Economic Modelling 51 (2015) 53–57

Contents lists available at ScienceDirect

Economic Modelling

journal homepage: www.elsevier.com/locate/ecmod

A robust estimation of the terms of trade between the United Kingdom and British India, 1858–1947☆

Atanu Ghoshray *

Newcastle University Business School, 5 Barrack Road, Newcastle upon Tyne NE1 4SE, United Kingdom

ARTICLE INFO

Article history:
Accepted 1 August 2015
Available online 24 August 2015

Keywords:
Trends
Terms of trade
Integrated process
Structural break
Price indices

ABSTRACT

This paper conducts a robust estimation of terms of trade between United Kingdom and British India over the period 1858 to 1947. The trend estimate of the terms of trade is measured using a novel econometric method due to Perron and Yabu (2009a) that is robust to the presence or absence of a unit root in the data. A further novel econometric procedure due to Perron and Yabu (2009b) for detecting a structural break is carried out allowing one to be completely agnostic to the underlying order of integration of the data. Taking into account transportation costs during this period, we conclude that there is no clear evidence whether the terms of trade improved for the United Kingdom with British India during the period considered.

1. Introduction

The issue of trends in empirical studies of the terms of trade has dominated the trade and development literature for many years. The most popular concept of terms of trade and widely used in the literature is that of the net barter terms of trade (NBTT) defined as the ratio of the price of exports to the price of imports. For example, if a country's price of exports has declined in relation to the price of imports, then the terms of trade for the country are said to have deteriorated. It has been argued that this phenomenon of deteriorating terms of trade has been reflected in the case of developing countries. In other words, developing countries (traditionally exporting primary commodities) are losing out to developed countries (exporting mainly capital intensive goods) as the NBTT for developing countries is believed to have deteriorated over time. This view put forward by Prebisch (1950) and Singer (1950), popularly known as the Prebisch–Singer Hypothesis, sparked a debate among development economists as to whether developing countries should specialise in the production and export of primary commodities.

It has been well documented in various studies that many developing countries depend heavily on just one or a few commodities for a large part of their national income. From the mid-eighteenth century to the mid-nineteenth century, India's exports included both manufactured goods and primary commodities. However, over the period analysed in this study, the exports from India started to be dominated by primary commodities and imports started to comprise of manufactured goods (Chaudhuri, 1983). This topic is of significance, because of the alleged view of some economic historians that there was an economic drain of resources from India to UK[1]. Appleyard (2006) conducted a study of the bilateral terms of trade between UK and British India during the period 1858 to 1947 and concluded that the terms of trade for the UK with British India improved. This conclusion is arrived at by analysing two regimes: the first regime (1858–1917) where the terms of trade showed slight improvement for the UK, and the second regime (1917–1947) where the terms of trade improved greatly. However, there are drawbacks to this study in terms of the econometric analysis. First, it is not clear why the regressions by Appleyard are run on the data in nominal terms rather than logarithms. Past studies[2] that have tested for the terms of trade have applied logarithmic transformation to the relative price ratio (terms of trade) so that the trend function represents the average growth rate of the time series. Secondly, if the terms of trade variable contain a unit root, the standard test for the null hypothesis of no trend will suffer from severe size distortions; in other words, the null hypothesis of no trend is likely to be rejected when no trend is present.

When considering the possibility of the existence of a trend in the terms of trade data one is naturally led to the question of whether the data series contains a unit root. In a seminal paper by Perron (1988) it was noted that the correct specification of the trend function is important in the context of testing for a unit root in the data. Noriega and de Alba (2001) simultaneously apply classical and Bayesian approaches to test for a unit roots while allowing for a structural break. If a data

☆ I am grateful to Prof Sushanta Mallick, and two anonymous referees for their insightful comments and suggestions. Any errors or omissions are entirely mine.
* Tel.: +44 1912081654.
E-mail address: Atanu.Ghoshray@ncl.ac.uk.

[1] See Dutt (1969).
[2] See for example, Ghoshray et al. (2014), Harvey et al. (2010), Kellard and Wohar (2006), Zanias (2005), Cuddington (1992) among many others.

http://dx.doi.org/10.1016/j.econmod.2015.08.002
0264-9993/

series contains a unit root, the standard method of least squares to test for the presence of a trend will suffer from severe size distortions. On the other hand, if the data series is generated by a trend stationary process but is modelled as a difference stationary process, the tests will be inefficient and will lack power relative to the trend stationary process[3]. The situation is further complicated if structural breaks are present in the data series. Neglecting a break in an otherwise trend stationary process can cause the spurious appearance of a unit root behaviour (Perron, 1989) while a neglected trend break in a difference stationary process can lead standard unit root tests to suggest an incorrect inference of stationarity (Leybourne et. al. 1998).

This paper estimates the terms of trade between UK and British India between 1858 and 1947 by employing a novel test due to Perron and Yabu (2009a, 2009b) that is valid with either I(0) or I(1) noise, in the sense that the limit distribution is the same in both cases. The advantage of these methods is that there is no need to conduct any separate tests for unit roots. The econometric procedures to test for the significance of the trend and the presence of a structural break can be carried out being agnostic about the order of integration of the data. By employing such novel procedures, the results are expected to give a clearer picture of whether Britain's terms of trade with India during 1858 to 1947 improved or not. This paper is organised as follows: the next section describes the econometric model, followed by a discussion of the data and the empirical results. The final section concludes.

