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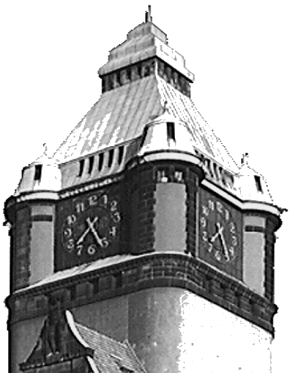
by
Klaus Wälde



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Does trade cause growth? A policy perspective

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April 2000

Several empirical papers have shown that international trade has a positive causal effect on a country's GDP or growth rate. A common conclusion from these results is that a free trade policy will increase a country's GDP. This comment does not dispute the empirical findings per se but questions this conclusion. An example is provided that shows that it is not obvious which policy recommendations can be supported by these empirical findings.

1 Introduction

There is a huge literature on the links between trade and growth. One of the main questions of this literature is to what extent international trade has a causal and positiv effect on domestic growth. Many of the difficulties of this literature come from the endogeneity of international trade variables as this endogeneity causes estimates to be biased. Various solutions to this problem have been suggested, starting with the Granger-causality paper by Jung and Marshall (1985). An innovative and very promising approach building on gravity equations has been suggested recently by Frankel and Romer (1999).[2] They find that "trade has a quantitatively large and robust, though only moderately statistically significant, positive effect on income" (p. 379).

[1]Department of Economics, University of Dresden, 01062 Dresden, Germany, klaus@waelde.com, http://www.waelde.com, Tel + 49.351.463 - 2172, Fax + 49.351.463 - 7736. I am grateful to David Romer and participants of the World Bank trade seminar for comments.
The first draft of this comment was written while the author was working at the World Bank.Views expressed in this paper do not necessarily represent the views of the World Bank, its Executive Directors, or the countries they represent.

[2]For a more detailed overview of the literature, cf. Frankel and Romer (1999) or Wälde and Wood (1999).

The present note is not directly concerned with the central question of this literature but with an implicit one. This implicit question has always been what recommendations should be given regarding trade *policy*. Findings by Frankel and Romer and related findings by other authors are often used to justify one or another policy statement. As international trade has been shown to have a causal positiv effect on growth, governments should embrace a free trade policy, one argument goes. This would increase domestic growth rates. This note shows that this reasoning is potentially erroneous. Trade policy recommendations, neither pro nor contra trade, can not be deduced from the empirical findings of this literature.

There are two reasons why such a conclusion can not be drawn. First, growth-regressions generally do not take policy variables, like trade tariffs, into account (a notable exception is Lee, 1993).[3] Hence, even if exports had a causal effect, there would be close to nothing a government can do to increase exports directly as exports are not a policy instrument of the government.

Second, the view that a reduction of a trade tariff would be beneficial is, technically speaking, a prediction made with respect to the country under consideration, based on the estimates of a regression. Making predictions, however, depends on the validity of some underlying true theoretical model. Usually, policymakers seem to believe in a first best world where tariffs are a distortion which reduce growth. If second best world aspects were taken into consideration, removing one distortion would not necessarily lead to higher welfare or growth (Lipsey and Lancaster, 1956) and such an argument could not be made. As empirical work does not discriminate between these possibilities, no true theoretical model is identified. Hence, even if trade instruments were taken into account, statistically significant results would still not allow to make unambiguous predictions.

We will support the claim of this comment and make the claim more precise by first presenting a theoretical model that represents our hypothetical true world. Countries undertake trade liberalization up to some optimal point and will thereby enjoy higher income. We will then run two cross-country growth regressions on data that result from this model. These regressions are intended to replicate in our are theoretical world the approaches taken in the empirical literature. The regressions predict a statistically significant positiv causal effect of trade on growth and a negative effect of tariff rates on growth. Using the theoretical model, which stands for the true world, allows us to make true predictions about the effects of further trade liberalization. As countries operate in a second best world, further trade liberalization would

[3] Other approaches where the effects of trade policy are estimated are surveyed by Feenstra (1995).

lead to losses in income. This shows that the empirical findings can not easily be generalized as the usual approaches do not capture the parameters required to determine whether trade policy takes place in a first best or second best world.

2 A theoretical model and a regression

2.1 Second best trade policy

Imagine a set of countries, as in Mayer (1974), with two sectors and two factors of production, labor and capital. Capital is sector specific and each country produces a good X and a good Y. Assume further some domestic distortion, which, for simplicity, we model here as a wage rigidity à la Brecher (1974). Clearly, this is just a convenient example representing other, potentially more complex, market and institutional failures.

