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Revisiting Balassa-Samuelson Hypothesis for Asia – A Critical Appraisal of Literature

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Abstract

Purpose: The present study is aimed at presenting a critical appraisal of the empirical literature on the Balassa-Samuelson hypothesis for emerging and developing Asian countries.
Design/methodology/approach: A critical appraisal of the relevant studies is carried out across various important dimensions of the empirical estimation of the Balassa-Samuelson hypothesis including the scheme of sectoral division followed, definitions and proxy variables used for constructing real exchange rate and price series, choice of output and employment series and their subsequent transformation, empirical methodology followed and (theoretically) different variants of the hypothesis chosen for empirical estimation.
Findings: Only a handful of studies have investigated the Balassa-Samuelson hypothesis for Asia. Nevertheless, these studies are characterized by a variety of irregularities in dealing with different important features of the theory, which may be of critical importance for yielding consistent empirical estimates.

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In multi-country studies for Asia, serious inconsistencies are observed whilst handling these critical aspects of the hypothesis. Such irregularities may hold serious implications for model estimates since the empirical evidence from Asia is very mixed, and in many cases, not even robust.
Practical implications: The inconsistencies highlighted in this review paper hold strong implications for future research in this area. The selection of price indicators for the construction of real exchange rate series, choice of econometric methodology and the theoretical framework followed are aspects of the empirical verification of the Balassa-Samuelson hypothesis that need to be handled with great caution since they turn out to be most sensitive in relation to yielding intuitively correct and robust model estimates.
Originality: To our knowledge, so far, no study on Asia has presented such an extensive appraisal of literature on the productivity-real exchange rate nexus. The present study is therefore novel in the sense that it critically evaluates studies on Asia against all those features of the Balssa-Samuelson theory which may stand responsible for yielding mixed and even contrasting empirical estimates for Asia.

Keywords: open economies macroeconomics, Balassa-Samuelson hypothesis, real exchange rate, purchasing power parity, emerging and developing Asian economies.

JEL: F11, F14, F41, F43

Weryfikacja hipotezy Balassy-Samuelsona dla Azji – krytyczna ocena literatury

Streszczenie

Cel: celem tego artykułu jest przedstawienie krytycznego przeglądu literatury zawierającego wyniki badań empirycznych na temat hipotezy Balassy-Samuelsona dla wschodzących i rozwijających się krajów azjatyckich.
Metoda: przeprowadzono krytyczną ocenę wyników badań w kluczowych wymiarach empirycznej weryfikacji hipotezy Balassy-Samuelsona, w tym: schematu podziału sektorowego, definicji i zmiennych pośredniczących wykorzystanych do skonstruowania szeregów realnego kursu walutowego i cen, wyboru danych dotyczących produkcji i zatrudnienia oraz ich późniejszą transformację, przyjętej metody badań empirycznych oraz teoretycznych.
Wnioski: w literaturze przedmiotu można zidentyfikować nieliczne badania dotyczące weryfikacji hipotezy Balassy-Samuelsona obejmujące kraje Azji. Dotychczasowe publikacje zawierają wiele niespójności w odniesieniu do kluczowych aspektów tej teorii, co może mieć istotny wpływ dla uzyskania wiarygodnych wyników badań. Takie nieprawidłowości mogą mieć poważne konsekwencje dla estymacji modelu, ponieważ wyniki badań empirycznych przeprowadzonych w Azji są bardzo zróżnicowane, a w wielu przypadkach nie są rzetelne.
Implikacje praktyczne: niespójności, które zidentyfikowano w trakcie prowadzonej oceny i analizy mają istotne implikacje dla przyszłych badań w tym obszarze. Wybór wskaźników cenowych do konstruowania szeregów realnych kursów walutowych, wybór metod ekonometrycznych i przyjęte ramy teoretyczne stanową ważne elementy empirycznej weryfikacji hipotezy Balassy-Samuelsona, które należy traktować z dużą ostrożnością, ponieważ są one bardzo wrażliwe i mają kluczowy wpływ na poprawny i rzetelny wynik estymacji modelu.
Oryginalność: zgodnie z naszą wiedzą, jak dotąd żadne badanie obejmujące kraje Azji nie przedstawiło tak obszernej analizy literatury na temat powiązania produktywności z realnym kursem walutowym. Niniejsze badanie jest nowatorskie w tym znaczeniu, że dokonuje krytycznej oceny badań obejmujących kraje Azji pod względem tych cech teorii Balssy-Samuelsona, które mogą być przyczyną uzyskania mieszanych, a nawet sprzecznych wyników dla Azji.

Słowa kluczowe: makroekonomia gospodarek otwartych, hipoteza Balassy-Samuelsona, realny kurs walutowy, parytet siły nabywczej, wschodzące i rozwijające się gospodarki azjatyckie.

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1. Introduction

The phenomenon of Balassa-Samuelson (BS) effect is widely recognized as one of the oldest and the most comprehensive supply-side explanation of real exchange rate trend departures from long-run equilibrium. The hypothesis is extensively tested for almost all the regions of the world; however, only a handful of empirical studies on the subject are produced for Asia, a region with a growing number of emerging economies at present. The region's tremendous efforts towards generating sustainable growth, the modest expansion of regional cooperation agreements and the degree of growth effects trickling down from high- to low-income regional states provide enough ground for revisiting the theory in favor of developing accession countries of the region. The proponents of regional economic integration never took into account the possibility of productivity-led inflation in smaller regional states, a dilemma described by the BS theory as an aftermath of growth progress in transition countries. As a consequence, a significant body of empirical research has been produced since the 1970s on various regions of the world (largely for the European Monetary Union, EMU), initiating a debate on the relative importance of regional growth convergence and the further enlargement of regional economic unions.

