

# MASTERS DISSERTATION

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## *Structural Change, Trade and Real Exchange Rates*

**Master of Research (MRes)**

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## **ABSTRACT**

Recent bodies of empirical literature have addressed the issue of real exchange rate misalignments and economic growth. Different author's using different estimation methods have mostly found that countries which have been able to keep their real exchange rate at undervalued levels have experienced higher growth rates, especially in the case of underdeveloped and developing economies. The main argument put forward by this literature to explain this empirical regularity is that Real Exchange Rate undervaluation can enhance competitiveness of tradable sectors and help to boost exports. However, the literature has mostly used measures of real exchange rate "equilibrium", from which misalignments are derived, in an uncritical manner. Therefore, an initial aim of this research is to develop a critical review of the different measures used in the literature, assessing their underlying hypothesis, ability to track long term trends of real exchange rate and discussing their embedded notions of equilibrium. We then propose an alternative approach proposed originally by Shaikh (1999) and further developed by Shaikh (2016) which is inspired by classical political economy. In this alternative framework, the real exchange rate of a country is essentially determined by the relative vertically integrated unit labour cost between the countries exporting sectors and its imports. Using world input-output tables, we develop an exploratory empirical application of Shaikh's approach for the UK economy between 1995 and 2009. The results are contrasted with a traditional measure based on the Purchasing Power Parity (PPP) and reveal a better fit to track real effective exchange rate movements. This highlight that changes in real exchange rates are also a consequence of changes in the country's relative competitive condition, represented by relative vertically integrated unit labour costs (RVIULC).

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## **1. Aims and Objectives**

This initial chapter outlines the motivation of the research and defines the main objectives and research questions to be addressed in the dissertation. Finally, a short introduction to the case study under consideration, and the composition of the dissertation, is given.

### **1.1 Statement of the problem**

Both in mainstream and in heterodox theories of economic growth, the level of the real exchange rate (defined as the nominal exchange rate adjusted by the relative price levels in each country) is usually not given a key role in explanations of economic growth. However, recent developments in the empirical literature have cast doubts on the conclusion drawn from both theoretical approaches regarding the real exchange rate (RER). Instigated by empirical findings of influential mainstream authors such as Rodrik (2008) and Eichengreen (2008), a growing empirical literature has confirmed their findings that emphasize causality between currency undervaluation and sustained economic growth, especially for undeveloped and developing economies. These results have been robust to different econometric techniques and specifications, samples and measures of equilibrium RER.

Explanations put forward in this literature vary. Rodrik (2008) indicates that undervalued real exchange rates compensate for institutional weakness and market failures in developing countries. Di Nino et.al. (2011) emphasize the role of increasing returns to scale of exports in a model with Bertrand competition. Gluzman et. al. (2012) highlight that weak exchange rates produce changes in the income distribution that are associated with higher savings and investments, a mechanism also emphasized by Gala (2008) in a Neo-Kaleckian framework. While reviewing the explanations found in the literature, Rapetti et. al. (2012) highlight two possible channels. One suggests that a weak real exchange rate can provide an incentive to shift resources to the tradable sector, which would possess greater externalities such as learning-by-doing and technological spillovers. Further, as Eichengreen (2008) comments, if the tradable sectors possess, in average, higher productivity levels than the rest of the economy, then a real exchange rate level that makes them competitive and, thus, allows for their expansion will lead to a boost to growth of GDP per capita. The second explanation found by Rapetti et al. (2012) is the role played by a competitive RER in relaxing the external balance constraint on growth.

This recent stream of literature on economic growth and exchange rate misalignment has focused primarily on testing this relation empirically. It has subjected empirical findings

to a diverse set of robustness checks, such as different econometric specifications and techniques and inclusion of different control variables. To a lesser extent empirical results have been contrasted with different definitions of equilibrium exchange rate. This is a crucial variable as it is based on these equilibrium (fundamental) values that a country's real exchange rate will be interpreted either as under or overvalued. In this literature, two approaches to define equilibrium exchange rate levels have been adopted. The majority of the studies have adopted a definition of real exchange rate based on purchasing power parity, with most of them adjusting their measure for the Balassa-Samuelson effect<sup>1</sup> (PPP-based). The second approach relies directly on macroeconomic models, in which the equilibrium real exchange rate will be estimated based on an *ad-hoc* chosen set of fundamentals, such as Fundamental Equilibrium Exchange Rate (FEER) and Behavioural Equilibrium Exchange Rate (BEER)<sup>2</sup>.

From our reading, it may be argued that the literature has jumped too quickly in drawing inference from real exchange rate misalignments to economic growth, without properly evaluating how well these currency misalignments are being measured. The definition of real exchange rate "equilibrium" and the ability of the different approaches to actually track long-term behaviour of RER has been a contentious matter. Thus, a possibility is that instead of the RER being misaligned, as is assumed in this body of literature regarding real exchange rate and growth, long-run "equilibrium" RER might be actually incorrectly measured, with its behaviour being explained, perhaps, by another set of relations.

## 1.2 Research Objectives

The aim of this dissertation is to review existing theories of real exchange rate determination used in the literature relating exchange rate misalignment and economic growth. Contrasting their embedded notion of equilibrium and ability to explain long-run trends of the Real Exchange Rate with an alternative approach, not yet tested in this literature<sup>3</sup>, based on the theory developed originally by Shaikh (1991, 1999) and further developed in Napoles (2004) and Shaikh (2016). In this alternative framework, the long-term movements of RER are explained primarily by relative unit labour costs, i.e. the evolution of relative labour productivity and real wages.

In our view, this approach has two interesting features. First, as it is based on a cost parity approach it is in our view more suitable to address issues regarding competitiveness,

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<sup>1</sup> Which tries to control for the difference in relative prices between tradable and non-tradable commodities in countries with different GDP *per capita* levels. See Balassa (1964) and Samuelson (1964).

<sup>2</sup> For an overview of the FEER and BEER frameworks, see Driver and Westaway (2004) and Siregar (2011).

<sup>3</sup> To the best of our knowledge.

which is the transmission mechanism that matters for economic growth as usually claimed by the reviewed literature. Thirdly, preliminary empirical work done have shown promising results in tracking long-term movements of RER<sup>4</sup>. Secondly, as it is based on a cost parity approach it is in our view more suitable to address issues regarding competitiveness, which is the transmission mechanism that matters for economic growth as usually claimed by the reviewed literature.

However, while in the theoretical presentation of the model Shaikh (1999) considers that RER are primarily governed by relative vertically integrated unit labour costs (i.e. both direct and indirect labour costs embodied in the inputs used in the production of tradables), empirical tests conducted so far have only considered direct unit labour costs. This is justified by Shaikh and Antonopoulos (2013) due to the lack of international input-output tables covering sufficiently long-time span to permit the creation of adequate time series. This necessary data was non-existent until recently when several independent efforts have been made to produce International Input-Output databases (such as WIOD, TiVA/OECD, AEORA).

Therefore, our main research objective, beyond the literature review, is to conduct an initial empirical exploratory application of Shaik's (1999) model of long run real exchange rate equilibria with vertically integrated unit labour cost, as it is in fact preconized in the theoretical model. Using the UK as a case study we construct a measure of the UK's vertically integrated unit labour cost relative to its main trading partners<sup>5</sup> using the WIOD database (Timmer et. al 2015) for the 1995-2009 period. This evolution of this measure is contrasted with the behaviour of the UK's real effective exchange rate and the other (reviewed) measures of long-run real exchange rate determination, i.e. PPP-based.

### **1.3 UK economy as a case study**

The choice of the United Kingdom (UK) economy as an initial case study is motivated mainly by its characteristics. The UK can be considered as a suitable candidate to assess the different theories of real exchange rate "equilibrium" as it fulfils many of the conditions under which the conclusions drawn from such theories are expected to hold. In particular, the UK is a fairly open economy, both in terms mobility of capital and its terms of trade. Its currency is also one of the most liquid currencies in foreign exchange markets and its exchange rate has been allowed to float rather freely by the Bank of England.

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<sup>4</sup> See Antonopoulos (1999), Sarich (2007), Martinez-Hernandez (2010, 2015), Ersoy (2010), Shaikh and Antonopoulos (2013).

<sup>5</sup> Namely: United States, Germany, France, Netherlands, Ireland, Italy, Japan and China.

After a sharp devaluation of the pound in 1992 which culminated in the exit of the UK from exchange rate mechanism (ERM)<sup>6</sup>, 1995 marks a turning point and beginning of a steep movement of real exchange rate appreciation of 26.8% until 1998 (see figure 5, chapter 4). This was followed by a period marked by stability in real value of the British pound against the currencies of its trading partners until 2003. Then, the real exchange rate resumed a tendency to appreciate. From 2003 to 2007, the real effective exchange rate of the UK increased by 10.9%, a tendency only reverted in 2008 when the value of the UK's currency depreciated heavily due to the effects of the international financial crisis that erupted in September 2008.

It has also experienced important changes in the composition of its productive structure and in its patterns of trade. Between 1995 and 2008 the share of the Manufacturing subsystem in UK's GDP, measured in constant prices of 1995, fell from 20.9% to only 14%<sup>7</sup>. The importance of manufacturing products in the UK's trade balance also diminished in the period under enquiry. In 1995, exports of manufacturing products represented 74.6% of UK total exports, while in 2007 it accounted for just 54.9% of the total. This pattern was also observed in the composition of UK's imports, although the drop wasn't as intense. In 1995 manufacturing products accounted for 78.3% of total imports, while in 2007 it accounted for 67.7% of the total. UK is, therefore, a country that in the period faced an appreciation of its currency in real terms and decreasing importance of its tradable sector in the economy.

#### **1.4 Composition of Dissertation**

In the following, a short outline of the dissertation is presented. The research study is structured into five chapters. A literature review is presented in chapter 2. The first section focus on the recent empirical literature that relates real exchange rate misalignment and economic growth, it serves the purpose to establish the significance of the research. In the second section the theoretical frameworks that inform the approaches used to measure real exchange rate equilibrium, such as the Purchasing Power doctrine approach, first proposed by Cassel (1916), and more recent developments within the mainstream framework (BEER and FEER). The chapter closes with the presentation of an alternative perspective on the determination of RER proposed by Shaikh (1999, 2016). Chapter 3 states the chosen data collection methods and discusses the reasons for selecting them in connection with the research paradigm. Furthermore, the limitations of the methodology approach are briefly outlined. In chapter 4 the calculation procedures are described and the data is analysed and

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<sup>6</sup> Which allowed the European currencies to vary within a defined band.

<sup>7</sup> For more details see tables 4, 5 and 6 presented in the appendix.

results interpreted. Finally, Chapter 5 presents a brief summary of the findings and discusses the main limitations of our research.

## **2. Literature Review**

### **2.1 Real Exchange Rate Misalignments and Economic Growth**

Once relegated to a secondary role in the explanation of economic growth, the nexus between RER levels and economic growth have made a comeback in recent years both in political and academic circles. During the 2000's the continuous increase in the trade deficit of the US against China led to increased political tension, with many advocating that this was a product of a deliberately policy by the Chinese government to maintain the Renminbi (i.e. the Chinese currency) artificially devalued against the dollar. The increasing complaints culminated in the introduction of a proposal in the congress of "The China Currency Manipulation Act" in April of 2008. Although never enacted, the proposal sparked a lot of discussion both in political and academic circles. In different ways that political tension resembled the tension of 1980's towards Japan, which led to the signature of, what has become known as, the Plaza Accord of 1985 in which the governments of France, West Germany, Japan, the United States, and the United Kingdom reached an agreement to enforce a depreciation of the U.S. dollar in relation to the Japanese yen and German Deutsche Mark by intervening in currency markets.

In a way, China's economic up rise and prominence in world trade is the most recent success story of the model adopted by newly industrialised countries in East Asia starting with Japan, followed by Hong Kong, Singapore, South Korea and Taiwan. A common feature in the trajectory of all these economies were the direct attention given to the real exchange rate as a development-relevant tool and the diversification of its economic structure and exports that accompanied this process (Eichengreen, 2008). In contrast, slower growth experienced by most of Latin American countries over the same decades has been linked with a recurrent overvaluation of the region's currency, a tendency often linked with the occurrence of Dutch Disease or low propensity to save, depending on the theoretical stand of the author (Palma, 2005).

Connected to the political situation, the revival of the topic in academic circles was led by papers written by two prominent authors, Dani Rodrik (2008) and Barry Eichengreen (2008), and since then a growing body of literature have tried to tackle this relation. Eichengreen (2008) provides, as well as new evidence, a thorough review of the literature<sup>8</sup>. Even though he asserts that the available evidence is not overwhelming, he concludes that keeping competitive levels and avoiding excessive volatility of exchange rates are important for growth. He regards it as a facilitating condition that enables countries to capitalize on

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<sup>8</sup> Hence, the following literature review is aimed at more recent studies, reflecting more recent developments.

solid fundamentals such as disciplined workforce, high savings rate, or its status as destination of foreign direct investment (FDI).

Rodrik's (2008) paper is primarily aimed at presenting new empirical evidence and, as remarked by Rapetti et. al. (2012), is among the first to explicitly test for asymmetries of the effect of exchange rate undervaluation in developing and developed countries. It calculates exchange rate misalignments based on a PPP-index adjusted for the Balassa-Samuelson effect for a set of 184 countries over the period of 1960-2011 and tests the effect of exchange rate undervaluation in economic growth through a fixed-effect econometric panel model. The definition of developed and developing countries is arbitrarily given by a threshold level of GDP *per capita* of US\$6000<sup>9</sup> and the empirical findings reveal a systematic positive relationship between undervaluation and growth, which is stronger and more robust in the case of developing countries. A relation that is not exclusive to the experience of East Asian tigers. Rodrik (2008) argue that the mechanism through which maintaining a currency undervalued enhance economic growth is due to an increase of profitability in the production of tradables and, hence, produce a positive impact on the share of tradables in the economy, especially in the manufacturing industry. The reasoning provided to why this would be more relevant to developing countries would be that these countries suffer more dramatically from institutional weakness and market failures.

MacDonald and Vieira (2010) confirm Rodrik's (2008) findings using a fundamentals-based equilibrium real exchange rate (FEER) to assess exchange rate misalignments. Rapetti et. al (2012) extends Rodrik's (2008) analysis by testing different criteria to classify countries as developing and developed economies. Their results confirm the strong robust effect of exchange rates for developing economies. However, they also find a positive relation of exchange rate undervaluation and economic growth for high income countries. With the contrasting behaviour of middle-income economies being regarded as an empirical puzzle.

Gala (2008) tests the effect of overvaluation on growth in a panel of 58 developing countries from 1960 to 1999, using a PPP-based index he finds that overvaluation hinders economic growth. While Berg, Ostry and Zettelmeyer (2008) study claims that overvaluation affects the duration of growth spells adversely. A result that can be related to the Balance of Payments Constrained Growth models inspired in Thirwall (1979) original contribution. In this case, a prolonged overvaluation of the real exchange rate may provoke a persistent current account deficit that may eventually lead to a capital flight when international

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<sup>9</sup> In PPP dollars. An alternative threshold of US\$8000 is also tested, but coefficients were lower and statistically less reliable.

liquidity dries up. Consequently, the economy slowdown as it was growing at higher level than the one consistent with equilibrium in the balance of payments.

More recently, Di Nino et. al. (2011) in long-span study, covering 150 years, for Italy regarding real exchange rate and growth found that nominal devaluations had persistent real effects, in which undervaluation supported growth by stimulating exports of high-productivity sectors. While Gluzmann et. al (2012) explore the effect of undervalued currency on different components of GDP, as well as in employment, and finds that undervaluation does not affect positively developing countries tradable sector. Instead, it is positively associated with economic growth due to its effect in stimulating greater domestic savings and investment, as well as employment.

The claim that real exchange rate undervaluation (overvaluation) enhances (hinders) economic growth has also been supported in studies using different approaches to estimate real exchange rate “equilibrium”. Berg and Miao (2010) misalignment concept relies on the notion of the fundamental equilibrium real exchange rate (FEER). In this framework, real exchange rate equilibrium is the one consistent with internal and external balance, reflected by price stability, government balance and current account positions. It uses an Ordinary Least Square macroeconometric model, with fixed effects, which includes “other fundamentals” that affect the FEER. Following the literature, these are the log of terms of trade (ToT), government consumption and total investment as shares of GDP and an openness index. The error term for each country is taken as their measure of misalignment. Their results confirm Rodrik’s (2008) claim, but this is not surprising as their measure of misalignment is highly correlated with the PPP-based used by Rodrik (2008) (Berg and Miao, 2010, p.11).

