

Productivity and Exchange Rate: A Meta-analysis

Abstract

Background

The factors that usually cause exchange rate to fluctuate have long been explained in many theoretical and empirical studies. Productivity remains one of the key determinants of these fluctuations in exchange rate. In literature, the productivity and exchange rate nexus is usually investigated to empirically test the Balassa-Samuelson hypothesis. According to this hypothesis, productivity causes exchange rate to appreciate. In other words, this hypothesis posits that there exists a positive relationship between productivity and exchange rate. Nevertheless, in the empirical literature, the results on the productivity and exchange rate nexus were mixed and divergent; while most studies revealed a positive relationship between productivity and exchange rate, some found a negative relationship and very few even demonstrated a null relationship.

Objectives

To this end, the present study aims at investigating the underlying elements influencing the productivity and exchange rate nexus within a meta-analysis framework. In particular, on the basis of the literature available, a thorough examination of our data set is done to obtain answers to a series of questions highly relevant for both researchers and policy-makers: (1) Do data characteristics, specification characteristics and estimation characteristics systematically influence the estimates? (2) Do home country's characteristics affect the size of the impact of productivity on exchange rate?

Research Design/Methodology/Approach

The first step of any meta-analysis is to collect the maximum possible number of empirical studies on the topic. As such, a systematic search of the literature has been conducted using Google scholar and journal databases such as Science Direct (<http://www.sciencedirect.com/>), Wiley Online Library (<http://onlinelibrary.wiley.com/>), Taylor and Francis Online (<http://www.tandfonline.com/>) and Springer (<https://link.springer.com/>) with keywords: “productivity”, “exchange rate”, “effect of productivity on exchange rate”, “productivity and exchange rate nexus”, “determinants of exchange rate” and “Balassa-Samuelson hypothesis” through until 2017. A search has also been carried out on the web sites of research institutes working on the topic and references from existing empirical studies. Pure theoretical papers

and those written in languages other than English have been excluded from our search. As such, we have also included master and Ph.D dissertations, articles from local journals and working papers. The searching process was repeated until no new studies have been found. The last study was added on 30 November 2017. The above search has initially produced a sample of 322 studies.

After having collected a maximum number of studies on the productivity and exchange rate nexus, we proceeded with the selection of studies to be included in our meta-analysis. To have a consistent analysis, four selection criteria have been established for the inclusion of studies in the meta-analysis: **(i)** the study must include a dependent variable describing exchange rate; **(ii)** the study must consist of an independent variable measuring productivity and **(iv)** the study must provide information on precision of estimates (*t*-statistics or standard-errors). Our sample was thus reduced to 121 studies with a total of 1392 estimates of the effect of productivity on exchange rate. However, we have observed that even after a careful re-checking of the data, several estimates remained remarkably different from the main population. These extreme values (outliers) might affect the results and the graphical analysis. As such, following Havranek and Irsova (2011), we used the multivariate method of Hadi (1994) to jointly detect outliers in both the estimates and their precisions. By this procedure, a total of 203 observations were identified as outliers. We, thus, continued our analysis using a much narrower set consisting of 1189 estimates of the effect of productivity on exchange rate extracted from 114 studies, without the outliers. The oldest study in our sample was published in 1982 and the most recent in 2017. Since different studies use different units of measurement, the estimates are not directly comparable. Thus, following previous meta-analyses conducted in economics (Valickova et al., 2015; Iwasaki and Tokunaga, 2014; Iwasaki and Tokunaga, 2016; Hamdaoui, 2017), we used partial correlation coefficients as standardized effect sizes to summarize and compare the results from various studies.

Moreover, one important concern when conducting a meta-analysis is publication selection bias, whereby some estimates of the impact of productivity on exchange rate may be more likely to be selected for publication than others. Publication selection bias in the literature has two potential sources: researchers may be tempted to report a particular direction of the effect of productivity on exchange rate (Type I publication bias), and some researchers may report statistically significant results more favourably than insignificant ones (Type II publication bias). In our case, the publication selection bias has been tested both graphically and

statistically. Furthermore, we employed the Rosenthal's Fail-safe N method to check whether the presence of publication bias can affect our analysis.

After assessing whether publication selection bias was a problem or not for our sample, a random-effects meta-analysis model has been used to obtain an overall effect of productivity on exchange rate. Finally, in order to understand the reasons behind the variations in the effect of productivity on exchange rate across the whole body of data, a meta-regression will be done. This will help us to understand whether data characteristics (annual data, quarterly data, monthly data, time-series data, panel data, cross-sectional data and sample size), specification characteristics (exchange rate measures, productivity proxies, theoretical background), estimation characteristics (regression specification, number of explanatory variables included in the regression, static/dynamic econometric models, long-run/short-run effect), publication characteristics (journal/working paper and year of publication) and home country characteristics (geographical location, economic size, level of economic development, macroeconomic stability, foreign direct investment inflows, trade openness and terms of trade) affect the empirical estimates. These distinct characteristics, with the exception of some variables accounting for home country characteristics, will be controlled using a set of dummy variables. Since there may be many such control variables which can explain the disparities among the effect sizes, the Bayesian Model Averaging (BMA) model will be applied to identify potential determinants of the latter. We will only consider control variables having a posterior inclusion probability higher than 0.1 as potential drivers of these variations across the literature. As a robustness check to the BMA, both the ordinary least square and the weighted least square methods will be used.

Anticipated Results

Both the funnel and Galbraith plots clearly depicted the presence of publication selection bias in the literature of productivity and exchange rate nexus. This was also confirmed by the FAT-PET test. However, Rosenthal's Fail-safe N proved that publication bias was not a serious problem in our case. In other words, the presence of publication bias in our sample would not affect the conclusions drawn from our analysis. On the other hand, the random-effects meta-analysis of the productivity estimates extracted from 114 studies generated a partial correlation coefficient of 0.225 with a 95% confidence interval [0.200, 0.251]. This suggested that the effect of productivity on exchange rate is positive and statistically significant. In other words, our results confirmed the Balassa-Samuelson hypothesis. In addition, it is obvious from the observed effect size, which ranged from 0.2 to 0.251, that the size of the impact of productivity

on exchange rate varies across studies. As such, a meta-regression analysis will be carried out in order to understand the reasons behind the variation in the effect sizes of productivity across the whole body of data.

Conclusions/Implications

To our knowledge, this is the first study to employ a meta-analysis framework to investigate the relationship between productivity and exchange rate. The findings from this study can be used to make a generalisation of the expected positive impact of productivity on exchange rate and whether the variations in the effect sizes across studies are influenced by data characteristics, specification characteristics, estimation characteristics, publication characteristics and home country characteristics. Thus, the findings from this study will be useful whenever an understanding of the productivity and exchange rate nexus is deemed pertinent and critically important.

Keywords: Productivity; Exchange Rate; Meta-analysis

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