However, even today, the imbalanced (sectoral) productivity growth progress and the consequent deviations of the real exchange rate from its long-run Purchasing Power Parity (PPP) based equilibrium are considered to be one of the most exiting phenomena in international macroeconomics. The notion is still rather under-explored for Asia and has always yielded mixed empirical evidence, thus making its valid existence somewhat questionable. The aim of this paper is to provide a detailed insight into the earlier and recent empirical work done on the long-run real exchange rate behavior in the context of the BS hypothesis for the regional member states of ASEAN and SAARC (South Asian Association for Regional Cooperation).

The empirical studies for Asia conducting a multi-country examination of the BS theory are found to be seriously inconsistent in dealing with different features of its empirical exploration. These primarily include the scheme of sectoral division adopted, definitions and proxy variables used for the real exchange rate and prices, inconsistency of output and employment time-series used, and empirical methodology followed. As a consequence, the results obtained from these studies are very mixed, and in many cases, not even robust. The presence of such discrepancies even cast shadow on the authenticity and reliability of explorations conducted in these papers, thus preventing readers to reach some final and agreeable consensus on the subject. In contrast, a sizeable number of studies on the BS hypothesis investigating countries in Europe and OECD are rather insightful as they discuss and verify many of the aspects of the hypothesis which are critically important in yielding reliable estimates. These studies have

carefully considered the issues such as coverage of industries and scheme of industrial classification between tradables and non-tradables (Rother, 2000; Klau & Mihajljek, 2003; Mihajljek et al., 2004; Coricelli & Jazbec, 2004; Egert, 2003, 2005; Gibson, 2008), choice of real exchange rate, price and productivity measures (Canzoneri et al., 1999; Egert et al., 2003; Lee & Tang, 2003), set of empirical estimation methods applied (Chong et al., 2012; Boreo et al., 2015), theoretical specifications of the hypothesis and testing its assumptions (Strauss & Ferris, 1996; Estrada & Lopez-Salido, 2004; MacDonald & Ricci, 2001, 2005; Schmillen, 2013) and revealed how sensitive the empirical estimates of the hypothesis are to correctly addressing these issues.

In light of these considerations, the present review paper lays down the following four criteria to gauge the relative performance of the studies analyzing the BS hypothesis for Asia. The primary objective of establishing these evaluation parameters is to obtain a comprehensive guideline to critically evaluate the existing studies for future reference, so that consistent and robust estimates could be made whilst testing the theory empirically. These four criteria are:

(a) Measurement of the real exchange rate
(b) Scheme of sectoral classification
(c) Empirical estimation techniques
(d) Theoretical foundations of the hypothesis: This is further categorized into:
    (i) Domestic version of the BS hypothesis
    (ii) Fundamental assumptions of the BS hypothesis
    (iii) Modified version of the BS hypothesis

In the forthcoming sections of this paper, each of these parameters are discussed in detail besides producing a critical review of the different aspects in the context of empirical studies on Asia.

2. Evaluating the Existing Literature Against Established Parameters

2.1. Measurement of the Real Exchange Rate

Empirical verification of the BS hypothesis necessitates a precise measurement of the real exchange rate for obtaining consistent estimates. However, the task is much complicated due to the lack of consensus by researchers on the most reflective real exchange rate proxy that is capable of reflecting the internal transmission channels from domestic prices to the real exchange rate.

In empirical studies on Asia, CPI is found to be the most popular price deflator used to construct the real exchange rate series. Drine and Rault (2002) use CPI-based effective real exchange rates of six Asian economies

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to test the BS hypothesis. Wang and Dunne (2003) verify the BS effect for a group of seven East Asian countries using CPI-based bilateral real exchange rates on quarterly data. Choudhri and Khan (2005) explain long-run behavior of CPI-based bilateral real exchange rates for a panel data set of 16 developing countries from East and South Asia, the Western Hemisphere, and Africa. Tsen (2011), Dumrongrittikul (2012), Kakkar and Yan (2012), Ricci et al. (2013) and Wang et al. (2016) also verify the BS hypothesis by using CPI-deflated bilateral real exchange rates for emerging Asia, in addition to former Asian developing and developed countries.

CPI represents the overall cost (weighted average) of a fixed basket of goods and services bought by a typical consumer relative to the price of the same basket in a base year. By including a broad range of goods and services (dominantly non-tradables like housing, consumer services, public administration, defense, medical care, etc.) in the fixed basket, CPI can provide an accurate estimate of the cost of living. It is important to remember that CPI is not a dollar value like GDP; it is an index number which captures the overall change in the price level from the base year. A change in this index over time should reflect the position of non-traded sectors over time. However, the index is not without its limitations. Firstly, CPI is highly exposed to price controls, subsidies and indirect taxes which may distort the role of market forces in determining prices (see Hinkel & Nsengiyumva, 1999). Secondly, CPI may have a fairly large number of imported items in its basket, thus preventing it to be a true representative of domestic production. The index contains some traded goods in its basket. If the proportion of traded goods in the basket is high, it might not be the ideal indicator for comparison. Thirdly, the degree of weights involved in the construction of CPI across countries can vary quite a bit. This causes a hindrance in cross-country comparisons of cost effectiveness and competitiveness. In such a situation, a rise in price of a certain commodity can be misleading with respect to improvement or deterioration of relative competitiveness between countries. The problem is more visible in developing countries which seriously lack a representative sample of goods and services in their CPI. Thus, despite its wide popularity as a measure of non-tradable prices, the measure holds some important caveats.