Bereau et. al. (2012) and Couharde and Sallenave (2013) both use behavioural equilibrium exchange rate (BEER) approach to estimate real exchange rate equilibrium. In this approach long-term movements in the real exchange rate are mainly related to relative sectoral productivity differentials and the outstanding stock of net foreign assets. Using non-linear panel smooth transition regressions techniques, their findings confirm previous results from the literature of the positive (negative) effect of undervaluation in economic growth. Couharde and Sallenave (2013) findings, however, show important non-linearity’s with modest undervaluation’s being positive for growth. Also in a BEER framework, Noura and Sekkat (2012) conduct panel cointegration regressions in order to deal with non-stationarity of the variables of interest. Differently from other studies, their findings contradict previous research as they find that currency undervaluation don’t have statistically significant effect on growth once overvaluation episodes are excluded.

As Eichengreen (2008) remarks that, while reviewing previous related empirical work, this literature takes real exchange rate as exogenous, while in practice the relation tested is susceptible to simultaneity bias. On the one hand, rapid economic growth can lead to real appreciations due to the effect of increase in prices of non-tradables (whose price levels are positively associated with GDP per capita levels, the Balassa-Samuelson effect). On the other hand, if rapid economic growth initially occurs in an environment of undervalued exchange rates than policy makers might be reluctant of allowing the domestic currency to appreciate, in what Levy-Yeyati and Sturzenegger (2007) have termed as “fear of appreciation”, and, thus, regressions results can be contaminated by reverse causality. In the literature this problem has been usually tackled by the use of generalized method of moments (GMM) models. However, according to Eichengreen (2008) the appropriate treatment would be the use of instrumental variables, i.e. the use of a variable (instrument) that is correlated with the real exchange rate but that (theoretically) cannot help to explain growth.

This is precisely the approach taken by Habib et.al (2016) which revisits the case of real exchange rate and economic growth using external instruments. Using two different country specific instruments: (i) global capital flows interacted with individual countries’ financial openness; (ii) the growth of official reserves. The authors’ findings suggest that real appreciation (depreciation) reduces (raises) significantly economic growth in developing economies and, only, for pegged currencies<sup>10</sup>.

Although subject to methodological remarks regarding possible problems of endogeneity, the results from the empirical literature have been mostly consistent in finding undervaluation (overvaluations) in exchange rates of a country tends to increase (reduce) economic growth, mostly, for developing countries. The results were robust for different econometric specifications and techniques. Most studies point out that increased competitiveness in the production of tradables, especially in the manufacturing, enabled by the currency undervaluation helps to boost exports. The gain in scale of production enhanced by exports allows the dynamic sectors to thrive, sectors whose initial development might have been blocked by the limited size of the domestic market in a low *GDP per capita* economy.

The relevance of promoting the development of these sectors for economic growth are justified by their higher productivity levels (Eichengreen, 2008), regarded as the locus of technological spillovers, learning by doing and as sectors where increasing returns to

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<sup>10</sup> i.e. currencies which are maintained pegged to another country currency.

scale are more prominent. This reasoning and results found by this strand of literature indicate that structure of production tends to play a key role for long-term economic growth.

This feature, however, is not a consensus among the different theories of growth and it is at odds with conventional neoclassical growth theory. As Palma (2005) discusses, one can classify the different theories of growth into three basic areas. For this, however, the author stresses the difference between concepts of "activity" and "sector". In which Research and Development (R & D) and education are examples of "activity", while manufacturing and agriculture are examples of "industry". Taking this distinction into consideration, the author divides growth theories into three main approaches: (i) traditional neoclassical models, *a la Solow*, in which economic growth is modelled from the supply side perspective of an aggregate production function, where long-term economic growth is determined by the growth of the workforce and exogenous technical progress. Therefore, economic growth can be classified as "indifferent to activity" and "indifferent to the sector"; (ii) new endogenous growth models and some neo-Schumpeterian models, which emphasize the role of R & D, human capital, innovations and quality of institutions which postulate that growth would be "activity-specific", but "indifferent to the sector"; And (iii) the heterodox approaches, which include some classic authors of economic development theory, such as Albert Hirschman and Arthur Lewis, the post-Keynesian school of thought and Latin American structuralist theories, inspired in the contribution Raul Prebisch and Celso Furtado, that consider economic growth as "sector-specific", and "activity" can be both "neutral" and "industry-specific".

Authors like Rodrik (2008) and Eichengreen (2008) attempt to reconcile their findings with a neo-classical view of economic growth based on endogenous growth theory that emphasize the role of market failure and quality of institutions. The role of undervaluation of real exchange rate in developing countries is justified as a second-best measure that compensate for institutional weakness and market failures and, thus, give it a more neoclassical flavour. However, the key mechanism still is that structure of production matter for growth.

However, except for small countries, exports tend to constitute only a small part of GDP and, thus, their direct contribution to growth tends to be relative small. Hence, another explanation put forward in the literature by Rapetti et.al (2012) is the effect of exchange rate undervaluation in relaxing the external constraint. However, in the original balance of payments constrained growth model pioneered by Thirlwall (1979) the real exchange rate

doesn't play a significant role in determining economic growth. Rather, economic growth is determined by what has become known as Thirlwall's law<sup>11</sup>:

$$y_{BP}^* = y = \frac{\beta(z)}{\pi} \quad (1)$$

Where economic growth is determined by the income elasticity for the country's exports ( $\beta$ ) relative to the domestic income elasticity for imports ( $\pi$ ) and by the growth rate of foreign income ( $z$ ). However, as many Keynesian short-run models, Thirlwall's original model assumes a highly aggregate nature. Therefore, it does not open room for effects arising from structural change. Nevertheless, the theoretical developments stemming from Araujo and Lima's (2007) derivation of a Multi-Sectoral Thirlwall law have led to a reassessment of the role of real exchange rate on theoretical grounds. In this framework a sustained undervaluation (or a *once-and-for-all* devaluation) of the real exchange rate might generate a structural change that can alter the composition of importing and exporting sectors (or their relative shares) and, hence, affect the aggregate income elasticities of imports and exports, even if sectoral income elasticities are kept unaltered. This, in its turn, would increase the rate of growth consistent with balance of payment equilibrium:

$$y_{BP}^{U*} = \frac{\sum_{j=1}^{n-1} \xi_j \beta_j l_j^U}{\sum_{j=1}^{n-1} \pi_j l_j^U} z \quad (2)$$

Where the  $l_j^U$  represents the sectoral shares. The multisectoral version of Thirlwall's law reveals that a country potential growth rate can be improved not only by changes in the income elasticities of its exports and imports, but also by changes in the composition of demand or in the structure of production. As such, if a country, through keeping its real exchange rate at an undervalued level, is able to produce a structural change in its productive structure towards the tradable sector it may be able to maintain a higher growth rate without incurring unsustainable current account deficits.

In the literature reviewed in this section, different approaches to the determination of equilibrium real exchange rate have been used to assess if a country real exchange rate is over or undervalued. Three main different approaches were used with similar results: (i) PPP-based indexes which adjusted for Balassa-Samuelson effect; (ii) a fundamentals-based approach, where most works try to estimate an equilibrium real exchange rate consistent with internal and external balance; and (iii) behavioural-based approach, which seeks to explain the behaviour of exchange rates by means of relevant economic variables without enforcing external and internal balance as occurs in the fundamentals-based approach. The underlying rationale of these approaches will be presented in the next section. Lastly, considering that the causal mechanism advanced in most of the literature through which real

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<sup>11</sup> Term originally coined by Skolka (1980).

exchange rate undervaluation foster economic growth is related to increased competitiveness of the production of tradables, an alternative measure of real exchange rate equilibrium based on a cost parity approach developed by Shaikh (1991, 1999) will be presented. Preliminary empirical applications (Antonopoulos, 1999; Martinez, 2010 and 2015; Shaikh and Antonopoulos; 2013) of this method have shown promising results on its ability to explain long-run trends of RER. Furthermore, as it's based on relative labour productivity and real wages, it is more intrinsically related to competitiveness than the aforementioned measures used in the literature reviewed.

## **2.2 Theories of Real Exchange Rate Equilibrium**

Within the history of economy thought different explanations for the long-run behaviour of RER have been advocated in the literature. Driver and Westaway (2004) provide an interesting survey of the different approaches of determination of real-exchange rates. The existing approaches differ among themselves not only in regards to underlying theoretical frameworks, but also to timeframes to which there focus rely, i.e. short-run, medium-run or long-run. As the main motivation of this work is to gain knowledge regarding the relation of RER and economic growth, our focus will be on frameworks developed to explain long-run trends of real exchange rate. More specifically, the review focus on the approaches used in the body of literature reviewed in section 2.1. Lastly, the alternative framework based on Shaikh (1991, 1999) will be presented. The review of the approaches presented in this section focus in two main issues: First, their ability to explain long-run movements of RER; secondly, they are analysed regarding their appropriateness to address the question of interest, i.e. the relation between exchange rate and economic growth.

### ***2.2.1 Mainstream approach to real exchange rate determination: Purchasing Power Parity (PPP) and its alternatives***

Although its roots can be traced back to the Salamanca School in the 16th Century, the specific terminology of the Purchasing Power Parity (PPP) was introduced by Gustav Cassel (1918) during the 1<sup>st</sup> World War, when special circumstances led to a breakdown of the exchange rate parities prevailing during the gold standard. As defined by Cassel the PPP doctrine asserts that:

“When two currencies have undergone inflation, the normal rate of exchange will be equal to the old rate multiplied by the quotient of the degree of inflation in the one country and in the other. There will naturally always be found deviations from this new normal rate, and during the transition period these deviations may be expected to be fairly wide. But the rate that has been calculated by the above method must be regarded as the new parity between currencies, the point of balance towards which, in spite of all temporary fluctuation, the exchange rates will always tend. This parity I call *purchasing power parity*.” (Cassel, 1922, p. 140; italic in the original)

The above definition given by Cassel relates to what has become known in the literature as the relative version of the PPP, in which nominal exchange rates in the long run adjusts to compensate different levels of inflation that any two trading economies experienced. This implies, therefore, that the real exchange rate between two given currencies would remain constant in the long-run.

The literature also makes reference to the absolute version of the PPP doctrine in which the ratio of price levels  $\left(\frac{p_A}{p_U}\right)$  of any given two countries would constitute the equilibrium value of nominal exchange rates, measured as monetary units of currency of country U exchanged per unit of currency of country A. That is, a unit of currency in one country has the same purchasing power in a foreign country.

After the Bretton Woods agreement<sup>12</sup>, implemented in the aftermath of the Second World War, the discussion of the fundamentals relating to the real exchange rate were left to one side. However, since the breakdown of the Bretton Woods monetary system in the early 1970s the topic has been intensively scrutinized and tested.

The support for the PPP hypothesis among the academic community in the past four decades has been a continuous tale of periods of excitement followed by disappointment as early empirical findings supporting the PPP hypothesis in new empirical strategies are subsequently undermined by perceived drawbacks in their methodology. The dilemmas faced by the empirical literature when trying to test PPP doctrine is nicely summarized by Sjolander (2007):

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<sup>12</sup> Which tied U.S. dollar to the price of gold, while all other currencies were “pegged” to the U.S. dollar.

“The fundamental dilemma in PPP research can be summarized as follows. If short time spans are used, there is not enough power, and if longer data sets are applied there is a high risk of structural breaks. If panel data analysis is applied, the numbers of observations increase, but in practise these added observations can be misleading since they are usually not mutually independent, and do not support the strong assumptions required for panel data studies. Non-linear adjustment models of the PPP examine a weaker form of PPP with questionable usefulness and weaker policy implications since it tests whether there is mean reversion to an equilibrium that arbitrarily changes over time depending on the observed appearance of the data. Furthermore, it is to some extent questionable that a long-run version of PPP is repeatedly changing to new equilibria over time.” (Sjolander, p.268, 2007)

As such, the empirical support for the validity of the PPP parity has been rather weak and despite this much of the profession has insisted in holding on to the theory. The lack of empirical support led many mainstream economists, such as Rogoff (1996), to argue that if any convergence between real exchange rate and PPP parity which might occur would be very slow. This apparent disconnection between RER and relative national price levels has since been regarded as an empirical puzzle. However, given the evidence one must ask if PPP should really hold in the long-run?

Developments proposed based on contributions of Harrod, (1933), Balassa (1964) and Samuelson (1964) highlight the role played by non-tradable goods and services in explaining why real exchange rate tend to differ from rates calculated based on the PPP. Although, in a context of free trade the prices of tradable can be expected to be equalized (i.e. the Law of One Price) prices of non-tradable goods and services can still differ. Since these enter in the calculation of the purchasing-power parities but do not affect exchange rates it is no wonder that these will tend to differ as long as the evolution of relative prices between non-tradable and tradable goods in each country differ, with relative prices of non-tradables usually being higher in countries with higher GDP per capita.

Bahmani-Oskooee and Nasir (2005) provides a comprehensive survey of the empirical literature regarding the topic. Initial research, based mostly on cross-sectional studies, in the late 70's found little evidence supporting the Harrod-Balassa-Samuelson (H-B-S) hypothesis. Later studies, based either in panel data or in time-series econometric approaches, found more supporting evidence in its favour. This difference in results are justified by Taylor and Taylor (2004) partially due to availability of more data, for a longer span and wider sample of countries, coupled together with more powerful econometric techniques. However, they suggest that the magnitude of the H-B-S effect has been variable across time, being more pronounced in the recent times. This evidence is quite reasonable if one takes into account that in the past few decades the share of services (which are mostly non-tradables) in GDP and consumption expenditures have risen consistently and, thus, their

weight in aggregate price indexes have also increased over time. Nevertheless, available evidence of the significance of the effect is often mixed (Bénassy-Quéré et. al, 2009).

Owing to the limitations in the PPP approach since the second half of the 1980's different approaches to estimate equilibrium exchange rates have been proposed. Two of these approaches, which have been used in the body of literature reviewed in section 2.1, are the Fundamental Equilibrium Exchange Rate (FEER) and the Behavioural Equilibrium Exchange Rate (BEER)<sup>13</sup>.

Contrary to the PPP approach the FEER framework allows for changes in the level of equilibrium RER due to changes in fundamentals. It is a normative approach as the conditions estimated are not the ones expected to prevail, necessarily, in the future, but instead it reflects a desirable outcome consistent with "ideal economic conditions" (Clark and MacDonald, 1998). The equilibrium real exchange rate is, thus, defined as an exchange rate that would be consistent with macroeconomic balance, considering both internal and external dimensions. As so the FEER approach is not *per se* a theory of exchange rate determination. However, there is an implicit assumption that, similarly to the PPP approach, current account imbalances set in motion forces that will move RER back to levels consistent with equilibrium in the current account (Clark and MacDonald, 1998).

As the FEER framework focus is in deriving a real exchange rate which is consistent with medium or long-run macroeconomic equilibrium the first step to estimate long-run determinants of the current account. For this, the it is key to disentangle cyclical factors from structural ones, which are the ones that are assumed to matter in the long run. Thus, the first step in this approach is to estimate structural current account position ( $CA_{trend}$ ) under the assumption that the actual level of real exchange rate ( $q_t$ ) will prevail, but output both home and abroad are set at their potential level<sup>14</sup>( $\bar{y}_d$  and  $\bar{y}_f$ , respectively)<sup>15</sup>:

$$CA_{trend} = b_0 + b_1q_t + b_2\bar{y}_d + b_3\bar{y}_f \quad \text{where } b_1 < 0, b_2 < 0 \text{ and } b_3 > 0 \quad (3)$$

The difference between the Structural Current account balance ( $CA_{trend}$ ) and actual current account balance are assumed to be due to cyclical factors, although technically they also account for any errors in the specification of the underlying equations (Driver and Westaway, 2004, p.44). What will be key from the above regression will be the estimated elasticity parameter ( $b_1$ ) that relates changes in the real exchange rate ( $q_t$ ) to changes in Structural current account balance ( $CA_{trend}$ ). Solving the previous equation for the real exchange rate ( $q_t$ ), we get:

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<sup>13</sup> For a thorough review of the different concepts of exchange rate equilibrium used in the literature please, including FEER and BEER frameworks, see Driver and Westaway (2004) and Siregar (2011).

