates do not shed light on possible temporary adjustment costs from greater integration. Moreover, it is worth noting that although the estimates indicate that over time there are substantial benefits from trade, they are silent about the channels through which this effect operates. In this regard, more disaggregated studies are essential to help design policies that tap trade integration to spur growth.

References

Cerdeiro, Diego, and Andras Komaromi, forthcoming, "Trade, Income, and Inequality in the Long Run," IMF Working Paper (Washington: International Monetary Fund).

Frankel, Jeffrey A., and David H. Romer, 1999, "Does Trade Cause Growth?," *American Economic Review*, June, Vol. 89, No. 3.

Hall, Robert E., and Charles I. Jones, 1999, "Why do Some Countries Produce So Much More Output Per Worker than Others?," *The Quarterly Journal of Economics*, 114 (1): 83-116.

Head, Keith, and Thierry Mayer, 2014, "Gravity Equations: Workhorse, Toolkit, and Cookbook," chapter 3 in Gopinath, Gita, Elhanan Helpman, and Kenneth Rogoff (eds), vol. 4 of the Handbook of International Economics, Elsevier: 131–195.

Head, K., and T. Mayer, 2014, "Gravity Equations: Workhorse,Toolkit, and Cookbook," chapter 3 in Gopinath, G, E. Helpman and K. Rogoff (eds), vol. 4 of the Handbook of International Economics, Elsevier: 131–-195.

Lakner, Christoph, and Branko Milanovic, 2016, "Global Income Distribution: From the Fall of the Berlin Wall to the Great Recession," *World Bank Economic Review*, World Bank Group, vol. 30(2), pages 203-232.

Santos Silva, J.M.C., and Silvana Tenreyro, 2006, "The Log of Gravity," *The Review of Economics and Statistics*, 88(4), pp. 641-658.

Solt, Frederick, 2016, "The Standardized World Income Inequality Database," *Social Science Quarterly* 97(5):1267-1281.