Some important studies analyze the BS hypothesis for Asia using the national output deflator (GDP or GNP) based real exchange rate (Bahmani-Oskooee & Rhee, 1996; Ito et al., 1999; Chinn, 2000; Bahmani-Oskooee & Nasir, 2004; Thomas & King, 2008, Ishaq et al., 2022). The GDP deflator is considered superior to CPI as a price measure in this case since it covers a broader range of commodities and services that are non-traded. In addition, the GDP deflator is highly proficient in capturing the effects of productivity shocks on the real exchange rate, provided the component of regulated prices of two types of industries that constitute the lion share of consumption expenditures (food and services in particular) is controlled for

(Jazbec, 2002; Egert et al., 2003). Nevertheless, the GDP deflator as the national price index is not the most perfect measure, either, and has its own caveats. This measure has been criticized in literature since GDP deflators do not necessarily correspond to the officially published inflation indices, which are normally represented by CPI, PPI or WPI rather than output deflators. Moreover, for modeling relative price movements between two countries, a base-weighted price index is preferred over a current-weighted price index (Goldstein et al., 1980).

2.2. Scheme of Sectoral Classification

Tradability (non-tradability) of goods and services is a much debated feature of the real economy. Although researchers suggest a few of methods for distinguishing between traded and non-traded sectors, these methods are not widely acknowledged as they are ad hoc in nature. A majority of studies on the BS hypothesis distinguish between traded and non-traded sectors arbitrarily (see Canzoneri et al., 1999; Chinn, 2000; Egert et al., 2003). Some studies rely on earlier studies (analyzing a similar set of countries) for differentiating between tradable and non-tradable sectors. For example, Kakkar (2002, 2003) follows the sectoral division of real economy into tradables and non-tradables as suggested by De Gregorio et al. (1994) and Stockman and Tesar (1995). Similarly, Thomas and King (2008) empirically test the BS hypothesis for Asia-Pacific countries by adopting Chinn's (2000) sectoral classification that tests the hypothesis for the same region.

The correct distinction between traded and non-traded sectors of an economy is of crucial importance for obtaining precise and robust empirical estimates for the BS hypothesis. Nevertheless, there is a serious lack of consensus on recognizing sectors as tradables or non-tradables owing to the disagreement at the conceptual level for measuring tradability (non-tradability) of an industry. The problem is further aggravated when the level of aggregation of the existing data may be too high to permit a clear classification of industries into one sector or the other. This concern goes largely unaddressed in the existing empirical literature on Asia. A vast majority of studies analyzing countries in Asia classify sectors in a rather subjective manner. Such a practice casts shadow over the reliability of their empirical estimates.

Ito et al. (1999) examine the BS hypothesis for Asia Pacific Economic Cooperation (APEC) member states and the Western Hemisphere and Oceania regions. The real economy of each country is classified into traded and non-traded sectors by assuming the manufacturing sector as tradable and services as non-tradable. The distinction is made completely arbitrarily under the assumption that East Asian productivity growth is substantially driven by those countries' high value-added manufactured goods exports (e.g. machine exports). Another important deficiency of their study is that the coverage of sectors is highly aggregated, which may result in biased

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estimates of sectoral productivity growth due to relative price movements. A number of prominent studies on the BS hypothesis for Europe and other non-Asian regions recognize the importance of more formal methods of sectoral division and better industry coverage for obtaining reliable estimates (see Rother, 2000; Mihajljek et al., 2003, 2004; Coricelli & Jazbec, 2004; Egert, 2004).

Choudhri and Khan (2005) cover a set of sixteen developing countries of Asia, Africa and the West with considerably varying economic structures. However, each of them is subject to a standard sectoral division with agriculture and manufacturing as tradable sectors and the rest of the economy as non-tradables. For empirical verification of the BS hypothesis, the sectoral output and price data are sourced from the World Development Bank Indicators (WDI) database. The database contains sectoral value-added and price deflator time-series but not with a fine sectoral classification. Each country is disaggregated into four distinct sectors – agriculture, manufacturing, industry and services – and these sectors are too broad to capture the internal transmission mechanism proposed theoretically. Using such highly aggregated data may result in forced (and even wrong) assignment of certain industries as non-tradables, whereas the industries should actually be classified as tradables (or at least partly tradables) for being exposed to foreign competition. Classic examples are the air and ship transportation services, the distribution sector and the utilities industries which are normally treated as non-tradables (see MacDonald & Ricci, 2005; Thomas & King, 2008).

In addition to the studies discussed above, a vast majority of Asian studies distinguish between traded and non-traded sectors arbitrarily (Bahmani-Oskooee & Rhee, 1996; Chinn, 2000; Wang & Dunne, 2003; Bahmani-Oskooee & Nasir, 2004; Drine & Rault, 2004; Olson, 2009; Chowdhury, 2012). Some studies rely on earlier studies (analyzing a similar or even dissimilar set of countries) for deciding between tradability (non-tradability) of sectors. For example, Thomas and King (2008) empirically test the Balassa-Samuelson hypothesis for Asia-Pacific countries by following Chinn's (2000) sectoral classification testing the hypothesis for the same region. Similarly, Kakkar (2012) analyzes six East Asian countries following the sectoral division suggested by De Gregorio et al. (1994) and OECD countries following Stockman and Tesar (1995). Similarly, Ricci et al. (2013) follow De Gregorio et al.'s (1994) sectoral classification for empirically investigating the augmented version of the BS hypothesis for a set of 48 industrial and emerging economies (including East and South Asian regions). In practice, adopting the sectoral division of earlier studies is acceptable provided (a) the base study covers a similar set of countries (or at least countries with reasonably similar economic structures), and (b) the base study categorizes sectors using some formal and well-recognized method of sectoral division rather than distinguishing sectors in a purely subjective way.