<sup>14</sup> Which themselves need to be estimated, but values used generally come from the literature.

<sup>15</sup> In this simplified exposition the Current account balance is reduced to the balance of trade.

$$q_t = \frac{(CA_{trend} - b_2 \bar{y}_d - b_3 \bar{y}_f)}{b_1} \quad (4)$$

Substituting  $CA_{trend}$  by what is considered to be the sustainable net flow in the capital account ( $\bar{KA}$ ) position, estimated from the investment and saving equations, we arrive at a different level of exchange rate, which would be the FEER:

$$q_t^{FEER} = \frac{(-\bar{KA} - b_2 \bar{y}_d - b_3 \bar{y}_f)}{b_1} \quad (5)$$

The FEER is the rate that supposedly brings the external and internal conditions into balance, both of which are assumed to be invariant to the real exchange rate (Driver and Westaway, 2004). One important drawback of this approach is the sensitivity of its estimates to changes in key parameters. Driver and Wren-Lewis (1999) while conducting a sensitivity analysis of FEER calculations for the US dollar, Japanese yen and German mark that changes in the value of the sustainable capital account position of 1% (as proportion of GDP) could produce changes of around 5% in the FEER estimates. As the sustainable capital account ( $\bar{KA}$ ) is also estimated they are also susceptible to measurement errors the FEER estimates should be understood within a confidence interval rather than a point estimate. Consequently, small deviations from FEER cannot be understood as misalignment of real exchange rate beyond reasonable doubt.

The excessive reliance on the role of the real exchange rate as the adjustment mechanism to close the current account gap and bring the country into macroeconomic balance is also problematic. This requires estimation of trade elasticities, from which one can compute the change in exports and imports that is expected to follow a 1% change in the real exchange rate and work backward the adjustment necessary in the real exchange rate to bring the economy back into external balance. Therefore, the estimation of accurate trade elasticities becomes a crucial step to the estimation of FEER. However, as remarked by Bussiere et. al. (2010) estimations of trade elasticities can vary substantially, depending on what methodology is used. Furthermore, the presence of other adjustment channels, such as financial linkages which might impact income transfers and the capital account, are usually not considered and have important implications for the estimation of the price elasticities.

Lastly, a more fundamental critique to the use of the FEER approach, or the PPP-based, to assess the link between exchange rate misalignment and growth is their embedded notion of exchange rate equilibrium as the one consistent with a balanced current account. As trade imbalances tend to be the norm and highly persistent, countries with current account surplus are expected to exhibit undervalued RER in this framework and the opposite occurs with countries that possess a current account deficit. As a consequence, what the results of empirical literature reviewed in section 2.1 based on PPP or in the FEER might actually be

telling us is that countries with current account surplus tend to grow faster than countries with current account deficits. A less thrilling result.

In this respect the BEER framework is an interesting alternative, as its notion of equilibrium isn't related to a determined current account balance position. Its point of departure rests on the concept of uncovered interest rate parity (UIP). Its empirically oriented nature leads for a search of variables that present explanatory power of the actual behaviour of RER. The literature has mainly put forward three variables as long run determinants: terms of trade (*ToT*), the Harrod-Balassa-Samuelson effect (*hbs*) and net foreign asset position (*nfa*), all measured relative to their foreign counterpart.

The use of actual levels of the explanatory variables such as the terms-of-trade, however, has the drawback that if this variable is (or have been for sufficient time) for some reason distorted in relation to its own determinants the estimated "equilibrium" real exchange rate will also be inconsistent with the one expected to prevail in the long-run, when terms-of-trade are expected to adjust to their "fundamental" value. Therefore, the estimates from BEER framework tends to be aimed at short and medium-run horizons and should not be regarded as long-run position of equilibrium, as they tend to vary a lot with change in the value of explanatory values<sup>16</sup>.

### ***2.2.2 A classical cost of production approach to the determination of real exchange rates***

Alternative to the neoclassical approach, a different reaction to the PPP "puzzle" put forward by Rogoff (1996) was developed by Anwar Shaikh (1991, 1999, 2016) and other researchers, such as Napoles (2004) and Antonopoulos (1999), from classical political economy perspective. In this approach the long-term determinants of real exchange rate in a context of free trade and international mobility of capital can be pinned down to relative unit labour costs.

The point of departure for Shaikh (1999) is an understanding that RER are international relative prices expressed in a common currency. Therefore, to gain knowledge on the factors ruling real exchange rate dynamics it's useful to start by considering the formation of competitive relative prices within one nation.

Suppose that in the production of any given commodity there exist firms producing with different set of techniques, yielding different costs of production. In a competitive market, meaning that competition among sellers of a similar commodity compels them to

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<sup>16</sup> For more details regarding this approach see for example Clark and MacDonald, 1998; or Benassy-Quére et. al. 2009.

sell their products at a similar price<sup>17</sup>, these producers will yield different rates of profits. However, the market price will be set by the firm with lowest reproducible costs. If they instead decide to sell at a higher price, they will yield a higher profit rate than prevailing in other competitive markets, thus attracting new investments flows in production capacity that will try reproduce their lower production cost.

Thus, Shaikh's view on the competitive process is that as commodity prices will reflect best practice production costs; it will be the profitability of new investment based on these costs that will regulate capital flows across industries. Therefore, rather than the average profit rate, it will be the profit rate on these regulating capitals that will tend to be equalized, regulating the capital flows across industries. Since, at any given moment, each sector will have a different proportion of non-regulating capital operating in their industry, the average sectoral profit rates need not to be equalized.

The difference in costs among different producers arise from the fact that on-going technical change gives rise to new capital goods which do not immediately replace all existing capital goods. Outdated capital goods will continue to operate despite no longer being cutting edge technology due to firms being able to still generate some profit out of its production. However, new investments will be directed to the best technology available which will form the regulating conditions. Therefore, the dominance of producers with the lowest reproducible cost is what makes 'absolute cost advantage' the regulating principle of competition within a single nation.

Starting from a simple one country economy with two regions, two-commodities and two producers, the price system is presented in the following form:

$$p_c = (p_k a_c + p_c w_{rc} l_c) * (1 + r_c) \quad p_k = (p_k a_k + p_c w_{rk} l_k) * (1 + r_k) \quad (6)$$

$$p_c = (p_k a'_c + p_c w'_{rc} l'_c) * (1 + r'_c) \quad p_k = (p_k a'_k + p_c w'_{rk} l'_k) * (1 + r'_k) \quad (7)$$

Where subscripts *c* represent consumption goods and *k* stands for capital goods; *p* represents the price which is the same for both competing producers; *a* represents the technical coefficient of intermediate inputs used in the production; *w<sub>r</sub>* is the real wage rate which is allowed to differ between regions and producers, *l* is the labour coefficients; and *r* is the profit rate.

If competition among sectors forces them to sell under the same price, then differences between embodied labour ( $l'_c > l_c$ ) or in the use of inputs from the capital goods producing sector ( $a'_c > a_c$ ) will have to be compensated by differences in the profit rates

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<sup>17</sup> Thus, assuming that the Law of One Price holds for tradable goods. If, on the other hand, transportations costs and taxes are high enough to block non-local producers than the good in question can be classified as a non-tradable.

( $r_c > r'_c$ ). If the market prices ( $p_c$  and  $p_k$ ) are determined by the regulating capitals (those producers with lowest value for the first bracket term in equations 3 and 4) and that profit rates between these producers in the two sectors are equalized ( $r_c = r_k$ ), then we get:

$$p_c = (p_k a_c + p_c w_{rc} l_c) * (1 + r) \quad p_k = (p_k a_k + p_c w_{rk} l_k) * (1 + r) \quad (8)$$

In terms of relative prices, taking  $p_k$  as the numeraire, we have:

$$p_c/p_k = (a_c + (p_c/p_k) w_{rc} l_c) * (1 + r) \quad (9)$$

$$1 = (a_k + (p_c/p_k) w_{rk} l_k) * (1 + r) \quad (10)$$

Following the Pasinetti (1973) vertically integrated sectors approach, Shaikh (1999, p.5) provides a different formulation for the above expression. A price of any commodity can be split into its different constituent elements, that is, into its direct unit labour costs (DULC),  $p_c w_c l_c$  in the case of the consumption good; direct unit profits (DUP),  $1 + r$ ; and unit input costs (UIC),  $p_k a_c$ . However, this last element is nothing but the price of some bundle of goods, and can, therefore, be split into its constituent elements (DULC, DUP, UIC), where the UIC can be decomposed again into its different constituent elements. As this process continues, the residual (UIC) will get smaller and smaller. If enough rounds of this procedure are undertaken, the price of the commodity (that we started this decomposition with) can be expressed as the sum of direct and indirect unit labour costs and its direct and indirect profit margins. Factoring out the former allows us to express the price of *any* commodity as the product of its vertically integrated unit labour costs ( $viulc = v$ ) and its vertically integrated profit-wage ratio<sup>18</sup>:

$$p = v * (1 + \pi) \quad (11)$$

In this setting, the relative prices are expressed by:

$$p_c/p_k = (v_{rc}/v_{rk}) \left[ \frac{(1 + \pi_c)}{(1 + \pi_k)} \right] \quad (12)$$

Decomposing the vertically integrated unit labour costs into the wages and labour requirements ( $\lambda_c$ ) components allow us to re-write the above expression as:

$$p_c/p_k = (w_{rc} * \lambda_c / w_{rk} * \lambda_c) Z_{ck} \quad (13)$$

In Shaikh's (1999, 2016) view the  $Z_{ck}$  can be thought as a 'disturbance' term whose size depends on the extent of the dispersion between profit wage-ratios of two sectors. However, it is important to bear in mind that here we are discussing vertically integrated profit-wage

<sup>18</sup> For a demonstration of this 'Smithian' decomposition used, please, see Shaikh (2016, p.385 to 387).

ratios  $(\pi_c, \pi_k)$ , which are a weighted average of direct profit-wage ratio. Thus, as different vertically integrated profit-wage ratio will have many of the same direct profit-wage ratios (with different weights) their dispersion will tend to be much smaller, especially when added 1 to the numerator and denominator to form  $Z_{ck}$ . As Ruiz-Napoles (2004) comments, however, the exact proportionality between relative unit labour costs and relative prices posed in the above expression would only hold if profits are equal to zero ( $\pi_c = 0 = \pi_k$ ) or, when profits are positive, if capital-labour ratios are uniform across sectors. According to the author, David Ricardo was aware of these limitations when he proposed the labour theory of value. However, he downplayed their importance and famously postulated that deviations could not be expected to be greater than 7 per cent (Ricardo, 1821 [1973]), an assertion that have been corroborated by some modern empirical studies (Ochoa, 1988; Bienenfeld, 1988; Shaikh, 1998; among others). Under this reasoning, Shaikh (1999) concludes that relative real vertically integrated prices can be seen as good approximation of relative prices:

$$p_c/p_k = (w_{rc} * \lambda_c / w_{rk} * \lambda_c) \quad (14)$$

Moving towards the determination of relative prices between two countries, i.e. the real exchange rate, the system of equations described above can be re-written as:

$$p_{cA} * E = (p_{kA} * E * a_{cA} + p_{cA} * E * w_{rcA} * l_{cA}) * (1 + r_A) \quad (15)$$

$$p_{kA} * E = (p_{kA} * E * a_{kA} + p_{cA} * E * w_{rkA} * l_{kA}) * (1 + r_A) \quad (16)$$

$$p_{cB} = (p_{kB} * a_B + p_{cB} * w_{rcB} * l_{cA}) * (1 + r_B) \quad (17)$$

$$p_{kB} = (p_{kB} * a_{kB} + p_{cB} * w_{rkB} * l_{kB}) * (1 + r_B) \quad (18)$$

Where E is the exchange rate defined as number of units of currency of country B per unit of country A ( $E = \frac{\text{units of currency of B}}{\text{unit of currency of A}}$ ). Assuming that after the opening up of trade there is a complete specialization between countries. Assuming also that, due to having lower reproducible costs in each sector, country A ends up exporting consumption goods and country B capital goods and that, thus, each determine the international current price in each of the commodities it exports. In this scenario, the above price system collapses to those equations which arise from international competition between capitals, i.e. equations (12) and (15) in the above system. Further, if we assume that under free trade conditions and negligible transportation costs that tradable goods are subject to the Law of One Price (i.e.  $p_{kA} * E = p_{kB}$  and  $p_{cB} = p_{cA} * E$ ), the system above can be rewritten in terms of relative prices by dividing both equations by  $p_{kB}$  as:

$$p_{cA} * E / p_{kB} = (a_{cA} + (p_{cA} * E / p_{kB}) * w_{rcA} * l_{cA}) * (1 + r_A) \quad (19)$$

$$1 = \left( a_{kB} + \left( p_{cA} * E / p_{kB} \right) * w_{rkB} * l_{kB} \right) * (1 + r_B) \quad (20)$$

This price system is also structurally identical to the national case with different profit rates across sectors presented in equations (6) and (7). Again, given the technical coefficients and real wages, we have a system of two equations with three variables: in this case, the international terms of trade<sup>19</sup>  $\left( p_{cA} * E / p_{kB} \right)$  and two national profit rates. As such, this configures an undetermined system and, hence, it allows for different ‘closures’, that is different choices to which variable is assumed to be determined outside the system.

Shaikh (1999), on purpose, sets the assumptions that produce the above price system in congruence to the typical framework assumed in the exposition of the comparative advantage theory of international trade. This is done so we are able to assess the conclusions normally withdrawn from it that the terms of trade will move in such a way that will restore the equilibrium in the trade balance. In this approach, it is the terms of trade that it is assumed to be the independent variable determined by some other set of relations outside the system, which in turn determine the two national rates of profit.

As Sarich (2006) remarks, PPP together with comparative advantage are the twin principles of standard international economics theory, in which adjustments in the real exchange rate is the operating mechanism that transform absolute disadvantage into relative advantage. In a fixed exchange regime (such as the prevailing gold standard in David Ricardo epoch), a trade deficit in a country accruing from absolute disadvantage in both tradable goods would lead to a reduction of money supply (an outflow of gold) which, accordingly to Quantity Theory of Money, would lead to a decrease in prices. This change in the terms of trade, however, would restore competitiveness of the country in the production of the commodity in which the country had the lowest comparative disadvantage. Thus, the PPP is restored through a change in both domestic and foreign prices. In floating exchange rate regimes, the adjustment is made through the nominal exchange rate, rather than through domestic prices. In either way, movement of real exchange rate would only come to rest when it reached a value in which purchasing power of the two countries in question is equalized – a rate at which the trade balance would be roughly equalized.

Shaikh (2014), drawing from insights of Marx and Harrod, criticizes the adjustment mechanism embodied in the PPP and in the comparative advantage approach, since they ignore the role played by short and long-term capital flows. Both authors highlight that the inflow (outflow) of funds generated by an initial trade surplus (deficit) would raise (lower)

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<sup>19</sup> In this simplified economy of only 2 commodities and full specialization, is analogous to the RER.

liquidity in short term financial markets, reducing (increasing) interest rates<sup>20</sup>. The differential in interest rates would induce capital outflows (inflows) from (into) the surplus (deficit) country covering the trade deficit and maintaining the balance of payments roughly balanced. In this sense Shaikh asserts: “*Trade imbalances are self-covering, not self-correcting*” (Shaikh, p.55, 2014, italics in the original).