Such a model can be summarized in one equilibrium condition, the equality of value marginal productivities of labor across sectors,

$$p_X^* X'(L_X) = [1+\tau]\, p_Y^* Y'(L_Y)\,. \tag{1}$$

International goods prices are denoted by p_X^* and p_Y^*, respectively, τ stands for the tariff rate on good Y, L_X and L_Y denote employment and a prime ($'$) stands for the first derivative. As can be seen, domestic prices are determined internationally and through the import tariff τ. The link between the tariff rate and GDP of such an economy is depicted in figure 1 (for an analytical derivation, cf. appendix).

A distortion free economy has the highest potential GDP, shown here by the line denoted GDP. GDP is highest when the tariff rate equals zero. Considering a country with some distortion, its GDP will also initially rise, starting at τ_0, when the tariff rate decreases, but it will reach its maximum earlier (at τ_j^*) than a distortion-free economy. Its GDP is exactly the same as the GDP of a distortion free economy, but, once the distortion becomes relevant, it is lower, as shown by GDP_j.

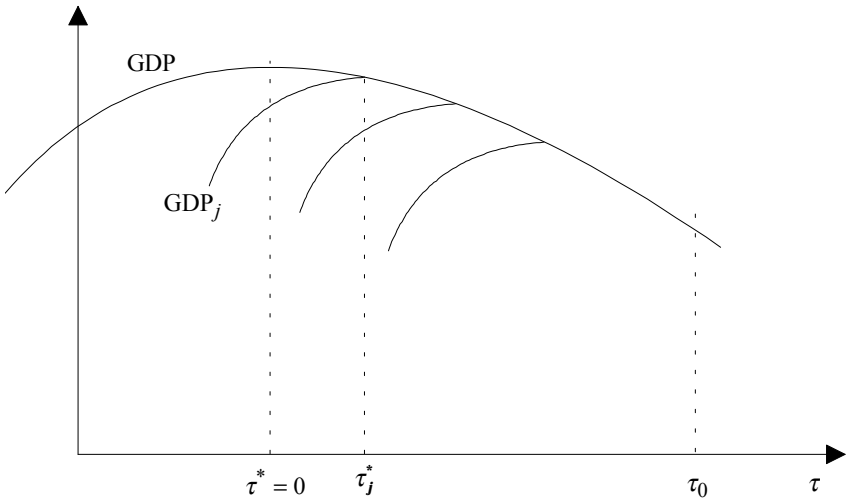

Figure 1: Tariff rates and GDP

2.2 A Cross-Country Growth Regression

Imagine an econometrician that gathers data for all countries at two points in time. Before trade liberalization (think of this as the period where countries believed in import substitution), all countries have the same tariff rate τ_0. After trade liberalization, all countries perform a constrained optimal economic policy, which means that the countries with domestic market or institutional failures (exemplified by wage rigidities) take those as given. The set of countries with perfect markets will then have zero tariffs $\tau^* = 0$ and a high GDP. The set of countries with the distortion will set some tariffs $\tau_j^* > 0$ and have a lower GDP.

Countries with no distortions will have a higher growth of GDP between these two points in time than countries with a domestic distortion. Solving our model economy numerically gives this data[4]. Running an OLS growth regression with the reduction of the tariff rate as explanatory variable,

$$g_i \equiv \frac{GDP_{1i} - GDP_{0i}}{GDP_{0i}} = \beta_1 + \beta_2 \left(\tau_{1i} - \tau_{0i}\right) + \varepsilon_i,$$

produces the following result,

$$\begin{array}{rcll} g_i & = & 0,0031 - 0,0846 \left(\tau_{1i} - \tau_{0i}\right). & (2) \\ & & (7.9) \qquad (-62,8) \qquad (t - values) & \end{array}$$

[4]The model was solved by using Mathematica. Regressions were run using PcGive. The program for Mathematica and the data generated by the program are available upon request.

Tariffs have a negative significant effect on growth.[5]

When tariff rates are replaced by the increase in trade, the following estimates would obtain,

$$\begin{aligned} g_i &= 0,0049 + 0,0018 \left(\frac{EX_{1i} + IMP_{1i}}{2} - \frac{EX_{0i} + IMP_{0i}}{2} \right). \qquad (3) \\ & \quad (9,7) \qquad (45,0) \qquad (t - values) \end{aligned}$$

For both regressions, R^2 is above 0.95.