2. Econometric model

Consider the following model:

$$TOT_t = \alpha + \beta t + u_t \qquad u_t = \psi u_{t-1} + \varepsilon_t \tag{1}$$

where TOT_t denotes the terms of trade; that is, the ratio of the export price index to the import price index, u_t measures the deviation from trend, which is described in this case as an AR(1) process[4]. The parameter β which measures the trend is the hypothesis of interest. If the trend is significant, that is, we reject $H_0 : (\beta = 0)$, then we proceed to observe whether the trend is negative, that is $(\beta < 0)$ to conclude that the terms of trade has deteriorated over time, or whether the trend is positive, that is $(\beta > 0)$ to conclude that the terms of trade has improved over time.

Consider the price model given by [1] where the error term is specified as an AR(1) model. The weighted least squares (WLS) is calculated using the following:

$$\mu_W = \sum \hat{u}_t \hat{u}_{t-1} / \left(\sum \hat{u}_t^2 + 1/T \sum \hat{u}_t^2 \right) \tag{2}$$

where μ_W denotes the weighted least square estimate and T denotes the total number of observations in the sample. Following Roy and Fuller (2001), we obtain the unbiased estimates $\hat{\mu}_{UB}$, and following Andrews (1993) the median unbiased estimates $\hat{\mu}_{MU}$ are calculated. Perron and Yabu (2009a) then obtain the following super-efficient estimate as follows:

$$\hat{\mu}_{US} = \begin{cases} \hat{\mu}_{UB} \text{ if } |\hat{\mu}_{UB} - 1| > T^{-1/2} \\ 1 \text{ if } |\hat{\mu}_{UB} - 1| \leq T^{-1/2} \end{cases} \tag{3}$$

or,

$$\hat{\mu}_{MS} = \begin{cases} \hat{\mu}_{MU} \text{ if } |\hat{\mu}_{MU} - 1| > T^{-1/2} \\ 1 \text{ if } |\hat{\mu}_{MU} - 1| \leq T^{-1/2} \end{cases} \tag{4}$$

where $\hat{\mu}_{US}$ and or $\hat{\mu}_{MS}$ are the super-efficient estimates based on the unbiased estimate and the median unbiased estimate respectively. The Feasible Generalised Least Square (FGLS) procedure is applied to obtain the estimate of the trend parameter β and construct the FGLS t-statistic for the unbiased and median unbiased estimate, that is, $t_\beta^F(UB)$ and $t_\beta^F(MU)$ respectively.

However, if the errors in [1] are a higher order than AR(1), the estimate $\hat{\mu}$ is obtained from the following regression:

$$\hat{u}_t = \mu \hat{u}_{t-1} + \sum_{i=1}^{k} \varsigma_i \Delta \hat{u}_{t-i} + e_{tk}. \tag{5}$$

The lag length k is selected using the Modified Akaike Information Criterion (MAIC) following Ng and Perron (2001) with k allowing to be in the range $[0, 12(T/100)^{1/4}]$. The weighted symmetric least squares estimator $\hat{\mu}_W$ is constructed for an AR(p) process [see Fuller (1996, p.415)]. The truncated estimate $\hat{\mu}_{MU}$ (median unbiased estimator) or $\hat{\mu}_{UB}$ (unbiased estimator) is then applied to obtain the super-efficient unbiased estimate $\hat{\mu}_{US}$ or super-efficient median unbiased estimate $\hat{\mu}_{MS}$ using [3] or [4] respectively. Finally, the quasi-FGLS procedure is applied to obtain the estimate of the trend parameter β and construct the Robust Quasi-FGLS t-statistic for the unbiased and median unbiased estimate, that is, $t_\beta^{RQF}(UB)$ and $t_\beta^{RQF}(MU)$ respectively. Perron and Yabu (2009a) show that for a similar sample size as chosen in this study, the $t_\beta^{RQF}(MU)$ has some liberal size distortions in comparison to the $t_\beta^{RQF}(UB)$. When $\psi = 1$, $t_\beta^{RQF}(MU)$ and $t_\beta^{RQF}(UB)$ have similar power, however, when ψ departs from unity $t_\beta^{RQF}(MU)$ has comparatively higher power.

So far, the economic literature have proposed and applied different unit root tests with and without structural breaks. Usually we do not know in advance whether the time series are affected by structural breaks, which conditions the analysis that can be conducted using unit root tests. Thus, if breaks are not accounted for when in fact they have affected the time series, the unit root tests can be biased towards the non-rejection of the null hypothesis of unit root. On the other hand, allowing for inexistent breaks when computing the unit root tests can imply reductions in the empirical power of the statistics. This issue has been recently addressed in Perron and Yabu (2009b) allowing for breaks in the level and slope of the trend function given by [1]. Perron and Yabu (2009b) find that the exponential functional of the Wald test has a limiting distribution that is nearly the same for both I(0) and I(1) variables. Following Roy and Fuller (2001), a biased corrected version of the least squares estimate of $\hat{\mu}$ is carried out to allow for good size and power properties in finite samples. Perron and Yabu (2009b) design a test statistic—hereafter, the $Exp - W$ break test statistic—that allows to test if there is a structural break affecting the time trend of the series regardless of whether the series is I(0) or I(1) given as follows:

$$Exp{-}W = ln\left[\frac{1}{T}\sum exp\left(\frac{1}{2}W(\lambda)\right)\right] \tag{6}$$

where λ denotes the break fraction and W denotes the Wald statistic. In this paper we have computed the $Exp - W$ break test statistic considering the model that allows for change both in the level and the slope of the time trend which is the most general specification.

3. Data & empirical results

The period of study is the British Crown Rule over India which lasted for 90 years from 1858 to 1947. This paper employs the same data used

[3] See Perron and Yabu (2009a).

[4] This assumption is relaxed in the following econometric analysis to allow for a general AR(p) process. To keep the description of the econometric methodology simple, we assume an AR(1) process at this stage.