The conclusion drawn from comparative advantage theory type of closure is that changes in relative prices (such as RER) are able to re-equilibrate trade imbalances disregard the tendency of countries displaying low export and import price elasticities (a non-satisfaction of the Marshall-Lerner condition) and the ignored role of capital flows, aforementioned. Shaikh (1999), however, addresses a more fundamental critique- the effect of the change in the real exchange rate on the rate of profit. In the scheme above, the fall in the real exchange rate would yield a lowering in  $r_A$  and an increase in  $r_B$ . Resolving the above price system for  $(1 + r_A)$  and  $(1 + r_B)$  highlights this fact:

$$(1 + r_A) = \frac{(p_{cA} * E / p_{kB})}{(a_{cA} + (p_{cA} * E / p_{kB}) * w_{r_{cA}} * l_{cA})} \quad (21)$$

$$(1 + r_B) = \frac{1}{(a_{kB} + (p_{cA} * E / p_{kB}) * w_{r_{kB}} * l_{kB})} \quad (22)$$

The increase in the profit rate of B due to a fall in the real exchange rate  $(p_{cA} * E / p_{kB})$  is evident. To understand the effect in the profit rate in country A one has to bear in mind that the term multiplying the real exchange rate in the denominator is the unit labour cost (which here in a two-good economy with full specialization is equivalent to the wage share) and, hence, lower than one which is what implicitly multiplies the real exchange rate in the numerator.

So, even in the case where the change in the real exchange rate is able to eliminate the initial trade imbalance the outcome would be unsustainable, as a difference between the profit rate among the two nations would emerge, hence provoking inflows (outflows) of capital. This inflow (outflow) of capital would by its turn lead to an appreciation (depreciation) of the real exchange rate, which would bring back the initial trade deficit (surplus). As such, in the presence of free mobility of capital, trade imbalances are bound to be a normal outcome of international trade among nations with different competitive positions.

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<sup>20</sup> In Harrod’s (1939) reasoning it would be through a positive response of investment to the lower interest rate which the trade balance would be affected, as investment would increase output and imports.

Therefore, let's suppose that profit rate differentials lead to capital inflows that are sufficiently strong to (roughly) equalize profit rates on new investments (i.e.  $r_A = r = r_B$ ). Then the price system represented by equation (16) and (17) can be re-written as:

$$p_{cA} * E / p_{kB} = \left( a_{cA} + \left( p_{cA} * E / p_{kB} \right) * w_{rcA} * l_{cA} \right) * (1 + r) \quad (23)$$

$$1 = \left( a_{kB} + \left( p_{cA} * E / p_{kB} \right) * w_{rkB} * l_{kB} \right) * (1 + r) \quad (24)$$

The structure of this system is identical to the case of the national economy with the addition of the nominal exchange rate to transform prices into a common unit of account. In this setting, the (international) profit rate of regulating capitals and international term of trade (i.e. real exchange rate) are determined for any given level of national wages and productivity. As occurred with the national case, profit rates will depend on relative wages and, thus, the real exchange rate can be roughly pinned down to relative real vertically integrated unit labour costs. Decomposing prices of commodities in terms of vertically integrated sectors, as before, highlights this aspect:

$$p_{cA} * E / p_{kB} = \left( v_{rcA} * E / v_{rkB} \right) \underbrace{\left[ \frac{(1 + \pi_{cA})}{(1 + \pi_{kB})} \right]}_{Z_{ck}} \quad (25)$$

The model derived so far involved only two tradable commodities, with only one consumption good. Once we move to a multi commodity setting, in which non-tradable commodities are accounted for, we need to distinguish terms of trade from the real exchange rate  $\left( e = \frac{p_A * E}{p_B} \right)$ , that is incorporate the Harrod-Balassa-Samuelson effect, following Shaikh (2016, p.519) the real exchange rate is, thus, defined as:

$$e = \frac{p_A * E}{p_B} = \underbrace{\left( \frac{v_{rcA}}{v_{rkB}} \right)}_{VIULC} \underbrace{\left( \frac{p_{cA} / p_{tA}}{p_{cB} / p_{tB}} \right)}_{\substack{\text{Price ratio of} \\ \text{non-tradeable} \\ \text{to tradable goods}}} \underbrace{\left( \frac{P_{tA} * E}{P_{tB}} \right)}_{\substack{=1 \text{ according} \\ \text{to the LoOP}}}_{\underbrace{Z_{ck}}_{\cong 1}} \quad (26)$$

There are several implications that can be drawn from this approach. According to Shaikh and Antonopoulos (2013), one of the implications of the 'closure' of the system through the equalization of profit rates (implied by the free trade and free mobility of capital conditions) is that changes in nominal exchange rates will not be able to balance trade (for given levels of output) unless they are able to affect the underlying variables that constitute real unit labour costs (i.e. real wages and productivity). In other words, nominal devaluations will only have lasting effects on the trade balance if it indirectly affects real unit labour costs or the tradable/non-tradable price ratio.

Therefore, the higher the share of imported intermediate inputs or in the consumption basket of workers the less likely it will be successful in enhancing a country competitiveness and economic growth. This theoretical result helps to understand the asymmetry in the results of real exchange rate undervaluation and economic growth between developing economies and developed economies found by the body of literature reviewed in section 2.1. As workers in developing countries are expected to have lower wages, their consumption basket is expected to be mostly composed of basic goods and having less sophisticated goods, which are more prone to be imported or at least have more imported components.

It is important to highlight that Shaikh (1999) constitutes his argument based on the presumed tendency for profit rates to equalize across international investments. However, he argues that the existence of direct investment is sufficient but not necessary for this process to occur. Short-term financial flows aimed at short-term investment in bond markets can be a force strong enough to lead the process. Given free mobility of capital, (risk adjusted) rates of return on bonds across nations should tend to equalize. As these are assets that compete with investments in productive assets, the profit rates on new investment in these productive assets would tend to equalize without the need of foreign direct investment flows.

Even though domestic (and foreign) demand and movements in the exchange rate may produce significant changes in the trade balance of a country in the short run, its 'structural' trade balance will be determined by the long-run determinants of the real exchange rate, that is, their relative real unit labour costs. From this understanding, we can derive the notion of a sustainable exchange rate, which is the one which that reflects relative competitive positions of a nation measured by their real unit labour costs relative to the one of theirs' (weighted average) trading partners. A prevailing real exchange rate that is different from the one determined by the structural determinants of competitiveness discussed above will yield structural trade imbalances (Shaikh and Antonopoulos, 2013). Therefore, this framework provides us with a different measure of exchange rate equilibrium. One that is directly connected to competitiveness in the production of tradables which was the main explanation put forward to explain the relation between RER and economic growth.

Regarding the long-run behaviour of real exchange rate equation (26) provides further insights of why RER are usually not constant as predicted by PPP theory. In this framework, on top of the Harrod-Balassa-Samuelson effect, the real exchange rate between two countries would be stationary only if their relative competitive positions remain unaltered during the period under analysis.

It also provides a theoretical explanation to why PPP seems to hold in context of high inflation. As relative real unit labour costs tend to suffer modest changes in a year to year basis, in cases of high inflation differential the bulk of the adjustment in real exchange rate would be covered by a depreciation of the nominal exchange rate (Shaikh, 1999). As such, the relative PPP would seem to hold.

Finally, it shows two basic roots through which a country can increase its relative competitive position. A *high road* in which a country gain competitiveness through continuous increases in productivity and a *low road* in which countries devalue their real exchange rate through compression of the real wages and shift the burden of the adjustment of an initial trade imbalance to workers (Shaikh and Antonopoulos, 2013).

The empirical evidence presented by the literature<sup>21</sup> that has applied Shaikh's model shows that real unit labour costs and RER present similar long-run trends, a relationship that is statistically significant. Its econometric approach is rather similar to the BEER framework as it uses cointegration tests to assess long-run relationship between RER and explanatory variables and associated econometric models such as vector error correction model (VECM) and autoregressive distributed lag (ARDL) modelling. However, rather than using directly the terms of trade it uses relative unit labour costs, which in this framework inspired in a classical political economy, is understood to be the long-run determinant of relative prices and, therefore, of the terms of trade.

Below we present some empirical evidence of previous applications of this framework. Figure 1 and 2 shows the real effective exchange rate<sup>22</sup> and adjusted real effective unit labour costs<sup>23</sup> for US and Japan calculated in Shaikh and Antonopoulos (2013). Figure 3 is taken from Martinez (2010) for the case of Mexico. The real exchange rate calculated by this latter author is a bilateral exchange rate rather than an effective exchange rate as is done by Shaikh and Antonopoulos (2013). Thus, the bilateral exchange rate between the Mexican peso and the US dollar is compared to the Mexican Unit Labour Cost relative to the USA only. Figure 4 is from Antonopoulos (1999) and shows results for Greece when compared to twelve selected OECD economies.

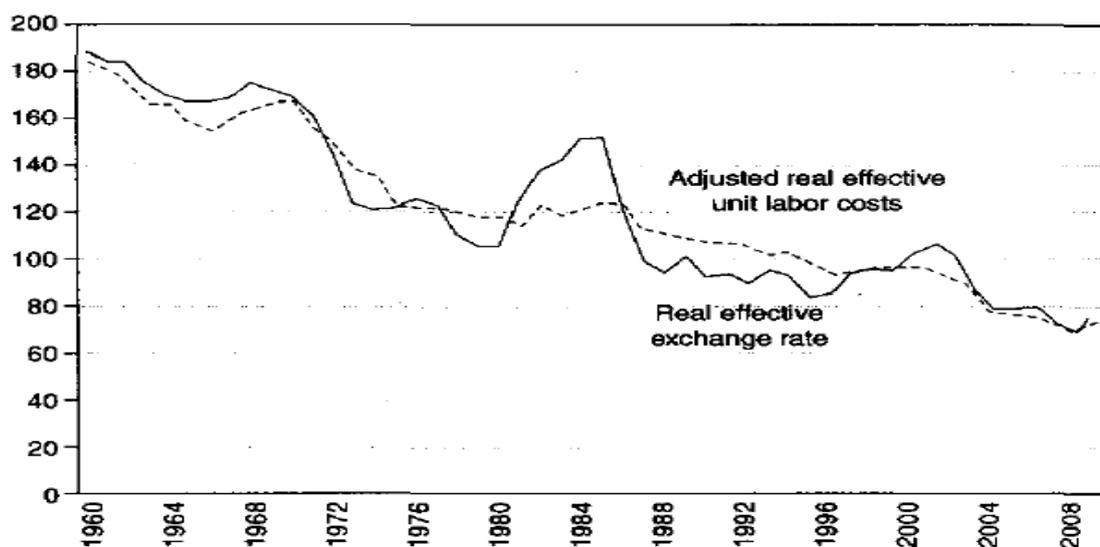
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<sup>21</sup> A non-exhausting list of empirical applications of this framework covering both developed and developing countries, covering Japan, USA, Spain, Greece, Turkey and México is Shaikh and Antonopoulos (2013), Napoles (2010), Antonopoulos (1999), Martinez-Hernandez (2010, 2015) and Ersoy (2010).

<sup>22</sup> The term effective in the term 'real effective exchange rate' refers to the exchange rate of the dollar against a basket of currencies which represent US's main trading partners.

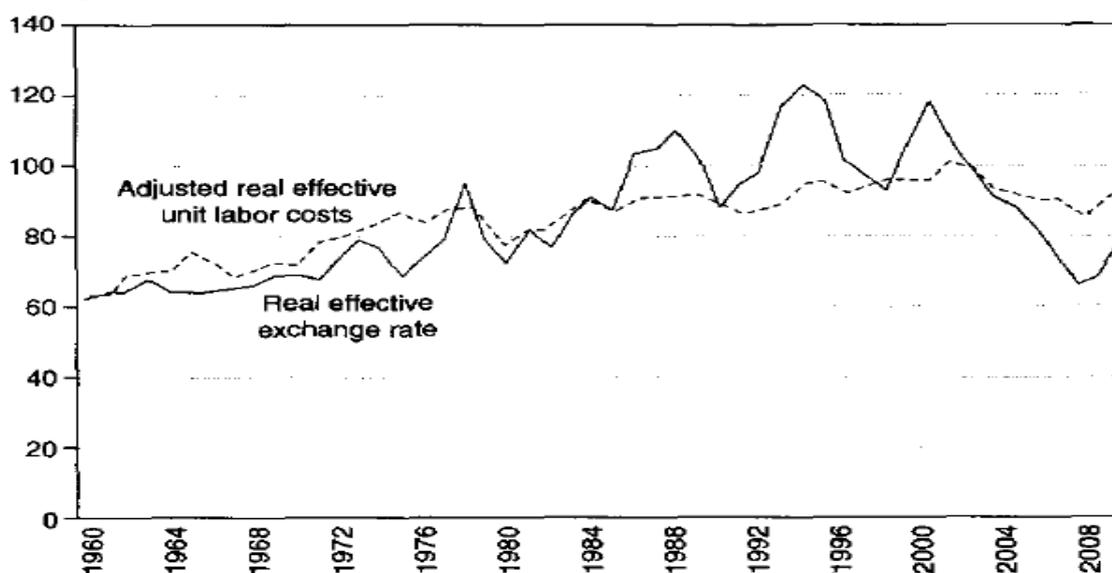
<sup>23</sup> The term adjusted in the term 'adjusted real unit labour cost' is due to the adjustment made in relative unit labour costs to address the Harrod-Balassa-Samuelson effect.

**Figure 1: Real Effective Exchange Rate and Adjusted Real Effective Unit Labour Costs for the USA.**



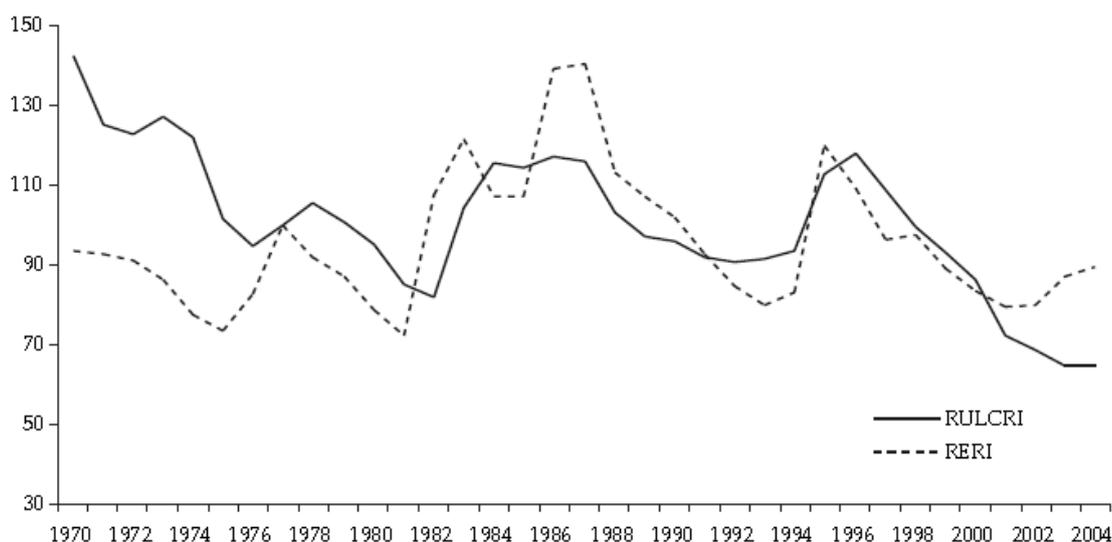
Source: Shaikh and Antonopoulos (2013)

**Figure 2: Real Effective Exchange Rate and Adjusted Real Effective Unit Labour Costs for Japan:**



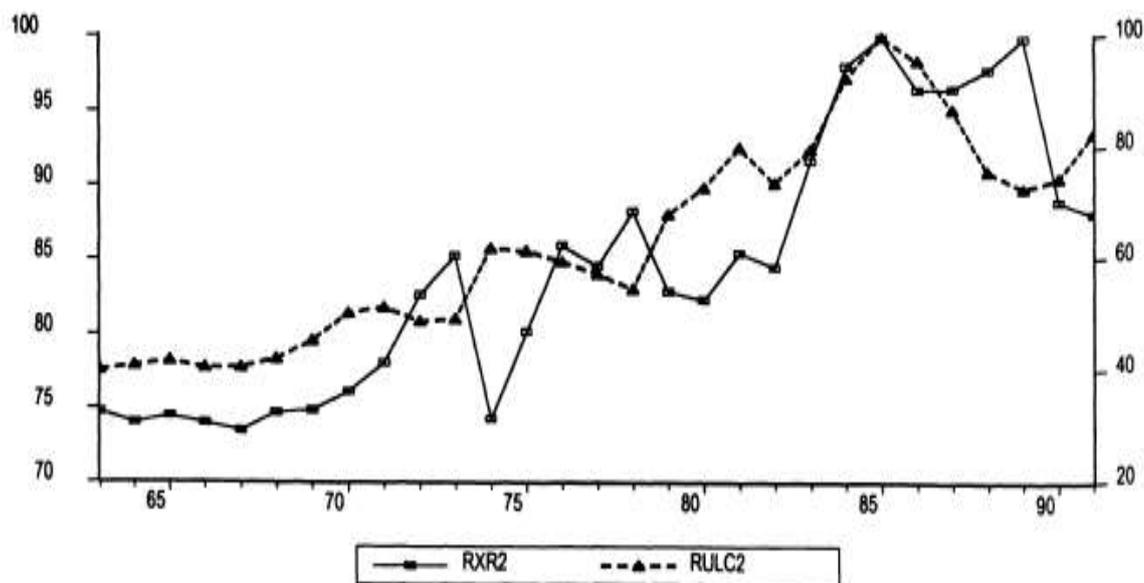
Source: Shaikh and Antonopoulos (2013)

**Figure 3: Real Exchange Rate and Real Unit Labour Costs in Mexico:**



Source: Martinez-Hernandez (2010)

**Figure 4: Real Exchange Rate and Real Unit Labour Costs in Greece:**



Source: Antonopoulos (1999)

In the econometric estimates, Antonopoulos (1999), Martinez-Hernandez, (2010, 2015), Ersoy (2010) and Shaikh and Antonopoulos (2013) include other variables in the model in order to track short-run influences such as interest rate differentials, which tend to enhance the results.

