"Does Trade Cause Growth?" - A Comment[1]

by

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The proposition that trade causes economic growth is a rich in international economic theory. Even so, how best to estimate and test for the effects of trade on economic growth remains a challenge to-date, mainly because of the joint determination of the empirical measures of both trade and economic growth. Professors Jeffrey Frankel and David Romer have offered and employed an insightful method of constructing an IV for trade that is less troubling than previous attempts. Yet the new method too has some small problems. This comment points out those problems and suggestions possible improvements.

JEL code: O40, F43

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[1] Copies of an early version of this comment were sent to both Professors Frankel (Harvard) and Romer (UC Berkeley) in 1999. The author of this comment did not request a response from them because the comment is more appreciative than critical of their work.

1. Introduction

The selective literature review to the article in the *American Economic Review* (June, 1999: 379-399) by Professors Jeffry Frankel and David Romer shows that the causal association between international trade (T) and output or income (Y), which economists since Adam Smith have alleged, remains a challenge for empirical research to-date (see also Alcala and Ciccone, 2001). The challenge has led to the unfortunate practice of incorporating T in a relationship in which Y is a T-augmented production function (f) of capital (K) and labor (L), i.e.,

$$Y = f(K, L, T). \qquad \textbf{(1)}$$

In that practice the role of T is defended on grounds that it is either a place-holder for land as in the classical version of production, or it is openness and T-allied technical change as in the new growth models. The latter set of models would measure T by either exports (X), imports (M), net trade (X - M), or gross trade (X + M).

While (1) is intuitively appealing, it poses serious problems, most of them arising from the definition of Y as well as the joint determination of T and Y (Cf. Temple, 1998). For example, if T / X is a flow, it is part of Y; if it is a capacity (stock), it is included in K. On the other hand, if T / M, one is faced with the task of sorting consumer goods from capital goods. In industrialized such a task is simply not easy; in developing countries the task is generally avoided by assuming, simplistically perhaps, that a large share of what these countries import is producer goods and intermediate inputs counted as capital, and the remainder of M is consumer goods included in the Consumption and/or Government components of the Keynesian Y = C + I + (X - M) + G.

Using T / X - M or T / X + M raises similar problems, in addition to the difficulty of interpreting the meaning of the effects on Y of changes in T. For example, if T / X - M = 0, then dY/d(T / X - M) would be undefined even though individually dY/d(T / X) 0 and dY/(T / M) 0. Moreover, when T / X - M < 0 (> 0), the Y generated without trade is smaller (larger) than the Y augmented by trade. Letting T / X + M leads to the dY/d(T / X + M) effect, whatever its arithmetic sign, to be meaningless because it mixes K and C goods.

Hence attempts at assessing the impacts of T on Y sought to go around the above-mentioned problems by employing X/Y, M/Y, (X-M)/Y, or (X+Y)/Y as proxies for T. To assess the effects of German aid to and trade with Namibia, Amavilah (1998) (X - M)/Y as a measure of capital flows between the two countries. However, in the literature of export-led growth, the following two

(2)

Y=f(K, L, x / X/Y) ~~~~~~~~~~~~~~~~~~~~~ (a)#

Y = A(x)f(K, L, M) ~~~~~~~~~~~~~~~~~~~~~~ (b)

formulations have been popularly used:

where (2a) implies export-led production given neutral technical change and (2b) implies production in which the state of technology A = A(e**x**ports). The problem is that if (2a) and (2b)

(3_

Y^ 2 = f(K, L, x) ΨY = sqrt f(K, L, X) ~~~~~~~~~~~~~#

Y^2 = A(x) f(K,L,M) ΨY = sqrt A(x)f(K, L,M).

above are multiplicative in determinants, then

Thus (2) does not resolve the joint determination problems; it formalizes a misspecification error by double-counting T as a part of Y on the LHS and a determinant of Y on the RHS.