One could ask whether OLS regressions are appropriate for this data generation process and whether they are a fair representation of the approaches chosen in the empirical literature, given that this literature uses more complex methods than OLS.

OLS are appropriate (apart from a omitted variable problem discussed below) for the regression using tariff rates as explanatory variables as tariff rates are exogenous in our theoretical world. (There might be other reasons why OLS is not appropriate but these other reasons are not essential to our point.) OLS is also appropriate for the regression with trade volumes as there is a non-stochastic relationship (and therefore not a second regression equation which would require trade volumes to be treated as endogenous variables) between trade volume changes and exogenous tariff changes.

We also believe that the above regressions are a fair representation of the usual empirical approaches. We just argued that our theoretical world does not pose the same problems as does the real world. We can therefore neglect all the refinements that are necessary in practice.[6]

3 Policy recommendations

3.1 The problem

What do these growth regressions in our theoretical world tell us about policy recommendations based on existing empirical work?

We have obtained in our regression the same statistically significant positive link between trade and growth as was often found in the literature. There is also a statistically significant negative link between trade barriers and growth as in Lee (1993). An economic advisor could now recommend to countries that still have a positive tariff rate that, because the regression has shown that high tariffs are detrimental to growth, tariffs should be reduced.

[5] Such a result was obtained with a "real-world data set" by Lee (1993), the only study we are aware of that explicitly includes trade policy variables in growth regressions.

[6] I am grateful to David Romer for raising these points.

This is the policy advice given by many, based on results of the growth and trade literature.

The policy advise is based on a prediction of the effects of trade liberalization which can be made by using the regression results. Such a prediction requires that the underlying and estimated parameters of the statistical model are valid also for the prediction. The outcome in our theoretical world for a country that has set a tariff $\tau_j^* > 0$ would be that this country is worse off after lowering tariffs due to the wage rigidity. As no growth regression in the literature takes market or institutional failures, of which the above theoretical model presents an example, into consideration (which is admittedly difficult), this might also happen in the real world. The shortcoming of standard approaches is therefore that no discrimination is achieved between theoretical models that predict that further trade liberalization leads to more or less growth. This discrimination fails as "true and deep" parameters are not estimated. More trade liberalization might lead to more growth if the general first-best-world view is valid - it might also lead to less growth if the second-best-world view presented here is more relevant. Statistically significant coefficients in existing growth regressions do therefore not allow to formulate policy recommendations.

It should be clear that the argument here is not an argument for protection of domestic industries. The only interest of the present argument is to raise awareness of the carefulness that is required when policy conclusions are drawn from empirical studies.[7] While this critique is basically an application of the Lucas critique (Lucas, 1976) to trade and growth regressions, and should therefore be acceptable without much discussion, everyday practice of policy advisors shows that such a reminder might be appropriate.

3.2 A constructive point

The regression equations underlying (2) and (3) are mispecified as they do not contain variables that capture the country specific characteristics, the distortions.[8] This is of course the point of the paper as these country specific characteristics are not taken into consideration in the "real-world" empirical literature, either.[9]

[7] The policy recommendation for our theoretical world is of course to remove domestic market or institutional failures.

[8] Given the behavior of countries as described above, a regression that would include such an explanatory variable should lead to a coefficient equal to zero for this variable as that variable does not have any explanatory power in the range observed.

[9] This misspecification is of relevance only for predictions and not for the question whether trade has a causal effect on GDP or not. This is the reason why this is a note

It might be difficult in practice to imagine a distortion that has an effect on GDP at low levels but not at low levels. Clearly, this is a theoretical simplification. As reality should be more general (there is some distortion at high protection levels and more distortion at lower protection levels), there is hope for discrimination with real-world data between the two theoretical models. If tariff rates (or other policy instruments) are included on the right hand side of the regression also with a quadratic term, one would allow for non-linearities as they are predicted by the above second-best-world model. This would be a first step towards discriminating between alternative theoretical models.[10]

Data requirements would be more demanding, however. Not only would country-specific aspects have to be taken into consideration but these country-specific aspects would also be of a non-linear nature. Simple country-specific fixed effects would then not be sufficient and longer time-series data would be required.