However, what is usually rarely discussed in this literature is what happens to the “fundamentals” (i.e. to relative real unit labour costs) when the deviations of the real exchange rate from the rate calculated based on them are reasonably long lasting as is seen in the evidence presented above. Furthermore, with increasing financialization of the world markets, market prices of commodities based on natural resources such as oil, iron, food grains and many others can deviate for long periods from prices of production. For many

countries such commodities represent the bulk of its exports or imports and, thus, as prices of these commodities deviate from their labour values so will the real exchange rate.

At theoretical level the economy is represented by 2 x 2 country-commodity level and with full-specialization, while in reality the economic system consists of  $n$  countries and  $n$  commodities, with no-full specialization<sup>24</sup>. This has important consequences to the construction of the empirical measures of the relevant best-practice unit labour costs, that is those that determine which are the regulating capitals. As discussed by Shaikh and Antonopoulos (2013), a robust empirical approach would be to assume that any given country is one of the best-practice producers of its own exports and so the task consists of estimating the unit labour costs of the exporting sector. However, considering the lack of consistent data across countries on exporting firms and sectors most studies use the manufacturing sector as the relevant scope of unit labour costs to be compared.

Further, differently from assumed in the theoretical model, empirical testing conducted so far have relied always, to the best of our knowledge, on direct unit labour costs instead of vertically integrated costs. This is justified by Shaikh and Antonopoulos (2013) due to lack of consistent input-output tables for the country in question and its trading partners, covering sufficiently long-time span, to permit the creation of adequate time series:

“A second difficulty arises from the fact that the theory requires vertically integrated unit labor costs, and time-series data is only readily available for direct unit labor costs - which is what we utilize. In order to estimate vertically integrated costs, one would need input-output tables for all of the countries involved, over a sufficient time span to permit the creation of an adequate time series. This too is beyond the scope of this study.” (Shaikh and Antonopoulos, 2013, p. 213)

This necessary data was non-existent until recently when several independent efforts have been made to produce International Input-Output databases (such as WIOD, TiVA/OECD, AEORA). As such the intended contribution of this dissertation is to fill the gap between theory and empirical applications developed so far. Therefore, in the next chapters we will calculate relative vertically integrated unit labour costs for the UK and eight selected trading partners to assess its relation to the behaviour displayed by the real exchange rate of the UK for the period between 1995 and 2009.

### **2.3 Summary**

From the initial review of the empirical literature regarding exchange rates misalignment and economic growth, conducted in section 2.1, we identified the main measures used to define real exchange rate “equilibrium” from which misalignments were derived. From our reading, it may be argued that this literature has jumped too quickly in

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<sup>24</sup> In the sense that more than one country will produce and, even export the same commodity.

drawing inference from real exchange rate misalignments to economic growth, without evaluating how appropriately these currency misalignments are being measured. Therefore, the second part of this chapter was aimed at reviewing these measures equilibrium of RER, focusing especially on the PPP approach. The measures were reviewed in regards to their ability to adequately explain the behaviour presented by the real exchange rate, their embedded notions of “equilibrium” and their appropriateness to address the relationship between exchange rate and growth.

The PPP doctrine implies that RER will be roughly constant in the long run. However, the empirical evidence doesn't tend to corroborate this claim. This is often explained due to the existence of non-tradable commodities in price indexes used to test the PPP such as consumer price indexes. As non-tradables are not subject to international competition prices have no need to be equalized. Therefore, the inclusion in the estimates of what is known as the Harrod-Balassa-Samuelson effect, which captures the evolution of relative prices between tradable and non-tradables, tries to reconcile the PPP approach with the available evidence of non-stationary RER. In this respect, the insight brought by the approach developed by Shaikh (1999) is that changes in the RER in the long-run are not solely due to Harrod-Balassa-Samuelson, but also due to changes in the countries relative competitive position, measured by the relative real unit labour costs.

When you review the embedded notion of real exchange rate equilibrium present in the FEER and in the PPP approaches one notice that these are related to exchange rate associated with equilibrium in the current account. Therefore, countries with current account surplus will tend to exhibit undervalued RER by these metrics and the opposite occurs with countries that possess a current account deficit. Thus, what the regressions in the literature reviewed in section 2.1 might be actually capturing is that countries with current account surplus tend to grow faster than countries with current account deficits. The argument thus suffers from a kind of circularity. As the interpretation of the exchange rate level as undervalued is in fact a result of the fact that the country has a current account surplus, which in itself contributes positively to economic growth.

The BEER framework, in the other hand, as it's exchange rate equilibrium condition is derived from current level of “fundamentals” does not reflect a rate associated with current account equilibrium. However, the use of actual levels of the explanatory variables such as the terms-of-trade has the drawback that if this variable is (or have been for sufficient time) for some reason distorted in relation to its own determinants the estimated “equilibrium” real exchange rate will also be inconsistent with the one expected to prevail in the long-run, when terms-of-trade are expected to adjust to their natural value.

In this respect, Shaikh's approach is more suitable to the analysis of long-run real exchange rate equilibrium as, instead of directly using terms-of-trade, it proposes that relative Vertically Integrated Unit Labour Costs (VIULC) which are the long-run determinants of relative prices and, therefore, of terms of trade, in classical political economy approach.

This alternative perspective developed by Shaikh (1999) provides an interesting alternative theory of determination of RER. It highlights that if an economy is to operate under free trade and perfect mobility of capital not only price of tradables are expected to equalize (in accordance with the Law of One price), but also the profit rates among all sectors and all countries are expected to be equalized in the long-run. Therefore, for a given level of wages and the technical conditions of production (i.e. labour productivity) there will be a level of RER that will roughly equalize the profit rates in both countries. If at this level the country faces a trade deficit, the only mechanism through which this can be permanently eliminated is by changes either in the real wages or in the labour productivity, as this will allow for changes in the real exchange rate to change without changing the profit rate. Nominal devaluations will only be effective as long as they are not compensated by increases in nominal wages or if they boost productivity.

Shaikh's approach uncovers the relation between income distribution and real exchange rate. This reveals a possible connection between the results found in the literature discussed in section 2.1. and the Post-Keynesian literature concerning income distribution and economic growth (Lavoie, 2014). In this strand, economic growth in a given country is said to be "profit-led" when a shift of income distribution towards profits enhances growth rates, while it will be considered "wage-led" in case an increase in the wage-share leads to a higher economic growth in the long-run.

In light of these frameworks, the result found by Rodrik (2008) and Rapetti et al (2012) that exchange rate undervaluation (in PPP-based framework) enhances economic growth mainly in low-income countries would be consistent with a "profit-led" growth regime occurring in these economies. While the lack of effect for the case of higher income economies would be consistent with these economies exhibiting a "wage-led" growth regime, a proposition coherent with findings put forward by Onaran and Galanis (2014). The impact of financialization, mentioned, especially in relation to international capital flows might also be instrumental to explain this result as high-income level countries with deeper financial markets can be expected to be able to sustain current-account deficits (perhaps implying currency overvaluation) for long periods.

### 3. Methods of Data Collection

After having identified the research topic and its significance, this chapter presents the research strategy, including the research paradigm, data collection and data analysis processes. In the final part, methodological challenges are briefly discussed.

#### 3.1 Design of Research Project

The research design adopted in this study has been informed by the research questions generated from the literature review. The focus of the research is to evaluate competing theories of determination of long-run movements of RER. In particular, the research focus of the framework developed by Shaikh (1991, 1999) that suggests that relative vertically integrated costs are one of the main determinants of the movements of RER, comparing the results with mainstream framework based on the PPP.

**Table 1 Core Elements of Research Design (Adapted from Blaikie, 2009)**

Elements	Description
Purpose of Research	Critical Assessment of alternative approaches to the determination of long-run equilibrium of real exchange rates
Research Strategy	Deduction: Formulation of hypothesis based on theoretical approaches. The research strategy is to then to assess the hypothesis with the use of quantitative framework, analysing if the results verify or falsify existing theories.
Research Paradigm	Positivism
Methodology	Quantitative case study of a country that satisfy the conditions under which the hypothesis of the analysed theories are assume to work

A case study approach is chosen in order to draw initial insights on the relationship between RER and relative vertically integrated unit labour costs for the case of the UK. The selection of the UK reflects the fact that they are a suitable candidate to corroborate the reviewed theories as it fulfils most of the main assumptions under which the reviewed theories of real exchange rate determination ought to be valid.

#### 3.2 Research Strategy and Paradigm

The underlying research strategy that informs our research is deduction. According to Blaikie (2009) a deductive research strategy is characterized by its aim to test theories, eliminating false ones and corroborating the survivor. It focuses in answering ‘why’ questions. Hypothesis regarding the behaviour of RER were formulated with the help of the existing theories reviewed in section 2.2. The strategy is then to assess the hypothesis with the use of quantitative framework, analysing if the results verify or falsify existing theories.

The research paradigm that informs our research falls mainly on a realist ontology and positivist epistemology. However, the research design may not be considered as strictly related to this epistemological approach as neither experiment, large-surveys or multi-cases, with statistical testing such as econometric regressions, will be conducted. Instead, the research is designed as an initial approach that deals with a case study for only one country. Hence, rather than achieving definite conclusions the nature of our empirical analysis is more exploratory. Corroboration or falsification of existing theories and relations between variables are aimed to provide more evidence, contributing to the empirical literature. Thus, findings are considered to be provisional and should be tested further.

### **3.3 Data Collection Methods**

Ideally, the empirical application of Shaikh's (1999) approach to the long-run determination of the RER requires the calculation of (i) Real Effective Exchange Rates; and (ii) Vertically integrated unit labour costs. The Real Effective Exchange rate is a multilateral measure of exchange rate which compares the value of the domestic currency against a set of currencies from foreign countries with which the domestic economy trades<sup>25</sup>. To construct a comparable measure of relative vertically integrated unit labour costs it is necessary, then, to calculate vertically integrated unit labour costs for all the trading partners (or at least the most important ones).

Until now, none of the empirical applications of the framework originally proposed by Shaikh (1991, 1999) has attempted to fulfil these two ideal aspects. In relation to the first aspects, Shaikh and Antonopoulos (2013) use seventeen OECD countries to calculate real effective exchange rates for Japan and USA and corresponding measures of relative real unit labour costs from 1960 to 2009, a sample of countries that is also used by Antonopoulos (1999) to study the case of Greece for the period 1963-1991. Ersoy (2010) uses in his calculations data from Turkey and their nine main trading partners from 1970 to 2014. Martinez (2010, 2015) calculates only bilateral RER for the Mexican Peso in relation to the US dollar and the corresponding measures of relative real unit labour costs between Mexico and USA for the period covering 1970 to 2004. The author justifies his option as the United States is Mexico's major trading partner, with exports to and imports from the US accounting for roughly 75% of México's foreign trade (Martinez, 2010).

In relation to the second aspect, as already mentioned, to the best of our knowledge no empirical work has attempted to apply the model using vertically integrated unit labour costs. Until recently, consistent international input-output tables covering a large sample of

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<sup>25</sup> With each foreign currency being weighted by their share in the trade balance of the domestic economy.

trading partners and sufficiently long-time span were inexistent. Therefore, one of the main aims of this research is to fill this gap between theory and empirical applications developed so far by calculating relative vertically integrated unit labour costs and comparing its behaviour with the trajectory of the real exchange rate.

Nevertheless, the use of vertically integrated unit labour costs imposes some restrictions in the possible scope of the empirical strategy as the existence of coherent time-series of cross-country input-output tables is a relative recent phenomenon. To the best of our knowledge, the only database that provides international input-output database in both current and previous year prices is the one compiled in the World Input-Output Database (WIOD) (Timmer et. al 2015). The time-span covered, however, ranges from 1995 to 2009 with a yearly frequency. This implies that testing Shaikh's theory through time-series econometric is unfeasible due to the small number of observations. As the WIOD database covers 39 countries (plus an aggregate matrix for the rest of the world) an alternative strategy to test empirically the theory is to conduct an econometric panel data analysis.

However, the manipulation procedures to calculate the vertically integrated unit labour costs can be extremely laborious and time consuming. Therefore, before investing time and resources into calculating Vertically Integrated Unit Labour Costs for all 39 countries for all the 15 years and the related trade weights for each observation, an initial approach undertaken here was to develop a small-scale case study for one country, namely the UK.

As discussed by Ersoy (2010), in order for the results of the study to have a high explanatory power of the patterns occurring in the real domain, it is important that the combined share in the foreign trade of the selected trading partners in the UK trade is reasonably high. With this in mind, we have selected, from the WIOD, input-output time-series of 8 of the UK's main trading partners: Germany, United States, France, Netherlands, Ireland, Italy, China and Japan.

This sample represented 53.6% of total exports of the UK in 1995, ranging between 50% and 58% of the total during the period until 2009 (see Table 2). From the imports perspective, this sample of countries represented 60.8% of the total in 1995 and varied between 52.7% and 62.8% until 2009 (see Table 3). The currencies of these countries US dollar, Euro, Yen and Yuan are also among the most traded currencies in contemporary foreign exchange markets (FX markets).

**Table 2: Share of each country in UK's total Exports**

Year	CHN	DEU	FRA	IRL	ITA	JPN	NLD	USA	Total
1995	1.5%	11.7%	7.9%	4.2%	5.0%	3.3%	5.0%	15.0%	53.6%
1996	1.4%	11.8%	7.9%	4.2%	5.0%	2.8%	4.8%	15.9%	53.8%
1997	1.5%	11.7%	7.6%	4.4%	5.1%	2.9%	4.9%	17.7%	56.0%
1998	1.4%	11.9%	8.0%	5.1%	5.2%	2.4%	4.8%	17.7%	56.4%
1999	2.0%	11.4%	7.8%	5.5%	4.9%	2.3%	4.7%	18.9%	57.3%
2000	1.8%	10.8%	7.5%	5.9%	4.7%	2.3%	4.7%	19.7%	57.4%
2001	2.0%	11.8%	7.2%	6.7%	4.4%	2.1%	4.7%	19.2%	58.0%
2002	1.9%	11.3%	7.1%	6.1%	4.4%	1.8%	4.5%	20.2%	57.3%
2003	1.7%	11.8%	7.0%	6.3%	4.5%	2.0%	4.8%	19.0%	57.3%
2004	1.8%	11.4%	6.6%	6.9%	4.8%	2.2%	5.3%	15.1%	54.0%
2005	2.0%	12.1%	6.1%	8.3%	4.7%	1.8%	4.8%	14.2%	53.9%
2006	2.3%	12.2%	6.8%	8.2%	4.8%	1.8%	5.7%	12.9%	54.7%
2007	2.9%	11.6%	6.2%	8.4%	4.1%	1.7%	5.5%	11.2%	51.6%
2008	2.1%	11.7%	5.7%	8.2%	3.0%	1.7%	5.3%	12.4%	50.0%
2009	2.2%	11.3%	5.9%	8.4%	3.3%	1.5%	5.5%	12.9%	51.0%
Average	1.9%	11.6%	7.0%	6.4%	4.5%	2.2%	5.0%	16.1%	54.8%

Source: Timmer et. al. (2015), World Input-Output Database.