2. Enters Frankel and Romer's New IV for T

Frankel and Romer proposed an insightful construction of instrumental T which in many ways avoids some of the problems that afflicted previous attempts. They started by letting Y

(4_

lnY ~=~ alpha ~+~ beta T ~+~ gamma W ~+~ error,

depend on international (T) and internal (W) trade expressed as

where *e* is the normal error term, and W depends on the **S**ize of the country (S),and can be represented by W = 0 + 8S + Λ. Furthermore, Size is measured by the **A**rea (A) and populatio**N** (N) of the country such that W = 0 + 8_AA + 8_NN + Λ. Substituting for

(5_

lnY = (alpha+gamma nu)+beta T +gamma lambda S +(gamma nu +error)~~~~~~#

lnY =(alpha+gamma nu)+beta T +gamma lambda_A A + gamma lambda_N N +(gamma nu +error)

W in (4) leads to,

In order to find an instrument for T, Frankel and Romer modify the conventional gravity model of bilateral T for country size (A and N), and introduce common **B**order and **L**andlockedness as additional variables. Then they "aggregate the fitted values"

(6_

ln(T / tau/GDP) = a'X + error,

of the gravity equation to estimate T as

where ϑ is the share of trade in Y from one country to another, X is a vector of independent variables [**D**istance, **S**ize (**A**, **N**), Common **B**order, **L**andlockedness] - see p. 384, including footnote 10. Then actual T becomes,

(7)

T = exp(a'X + error) =exp(a'X) ~ ~ E[exp(error)] = 0,
where E is the expectation about *e*. It then follows that a country's overall trade share is

(8)

T^* = Sum T = Sum exp(a'X).

Hence (5) can also be estimated as

(9_

lnY = (alpha+gamma nu)+beta T^* +gamma lambda S +(gamma nu +error)~~~~~~#
lnY =(alpha+gamma nu)+beta T^* +gamma lambda_A A + gamma lambda_N N +(gamma nu +error)

3. The Small Problems

The IV construction is clearly insightful, yet it raises a number of small problems. Eqs. (5) and (9) include S twice - once in calculating T and T* and again in determining Y statistically. This point is obvious if one rewrites the original Eq. (9) on p. 386 as

(10_

ln Y = a + b [exp(a'X)]+ c_1 ln N + c_2 ln A + u~~~~~~~#
ln Y = a + b [sum(exp(a'X))]+ c 1 ln N + c 2 ln A + u.

However, in its simple form X is a vector [1, D, A, N], or it is vector [1, D, N, A, BD, BA, BN, ..., BL] when the interaction terms common B and L are included.

The first problem is that there seems to be too many A's and N's in one equation, which questions the efficiency of the estimates. Even with B and L excluded, there are already seven exogenous variables. Variables A and N appear twice and the constant and error terms each has two components. When B and L are included, the number of exogenous variables raises to fifteen with A and N appearing at least three times in the same equation while the components of the constant and error terms go up to three. In other words, the constant and residual terms are getting bigger and bigger even as we add more and more regressors. Consequently the raise in the adjusted R-squared and the fall in the SE of the regression are both minimal. And so the increase in the multi-components of the constant and error terms seems to suggest more ignorance than knowledge of the system.

A second problem is about what the rationale is for running T = f(T*, S) = f(T*, N, A). Since T* = sum(T), the results of Table 3, p. 385 are not unexpected. Even so, one is struck by why the adjusted R-squared   1.0! One also gets a sense that perhaps it would be better if T = f(T*-lagged by some time period) since the history of aggregate trade is more likely than contemporaneous aggregate trade to affect current bilateral trade for any given country.

With so many A's and N's included in one equation, why is the degree of the proposed model higher? That is the third problem. Presumably raising the degree of the model would complicate estimation given the interaction terms. Even so, one is left to wonder whether the effect on Y of T* is larger than that of T only because the former counts S twice. As in the case of the first problem above, the model fails one of Friedman's (1953) criteria for a "good" model because it explains little with more rather than more with little.

Finally, it seems reasonable to have set $8 = 8_A + 8_N = 1$ because A and N measure the same thing only differently. One country may be considered large because it has a large A AND a large N (China or India). Another country may be large because it has EITHER a large A (United States or Saudi Arabia) OR a large N (Nigeria or Indonesia). Therefore, although A and N are statistically independent of each other, they are related in what they measure about a country's trade and income. Failure to set $8 = 1$ is further complicated by the other included explanatory variables. For instance, many African countries share wide **B**s, but T between and among them is zero. Nigeria has no B with Ghana, and has a large B with Cameroon, but because D between Accra (Ghana) and Lagos (Nigeria) is shorter than it is between Lagos and Younde (Cameroon), T between Nigeria and Ghana is larger than T between Nigeria and Cameroon. Moreover, proximity variables (B and D) are also troubling because if we consider T between USA and Guatemala, D and B plausibly measure two different things. For T between Mexico and USA, or USA and Canada D and B measure the same thing and not for reasons of the two countries being members in NAFTA. The reason is that T between Mexico and USA is really T between US and Mexican states sharing common Bs. In such cases T = W, and how Mexico City is from Washington DC is not a strong determinant of bilateral trade.

