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Distance measures between free trade and autarky for the world economy ☆

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ABSTRACT

We develop a methodology to determine numerically how globalized the world economy is. We present a global general equilibrium model capturing major OECD economies and a residual rest of world for which alternative metrics of distance between observed, free trade and autarky equilibria can be developed. We use data for 2000 and report a number of distance measures between the 2000 observed trade restricted equilibrium and both free trade and autarky equilibria noting the absence of prior literature on metrics of distance between equilibria. The measures are used to determine the degree to which the world economy is globalized.

1. Introduction

Popular magazines such as the Economist and Foreign Affairs now report each year indices showing how globalized individual economies are. They typically focus on such measures as the ratio of trade to GDP. But trade theory stresses that these measures are hard to evaluate for individual economies, since large economies may experience little change in behavior when they remove their own barriers to trade, but these will greatly affect economic activity in smaller economies. Instead, the question should perhaps be how globalized is the world economy?

One way to answer such a question is to assess how far the world economy is between autarky and free trade. Here we develop methodologies to answer that question numerically, using welfare, price and quantity distance measures. The distance measures we construct raise broader issues in equilibrium analysis and modeling since the main focus of prior general equilibrium literature is on comparative statics and issues of existence, uniqueness, and stability (see Arrow and Hahn (1971), and Mas-Colell (1985)) not measures of distance between equilibria.[1]

We use a global general equilibrium model and data for 2000 for ten OECD countries (Australia, Canada, Germany, Italy, Japan, Korea, Mexico, Norway, UK, and US) and a residual rest of world to calculate a number of distance measures for existing trade restricted global equilibria relative to both autarky and free trade. The country cases we consider vary by size, level of income per capita, trade pattern, and size of trade barriers. Our results show that alternative distance measures behave in different ways, and no unambiguously preferred measure seems to offer itself despite the growing importance attached to distance metrics in more popular globalization debate. Also, the treatment of trade imbalances in the observed trade restricted equilibria influences results.

One feature of our results is that with endogenous global prices as trade and other barriers are removed or modified, little change in domestic price need occurs for large economies and so they are in this sense already close to free trade. Thus distances from free trade for large economies may be small even if their own barriers are large. Equally, small economies will effectively integrate into larger

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[1] Measures of distance between equilibria are also critical in a number of other subareas of economics. In calibration, for instance, inexact calibration (see Dawkins et al. (2001)) involves choosing parameter values for equilibrium structures so as to produce model generated equilibria as close as possible to observed data (pre-adjusted for compatibility with model equilibrium conditions), and closely related metrics of distance between equilibria are also needed here. Our discussion builds on but goes substantially beyond that of distance measure from free trade for individual economies in Riezman et al. (2005).

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economies if all barriers to trade are removed globally, and so distance measures for small countries can be large even if their own barriers are small. Thus barriers in foreign markets can influence the distance between free trade and autarky for any given economy as well as (and in some cases more so than) barriers at home. Also, we show how small economies, which in the presence of trade have consumption and production of sharply differing composition, can suffer large losses moving to autarky if the domestic production frontier has significant curvature.

2. Distance measures between free trade and autarky for the global economy

Several possible distance measures suggest themselves in any assessment of how close or far away a current trade restricted equilibrium for the world economy is either from that which would characterize full integration by all economies into the global economy (free trade) or autarky for each economy. The task is to compare an observed global trade (or factor flow) restricted equilibrium to unobserved full integration or autarky equilibria. The general presumption is that with lower trade barriers in the global economy as they have fallen under GATT / WTO negotiating rounds, the global economy is closer to free trade than to autarky. Is this so?

To construct measures of distance between these equilibria, we first calibrate a model of global trade, production and consumption by region to data in the presence of trade restrictions, and then use the model parameterization generated in this way to compute the unobservable global free trade and autarky equilibria. We thus compute the two unobservable equilibria, and our distance measures involve pairwise equilibrium comparisons to a base case equilibrium. We make the strong assumption that the free trade, autarky, and observed trade restricted equilibria are unique.[2]

We first construct measures of distance between (computed) free trade, autarky, and (observed) trade restricted global equilibria based on welfare metrics such as Hicksian compensating and equivalent variants. How to take into account trade imbalances is a key issue here. We then construct a second class of measures by summing the squares of differences across equilibria in endogenous variables (prices and quantities). There are also a number of difficulties which arise with these measures. One is that if price variables are involved measures are not invariant to alternative price normalizations. Another is that the rationale for including all variables in such measures (such as both prices and quantities) is not clear, while neither is it clear whether some variables should be excluded. Another is that one can have pairs of equilibria for this class of measures which yield sharp differences in distance measures (close and far) in prices and quantities. Also, if only a subset of variables is included in such measures one has to rationalize which they are and why they should be so used. These metrics could also involve exogenous variables such as endowments.