**Table 3: Share of each country in UK's total Imports**

Year	CHN	DEU	FRA	IRL	ITA	JPN	NLD	USA	Total
1995	2.2%	16.5%	9.4%	4.0%	5.5%	5.0%	7.5%	10.8%	60.8%
1996	2.2%	15.4%	9.5%	3.8%	5.9%	4.1%	7.3%	11.2%	59.4%
1997	2.4%	15.0%	10.1%	4.2%	5.9%	4.3%	7.1%	13.3%	62.3%
1998	2.8%	14.4%	10.0%	4.4%	6.1%	4.2%	7.5%	13.0%	62.5%
1999	3.1%	14.3%	9.7%	4.5%	5.6%	4.1%	6.9%	12.1%	60.3%
2000	3.3%	14.2%	8.8%	4.7%	5.3%	4.1%	6.9%	12.0%	59.2%
2001	3.6%	14.0%	8.8%	4.8%	5.5%	3.6%	6.6%	12.5%	59.4%
2002	3.6%	14.7%	8.8%	4.4%	5.8%	3.3%	6.7%	11.6%	59.0%
2003	4.1%	15.4%	8.6%	4.3%	5.9%	3.1%	6.8%	9.5%	57.8%
2004	4.6%	13.9%	7.8%	4.8%	5.6%	2.7%	6.4%	9.4%	55.2%
2005	4.6%	13.7%	7.1%	4.5%	5.0%	2.7%	6.1%	9.0%	52.7%
2006	5.0%	13.9%	6.9%	4.3%	5.0%	2.5%	6.2%	10.4%	54.1%
2007	5.5%	14.6%	7.1%	4.2%	4.9%	2.0%	6.9%	10.1%	55.2%
2008	6.2%	13.3%	6.5%	4.1%	4.1%	2.2%	7.6%	9.9%	53.9%
2009	6.5%	13.0%	6.7%	4.3%	3.8%	2.2%	7.6%	11.1%	55.3%
Average	4.0%	14.4%	8.4%	4.4%	5.3%	3.3%	6.9%	11.1%	57.8%

Source: Timmer et. al (2015), World Input-Output Database.

### 3.4 Methodological Challenges

In the following, methodological challenges are briefly discussed. The use of secondary data might lead to complications. Since the researcher does not have control over how the data is collected and presented, the data needs to be analysed cautiously.

The World Input-Output database (WIOD) compiles Input-Output tables originally produced by different National Statistics Office. The costs of conducting surveys to compile the information needed to produce Input-Output tables are high and technical coefficients

tend to change slowly. Therefore, most countries only produce Input-Output tables for reference years, i.e. for one given year for every three to five years usually.

To be able to have a time series on a yearly basis the research community has developed a series of updating procedures to estimate input-output tables for intermediate years by combining input-output tables compiled for the reference years with Supply and Use tables of the year to which one wants to estimate an input-output table. This alone is a huge challenge and the results of such procedures must be seen as mere approximations.

As mentioned, to obtain international input-output tables one must combine different national input-output tables produced by different National Statistics Offices. Although the methodology to produce Input-Output tables can be seen as fairly standard, countries differ in monetary resources to invest in surveys and, consequently, quality of primary information used by each National Statistics Office will likely differ. Moreover, given the different structure of production of each country (which affects the number of companies operating in different sectors) sectoral disaggregation presented in input-output tables tends to differ from one country to another. The solution found to this problem is to develop a “translator” which reconciles both sectoral disaggregations. However, the resulting classification has usually a lower number of sectors, which leads to potential biases of comparing what is actually two different industries as if they were the same.

In our study, as we are interested in the evolution of real unit labour costs there is an additional need - the existence of input-output databases in current and previous year prices. From the different efforts conducted in the last years to produce international input-output databases such as the ones compiled by TiVa/OECD, AEORA and WIOD projects, only the last one produced input-output tables in previous year prices and, thus, was the database chosen to conduct the empirical research.

Another methodological challenge that poses concerns to the research is the use of case study for theory testing. One concern is the generalizability of the results, as the case under inquiry might not be representative and its results can be biased because of specific factors affecting the particular unit of analysis.

### **3.5 Ethical Issues**

During the development of the research project possible Ethical issues were considered. However, considering the nature of this dissertation and the use of publicly available data to examine macroeconomic theory, these issues were found not to be significant.

## 4. Collecting and Analysing the Data

In the following, the strategy for the quantitative analysis and the derived results is presented.

### 4.1 Data Collection and Calculation procedures

In this section, we proceed to the description of the methodology adopted to construct time-series of real effective exchange rates, relative real vertically integrated unit labour costs and real interest rate differentials for the UK, all these series were calculated in annual index form (1995=1) for the period 1995-2009. The real effective exchange rate (REER) is a trade-weighted<sup>26</sup> real effective exchange rate index provided by the International Financial Statistics (IFS) database from International Monetary Fund (IMF), and is deflated using relative consumer price indexes (CPI)<sup>27</sup>.

The next step was to calculate the vector of Real Vertically Integrated Unit Labour Costs for the UK and selected trading partners. To do so we need four pieces of information which were extracted from the WIOD (Timmer. et.al, 2015): the number of employees and wages that are available in the social economic accounts (SEA), gross output in current and previous year prices and the, respective, technical coefficients which are extracted from the World Input Output Tables.

The first step is to calculate the sectoral direct labour coefficient<sup>28</sup>  $(dl_j = \frac{L_j}{GO_j})$ , where  $L_j$  stands for number of employees<sup>29</sup> in the  $j$ -th sector and  $GO_j$  is the gross output of the  $j$ -th sector. This was computed both in current and previous year prices. The row vector formed by each sector direct labour coefficient then multiplies the diagonal matrix containing the average sectoral wages<sup>30</sup>, which in the case of previous year prices were always deflated using the country's CPI, to form the unit labour costs of each sector<sup>31</sup>:

$$ulc_{1 \times 35} = dl_{1 \times 35} W_{35 \times 35} \quad (27)$$

Finally, to obtain the vector of Vertically Integrated Unit Labour Costs ( $viulc$ ) we conjoined the Unit Labour Costs ( $ulc$ ) with the Leontief inverse:

$$viulc_{1 \times 35} = ulc_{1 \times 35} (I - A)_{35 \times 35}^{-1} \quad (28)$$

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<sup>26</sup> Weights are given by the countries average share in imports and exports of the UK.

<sup>27</sup> The choice of the CPI to deflate was do with wider coverage for countries involved and its use in the PPP literature.

<sup>28</sup> i.e. the inverse of the direct labour productivity.

<sup>29</sup> Obtained from the Social Economic accounts provided by the WIOD.

<sup>30</sup> Which in the case of previous year prices were always deflated using the country's CPI

<sup>31</sup> The sectoral disaggregation of the WIOD is composed of 35 sectors.

All these series were calculated in current and previous year prices, from which annual growth rates were obtained and then transformed into a chained index, where 1995 was the base year (1995=100).

Once the sectoral *viulc* indexes of each country were calculated, the next step was to proceed to the aggregation of the results, in order to be possible to calculate the *viulc* from the UK relative to the selected trading partners. If we recall the presentation of Shaikh's model, the relevant aggregate measure of relative *viulc* for the determination of the real effective exchange rate is the *viulc* of UK's exporting sector relative to the *viulc* embodied in its imports (i.e. the *viulc* of the exporting sectors of its trading partners to the UK). Thus, the relative vertically integrated unit labour cost (*rviulc*) is calculated as:

$$rviulc_{1x1} = \frac{viulc_{1x35}^{UK} c_{35x1}^{Xj,UK}}{\sum_{i=1}^8 b_i^{MUK} (viulc_{1x35}^i c_{35x1}^{Xji})} \quad (29)$$

The term in the numerator is the multiplication of the row vector containing the index of each sector of the UK vertically integrated unit labour cost ( $viulc_{1x35}^{UK}$ ) by the column vector containing the share of each sector  $j$  in the total exports from the UK to the selected trading partners used in the analysis ( $c_{35x1}^{Xj,UK}$ ). The term inside the brackets in the numerator contains the equivalent measure of each of the UK's selected trading partners ( $i=1, \dots, 8$ ), with the column vector containing the share of sector  $j$  in the total exports of country  $i$  to the UK ( $c_{35x1}^{Xji}$ ). Finally, the term outside the brackets in the numerator ( $b_i^{MUK}$ ) is the share of each of the selected trading partners in the total imports of the UK coming from these (8) trading partners.

To address the issues of relative prices changes between tradable and non-tradables, i.e. the Harrod-Balassa-Samuelson (*H-B-S*) effect, the literature has proposed several different measures. Here we adopt one of the simplest measures used: the relative level of GDP per capita, in PPP US dollars. This measure was the one used by Rodrik (2008) in his benchmark econometric specification. The data also comes from the World Bank database. The UK GDP per capita was compared to the GDP per capita of the selected trading partners through the following expression:

$$H - B - S_{effect} = realGDPpercapita = \frac{GDPpercapita_{UK}}{\sum_{i=1}^8 a_{i,UK} GDPpercapita_i} \quad (30)$$

Where  $a_{i,UK}$  represents the foreign trade weight of the particular country in total trade of the chosen sample of countries with the UK:

$$a_{i,UK} = \left( \frac{(X_i/X_{tot} + M_i/M_{tot})}{2} \right) \quad (31)$$

Finally, multiplying the relative vertically integrated unit labour cost for the relative GDP *per capita*, to control for the Harrod-Balassa-Samuelson effect, we arrive at Shaikh's measure of adjusted Relative Vertically Integrated Unit Labour Costs:

$$adjustedRVIULC = rviulc_{1x1} * H - B - S_{effect} \quad (32)$$

We will compare these results with measures based on a mainstream approach such as the one used by Rodrik (2008) and others. Therefore, we construct an *adjusted PPP* measure based on the relative inflation rates, using consumer price indexes (CPI), of the UK and the eight selected trading partners adjusted for the H-B-S effect:

$$adjustedPPP = \frac{\sum_{i=1}^8 a_{i,UK} CPI_i}{CPI_{UK}} * H - B - S_{effect} \quad (33)$$

In Shaikh's (1999) framework, the relative vertically integrated unit labour costs (*rviulc*) represent the main long-run determinant of real effective exchange rates and should be seen as a centre of gravity around which real effective exchange rates fluctuate. Under free trade and perfect mobility of capital in the "long-run" competition among capitals should promote the equalization (risk adjusted) rates of return on bonds across nations. In the short-term, however, interest rate differentials exist and can be an explanation for the fluctuation of the real effective exchange rate around the value determined by relative vertically integrated unit labour costs. Therefore, following Martinez (2010) we also calculate real effective interest rate differentials between the UK and the selected trading partners.

The data used was also from the IFS database from the IMF and whenever available we used the yearly interest rates of treasury bills. The nominal interest rates were first transformed into real interest rates using previous year CPI's. Then the real effective interest rate differential between the UK and selected trading partners for each period was calculated following the expression below:

$$realinratediff_t = realinrate_t^{UK} - \sum_{i=1}^8 a_{i,UK} * realinrate_t^i \quad (34)$$

Where  $a_{i,UK}$  are the foreign trade shares of each trading partner with the UK which were also used as weights in the calculation of the real effective exchange rate.

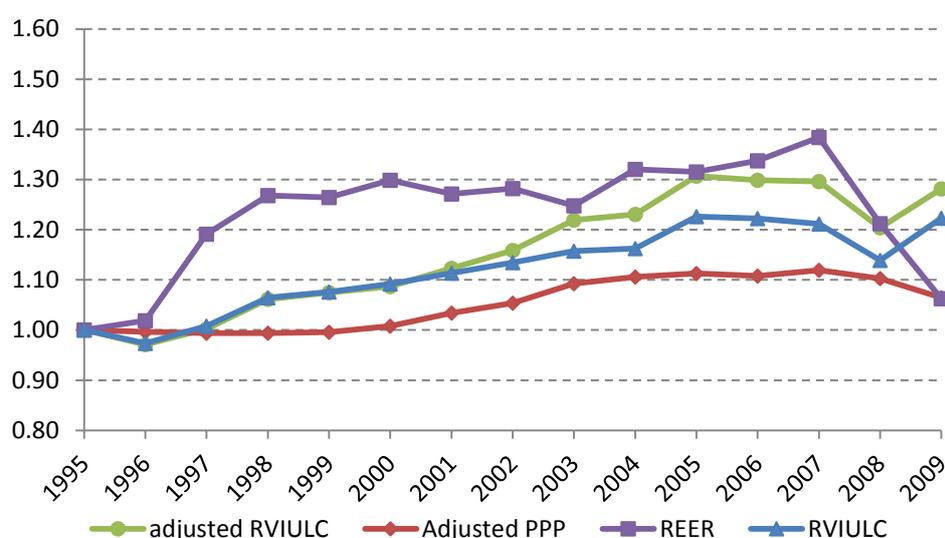
## 4.2 Data analysis

After having seen the description of the research design and methods, the collected data is presented. Based on Shaikh's approach to real exchange rate determination, a quantitative analysis of the Real Effective Exchange Rate is developed for the case of the United Kingdom, the results are contrasted with a measure of Real Exchange Rate equilibrium derived from a PPP framework. The timeframe is confined to the period between

1995 and 2009. The choice of the timeframe was restricted due to the data availability, but it is a period of interest in its own merits, as it represents the run up to the financial crisis of 2008 and a period marked by increased globalization both in trade and finance.

First of all, the evolution of the real effective exchange rate (*REER*) is presented and contrasted with the Vertically Integrated Unit Labour Costs of UK's exporting sectors relative to the adjusted Vertically Integrated Unit Labour Costs (*adjusted RVIULC*) of UK imports from the selected trading partners<sup>32</sup> and a PPP based measure (*adjusted PPP*), both adjusted for the Harrod-Balassa-Samuelson effect.

**Figure 5: UK's Real Effective Exchange Rate, adjusted Relative Vertically Integrated Unit Labour Costs and Adjusted PPP**



Source: WIOD (Timmer et.al, 2015) and World Bank. Author's own elaboration.

As we are working with index numbers and rates of change, a crucial decision to be made was the definition of the year to be taken as the *numéraire*. In our case, 1995 was chosen not because it was the initial year of our sample, but due to it being the year which UK's trade balance was closest to a balanced result (see figure 7 in the appendix) and this implies that the prevalent real effective exchange rate was closest to equilibrium in a PPP framework. Also, 1995 is the year where real interest rate differential was closest to zero in the sample, which in Shaikh framework can be seen as proxy of a rough equalization of profit rates which is its long-term expected position.

As mentioned in the introduction, the real effective exchange rate (REER) of the UK showed a marked appreciation between 1995 and 1998, meaning that its imports became cheaper in the domestic market while its exports became more expensive in the foreign markets. By 2000, REER of the UK had accumulated a 30% appreciation and, in the years after, it floated around the same level until the effects of the international financial crisis

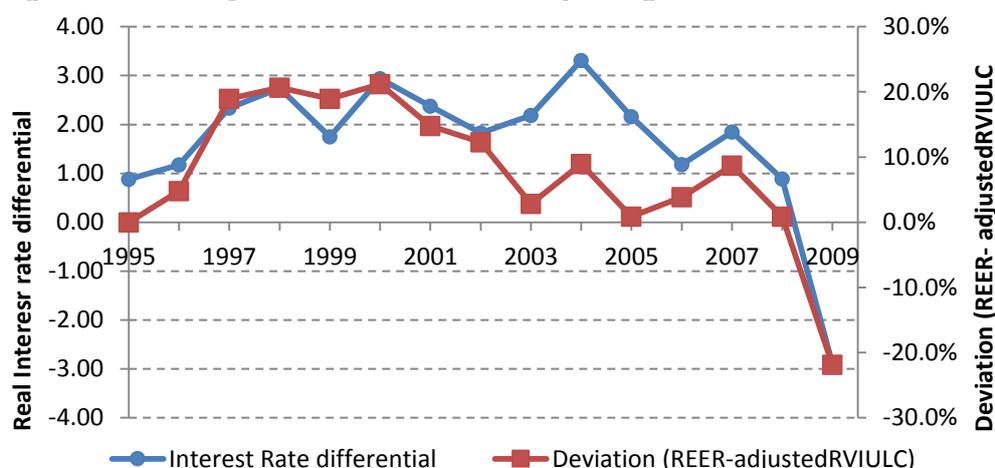
<sup>32</sup> United States, Germany, France, Netherlands, Ireland, Italy, China and Japan.

began to be felt. The RVIULC and the *adjusted RVIULC* also increased between 1995 and 2008. By 2000 RVIULC had accumulated an 8.6% increase, meaning that average labour cost of production the of UK’s exports relative to the cost of production its imports was higher by such rate. By 2005 the *adjusted RVIULC* was 31.5% higher than in 1995. This increase was exactly equivalent to the increase in the REER between 2005 and 1995. On the other hand, *adjusted PPP* showed a much more stable pattern. From 1995 to 2000 it remained almost unchanged, increasing only 1% in five years. From 2000 to 2004 it increased by 11%, reflecting mostly the increase in our H-B-S measure, remaining fairly constant in the remaining years of our sample.