The only study on Asia that stands out in the literature in the context of precise sectoral classification was done by Dumrongrittikul (2012). It is distinct since the author uses a combination of two approaches for sectoral division. The study tests the BS hypothesis empirically for a set of 33 developed and developing economies (including 14 countries from East and South Asia). The sectors are divided at a sufficiently disaggregated level into seven distinct industries. The study is distinctive in the sense that the author employs the Engle-Granger (1987) single-equation error correction model in addition to the traditional method of calculating the tradability ratio. The method allows for country-specific heterogeneity of each industry and changes in classification along the period. The underlying belief behind this methodology of sector division is that tradable commodities across countries are likely to satisfy the law of one price (LOOP) and purchasing power parity (PPP). The author suggests estimating the 2-step Engle-Granger error correction model by regressing the domestic price level of each sector on the corresponding sector's price in the U.S., the reference country in his analysis. Rejection of the null hypothesis at a desirable significance level displays the potency of the domestic sectoral price series to co-move with the international market prices establishing PPP. This allows for the distinction between tradable and non-tradable sectors.

A recent study produced by Jangam and Rath (2020) uses industry-level output (Gross Value Added – GVA) and employment data with a very fine degree of disaggregation while studying the BS hypothesis for a set of 38 developed and developing countries from Europe, East Asia and Pacific regions. Using 35 industry-level disaggregated data sets, the paper makes a very precise and more disaggregated classification of economic sectors into tradabales and non-tradables, ensuring sufficient coverage of industries for empirical analysis of the BS hypothesis. Unlike many other studies, the authors follow a popular and well-defined approach towards industry classification, i.e. the measure of tradability ratio, first proposed by De Gregorio (1994). Industries are classified as tradables and non-tradables by calculating the export to GVA ratio for each of the 35 sample industries. If the average export to GVA percentage turns out to be greater than 10%, the specific industry is classified as a tradable sector, otherwise, the industry is treated as non-tradable.

2.3. Empirical Estimation Techniques

Estimates of the BS hypothesis are quite sensitive to alternative empirical estimation techniques (Chinn, 2000; Wang & Dunne, 2003; Tintin, 2009; Kakkar & Yan, 2012). In the studies investigating the BS hypothesis empirically, the long-run model is estimated using either the EG two-step single-equation cointegration procedure or some form of generalized one-step error correction method (see Canzoneri et al., 1999; Chinn, 2000; Lommatzsch & Tober, 2004; Bogoev et al., 2008; Thomas & King, 2008;

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Tsen, 2011; Findreng, 2014). On the other hand, the maximum likelihood-based rank test, proposed by Johansen (1988, 1991) and Johansen and Juselius (1990), is also popular amongst researchers. Though less widely used than residual-based cointegration tests, a number of studies on the BS effect use the multivariate cointegration model to explore the plausible long-run association between productivity and the real exchange rate (see Faruqee, 1995; Loko & Tuladhar, 2005; Konopczak & Torój, 2010; Jabeen et al., 2011; Boreo et al., 2015). Researchers have used both time-series empirical methods as well as pooled data estimation techniques to test the hypothesis (see MacDonald & Ricci, 2001; Drine & Rault, 2002; Lojschová, 2003; Blaszkiewicz et al, 2004; Choudhari & Khan, 2005; Lee & Tang; 2003; Dumrongrittikul, 2012; Kakkar & Yan, 2012).

In the BS literature on Asia, there is a mix of evidence on the use of time-series or pooled data estimation methods. Bahmani-Oskooee and Nasir (2004) conduct an individual country-by-country study to test the BS hypothesis for a set of 44 countries (including six from East Asia). The study employs the bound testing approach for cointegration (ARDL model) to estimate the long-run effect of productivity on the real exchange rate. A model based on the unrestricted (unconstrained) error correction test is proposed by Pesaran and Shin (1999) and Pesaran et al. (2001) to model the long-run and short-run relationship between system variables simultaneously. Choudhari and Khan (2005) conduct a panel study on the BS hypothesis and examine two individual panels of low-income and high-income countries comprising East Asian, African and Western Hemisphere states. Using Panel Dynamic Ordinary Least Squares (PDOLS) tests for cointegration, the study establishes the long-run Balassa-Samuelson effect for two groups of countries by assuming homogenous cointegrating vectors within the group. Thomas and King (2008) investigate a set of nine East Asian countries using a single-equation residual-based error correction model. The model was originally proposed by Zivot (1994). The existence (inexistence) of a valid cointegrating relationship between model variables is decided through an error correction process.

More recent studies from Asia use pooled data estimation techniques to investigate the Balassa-Samuelson hypothesis. Dumrongrittikul (2012) applies panel data estimation techniques to examine the BS hypothesis for a set 33 developing and developed countries. Using the group-mean panel dynamic ordinary least squares estimator suggested by Pedroni (2004), the test allows for greater flexibility in the presence of heterogeneity of cointegrating vectors since the panel includes countries from different regions. Ricci et al. (2013) analyze an augmented version of the BS hypothesis for two individuals sets of countries: advanced economies and newly industrialized emerging markets. Their sample includes 12 Asian countries. The estimation of an equilibrium long-run cointegrating relationship between the real exchange rate and its proposed determinants is undertaken using the panel dynamic ordinary least

squares estimator developed by Stock and Watson (1993). The estimated relationship is further explored through the panel error correction model to gauge the speed of convergence of the real exchange rate towards its long-run equilibrium. Wang et al. (2016) base their study of the BS effect on a panel data set of 40 countries. Their sample includes 9 countries from Asia. The BS hypothesis is tested by employing an extended version of panel cointegration techniques, proposed by Bai and Carrion-i-Silvestre (2013), allowing for structural breaks and cross-sectional dependence. In their study, the long-run BS effect is estimated using the group-mean panel cointegration estimator and the results suggest significant absence of the BS effect for the set of developing countries (only).