We then construct a third type of distance measure by computing excess demands in the neighborhood of one equilibrium using the equilibrium prices associated with other equilibria. The absolute size of excess demands relative to total demands then yields the distance measure. We calibrate our global model using data generated in the presence of trade barriers and then introduce computed free trade equilibrium prices into the calibrated model parameterization in the presence of trade barriers and compute global excess demands (i.e. the sum of country imports and exports). The distance measure this yields is the absolute value of global excess demands generated in this way relative to total global demands. These are model dependent measures in that the numerical value of the distance measure will vary with the underlying model parameterization generated by calibration to observed equilibrium data in the presence of country trade barriers (say, as elasticities of substitution and share parameters in CES functions used in calibration to the same data set change). Other problems arise with these types of measures. One is that these measures are only easy to use where there are point-to-point mappings, not correspondences.

Finally we use a fourth global distance measure which we construct in model parameter space, and which is motivated by the Debreu (1951) coefficient of resource utilization. This measure yields an estimate of the maximum proportional uniform shrinkage in the endowments of all economies in the global economy which can be achieved subject to the constraint that global utility (in the form of a global social welfare function) is preserved as trade barriers are removed. Ideally these measures should all yield a consistent measure of how globalized the world economy is as a whole. If they are not consistent there is no obvious way of choosing between these measures, and no single measure dominates all others.

To formalize this discussion we consider the case of a global economy with N countries, 2 produced goods in each country and 1 mobile factor (labor) in production of each good, and decreasing returns to scale. This form of production structure is used so as to avoid the specialization problems that arise in numerical trade models of the Hecksher–Ohlin form as discussed by Johnson (1966), and Abrego and Whalley (2003). We assume that products are homogeneous across countries, and thus are closer to pure theory models of trade rather than the Armington type heterogenous product models used in numerical simulation models (see Whalley (1985)). Such a treatment is also needed for autarky equilibria to be well defined. We further assume that there are various features which limit the integration of national economies into the global economy, such as tariffs, domestic taxes, quotas and other policy interventions, and that these are present in the observed trade restricted equilibrium but absent in a hypothetical globally integrated free trade equilibrium. Because of the production structure we use, neither free trade nor autarky equilibria will involve specialization and so computation of unobserved equilibrium is relatively straight forward.

For each country n we assume production functions for the two goods to be given by

$$Q_{nj} = \phi_{nj} L_{nj}^{\delta_{nj}}, \qquad j = 1,2 \tag{1}$$

where Q_{nj} denotes output of the j-th industry, L_{nj} is the labor input, ϕ_{nj} is the scale or unit parameter, and $\delta_{nj} < 1$ is the distribution parameter.

World prices for goods are P_{0j} and are endogenous to the model. The trade barriers on imports of goods j in country n are assumed to be represented by the tariff rates r_{nj}. $r_{nj} > 0$ if good j is imported ($X_{nj} > Q_{nj}$), and $r_{nj} = 0$ if good j is exported ($X_{nj} \le Q_{nj}$). The domestic price of good j is $P_{nj} = (1 + r_{nj}) P_{0j}$.

The wage rate w_n in country n equals the value marginal product of labor in the sector, i.e.

$$w_n = P_{nj} \frac{\partial Q_{nj}}{\partial L_{nj}} = \phi_{nj} \delta_{nj} P_{nj} L_{nj}^{\delta_{nj}-1}, \qquad j = 1,2. \tag{2}$$

On the demand side of each economy we consider a representative consumer with a Cobb–Douglas utility function given by

$$U_n = \prod_{j=1,2} X_{nj}^{\alpha_{nj}} = X_{n1}^{\alpha_{n1}} X_{n2}^{\alpha_{n2}} \tag{3}$$

where X_{nj} is the quantity of good j demanded by the consumer, and α_{nj} is the share parameter ($\sum_{j=1,2} \alpha_{nj} = 1$).

Consumer income in each economy has four parts: endowment income $w_n E_n$; profits $\sum_{j=1,2} P_{nj} Q_{nj} - w_n E_n$; tariff revenues

[2] See the discussion of the likelihood of multiplicity of equilibria in models similar to those we use in Kehoe (1991) and Whalley and Zhang (2004).