In regards to an assessment of over/undervaluation of REER both frameworks (PPP and RIVULC) point out that the UK exchange rate was overvalued if we assume the prevailing rate in 1995 was a rate of equilibrium. However, the magnitudes of such overvaluation vary considerably between both metrics, being much lower when analysing under a RVIULC basis.

In Shaikh’s framework the *adjusted RVIULC* is seen as long-term determinant of RER, a centre of gravity around which they fluctuate. Cyclical factors might influence the behaviour of the REER. One possibility often included in the empirical literature is the real interest rate differential. To assess its influence, we plot on Figure 6 below the real interest rate differential between the UK and the selected trading partners (which were also used in the RVIULC comparison). We compare it with the deviation observed between REER and the *adjusted RVIULC*. Although the small number of observations doesn’t allow us to withdraw definite conclusions, the results show a fairly strong correlation of 0.83<sup>33</sup>.

**Figure 6: Real Interest Rate differential and Deviation between the Real Effective Exchange Rate and adjusted Relative Vertically Integrated Unit Labour Costs.**



Source: WIOD (Timmer et.al, 2015) and World Bank. Author’s own elaboration.

<sup>33</sup> If we consider 2009 to be an odd year due to the financial crisis and decide to discard the observation, the correlation coefficient drops to 0.53. If, for the same year, we also discard 2008, the coefficient drops to 0.44, which still is a fairly strong association.

## 5. Findings and Limitations of the research approach

As discussed in the literature review, a claim made by Shaikh (1999, 2016) is that changes in the RER overtime reflect not only changes associated with Harrod-Balassa-Samuelson effect, but also reflect changes in countries relative competitive position. In the case of the UK during the 1995-2008 period the relative labour costs of the production of its exports increased relative to the labour costs of production of its imports.

Initially, it may seem quite odd that the real exchange rate of a country is likely to appreciate when a country's relative competitive position deteriorates, other things being constant. Shaikh and Antonopoulous (2013, p. 210), though, argue that this is analogous to the case of competition within one country, in which an industry whose production costs relative to other industries increase will likely face also an increase in its relative price. Therefore, in international competition, a country's export prices are likely to increase relatively, when expressed in common-currency, when their corresponding relative real costs of production increase.

Furthermore, it reveals that countries with lower productivity growth (or higher growth in real wages) are more likely to experience real exchange rate appreciation. If we assess exchange rate misalignment through a measure of equilibrium that fails to capture the change in relative competitive positions (such as the PPP-based measures used in the literature reviewed in section 2.1), then, countries with higher productivity growth (and/or lower real wage growth) will tend to present “undervalued” currencies and countries with lower productivity growth (and/or higher real wage growth) will be considered as “overvalued”. As such, empirical results like the ones found by Rodrik (2008) and the literature reviewed in section 2.1 based on the PPP come as no surprise, as they compare countries with higher productivity growth (i.e. countries with undervalued currencies) with countries with slower productivity growth (i.e. countries with overvalued currencies).

As predicted by the Shaikh approach, the Relative Vertically Integrated Unit Labour Cost (RVIULC) and the Real Effective Exchange Rate (REER) display a similar trend. Moreover, the high correlation between real interest rate differential and the deviation of the Real Effective Exchange Rate in relation to the Relative Vertically Integrated Unit Labour Cost indicates that the econometric specification of Shaikh’s model including Relative Vertically Integrated Unit Labour Cost, Harrod-Balassa-Samuelson effect and interest rate differential should be further tested. As our dataset comprises only 15 observations for each variable, we didn’t proceed with any econometric analysis. However, it is possible to expand the analysis, including more countries, and pursuing an econometric analysis using a panel data framework.

However, as discussed previously, the empirical work developed here has an exploratory nature and its findings should be regarded with caution. We have calculated the Vertically Integrated Unit Labour Costs of UK exports against the Vertically Integrated Unit Labour Costs of its imports from 8 selected trading partners<sup>34</sup>. Although the selection of these trading partners was done following specific criteria, i.e. importance in the UK trading balance and of the country's currency in FX markets, the final decision to include only 8 trading partners was utterly done in an *ad-hoc* manner. Countries such as Belgium and Spain have only slightly less importance in the UK trading balance than Italy. Canada's share in the UK trade balance was higher than China's in 1995 and higher than Japan's in the end of the sample. If we were to change the selected sample of trading partners including other countries or excluding one of the selected ones our results would change. However, unless trading partners such as the US or Germany are excluded, we believe, changes are bound to be of slight magnitude.

Another limitation of our research is that we haven't compared our estimate based on the *adjusted* relative vertically integrated unit labour cost (*adjusted* RVIULC) with equilibrium rates estimated from approaches such as Fundamental Equilibrium Exchange Rate (FEER) and Behavioural Equilibrium Exchange Rate (BEER). Estimation of such equilibrium rates are far beyond the scope of this dissertation and unfortunately no ready available data with estimates covering our entire time-frame was found in the literature.

The classical political economy approach developed by Shaikh to exchange rate determination is also a long-run approach, which is flexible enough to allow for deviations of the real exchange rate from its equilibrium values. Therefore, at any given point in time the real exchange rate can be regarded as under or overvalued, as such Rodrik's hypothesis that exchange rate undervaluation can promote growth can be re-evaluated under this framework. Which in our view provides a sounder explanation for long-run behaviour of RER and one that is directly related to competitiveness.

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<sup>34</sup> The same is valid for our measure of H-B-S effect.

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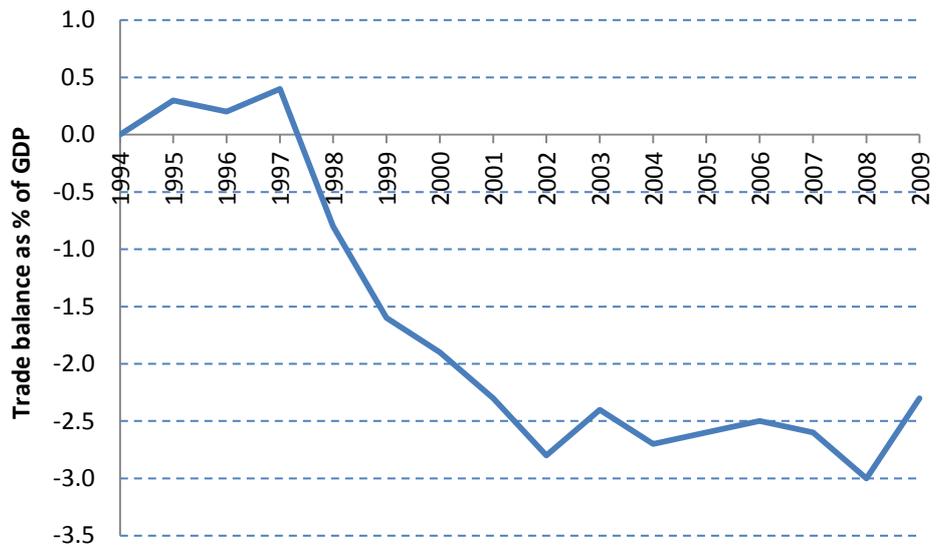
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## Appendix

**Figure 7: UK trade account balance as percentage of GDP**



Source: Office for National Statistics, United Kingdom

**Table 4: Productive Structure of the UK economy between 1995 and 2009**

	Subsystem	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
c1	Agriculture, Hunting, Forestry and Fishing	1.8%	1.7%	1.6%	1.5%	1.4%	1.3%	1.2%	1.3%	1.3%	1.2%	1.4%	1.3%	1.3%	1.3%	1.3%
c2	Mining and Quarrying	2.4%	2.6%	2.4%	2.2%	2.3%	2.4%	2.2%	2.0%	1.9%	1.7%	1.6%	1.5%	1.4%	1.5%	1.3%
c3	Food, Beverages and Tobacco	2.8%	2.8%	2.8%	2.7%	2.7%	2.6%	2.6%	2.5%	2.5%	2.4%	2.3%	2.3%	2.2%	2.1%	2.0%
<b>c4</b>	<b>Textiles and Textile Products</b>	<b>1.0%</b>	<b>1.0%</b>	<b>1.0%</b>	<b>0.9%</b>	<b>0.8%</b>	<b>0.7%</b>	<b>0.6%</b>	<b>0.6%</b>	<b>0.5%</b>	<b>0.4%</b>	<b>0.4%</b>	<b>0.4%</b>	<b>0.4%</b>	<b>0.4%</b>	<b>0.4%</b>
c5	Leather, Leather and Footwear	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
c6	Wood and Products of Wood and Cork	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.2%
<b>c7</b>	<b>Pulp, Paper, Paper, Printing and Publishing</b>	<b>2.6%</b>	<b>2.5%</b>	<b>2.5%</b>	<b>2.5%</b>	<b>2.4%</b>	<b>2.4%</b>	<b>2.3%</b>	<b>2.2%</b>	<b>2.1%</b>	<b>2.0%</b>	<b>1.9%</b>	<b>1.8%</b>	<b>1.8%</b>	<b>1.7%</b>	<b>1.6%</b>
c8	Coke, Refined Petroleum and Nuclear Fuel	0.4%	0.4%	0.4%	0.4%	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
<b>c9</b>	<b>Chemicals and Chemical Products</b>	<b>2.3%</b>	<b>2.3%</b>	<b>2.2%</b>	<b>2.1%</b>	<b>2.1%</b>	<b>2.0%</b>	<b>2.0%</b>	<b>2.0%</b>	<b>1.8%</b>	<b>1.9%</b>	<b>1.5%</b>	<b>1.5%</b>	<b>1.4%</b>	<b>1.4%</b>	<b>1.3%</b>
c10	Rubber and Plastics	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	0.9%	0.9%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.7%
c11	Other Non-Metallic Mineral	0.8%	0.7%	0.7%	0.7%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.5%	0.5%
<b>c12</b>	<b>Basic Metals and Fabricated Metal</b>	<b>2.4%</b>	<b>2.4%</b>	<b>2.4%</b>	<b>2.3%</b>	<b>2.2%</b>	<b>2.1%</b>	<b>2.0%</b>	<b>1.9%</b>	<b>1.8%</b>	<b>1.7%</b>	<b>1.7%</b>	<b>1.7%</b>	<b>1.6%</b>	<b>1.5%</b>	<b>1.5%</b>
<b>c13</b>	<b>Machinery, Nec</b>	<b>1.8%</b>	<b>1.8%</b>	<b>1.8%</b>	<b>1.7%</b>	<b>1.6%</b>	<b>1.5%</b>	<b>1.5%</b>	<b>1.4%</b>	<b>1.3%</b>	<b>1.3%</b>	<b>1.3%</b>	<b>1.3%</b>	<b>1.3%</b>	<b>1.2%</b>	<b>1.2%</b>
<b>c14</b>	<b>Electrical and Optical Equipment</b>	<b>2.6%</b>	<b>2.7%</b>	<b>2.8%</b>	<b>2.9%</b>	<b>3.0%</b>	<b>3.1%</b>	<b>2.7%</b>	<b>2.4%</b>	<b>2.2%</b>	<b>2.1%</b>	<b>1.9%</b>	<b>1.9%</b>	<b>1.9%</b>	<b>1.8%</b>	<b>1.7%</b>
c15	Transport Equipment	2.0%	2.0%	2.1%	2.1%	2.0%	1.9%	1.9%	1.8%	1.8%	1.7%	1.5%	1.6%	1.5%	1.5%	1.4%
c16	Manufacturing, Nec; Recycling	0.7%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.7%	0.7%	0.7%	0.6%	0.6%	0.6%	0.6%	0.5%
c17	Electricity, Gas and Water Supply	2.3%	2.4%	2.4%	2.3%	2.2%	2.1%	2.0%	2.0%	2.0%	1.9%	2.1%	1.9%	1.9%	2.0%	1.7%
c18	Construction	5.0%	5.0%	4.9%	4.9%	4.8%	4.8%	4.9%	5.0%	5.1%	5.1%	5.0%	4.9%	5.0%	4.9%	4.6%

Source: WIOD, Timmer et. al. (2015). Authors own calculations.

**Table 4 (cont.): Productive Structure of the UK economy between 1995 and 2009**

		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
c19	Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	1.9%	1.8%	1.8%	1.8%	1.9%	1.9%	2.0%	2.0%	2.1%	2.1%	2.5%	2.5%	2.5%	2.5%	2.5%
c20	Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	4.3%	4.3%	4.4%	4.6%	4.5%	4.5%	4.6%	4.3%	4.3%	4.3%	4.7%	4.7%	4.7%	4.6%	4.6%
c21	Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	5.1%	5.1%	5.1%	5.0%	5.1%	5.2%	5.2%	5.4%	5.4%	5.6%	5.7%	5.7%	5.7%	5.6%	5.7%
c22	Hotels and Restaurants	2.4%	2.5%	2.6%	2.6%	2.7%	2.7%	2.8%	2.8%	2.9%	2.8%	2.7%	2.7%	2.7%	2.7%	2.7%
c23	Inland Transport	2.4%	2.3%	2.4%	2.4%	2.4%	2.4%	2.4%	2.3%	2.2%	2.2%	2.2%	2.2%	2.2%	2.1%	2.2%
c24	Water Transport	0.2%	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
c25	Air Transport	0.6%	0.7%	0.7%	0.7%	0.6%	0.6%	0.6%	0.5%	0.6%	0.6%	0.5%	0.5%	0.5%	0.5%	0.5%
c26	Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	1.7%	1.7%	1.8%	1.9%	1.9%	1.9%	1.9%	1.9%	1.9%	1.9%	1.7%	1.7%	1.7%	1.7%	1.7%
c27	Post and Telecommunications	2.7%	2.9%	3.1%	3.4%	3.8%	4.3%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.3%	4.4%
<b>c28</b>	<b>Financial Intermediation</b>	<b>6.4%</b>	<b>6.5%</b>	<b>6.5%</b>	<b>6.3%</b>	<b>6.2%</b>	<b>6.0%</b>	<b>6.0%</b>	<b>7.1%</b>	<b>7.6%</b>	<b>7.9%</b>	<b>8.6%</b>	<b>8.7%</b>	<b>8.8%</b>	<b>9.0%</b>	<b>9.0%</b>
c29	Real Estate Activities	7.9%	7.8%	7.7%	7.6%	7.5%	7.5%	7.4%	7.0%	7.0%	7.2%	6.9%	7.0%	6.9%	7.1%	7.1%
<b>c30</b>	<b>Renting of M&amp;Eq and Other Business Activities</b>	<b>10.2%</b>	<b>10.5%</b>	<b>11.0%</b>	<b>11.8%</b>	<b>12.3%</b>	<b>12.8%</b>	<b>13.4%</b>	<b>13.6%</b>	<b>14.0%</b>	<b>14.4%</b>	<b>14.9%</b>	<b>15.6%</b>	<b>16.5%</b>	<b>16.9%</b>	<b>16.9%</b>
c31	Public Admin and Defence; Compulsory Social Security	5.8%	5.6%	5.3%	5.0%	4.9%	4.8%	4.9%	4.8%	4.9%	5.0%	4.5%	4.5%	4.4%	4.4%	4.7%
c32	Education	5.4%	5.3%	5.2%	5.1%	5.1%	5.0%	5.0%	5.0%	4.9%	4.7%	4.4%	4.3%	4.1%	4.1%	4.4%
c33	Health and Social Work	6.2%	6.1%	6.0%	6.0%	5.9%	6.0%	6.2%	6.3%	6.4%	6.4%	6.5%	6.5%	6.4%	6.4%	6.8%
c34	Other Community, Social and Personal Services	3.6%	3.7%	3.8%	3.9%	3.8%	3.8%	3.9%	3.9%	3.9%	3.8%	3.8%	3.8%	3.7%	3.7%	3.9%
c35	Private Households with Employed Persons	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%

Source: WIOD, Timmer et. al. (2015). Authors own calculations.