There are only a few studies on Asia that investigate the BS hypothesis by employing alternative estimation methods. Interestingly, their findings yield quite conflicting results when the same log-run model is tested against two different empirical tests. Chinn (2000) observes valid existence of the BS effect, but of varying degree when the long-run model is tested through time-series estimations methods and the pooled data estimator. When conducting individual country analysis, the study employs the single-equation residual-based error correction model of Phillips and Loretan (1991). Assuming that the model regressors are weakly exogenous, the author tests the BS hypothesis using non-linear least squares (NLS) regressions for nine East Asian states. The time-series analysis provides some evidence in support of valid existence of the BS effect. For only three out of nine countries, the real exchange rate and productivity trend movements are found to comply with the theoretical predictions of the BS hypothesis. On the contrary, panel data estimation results are rather encouraging. Using the panel NLS error correction model, the author confirms the valid existence of the BS effect for the panel countries. He finds significant mean reversion in errors and convergence of the real exchange rate towards its long-run equilibrium. Kakkar and Yan (2012) report considerable variation in their results when testing the BS hypothesis for six East Asian countries using alternative specifications of Kao and Pedroni panel cointegration tests. Though the two tests significantly favor the existence of the BS effect, the magnitude of effect is found to be highly varying under different circumstances. When the condition of homogenous cointegration vectors is imposed, the long-run BS coefficient is found to be 0.64 (approximately). Allowing for heterogeneous cointegrating vectors, the individual long-run coefficient estimates are found to vary widely between 0.13 and 0.90.

2.4. Theoretical Foundations of the Hypothesis

(a) Domestic Version of the Balassa-Samuelson Hypothesis

While testing the BS theory empirically, researchers have distinguished between the internal and external transmission mechanisms of the hypothesis. The internal mechanism of the hypothesis proposes that the

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sectoral productivity gap in a country may drive internal relative prices of non-tradables. A faster productivity growth in the traded sector of the county may cause its relative price of non-tradables to rise. This effect is known in the literature as the Baumol-Bowen effect. Baumol and Bowen (1966) argued that within a country, there is a broad tendency for the prices of service-intensive goods (education, health care, banking, etc.) to rise over time as, historically, productivity growth in these activities has tended to be slower than in more capital-intensive manufacturing industries. A sizeable number of non-Asian studies have tested the domestic version of the Balassa-Samuelson hypothesis (see Canzoneri et al., 1999; Egert, 2002, 2005; Lojschova, 2003; Mihaljek & Klau, 2004; Lee & Tang, 2003; Funda et al., 2008). These studies indicate that the domestic version of the hypothesis is the key driver of the standard BS mechanism.

However, there is a serious dearth of studies investing the domestic version of the BS theory for Asia. To our knowledge, the only credible work conducting a multi-country analysis of Asia for the internal version of the BS hypothesis was done by Thomas and King (2008). The study investigates the long-run relationship between internal relative sectoral productivities and internal sectoral price ratios (augmented with a number of domestic demand side control variables like government consumption spending, GDP per capita, oil prices and terms of trade) for a set of nine East Asian countries and the U.S. In their study, seven out of ten countries reject the null hypothesis of no cointegration between model variables at a ten percent or better significance level. However, when a general to specific approach is applied, i.e., clearly insignificant variables are dropped out of model, the parsimonious version of the model yields even more encouraging results. In the case of nine out of ten countries, with Korea being the only exception, the null hypothesis of no cointegration is rejected.

The assumed value of relative labor intensities of non-traded sector plays an important role in testing the domestic version of the BS hypothesis. If a non-traded sector is relatively more labor-intensive, then even a balanced (proportionate) sectoral productivity growth may lead to an appreciation of relative prices of non-tradables (Froot & Rogoff, 1985). While testing the hypothesis empirically, Thomas and King (2008) assume an equi-proportionate relationship between biased sectoral productivity and relative sectoral prices, i.e., labor intensity is equal across sectors. However, individual country estimates reveal that none of the studied economies meet this assumption. Almost always, the relative productivity bias in tradables appear to bear a disproportionate relationship with the internal price ratio. This approach is consistent with the empirical findings of some earlier studies confirming the validity of a domestic BS effect but with disproportionate effects of productivity differentials on the internal real exchange rate (Mihaljik & Klau, 2004; Egert, 2005; Lee & Tang, 2003; Funda et al., 2008).

(b) Controlling for the Assumptions of the Hypothesis

The BS hypothesis is widely criticized in recent empirical studies for its assumptions. Long-run PPP between inter-country traded sector prices (see Canzoneri et al., 1999; Egert, 2002b; Egert et al., 2003; Kovacs, 2003; Lojschová, 2003; Blaszkiewicz et al., 2004; MacDonald & Ricci, 2005; Lee & Tang, 2007; Garcia-Solanes et al., 2008) and inter-sectoral equalized wages (see Strauss & Ferris, 1996; Strauss, 1997, 1998; Nenovsky & Dimitrova, 2002; Lee, 2005) are two of the core assumptions of the theory that are most widely tested in literature and are largely found to be inexistent. In this section of the paper, we focus on the validity (invalidity) of the assumption that presumed long-run PPP between tradables prices across countries. The testing of this assumption is rather under-explored for Asia.