4. Possible Model Improvements

My reading of Frankel and Romer suggests a number of alternative adjustments that can be made to improve the model. First, one

(11_

$$\ln \hat{Y}^{*} = a + bT' + c\,1 \ln N + u.$$

could leave out N from T and A from Y so that

(12_

$$\ln(\hat{Y}^{*} / N) = a + b(T'/N) + u,$$

The intensive form of (11) would be,
where Y* is Y without A and T' is T without N as determinants. Eq (12) implies per capita income/output, assuming that N is like labor in neoclassical production function analysis.

(13_

ln Y^{**} = a + b T'' + c 2 lnA + u,

A second alternative is to omit A from T and N from Y such that

(14_

ln (Y^{**}/A) = a + b(T''/A) + u,

the productivity form of which is

where Y** is Y without N and T'' is T without A as independent variables. Eq.(14) represents the productivity of A. If one assumes that A is for land in the classical sense, then for a developing country that trades in raw materials (e.g., coffee, mineral ores, etc.) T and A would simply represent traded and non-traded land, respectively.

The third alternative is to consider bilateral trade in terms of relatives. In that case vector X = [1, D, **a** / Ai/Aj, **n** / Ni/Nj, ...], and A and N remain determinants of Y.

5. Implications for Economic Growth

The preceding suggestions fit well into the proposed model. Following Frankel and Romer's example in Section II.D (pp. 390ff), one can determine the mechanisms through which trade generates income/output by introducing T directly into the Hall-

(15_

Y = K^alpha[exp(phi(G) rho N)^beta exp(gamma T) or Y = K^alpha[exp(phi(G) rho N) exp(gamma T)]^beta,

Jones (1999) income/output,

where ∀ + ∃ = 1.[2] **But since a change in □ leads to corresponding changes in K and T, the Klenow-Rodriguez-Clare[3] income/output**

(16_

Y = (K/Y)^{alpha/beta} exp(phi(Gi)) rho N ~exp(gamma T) + u.

becomes[4],

And so dividing through by N and taking the natural logs leads to

(17_

ln(Y/N) = ln rho + (alpha/beta) ln (K/Y) + phi G + (gamma/beta) $\bar{T}$ + u.

From (17) one can finally examine the direct effect of T on Y, and the components of Y as Frankel and Romer did so well. But

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[2] I have replaced S and A in the original equation with G (index of average workers' schooling) and Δ (technical efficiency) to avoid confusion between S for size and A for Area.

[3] I have seen, but not read, Peter Klenow and Andres Rodriguez-Clare's paper. So I have relied on Frankel and Romer's restatement of it.

[4] Note that there is no need for T/Y because T = ϑ**/GDP = □/Y).**

there is another implication worth mentioning, and that is that if Y is K-intensive and K grows at a rate equal to that of T[5], then

(18_

Y = [K/Y~exp(gamma T)]^{alpha/beta} exp(phi(G)) rho N.

(19_

ln(Y/N) = (alpha/beta) ln (K/Y) + (alpha gamma/beta) T + phi(G)+ln rho.

Assuming N to be a numeraire and taking the logs of (18) gives

5. Concluding Remark

There is no doubt that the model the authors proposed represents a new path for future research in this area. For a long time the heavily used highways have been rife with potholes, it is nice to see a promising pathway. However, it seems that by counting S twice the results may be more robust than they would otherwise be. This comment has considered possible improvements and briefly showed how they fit into the overall growth model.

6. References

Alcala, Francisco and Antonio Ciccone (2001) Trade and Productivity. IMF Working Paper (October).

Amavilah, VH (1998) German aid and trade versus Namibian GDP and labour productivity, Applied Economics, 30, 689-695.

Frankel, Jeffrey and David Romer (1999) Does trade cause growth? AER vol 89, no 3 379-399.

Friedman, Milton (1953) The Methodology of Positive Economics, in Essays in Positive Economics (Chicago: University of Chicago Press), 3-43.

Hall, Robert and Charles I. Jones (1999) Why do some countries produce so much more output per worker than others? Quarterly Journal of Economics, 114(1), 83-116.

Temple, Jonathan (1999) The new growth evidence JEL, Vol. XXXVII (1), 112-156.

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[5] This supposition is not at all unrealistic because many developing countries import all their capital goods.