**Table 5: Sectoral distribution of UK's Exports**

		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
c1	Agriculture, Hunting, Forestry and Fishing	1.0%	0.9%	0.8%	0.7%	0.7%	0.6%	0.6%	0.6%	0.7%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%
c2	Mining and Quarrying	5.2%	5.4%	4.6%	3.5%	4.4%	6.0%	6.1%	5.7%	5.4%	4.9%	5.3%	5.5%	4.9%	5.6%	4.5%
<b>c3</b>	<b>Food, Beverages and Tobacco</b>	<b>5.5%</b>	<b>5.0%</b>	<b>4.8%</b>	<b>4.4%</b>	<b>4.2%</b>	<b>3.7%</b>	<b>3.6%</b>	<b>3.7%</b>	<b>3.8%</b>	<b>3.6%</b>	<b>3.5%</b>	<b>3.3%</b>	<b>3.3%</b>	<b>3.4%</b>	<b>3.9%</b>
<b>c4</b>	<b>Textiles and Textile Products</b>	<b>3.1%</b>	<b>3.0%</b>	<b>2.9%</b>	<b>2.7%</b>	<b>2.4%</b>	<b>2.1%</b>	<b>2.0%</b>	<b>1.9%</b>	<b>2.0%</b>	<b>2.2%</b>	<b>2.1%</b>	<b>2.0%</b>	<b>1.8%</b>	<b>1.6%</b>	<b>1.6%</b>
c5	Leather, Leather and Footwear	0.5%	0.5%	0.5%	0.4%	0.4%	0.4%	0.3%	0.3%	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%
c6	Wood and Products of Wood and Cork	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%
<b>c7</b>	<b>Pulp, Paper, Paper, Printing and Publishing</b>	<b>2.9%</b>	<b>2.8%</b>	<b>2.6%</b>	<b>2.7%</b>	<b>2.6%</b>	<b>2.4%</b>	<b>2.4%</b>	<b>2.5%</b>	<b>2.6%</b>	<b>2.4%</b>	<b>2.2%</b>	<b>2.1%</b>	<b>2.0%</b>	<b>1.9%</b>	<b>1.9%</b>
c8	Coke, Refined Petroleum and Nuclear Fuel	1.9%	2.1%	2.2%	1.5%	1.8%	2.6%	2.3%	2.3%	2.7%	2.9%	3.4%	3.6%	3.5%	4.5%	3.8%
<b>c9</b>	<b>Chemicals and Chemical Products</b>	<b>11.7%</b>	<b>11.1%</b>	<b>10.5%</b>	<b>10.7%</b>	<b>10.8%</b>	<b>10.4%</b>	<b>11.2%</b>	<b>11.5%</b>	<b>12.0%</b>	<b>10.8%</b>	<b>10.7%</b>	<b>10.7%</b>	<b>10.2%</b>	<b>10.3%</b>	<b>11.7%</b>
c10	Rubber and Plastics	2.2%	2.1%	2.0%	2.0%	1.9%	1.7%	1.7%	1.7%	1.8%	1.6%	1.7%	1.6%	1.6%	1.5%	1.5%
c11	Other Non-Metallic Mineral	1.1%	1.1%	1.0%	1.0%	0.9%	0.8%	0.8%	0.8%	0.8%	0.8%	0.7%	0.7%	0.7%	0.6%	0.6%
c12	Basic Metals and Fabricated Metal	6.5%	5.8%	5.4%	5.2%	4.5%	4.7%	4.7%	4.5%	4.6%	4.7%	5.1%	5.3%	5.5%	5.5%	4.3%
<b>c13</b>	<b>Machinery, Nec</b>	<b>8.3%</b>	<b>8.2%</b>	<b>8.1%</b>	<b>8.0%</b>	<b>6.9%</b>	<b>6.3%</b>	<b>6.3%</b>	<b>6.0%</b>	<b>6.0%</b>	<b>5.5%</b>	<b>5.7%</b>	<b>5.5%</b>	<b>5.4%</b>	<b>5.4%</b>	<b>5.0%</b>
<b>c14</b>	<b>Electrical and Optical Equipment</b>	<b>17.7%</b>	<b>17.7%</b>	<b>17.4%</b>	<b>17.9%</b>	<b>17.6%</b>	<b>18.1%</b>	<b>16.8%</b>	<b>14.6%</b>	<b>12.4%</b>	<b>11.0%</b>	<b>9.8%</b>	<b>9.2%</b>	<b>7.8%</b>	<b>7.6%</b>	<b>7.9%</b>
c15	Transport Equipment	11.0%	12.0%	13.3%	13.2%	13.0%	12.5%	12.2%	12.5%	12.9%	11.4%	11.3%	10.9%	10.8%	10.3%	10.1%
c16	Manufacturing, Nec; Recycling	1.9%	1.9%	1.9%	1.9%	1.7%	1.5%	1.6%	1.6%	1.7%	1.6%	1.7%	1.7%	1.8%	1.8%	1.8%
c17	Electricity, Gas and Water Supply	0.1%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.2%	0.1%	0.1%	0.1%
c18	Construction	0.1%	0.1%	0.1%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.3%	0.3%	0.3%	0.3%

Source: WIOD, Timmer et. al. (2015). Authors own calculations.

**Table 5 (cont.): Sectoral distribution of UK's Exports**

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
c19 Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%
c20 Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	0.4%	0.4%	0.5%	0.5%	0.5%	0.5%	0.6%	0.4%	0.3%	0.3%	0.4%	0.3%	0.4%	0.4%	0.4%
c21 Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
c22 Hotels and Restaurants	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.0%	2.1%	2.1%	2.1%	1.8%	1.9%
c23 Inland Transport	0.3%	0.3%	0.3%	0.4%	0.4%	0.3%	0.3%	0.4%	0.4%	0.6%	0.6%	0.6%	0.6%	0.5%	0.6%
c24 Water Transport	1.6%	1.6%	1.6%	1.5%	1.3%	1.3%	1.3%	1.5%	1.8%	2.4%	2.4%	2.1%	2.2%	2.1%	2.2%
c25 Air Transport	2.0%	2.0%	2.0%	2.1%	2.1%	2.0%	1.8%	1.7%	1.6%	1.5%	1.5%	1.4%	1.3%	1.2%	1.2%
c26 Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	0.6%	0.6%	0.6%	0.7%	0.7%	0.7%	0.8%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%
c27 Post and Telecommunications	0.6%	0.6%	0.6%	0.7%	0.8%	0.9%	0.9%	1.0%	0.9%	1.3%	1.4%	1.5%	1.4%	1.2%	1.3%
c28 Financial Intermediation	4.2%	4.7%	5.7%	5.7%	6.7%	6.9%	7.3%	7.9%	7.7%	10.2%	9.7%	11.2%	13.8%	14.8%	15.2%
c29 Real Estate Activities	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
c30 Renting of M&Eq and Other Business Activities	6.8%	7.5%	7.6%	9.6%	10.6%	10.3%	11.1%	12.2%	13.1%	12.6%	12.6%	13.0%	13.1%	12.5%	13.0%
c31 Public Admin and Defence; Compulsory Social Security	0.4%	0.3%	0.3%	0.3%	0.2%	0.2%	0.4%	0.3%	0.4%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
c32 Education	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.7%	0.6%	0.6%	0.6%	0.6%	0.6%	0.5%	0.5%
c33 Health and Social Work	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
c34 Other Community, Social and Personal Services	1.7%	1.8%	1.8%	1.9%	2.0%	2.2%	2.3%	2.5%	2.4%	2.4%	2.6%	2.4%	2.3%	2.1%	2.2%
c35 Private Households with Employed Persons	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Source: WIOD, Timmer et. al. (2015). Authors own calculations.

**Table 6: Sectoral distribution of UK Imports**

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
c1 Agriculture, Hunting, Forestry and Fishing	2.8%	2.8%	2.7%	2.6%	2.3%	2.1%	2.1%	2.3%	2.3%	2.0%	2.1%	2.0%	2.0%	2.0%	2.2%
c2 Mining and Quarrying	3.3%	3.3%	3.0%	2.4%	2.7%	3.5%	3.3%	3.1%	3.3%	4.0%	5.1%	5.9%	5.5%	7.2%	5.7%
c3 Food, Beverages and Tobacco	6.7%	6.7%	6.5%	6.5%	6.5%	5.8%	5.8%	5.9%	6.4%	7.0%	6.9%	6.7%	6.7%	7.0%	7.9%
c4 Textiles and Textile Products	4.9%	4.9%	5.1%	5.1%	4.9%	4.7%	4.8%	4.9%	5.0%	4.9%	4.6%	4.4%	4.2%	4.0%	4.4%
c5 Leather, Leather and Footwear	1.1%	1.1%	1.2%	1.1%	1.1%	1.0%	1.1%	1.1%	1.1%	0.9%	0.9%	0.9%	0.8%	0.8%	0.9%
c6 Wood and Products of Wood and Cork	1.1%	1.1%	1.1%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	0.9%	0.8%	0.8%	0.9%	0.7%	0.7%
c7 <b>Pulp, Paper, Paper , Printing and Publishing</b>	<b>4.1%</b>	<b>4.1%</b>	<b>3.3%</b>	<b>3.2%</b>	<b>3.1%</b>	<b>2.9%</b>	<b>3.0%</b>	<b>2.8%</b>	<b>2.8%</b>	<b>2.5%</b>	<b>2.3%</b>	<b>2.2%</b>	<b>2.1%</b>	<b>2.1%</b>	<b>2.1%</b>
c8 Coke, Refined Petroleum and Nuclear Fuel	1.4%	1.4%	1.3%	1.2%	1.4%	1.9%	1.9%	1.7%	1.9%	2.6%	3.3%	3.5%	3.8%	4.6%	3.7%
c9 <b>Chemicals and Chemical Products</b>	<b>9.4%</b>	<b>9.4%</b>	<b>8.5%</b>	<b>8.2%</b>	<b>8.2%</b>	<b>8.3%</b>	<b>8.6%</b>	<b>8.8%</b>	<b>9.3%</b>	<b>8.3%</b>	<b>8.0%</b>	<b>7.8%</b>	<b>8.0%</b>	<b>8.0%</b>	<b>8.6%</b>
c10 Rubber and Plastics	2.4%	2.4%	2.2%	2.2%	2.1%	2.0%	2.0%	2.1%	2.2%	2.0%	2.0%	1.9%	1.9%	1.9%	2.0%
c11 Other Non-Metallic Mineral	1.0%	1.0%	1.0%	1.0%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.8%	0.8%	0.8%	0.8%	0.8%
c12 <b>Basic Metals and Fabricated Metal</b>	<b>6.7%</b>	<b>6.7%</b>	<b>6.0%</b>	<b>5.9%</b>	<b>5.1%</b>	<b>5.2%</b>	<b>5.3%</b>	<b>4.9%</b>	<b>5.1%</b>	<b>4.8%</b>	<b>4.8%</b>	<b>5.5%</b>	<b>5.8%</b>	<b>5.5%</b>	<b>4.9%</b>
c13 <b>Machinery, Nec</b>	<b>7.2%</b>	<b>7.2%</b>	<b>7.0%</b>	<b>6.9%</b>	<b>6.6%</b>	<b>6.3%</b>	<b>6.3%</b>	<b>6.2%</b>	<b>6.2%</b>	<b>5.6%</b>	<b>5.7%</b>	<b>5.5%</b>	<b>5.6%</b>	<b>5.6%</b>	<b>5.2%</b>
c14 <b>Electrical and Optical Equipment</b>	<b>16.8%</b>	<b>16.8%</b>	<b>17.0%</b>	<b>17.2%</b>	<b>18.3%</b>	<b>19.9%</b>	<b>17.4%</b>	<b>16.0%</b>	<b>14.7%</b>	<b>13.5%</b>	<b>12.5%</b>	<b>12.2%</b>	<b>10.9%</b>	<b>10.7%</b>	<b>10.9%</b>
c15 <b>Transport Equipment</b>	<b>12.9%</b>	<b>12.9%</b>	<b>14.7%</b>	<b>15.2%</b>	<b>15.2%</b>	<b>13.9%</b>	<b>15.3%</b>	<b>16.3%</b>	<b>15.8%</b>	<b>13.4%</b>	<b>12.8%</b>	<b>12.5%</b>	<b>13.1%</b>	<b>11.7%</b>	<b>11.3%</b>
c16 Manufacturing, Nec; Recycling	2.6%	2.6%	2.9%	2.8%	2.7%	2.8%	3.0%	3.3%	3.3%	2.9%	2.8%	2.9%	3.0%	2.9%	3.0%
c17 Electricity, Gas and Water Supply	0.3%	0.3%	0.3%	0.3%	0.3%	0.2%	0.2%	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%	0.3%	0.3%
c18 Construction	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.3%	0.3%	0.4%	0.4%	0.4%

Source: WIOD, Timmer et. al. (2015). Authors own calculations.

**Table 6 (cont.): Sectoral distribution of UK Imports**

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
c19 Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
c20 Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	1.0%	0.9%	0.9%	1.0%	0.9%	0.9%	0.8%	1.0%	0.9%
c21 Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	0.2%	0.2%	0.2%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%
c22 Hotels and Restaurants	0.8%	0.8%	0.9%	1.0%	0.9%	0.9%	0.8%	0.8%	0.8%	3.9%	3.9%	3.7%	3.6%	3.4%	3.6%
c23 Inland Transport	0.4%	0.4%	0.5%	0.5%	0.5%	0.6%	0.6%	0.6%	0.6%	1.1%	1.1%	1.0%	0.9%	1.1%	1.0%
c24 Water Transport	0.7%	0.7%	1.1%	1.0%	0.8%	0.8%	0.9%	0.9%	0.9%	1.1%	0.9%	0.9%	0.8%	0.6%	0.7%
c25 Air Transport	2.0%	2.0%	2.3%	2.4%	2.5%	2.5%	2.3%	2.4%	2.4%	2.5%	2.5%	2.4%	2.2%	2.0%	2.1%
c26 Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	0.7%	0.7%	0.9%	0.8%	0.7%	0.7%	0.7%	0.7%	0.7%	0.6%	0.6%	0.5%	0.5%	0.4%	0.5%
c27 Post and Telecommunications	1.0%	1.0%	1.0%	1.0%	1.1%	1.0%	1.1%	1.1%	1.1%	1.1%	1.2%	1.2%	1.3%	1.2%	1.2%
c28 Financial Intermediation	0.8%	0.8%	1.0%	1.0%	1.2%	1.4%	1.4%	1.4%	1.6%	2.3%	2.8%	3.0%	3.2%	3.2%	3.4%
c29 Real Estate Activities	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.4%	0.4%	0.3%	0.4%	0.4%	0.4%
c30 Renting of M&Eq and Other Business Activities	5.1%	5.1%	5.2%	6.0%	6.5%	6.2%	6.5%	6.6%	6.9%	6.1%	6.3%	6.6%	6.9%	7.2%	7.6%
c31 Public Admin and Defence; Compulsory Social Security	0.3%	0.3%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
c32 Education	0.2%	0.2%	0.1%	0.1%	0.2%	0.1%	0.1%	0.2%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
c33 Health and Social Work	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.5%	0.5%	0.4%	0.4%	0.4%	0.5%
c34 Other Community, Social and Personal Services	1.7%	1.7%	1.5%	1.7%	1.6%	1.6%	1.7%	1.9%	1.7%	2.4%	2.3%	2.3%	2.5%	2.4%	2.6%
c35 Private Households with Employed Persons	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Source: WIOD, Timmer et. al. (2015). Authors own calculation.