Few studies test the hypothesis by relaxing the PPP assumption and find quite different results. Ito et al. (1999) investigate countries in Asia, Western Hemisphere and Oceania countries for the BS hypothesis and find sustained departures in traded sector prices vis-a-vis the U.S. Through simple regressions, they find that ten out of eleven countries reportedly experience trend deviations in their relative prices of tradables against the U.S. The only exception was Korea, which seems to be consistent with the assumption of PPP. This finding casts shadow over one of the fundamental assumptions behind the BS hypothesis, i.e. trend deviations in the real exchange rate are contributed only from appreciation of non-traded sector prices. Similarly, for a set of nine East Asian countries, Thomas and King (2008) investigate the equi-proportionate relationship between home tradables prices and the corresponding U.S. prices as proposed by the BS hypothesis. Using single-equation error correction models, their findings reveal a valid long-run co-movement amongst model variables, but only for half of the sample countries. Kakkar and Yan (2012) examine the assumption of tradable sector PPP for East Asia and find mixed evidence. Their empirical analysis provides some support for PPP between inter-country traded sector prices when the restriction of homogeneity on cointegration vectors is imposed. However, the evidence is generally weaker when heterogeneous vectors are considered. Imai (2018) investigates the sharp appreciation of the Chinese real exchange rate vis-à-vis the U.S. dollar under the theoretical predictions of the Balassa-Samuelson theory. The study evidently reveals that for China the magnitude of Balassa-Samuelson effect is modest and finds appreciation in traded sector prices responsible for inducing long-run trend appreciation in the country's real exchange rate against the U.S. dollar. Ishaq et al. (2022) empirically examine a new (relaxed) variant of the BS hypothesis for East and South Asian emerging economies. They test the validity underlying the theoretical assumption around PPP, strongly presumed to hold for traded sector prices under the international version of the model. The assumption, when empirically tested, does not always

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hold valid, since seven out of nine sample countries demonstrate a price difference in tradables against the world (U.S.), a potential driver of their trend in real exchange rate deviations (appreciation).

(c) Modified Version of the BS Hypothesis

A couple of recent studies re-examine the BS hypothesis from a new perspective, using a modified version of the theory. The motivation behind estimating the modified variant of the BS theory is certainly to obtain more realistic and convincing empirical estimates. By controlling for the over-idealist assumptions of the hypothesis or by giving a (due) theoretical representation to inherent macroeconomic features of the sample countries, these papers attempt to depict the most honest picture of the productivity-real exchange rate linkage, which otherwise would be compromised.

While studying the price-income relationship in the context of structural transformation of developed and developing economies of Europe, Africa, Middle East, Asia and Pacific, Hassan (2016) modifies the BS hypothesis by connecting the price level to the process of structural change. Using Total Factor Productivity (TFP) as representative of sectoral (tradables and non-tradables) productivity, the sectoral TFPs of agriculture, manufacturing and services are weighted by their relative employment shares, so that the price index reflects the stage of structural transformation a country is currently experiencing. After taking into account structural shifts in driving the price-income relationship, the study reveals some fascinating and intuitively compelling insights about the BS mechanism. The agriculture sector TFP tends to increase across the sample countries at the initial stage of growth. As a consequence, a country's overall price level tends to fall given the high relative employment share of agriculture in its economy. Such a trend pattern of a country's general price level contradicts the prescribed mechanisms of BS theory. However, at advanced stages of structural transformation, the employment share of the agricultural sector is surpassed by that of the manufacturing sector, resulting in the overall contribution of agriculture to the country's total employment being very small or even negligible. Hence, in the long run, the relative TFP in manufacturing emerges as the main driver of cross-country inter-sectoral price differentials, a pattern confirming the theoretical predictions of the BS hypothesis.

Heterogeneity in regional prices (inflation) has been frequently analyzed in the theoretical framework of the PPP (Cassel, 1918), suggesting a bias in regional prices. Thus, economic determinants (transaction costs, tariff and non-tariff barriers, etc.) contributing to the violation of the PPP have been considered amongst the most convincing explanations for heterogeneous regional prices or inflation (Dumas, 1992). Similarly, distance has been evidently reported to be a reason for heterogeneous inter-country inflation (Chen, 2004; Kano et al., 2013; Ikeno, 2014). In this context, Nagayasu (2020)

revisits the BS hypothesis for Japan by considering the regional location of the country as the key model determinant. To analyze the role of distance in determining the BS effect, the study employs a spatial econometric model which is absolutely consistent with the theoretical specifications of the BS mechanism. Assuming perfect labor mobility across sectors (tradables and non-tradables), but restriction on labor mobility across intra-country regions (urban and rural), the productivity growth bias across regions is captured by considering the productivity gap of neighboring regions. This bias is estimated empirically using a spatial econometric model. The results from the study hold important policy implications for countries (such as Japan) where there is sharp demarcation (in terms of productivity growth bias) between urban and rural regions. Moreover, the study finds a high correlation in regional inflation patterns and observes a rising trend of urbanization in the country due to abrupt demographic changes.

Ishaq et al. (2022) revisit the BS hypothesis for a set of nine East and South Asian states and establish a relaxed version of the hypothesis. The BS hypothesis is often criticized for one of its underlying but highly idealistic assumptions: assuming that Purchasing Power Parity (PPP) holds for tradables prices across countries. The study empirically tests the plausible existence of PPP amongst cross-country tradables against the world (U.S.), while considering the failure of the Law of One Price (LOP) to hold in the long run. For Japan, Korea, Pakistan, the Philippines, and Thailand, the results indicate the absence of any valid existence of PPP with the U.S. Singapore, Hong Kong, and Sri Lanka, however, yielded mixed results. Indonesia and Malaysia were the only two countries that provided strong substantiation for PPP, their traded-sector prices significantly co-moving with their U.S. counterparts. Furthermore, their prices showed evidence of an equi-proportionate long-run relationship with those of the U.S., indicating the presence of PPP in its absolute version. The inexistence of PPP (to a large extent) for tradables can be considered as a suggestion that a tradables price gap against the U.S. is a plausible determinant of long-run real exchange rate appreciation in the respective economies. The assumption of tradables PPP is therefore relaxed, and the theory is empirically tested in its relaxed version using a variety of single-equation and multivariate time-series and pooled data econometric tests. In addition to the inter-country sectoral productivity differential, tradables prices in the home country and the U.S. were allowed to deviate from their PPP equilibrium, displaying the potential to induce trend movements in the real exchange rate based on non-tradable prices in home economies. Nevertheless, this effort proved fruitless. Allowing for the divergence of tradables prices from PPP did not bring us any closer to finding substantial support for the BS hypothesis. Of all the countries, only Pakistan and the Philippines showed any evidence of a valid BS effect, although even here the evidence was mixed, with supporting evidence coming only from the single-equation time-series