4 Conclusion

The present note made an argument which, from a puely academic perspective, is very easy to understand, almost trivial. Cross country regressions that establish a causal link from trade to growth can not be used as basis for policy recommendations. Using well-known models from the trade literature, it was shown that even if regressions used trade policy instruments as explanatory variables, no generalization to all countries at all times can be made. The basic reason are variables that are omitted from the regressions which are required for identifying the true theoretical model and for making valid predictions.

Despite the straightforward nature of the arguments made here, they are extremely important for economists that give policy advice to governments. Findings like the ones by Frankel and Romer, or others, are routinely used to support free trade arguments. While free trade can be supported on many theoretical and empirical grounds, this note has shown that it can not be supported by this approach. Policy advisors should therefore be more careful when providing support for their arguments.

on the policy implications drawn from empirical studies and not a note on the empirical studies themselves.

[10] Again, I am indebted to David Romer for having drawn my attention to these points.

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5 Appendix

5.1 Factor allocation and the effect of tariffs

Our model economy can be summarized in equilibrium condition (1). When there is full employment, i.e. when the minimum wage is not binding, sectorial employment sums up to labor supply,

$$L_X + L_Y = L. \tag{4}$$

Applying the implicit function theorem to (1) with (4) immediately shows that employment in sector X is decreasing in the tariff rate,

$$\frac{d}{d\tau} L_X < 0. \tag{5}$$

For distortion free economies, GDP measured in terms of international goods prices,

$$GDP = p_X^* X + p_Y^* Y, \tag{6}$$

has a maximum where the tariff rate is zero:[11] The derivative of GDP with respect to the tariff rate is given by

$$\begin{aligned} \frac{d}{d\tau} GDP &= p_X^* X_{L_X} \frac{dL_X}{d\tau} + p_Y^* Y_{L_Y} \frac{dL_Y}{d\tau} > 0 \\ &\Leftrightarrow \left[1+\tau\right] \frac{dL_X}{d\tau} - \frac{dL_X}{d\tau} = \tau \frac{dL_X}{d\tau} > 0 \\ &\Leftrightarrow \tau < 0 \end{aligned}$$

where the last step used (5). When the tariff rates is negative, GDP increases when the tariff rate increases. When the tariff rate is positive, GDP falls when the tariff rate increases. This is the standard result that the GDP maximizing tariff rate is zero for distortion free economies.

Let us now consider an economy where the distortion is binding. Such an economy can be summarized by an equilibrium condition as for the undistorted economy in (1), only that now wages are determined exogenously by the minimum wage $\bar{w}$,

$$\bar{w} = p_X^* X'\left(L_X\right) = \left[1+\tau\right] p_Y^* Y'\left(L_Y\right).$$

[11] Real GDP could be alternatively measured in terms of prices before trade liberalization or prices after trade liberalization, as long as goods prices are kept fix.

This shows that employment in sector X is constant. Employment in sector Y is an increasing function of the tariff rate. These functional relationships are illustrated in figure 2.

As output of sector X and output of sector Y follow qualitatively similar curves as employment in these sectors, this figure also shows that GDP falls when the tariff rate falls below the level τ^* where the minimum wage becomes binding.

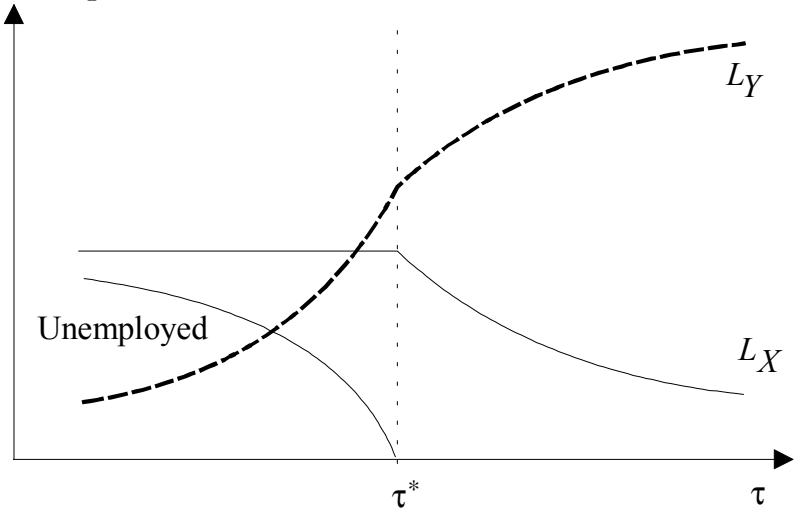

Figure 2: Tariff rates and employment

5.2 Exports, imports and consumption levels

As we would like to run a regression on the relationship between exports and growth as well, we need to first understand consumption levels of both goods. Consumption is determined by total domestic expenditure which is the sum of labor and capital income and of tariff revenues,

$$\begin{aligned} E &= wL + rK + T \\ &= p_X X + p_Y Y + \tau p_y^* [C_y - Y]. \end{aligned} \tag{7}$$

The last equality uses the finding that under perfect competition the sum of labor and capital income equals the value of total output. Tariff income of the economy is given by the tariff rate times the value of imports.