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cointegration models. Nevertheless, these estimates are strongly rejected by pooled data estimators, since the panel estimators yield a negative and statistically significant long-run BS coefficient. This is inconsistent with the theoretical prediction of the BS hypothesis, which therefore can be interpreted as strong evidence against the reliable existence of the BS hypothesis. Finally, in the context of long-run PPP between inter-country tradables prices, long-run elasticities suggest a significant contribution of traded-sector prices to deviations of the (non-tradables-based) real exchange rate from its long-run equilibrium. Thus, the lack of PPP between tradables in the home country and the U.S. was found to significantly induce trend departures in the Asian countries' real exchange rate.

The table presented below provides a summary of the existing literature examining the BS hypothesis for East Asia and South Asia. It offers readers a quick view of each study highlighting the sample countries, a scheme of sectoral division, measures of the real exchange rate, verification of the underlying assumptions and final conclusions about the existence of the BS effect.

3. Conclusion

This review paper is aimed at critically analyzing the earlier literature on the BS hypothesis for Asia with a special emphasis on various important dimensions associated with its empirical estimation. It is believed that careful handling of these critical aspects are of vital significance for yielding reliable empirical estimates. Therefore, the present paper serves as a critical commentary on major inconsistencies commonly found, including an incomparable scheme of sectoral division followed, deficiently reflective definitions and proxy variables for the real exchange rate and prices, choice of output and employment series used and their subsequent transformation, empirical methodology and (theoretically) different variants of the hypothesis chosen for estimation. The empirical evidence on the BS hypothesis for emerging Asian states is very mixed, and in many cases, not robust. Such a state of indeterminacy on the valid existence of the BS effect for Asia can largely be attributed to data and irregularities, the econometric estimates being highly sensitive to the choice of price and productivity measures involved in the empirical estimation of the BS model.

Table 1
Summary of Critical Features of Prominent BS Studies on Asia

Critical Features of the Study	Bahmani-Oskooee and Rhee (1996)	Ito et al. (1999)	Chinn (2000)
(a) Sample Countries	Korea	18 APEC countries (11 from Asia, 4 from Western Hemisphere and 3 from Oceania)	China, Indonesia, Japan, Korea, Malaysia, Philippines, Singapore, Taiwan and Thailand
(b) Sample Data Set	Quarterly 1979–93	Annual 1973–93. Start and end dates vary from country to country	Annual 1970–92. Start date varies from country to country
(c) Scheme of Sectoral Division	–	Highly aggregated, T = Manufacturing, NT = Services	T = LDCs: Manufacturing, U.S. & Japan: Industry, mining, transportation & agriculture NT = LDCs: Services, construction, mining and transportation, US & Japan: Services, construction, government
(d) Measure(s) of RER	GNP deflator-based RER	GDP deflator-based RER	GDP deflator-based RER
(e) Domestic or/and International Version of the Hypothesis	International version of the hypothesis is tested only.	International version of the hypothesis is tested only	International version of the hypothesis is tested only
(f) Controlling for the Idealist Assumptions of the Theory	No	The countries' exchange rates are allowed to deviate from PPP	Demand-side factors are allowed to explain real exchange rate movements
(g) Empirical Estimation Methodology	Johansen-Juselius maximum likelihood cointegration test	Simple OLS regression model	Time-series and panel error correction regressions
(h) Conclusion	Valid existence of BS effect is found.	Mixed support is found in favor of BS hypothesis	Valid existence of BS effect is confirmed more robustly through panel data estimation methods

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Table 1 – continued

Critical Features of the Study	Drine and Rault (2002)	Wang Dunne (2003)	Bahmani-Oskooee and Nasir (2004)
(a) Sample Countries	India, Indonesia, Korea, Philippines, Singapore and Thailand	Indonesia, Japan, Korea, Malaysia, Philippines, Singapore and Thailand	A set of 44 developed, developing and less developed countries including six countries from East and South Asia
(b) Sample Study Period	Annual 1983–98	Quarterly 1973–96. Start date varies for some countries	Annual 1960–90
(c) Scheme of Sectoral Division	T = Manufacturing sector and agriculture, hunting, forestry and fishing. NT = Services	Inter-country tradable sector productivity gap is taken into account only. The tradable sector is represented by manufacturing sector of each country and for those countries where manufacturing output data is not available, real GDP is used as an alternative measure	–
(d) Measure(s) of RER	CPI-based effective RER	CPI-based bilateral RER	GDP deflator-based RER
(e) Domestic or/and International Version of the Hypothesis	International version of the hypothesis is tested only	International version of the hypothesis is tested only	International version of the hypothesis is tested only
(f) Controlling for the Idealist Assumptions of the Theory	The countries' exchange rates are allowed to deviate from PPP	No	No
(g) Empirical Estimation Methodology	Multivariate (Johansen) and panel (Pedroni) cointegration tests	Johansen-Juselius ML cointegration method and generalized variance decomposition test	Autoregressive Distributed Lag (ARDL) bound testing for cointegration and error correction model
(h) Conclusion	BS effect is invalidated for the sample countries	Except Singapore, very little evidence is obtained in support of BS effect for other sample countries	For Asia, 4 out of 6 countries display the valid existence of BS effect