Assuming Cobb-Douglas preferences, domestic consumption is given by

$$C_X = \frac{\sigma E}{p_X^*}, \quad C_Y = \frac{(1-\sigma)E}{(1+\tau)p_Y^*}. \tag{8}$$

It is clear that these equations can not be used to compute consumption levels as total expenditure E is itself a function of consumption. Inserting

the expression for expenditure into the expression for consumption of good Y gives an appropriate expression:

$$\begin{aligned}
(1+\tau)p_Y^* C_Y &= (1-\sigma)(p_X^* X + p_Y^*(1+\tau)Y + \tau p_Y^*(C_Y - Y)) \Leftrightarrow \\
(1+\tau-(1-\sigma)\tau)p_Y^* C_Y &= (1-\sigma)\left(p_X^* X + p_Y^*\left(1+\tau\right)Y - \tau p_Y^* Y\right) \\
&= (1-\sigma)\left(p_X^* X + p_Y^* Y\right) \Leftrightarrow \\
C_Y &= \frac{1-\sigma}{(1+\sigma\tau)\, p_Y^*} GDP \qquad (9)
\end{aligned}$$

Expressing expenditure as

$$\begin{aligned}
E &= p_X^* X + (1+\tau)\, p_Y^* Y + \tau p_Y^* C_Y - \tau p_Y^* Y \\
&= p_X^* X + p_Y^* Y + \tau p_Y^* C_Y = GDP + \tau \frac{1-\sigma}{1+\tau\sigma} GDP \\
&= \left(1 + \tau \frac{1-\sigma}{1+\sigma\tau} GDP\right) = \frac{1+\tau}{1+\tau\sigma} GDP,
\end{aligned}$$

where we started from (7) and inserted (6) and (9), yields an expression for expenditure that can be used to compute consumption of good X,

$$C_X = \frac{\sigma}{p_X^*} \frac{1+\tau}{1+\tau\sigma} GDP.$$

These expressions allow us to compute exports and imports as

$$EX = X - C_X, \quad IMP = Y - C_Y.$$

To check consistency, we note in passing that as households satisfy their budget constraints, the trade balance is always in equilibrium: The budget constraint of households equalize expenditure for consumption with labor, capital and tariff income,

$$\begin{aligned}
p_X^* C_X + (1+\tau)\, p_Y^* C_Y &= E \\
&= wL + rK + T
\end{aligned}$$

As factor rewards equal the value of output,

$$wL + rK = p_X X + p_Y Y = p_X^* X + (1+\tau)\, p_Y^* Y,$$

the budget constraint of households becomes

$$p_X^* C_X + p_Y^* C_Y = p_X^* X + p_Y^* Y + \tau p_Y^* Y - \tau p_Y^* C_Y + T.$$

As tariff income is given by $T = \tau p_y^* [C_y - Y]$, the budget constraint can be expressed as

$$p_X^* \left(C_X - X\right) + p_Y^* \left(C_Y - Y\right) = 0$$

which is the trade balance equilibrium.

5.3 Model implementation

For the regression, we chose functional forms such that the equilibrium condition (1) reads

$$\begin{aligned} p_X^* A_X \alpha L_X^{\alpha-1} &= [1+\tau]\, p_Y^* A_Y \beta L_Y^{\beta-1} \Leftrightarrow \\ \frac{(L-L_X)^{1-\beta}}{L_X^{1-\alpha}} &= [1+\tau]\, \frac{p_Y^* A_Y \beta}{p_X^* A_X \alpha} \end{aligned}$$

The parameter values chosen are

$$\alpha = .6;\ \beta = .8;\ L = 100;\ p_X^* = 3;\ p_Y^* = A_Y = A_X = 1;$$

The parameter values for α and β imply that sector X is more capital intensive than sector Y. The price p_X^* was set at 3 to slightly balance the differences in labor intensity.

The program for Mathematica and the data generated by the program are available upon request.