Table 1 – continued

Critical Features of the Study	Choudhri and Khan (2005)	Thomas and King (2008)	Olson (2009)
(a) Sample Countries	The study includes 14 Asian, African and South American countries at high-, low- and medium-income levels	China, Indonesia, Japan, Korea, Malaysia, Philippines, Singapore, Taiwan and Thailand	China, Indonesia, Japan, Korea, Malaysia, Philippines, Singapore, Taiwan, and Thailand
(b) Sample Study Period	Annual 1976–94	Annual 1960–2004. Start date varies from country to country	Annual 1970–2007
(c) Scheme of Sectoral Division	T = Manufacturing and agriculture NT = All other sectors	T = Manufacturing NT = Services, construction and utilities	–
(d) Measure(s) of RER	CPI-based RER	GDP deflator-based RER	CPI-based RER
(e) Domestic or/and International Version of the Hypothesis	International version of the hypothesis is tested only	Both domestic and international versions of the hypothesis are tested	International version of the hypothesis is tested only
(f) Controlling for the Idealist Assumptions of the Theory	No	i. Long run co-movement between cross-country tradables prices (PPP) is investigated. ii. Non-tradable price component in tradable prices is taken into account.	No
(g) Empirical Estimation Methodology	Two residual-based Pedroni tests and panel DOLS estimator	Time-series error correction regressions	Single-equation cointegration model and impulse response function
(h) Conclusion	The results strongly suggest that the BS hypothesis is in operation	Authors obtain significantly stronger support in favor of valid existence of BS effect	The model augmented with demand-side shocks supports the valid existence of BS effect for studied countries

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Table 1 – continued

Critical Features of the Study	Tsen (2011)	Dumrongrittikul (2012)	Chowdhury (2012)
(a) Sample Countries	Japan, Korea, and Hong Kong	33 countries in total. 17 developing countries and 16 developed countries. Fourteen countries in the sample are from Asia	Seven low-income SAARC economies (Bangladesh, Bhutan, Nepal, India, Maldives, Pakistan and Sri Lanka)
(b) Sample Study Period	Quarterly 1960–2009. Start date varies from country to country	Annual 1970–2008	Annual 1950–2007. Start date varies from country to country.
(c) Scheme of Sectoral Division	–	Each country's real economy is divided into seven distinct sectors. T and NT sectors vary from country to country	–
(d) Measure(s) of RER	CPI-based bilateral RER	CPI-based RER	GDP deflator-based RER
(e) Domestic or/and International Version of the Hypothesis	International version of the hypothesis is tested only.	International version of the hypothesis is tested only	International version of the hypothesis is tested only
(f) Controlling for the Idealist Assumptions of the Theory	No	No	No
(g) Empirical Estimation Methodology	Engle-Granger residual-based test for cointegration, Johansen (1988) cointegration method and the SL cointegration method and the generalized forecast error variance decomposition	Four residual-based Pedroni tests and group-mean panel DOLS and time-series DOLS estimators	Autoregressive Distributed Lag (ARDL) bound testing cointegration approach and error correction model
(h) Conclusion	Considerable amount of support is yielded for hypothesis	For the set of developing countries (only), strong evidence in support of the BS effect is found	Dominant inexistence of BS effect is found

Table 1 – continued

Critical Features of the Study	Kakkar and Yan (2012)	Ricci et al. (2013)	Ishaq et al. (2022)
(a) Sample Period	Hong Kong, Indonesia, Korea, Malaysia, Singapore, and Thailand	The sample set comprises a mix of industrial economies and emerging market. 11 countries are selected from Asia	The sample set comprises nine emerging economies of Asia
(b) Sample Study Period	Annual 1980–2001	Annual 1980–2004	Annual 1970s and 1980s to 2018
(c) Scheme of Sectoral Division	T = manufacturing; mining & quarrying; ocean and air transport; wholesale & retail trade; and financing, insurance & business services NT = utilities; construction; real estate; community, social, and personal services; land transport and communication; and restaurants	T = agriculture, hunting, forestry, and fishing; mining, manufacturing, and utilities; and transport, storage, and communication NT = construction; wholesale and retail trade; and other services	Each economy is disaggregated into seven sectors: (i) agriculture, (ii) manufacturing, (iii) mining and utilities, (iv) construction, (v) wholesale, retail trade and hospitality, (vi) transport and (vii) communication and other activities. Tradable and non-tradable sectors vary from country to country
(d) Measure(s) of RER	CPI-based RER	CPI-based effective RER	GDP deflator-based RER
(e) Domestic or/and Internatio-nal Version of the Hypothesis	International version of the hypothesis is tested only	International version of the hypothesis is tested only	International version of the hypothesis is tested only
(f) Controlling for the Idealist Assump-tions of the Theory	Long-run co-movement between cross-country tradable prices (PPP) is investigated	Demand-side determinants are also modeled against RER	The assumption of PPP for tradables is relaxed

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Table 1 – continued

Critical Features of the Study	Kakkar and Yan (2012)	Ricci et al. (2013)	Ishaq et al. (2022)
(g) Empirical Estimation Methodology	Kao and Pedroni cointegration tests for detecting plausible long-run association. The long-run elasticities are calculated through panel DOLS estimator	Panel DOLS and panel error correction model	Engle-Granger test of cointegration, error correction testing, Pedroni panel cointegration tests, time-series and panel single-equation cointegration regression tests
(h) Conclusion	Valid BS effect is found	Valid BS effect is found but with small magnitude (particularly for industrialized countries)	Valid BS effect is found but with small magnitude (particularly for industrialized countries)

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